Section E

Hydraulics

Service Manual - Backhoe Loader

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World Class
Customer Support

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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
-	Bonded Washers - see tool detail reference for content	⇒ Fig 8. (E-4)
-	Female Cone Blanking Plugs - see tool detail reference for content	⇒ Fig 5. (E-4)
-	Female Connectors - see tool detail reference for content	⇒ Fig 7. (E-4)
-	Hydraulic Flow Test Equipment - see tool detail reference for content	⇒ Fig 13. (E-6)
-	Hydraulic Hand Pump Equipment - see tool detail reference for content	⇒ Fig 17. (E-8)
-	Male Adapters - BSP x BSP - see tool detail reference for content	⇒ Fig 1. (E-3)
-	Male Adapters - BSP x NPT (USA only) - see tool detail reference for content	⇒ Fig 1. (E-3)
-	Male Cone Blanking Caps - see tool detail reference for content	⇒ Fig 6. (E-4)
-	Pressure Test Points - `T' Adaptors - see tool detail reference for content	⇒ Fig 3. (E-3)
-	Pressure Test Points - Adaptors - see tool detail reference for content	⇒ Fig 2. (E-3)
892/00011	Spool Clamp	⇒ Fig 20. (E-8)
892/00167	Ram Protection Sleeve for 90 mm Rod Diameter	⇒ Fig 9. (E-5)
892/00252	Test Block for Loader Valve A.R.V. (214e Machines Only)	⇒ Fig 21. (E-9)
892/00253	Hydraulic Circuit Pressure Test Kit - see tool detail reference for content	⇒ Fig 15. (E-7)
892/00309	A.R.V. Pressure Test Kit - see tool detail reference for content	⇒ Fig 23. (E-9)
892/00334	Ram Seal Fitting Tool	⇒ Fig 10. (E-5)
892/00881	Valve Spool Seal Fitting Tool	⇒ Fig 19. (E-8)
892/01016	Ram Protection Sleeve for 25 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01017	Ram Protection Sleeve for 30 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01018	Ram Protection Sleeve for 40 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01019	Ram Protection Sleeve for 50 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01020	Ram Protection Sleeve for 50 mm Rod Diameter (slew ram)	⇒ Fig 9. (E-5)
892/01021	Ram Protection Sleeve for 60 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01022	Ram Protection Sleeve for 60 mm Rod Diameter (slew ram)	⇒ Fig 9. (E-5)
892/01023	Ram Protection Sleeve for 65 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01024	Ram Protection Sleeve for 70 mm Rod Diameter	⇒ Fig 9. (E-5)

Numerical List

Part Number	Description	Tool Detail Reference
892/01025	Ram Protection Sleeve for 75 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01026	Ram Protection Sleeve for 80 mm Rod Diameter	⇒ Fig 9. (E-5)
892/01027	Piston Seal Assembly Tool	⇒ Fig 12. (E-5)
892/01042	Nitrogen Charging Tool Kit	⇒ Fig 22. (E-9)
992/09100	Excavator Spool Clamp	⇒ Fig 20. (E-8)
992/09300	Hexagon Spanner 55mm A/F	⇒ Fig 11. (E-5)
992/09400	Hexagon Spanner 65mm A/F	⇒ Fig 11. (E-5)
992/09500	Hexagon Spanner 75mm A/F	⇒ Fig 11. (E-5)
992/09600	Hexagon Spanner 85mm A/F	⇒ Fig 11. (E-5)
992/09700	Hexagon Spanner 95mm A/F	⇒ Fig 11. (E-5)
992/09900	Hexagon Spanner 115mm A/F	⇒ Fig 11. (E-5)
992/10000	Hexagon Spanner 125mm A/F	⇒ Fig 11. (E-5)

Tool Detail Reference

T11-010

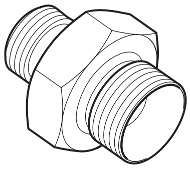

Fig 1. Male Adaptors

	Male Adapters - BSP x BSP
1606/2052	3/8 in. x 1/4 in.
1604/0003A	3/8 in. x 3/8 in.
892/00071	3/8 in. x 3/8 in. taper
1606/0004	1/2 in. x 1/4 in.
1606/0007A	1/2 in. x 3/8 in.
1604/0004A	1/2 in. x 1/2 in.
1606/0017	5/8 in. x 1/2 in.
1606/0008	3/4 in. x 3/8 in.
1606/0009	3/4 in. x 1/2 in.
1604/2055	3/4 in. x 3/4 in.
1606/0012	3/4 in. x 1 in.
1606/0014	3/4 in. x 1.1/4 in.
1606/0015	1 in. x 1.1/4 in.

	Male Adapters - BSP x NPT (USA only)
816/00439	3/8 in. x 1/4 in.
816/00440	1/2 in. x 1/4 in.
816/15007A	3/8 in. x 3/8 in.
816/15008	1/2 in. x 3/8 in.

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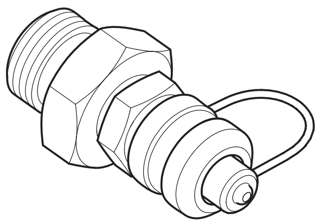

Fig 2. Pressure Test Adapters

892/00255	1/4 in. BSP x Test Point
892/00256	3/8 in. BSP x Test Point
892/00257	1/2 in. BSP x Test Point
892/00258	5/8 in. BSP x Test Point
816/15118	3/4 in. BSP x Test Point
892/00259	1 in BSP x Test Point
892/00260	1.1/4 in. BSP x Test Point
892/00261	5/8 in. UNF x Test Point

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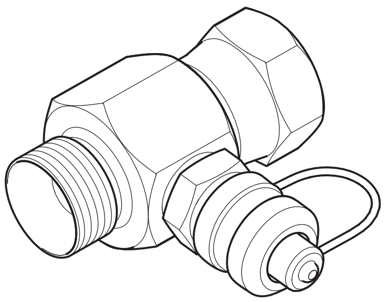

Fig 3. Pressure Test 'T' Adapters

816/55045	1/4 in. M BSP x 1/4 in. F BSP x Test Point
816/55038	3/8 in. M BSP x 3/8 in. F BSP x Test Point
816/55040	1/2 in. M BSP x 1/2 in. F BSP x Test Point
892/00263	5/8 in. M BSP x 5/8 in. F BSP x Test Point
892/00264	3/4 in. M BSP x 3/4 in. F BSP x Test Point
892/00265	1 in. M BSP x 1 in. F BSP x Test Point
892/00266	1.1/4 in. M BSP x 1.1/4 in. F BSP x Test Point
892/00267	1.1/4 in. M BSP x 1.1/2 in. F BSP x Test Point

Tool Detail Reference

T11-010

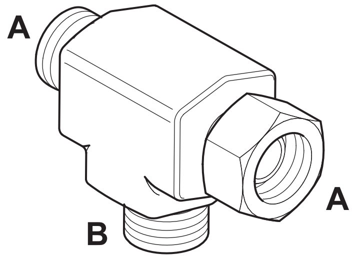

Fig 4. 'T' Adapters

892/00047	3/8 in. BSP (**A**) x 1/4 in. BSP (**B**)
892/00048	1/2 in. BSP (**A**) x 1/4 in. BSP (**B**)
892/00049	5/8 in. BSP (**A**) x 1/4 in. BSP (**B**)
816/50043	3/4 in. BSP (**A**) x 1/4 in. BSP (**B**)
892/00051	1 in. BSP (**A**) x 1/4 in. BSP (**B**)
816/50005	1/2 in. BSP (**A**) x 1/2 in. BSP (**B**)
816/60096	3/4 in. BSP (**A**) x 3/4 in. BSP (**B**)
816/00017	1 in. BSP (**A**) x 1 in. BSP (**B**)

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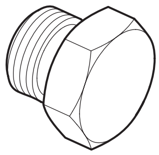

Fig 5. Female Blanking Caps

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

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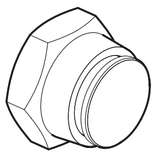

Fig 6. Male Cone Blanking Caps

816/90045	1/4 in. BSP
816/00189A	3/8 in. BSP
816/00190A	1/2 in. BSP
816/90022	5/8 in. BSP
816/90274	3/4 in. BSP
816/90205	1 in. BSP

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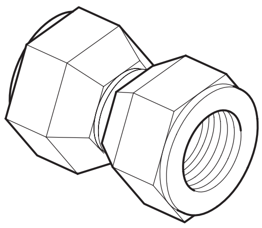

Fig 7. Female Connectors

892/00074	3/8 in. BSP x 3/8 in. BSP
892/00075	1/2 in. BSP x 1/2 in. BSP
892/00076	5/8 in. BSP x 5/8 in. BSP
892/00077	3/4 in. BSP x 3/4 in. BSP

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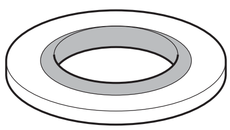


Fig 8. Bonded Washers

1406/0011	1/4 in. BSP
1406/0018	1/2 in. BSP
1406/0014	5/8 in. BSP
1406/0021	3/4 in. BSP
1406/0029	1.1/4 in. BSP

Tool Detail Reference

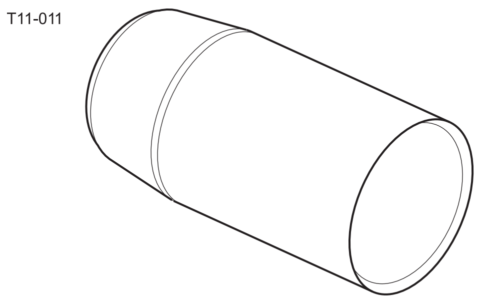


Fig 9. Ram Protection Sleeves

892/01016	For 25 mm Rod Diameter
892/01017	For 30 mm Rod Diameter
892/01018	For 40 mm Rod Diameter
892/01019	For 50 mm Rod Diameter
892/01020	For 50 mm Rod Diameter (slew ram)
892/01021	For 60 mm Rod Diameter
892/01022	For 60 mm Rod Diameter (slew ram)
892/01023	For 65 mm Rod Diameter
892/01024	For 70 mm Rod Diameter
892/01025	For 75 mm Rod Diameter
892/01026	For 80 mm Rod Diameter
892/00167	For 90 mm Rod Diameter

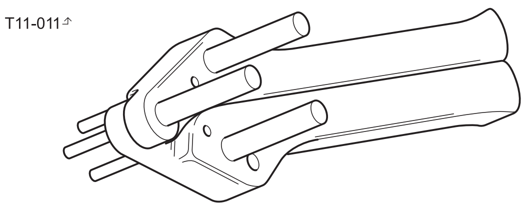


Fig 10. 892/00334 Ram Seal Fitting Tool

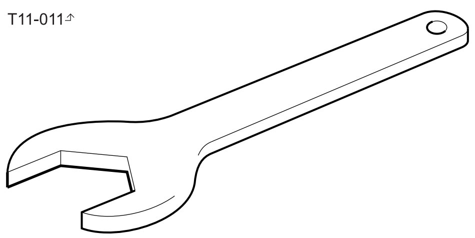


Fig 11. Hexagon Spanners for Ram Pistons and End Caps

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

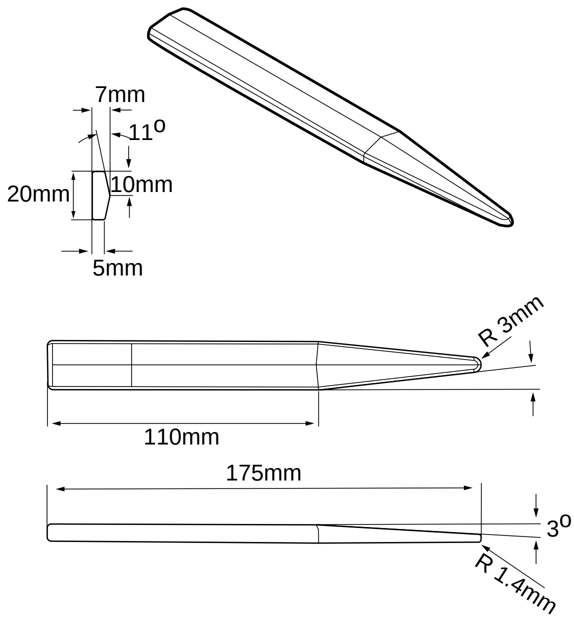
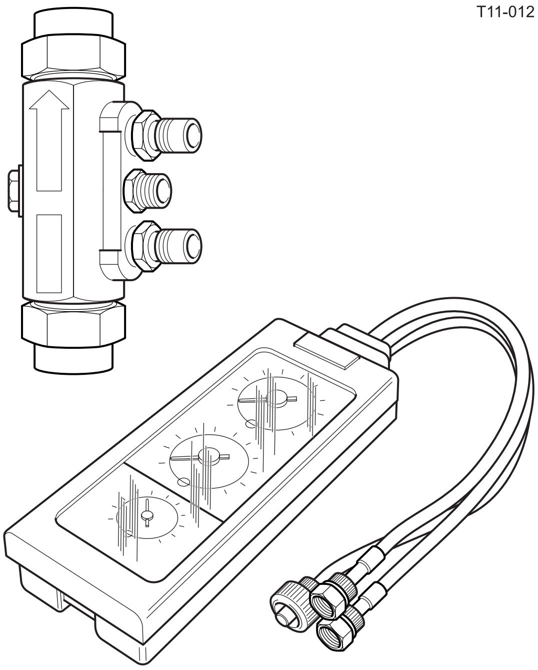
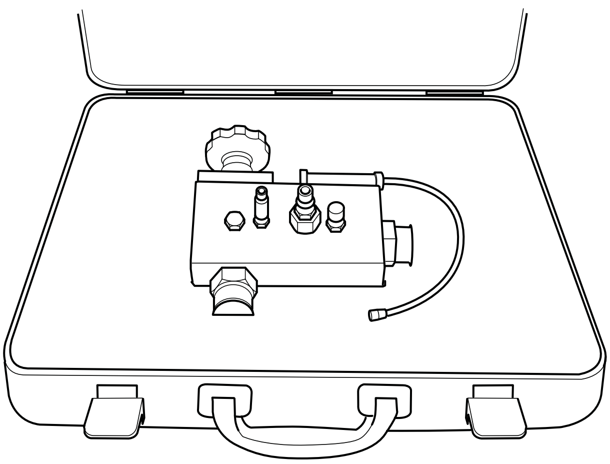


Fig 12. 892/01027 Piston Seal Assembly Tool

Tool Detail Reference

Note: *No longer available, refer to 998/11046 JCB ServiceMaster Flow Test Kit.* *⇒ Fig 14. (E-6).*	892/00268	Flow Monitoring Unit
 **Fig 13. Flow Test Equipment**	892/00269	Sensor Head 0 - 100 l/min (0 - 22 UK gal/min)
	892/00273	Sensor Head 0 - 380 l/min (0 - 85.5 UK gal/min)
	892/00293	Connector Pipe
	892/00270	Load Valve
	1406/0021	Bonded Washer
	1604/0006A	Adapter 3/4 in M x 3/4 in M BSP
	1612/2054	Adapter 3/4 in F x 3/4 in M BSP
	892/00271	Adapter 3/4 in F x 5/8 in M BSP
	892/00272	Adapter 5/8 in F x 3/4 in M BSP
	816/20008	Adapter 3/4 in F x 1/2 in M BSP
	892/00275	Adapter 1/2 in F x 3/4 in M BSP
	892/00276	Adapter 3/4 in F x 3/8 in M BSP
	892/00277	Adapter 3/8 in F x 3/4 in M BSP
	1606/0015	Adapter 1.1/4 in M BSP x 1 in M BSP
	892/00078	Connector 1 in F x 1 in F BSP
	1604/0008	Adapter 1 in M x 1 in M BSP
	1606/0012	Adapter 1 in M x 3/4 in M BSP
	816/20013	Adapter 3/4 in F x 1 in M BSP

 **Fig 14. 998/11046 JCB ServiceMaster Flow Test Kit**	998/11047	600 LPM Flow Turbine with Loading Valve
	998/11048	1-7/8" UNF x1 - 1/4" BSP Flow Block Adaptors x2
	998/11049	Carrying Case for Flow Test Kit
	998/11050	Temperature Sensor (125°C Max)

Tool Detail Reference

***Note:** No longer available, refer to 998/11051 JCB ServiceMaster Digital Hydraulic Datalogger Pressure Test Kit.* *⇒ Fig 16. (E-7).*

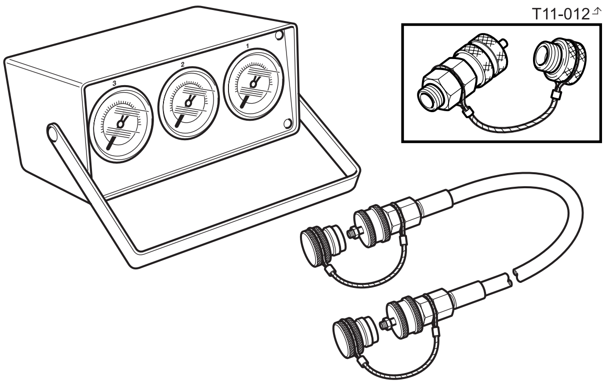


Fig 15. 892/ 00253 Hydraulic Circuit Pressure Test Kit

892/00201	Replacement Gauge 0-20 bar (0-300 lbf/in²)
892/00202	Replacement Gauge 0-40 bar (0-600 lbf/in²)
892/00203	Replacement Gauge 0-400 bar (0-6000 lbf/in²)
892/00254	Replacement Hose
993/69800	Seal Kit for 892/00254 (can also be used with probe 892/00706)
892/00706	Test Probe
892/00347	Connector - Hose to gauge

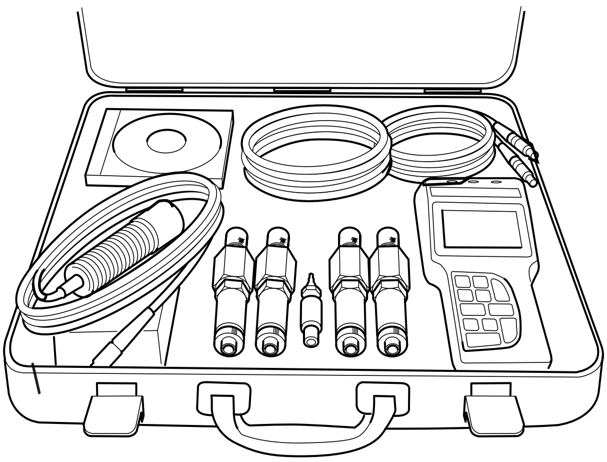


Fig 16. 998/11051 JCB ServiceMaster Digital Hydraulic Datalogger Pressure Test Kit

998/11052	Hand Held 4-Channel ServiceMaster Unit
998/11053	SensoWin Software Kit and PC Cable
998/11054	Equiment Case SCC-750
998/11055	0-600 Bar Pressure Transduce x2
998/11056	0-100 Bar pressureTransducer x2
998/11057	RPM Tachometer (includes fixed cable, 2 meters)
998/11058	5 Meter Connecting Cable
998/11059	M16 Metric Adaptors for Test Points x4
998/11060	400mm Test Hose 90˚ HSP to M16 x2
998/11061	400mm Test Hose Straight HSP to M16 x2

Tool Detail Reference

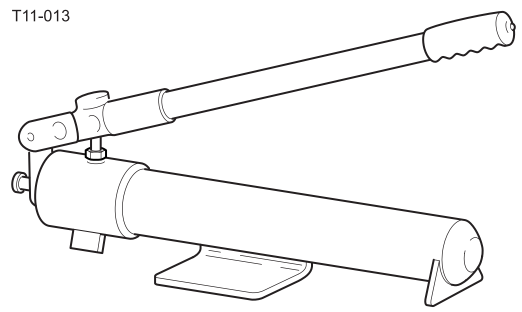


Fig 17. Hand Pump Equipment

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

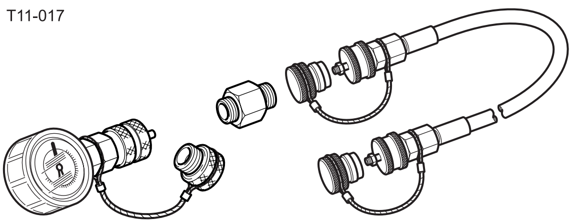


Fig 18. Hydraulic Circuit Test Gauges and Connections

892/00280	Pressure Gauge 0-600 bar (0-9000 lbf/in^2)
892/00279	Pressure Gauge 0-400 bar (0-6000 lbf/in^2)
892/00346	Pressure Gauge 0-70 bar (0-1000 lbf/in^2)
892/00347	Connector
892/00254	Hose

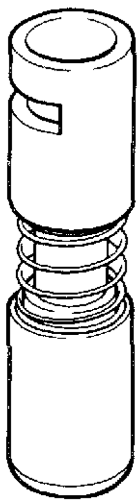


Fig 19. 892/00881 Valve Spool Seal Fitting Tool

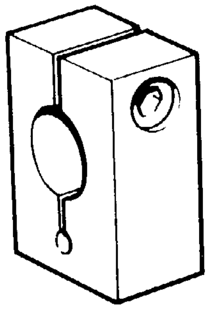


Fig 20. Spool Clamps

992/09100	Excavator Spool Clamp
892/00011	Spool Clamp

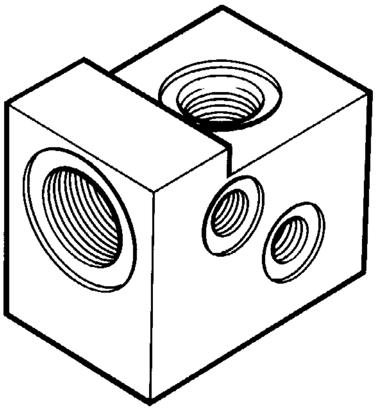


Fig 21. 892/00252 Test Block for Loader Valve A.R.V. (214e)

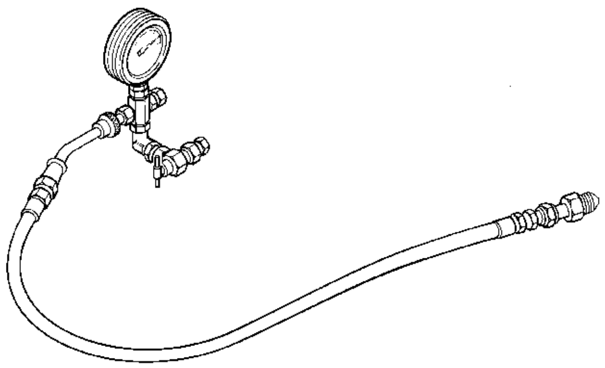


Fig 22. 892/01042 Nitrogen Charging Tool Kit

892/01043 Connector

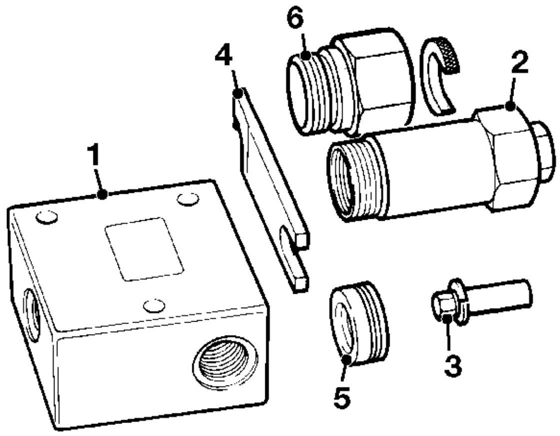


Fig 23. 892/00309 A.R.V. Pressure Test Kit

For 4CX Variable Flow machines use 25/201103

1	892/00340	Test Block Body
2	892/00341	Setting Body
3	993/68300	Adjusting Pin
4	892/00343	Spanner
5	892/00345	Anti-cavitation Lock Out Bung
6	892/00335	A.R.V. Cartridge Removal Tool

Technical Data

Gearpump - 3CX, 4CX Machines

Standard

- Machines up to serial no. 964124
- North American machines up to serial no. 912261

Model Reference:	Double pump 4070H		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	33	2.01	
Pump section 2	23	1.40	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	65.3	14.4	17.2
Pump section 2	45.5	10.0	12.0
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	24 kg (53 lbs)		

Model Reference:	Double pump 83103		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	36	2.19	
Pump section 2	26	1.59	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	71.3	15.7	18.8
Pump section 2	51.5	11.3	13.5
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	23.8 kg (52 lbs)		

Model Reference:	Double pump 7441N		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	41	2.50	
Pump section 2	26	1.59	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	81.2	17.9	21.5
Pump section 2	51.5	11.3	13.5
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	24.5 kg (54 lbs)		

Gearpump - 3CX, 4CX Machines

Model Reference:	Double pump 4071F		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	41	2.50	
Pump section 2	29	1.77	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	81.2	17.9	21.5
Pump section 2	57.4	12.6	15.1
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	24.5 kg (54 lbs)		

High Pressure Type

– Machines from serial no. 964125
– North American machines from serial no. 912262

Model Reference:	Double pump PGP620 33-23		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	33	2.01	
Pump section 2	23	1.40	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	65.3	14.4	17.2
Pump section 2	45.5	10.0	12.0
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	28.6 kg (63 lbs)		

Model Reference:	Double pump PGP620 36-26		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	36	2.19	
Pump section 2	26	1.59	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	71.3	15.7	18.8
Pump section 2	51.5	11.3	13.5
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	26.9 kg (59 lbs)		

Model Reference:	Double pump PGP620 36-29		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	36	2.19	
Pump section 2	29	1.77	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	71.3	15.7	18.8
Pump section 2	57.4	12.6	15.1
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	28 kg (61.5 lbs)		

Gearpump - 3CX, 4CX Machines

Model Reference:	Double pump PGP620 37-33		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	37	2.26	
Pump section 2	33	2.01	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	73.26	16.14	19.38
Pump section 2	65.3	14.4	17.2
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	28.5 kg (63 lbs)		

Variable Flow Pump

Model Reference:	A10VO - 978753
Type	Variable Displacement
Mounting	Gearbox
Load Sense Pressure (in neutral position)	Maximum permitted - 5 bar; 72.5 lbf/in^2
Load sense pressure relief Valve (if fitted)	230 bar; 3335 lbf/in^2
Standby Pressure	20 bar; 290 lbf/in^2
Maximum Hydraulic Stall Pressure	270 bar; 3915 lbf/in^2
Maximum Displacement	74cc/rev; 4.5 in^3/rev
Flow at 2200 rev/min and 2500 lb/in^2 pressure (1)	
minimum acceptable flow rate (new or rebuilt pump)	75 - 80 litres/min; 16.5 - 17.6 UK gal/min
minimum acceptable flow rate (used pump)	70 - 75 litres/min; 15.4 - 16.5 UK gal/min
Flow in the Load Sense Line at 2200 rev/min (no pressure)	1 - 5 litres/min; 0.22 - 1.1 UK gal/min
Weight	TBA kg (TBA lbs)

(1) It is not possible to test full pump flow at system pressure, figures quoted give a `snapshot' indication of pump performance. For more detail refer to Service Procedures, Variable Flow Pumps - Flow and Pressure Testing.

Gearpump - 3C-14 (214e) Machines

Standard

– Machines up to serial no. 964124
– North American machines up to serial no. 912261

Model Reference:	Double pump PGP620 Common outlet		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	29	1.77	
Pump section 2	23	1.40	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	57.4	12.6	15.1
Pump section 2	45.5	10.0	12.0
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	24 kg (53 lbs)		

High Pressure Type

– Machines from serial no. 964125
– North American machines from serial no. 912262

Model Reference:	Double pump PGP620 29-23		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	29	1.77	
Pump section 2	23	1.40	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	57.4	12.6	15.1
Pump section 2	45.5	10.0	12.0
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	24 kg (53 lbs)		

Model Reference:	Double pump PGP620 36-26[(1)]		
Mounting	Gearbox		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
Pump section 1 (mounting flange end)	36	2.19	
Pump section 2	26	1.59	
Flow at 2200 rev/min and system pressure (90% min displacement):	**litres min**	**UK gal min**	**US gal min**
Pump section 1 (mounting flange end)	71.3	15.7	18.8
Pump section 2	51.5	11.3	13.5
Maximum speed	3000 rev/min		
Minimum speed	500 rev/min		
Weight	26.9 kg (59 lbs)		

(1) Option for machines with 68 kW (90 bhp) engines only.

Gearpump - 3C Machines (Sideshift)

Model Reference:	Single pump PGP620 33		
Type:	Gearpump with load sensing priority valve		
Mounting:	Engine		
Direction of Rotation:	Anti-clockwise		
Theoretical displacement:	**cc/rev**	**cu in/rev**	
	33	2.01	
Flow at 2200 rev/min and system pressure:	**litres/min**	**UK gal/min**	**US gal/min**
(90% min. displacement)	65.3	14.4	17.3
Maximum Pressure:	**bar**	**kg/cm²**	**lb/in²**
port EF	235	240	3400
port P	220	225	3200
Maximum Speed:	3000 rev/min		
Minimum Speed:	500 rev/min		
Weight:	14.3 kg (31.5 lbs)		

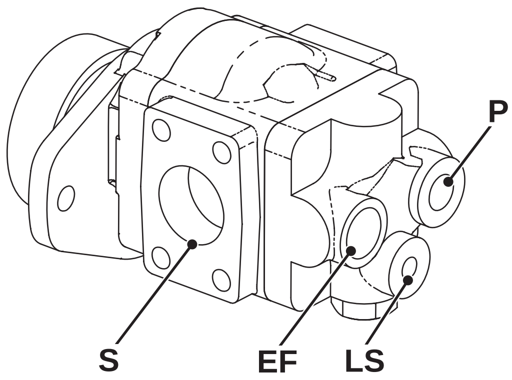


Fig 24.

Component Key:

EF Feed (to loader valve block)
LS Load sense (from steer unit)
P Feed (to steer unit)
S Suction port

Loader Valve - 3CX, 4CX Machines

Standard

– Machines up to serial no. 964124
– North American machines up to serial no. 912261

Relief Valve Pressures: ⇨ *Fig 25. (E-19)*	**bar**	**kgf/cm²**	**lbf/in²**
Main Relief Valve (MRV)	236 - 241	240 - 245	3420 - 3500
Unloader Valve	207 - 214	207 - 211	3000 - 3100
Auxiliary Relief Valves (ARV)			
Shovel Ram Head Side	172 - 179	176 - 183	2500 - 2600
Shovel Ram Rod Side	310 - 317	316 - 323	4500 - 4600

Weight: 25 kg (55 lbs)

High Pressure Type

– Machines from serial no. 964125
– North American machines from serial no. 912262

Relief Valve Pressures: ⇨ *Fig 25. (E-19)*	**bar**	**kgf/cm²**	**lbf/in²**
Main Relief Valve (MRV)	248 - 252	253 - 256	3600 - 3650
Unloader Valve	224 - 231	228 - 235	3250 - 3350
Auxiliary Relief Valves (ARV)			
Shovel Ram Head Side	172 - 179	176 - 183	2500 - 2600
Shovel Ram Rod Side	310 - 317	316 - 323	4500 - 4600

Important: *Relief valves fitted to machines prior to serial no. 964125 cannot be adjusted to the high pressure.*

Note: *Instructions for pressure testing and adjustment are described in* ***Service Procedures, Loader Valve - Pressure Testing****.*

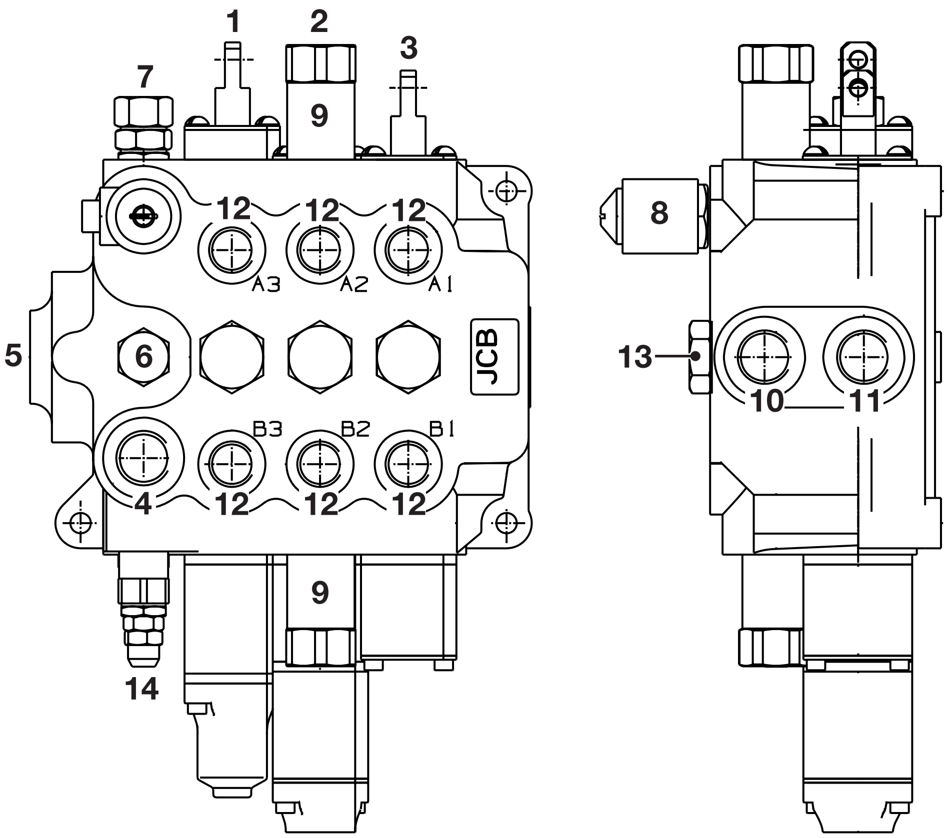


Fig 25.

Component Key:

1	Arms lift service	8	Unloader solenoid
2	Shovel service	9	Auxiliary relief valve (ARV)
3	Auxiliary service (optional)	10	Tank port
4	Pump section 1 - inlet	11	High pressure carry-over (HPCO) port
5	Pump section 2 - inlet	12	Service ports
6	Pressure test port	13	Load hold check valve assemblies
7	Unloader assembly	14	Main relief valve (MRV)

Loader Valve - Variable Flow

Relief Valve Pressures: ⇒ *Fig 26. (E-20)*	bar	kgf/cm²	lbf/in²
Priority Relief Valve (1)	170 - 176	173 - 179	2450 - 2550
Auxiliary Relief Valves (ARV) @ 0.5 gal/min (1.9 litres/min)			
Shovel Ram Head Side	170 - 174	173 - 177	2465 - 2520
Shovel Ram Rod Side	306 - 314	312 - 320	4450 - 4550

Weight: TBA kg (TBA lbs)

(1) Steer circuit pressure is controlled by a relief valve housed in the hydraulic steer unit (Refer to Section H Steering). The priority relief valve housed in the loader valve must be set at 2500 lb/in2, this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.

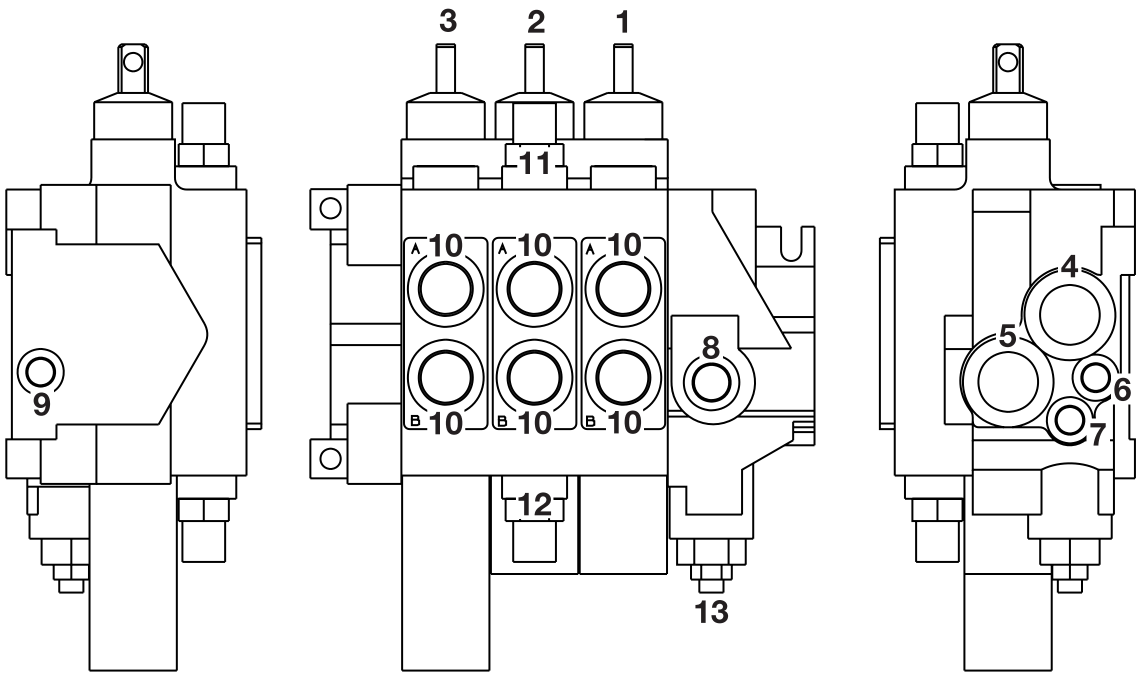


Fig 26.

Component Key:

1 Auxiliary service (optional)
2 Shovel service
3 Arms lift service
4 Pump inlet
5 Tank port
6 Load sense port (to pump)
7 Priority load sense port (from steer unit)
8 Priority work port (to steer unit)
9 Load sense carry-over port (to backhoe valve)
10 Service ports
11 Auxiliary relief valve (rod side)
12 Auxiliary relief valve (head side)
13 Priority relief valve

Loader Valve - 3C-14 (214e) Machines

Standard

- Machines up to serial no. 964124
- North American machines up to serial no. 912261

Relief Valve Pressures: ⇨ *Fig 27. (E-22)*	**bar**	**kgf/cm²**	**lbf/in²**
Main Relief Valve (MRV)	228 - 235	233 - 239	3300 - 3400
Auxiliary Relief Valves (ARV)			
Shovel Ram Head Side	172 - 179	176 - 183	2500 - 2600
Shovel Ram Rod Side	310 - 317	316 - 323	4500 - 4600

Weight: 10 kg (22 lbs)

High Pressure Type

- Machines from serial no. 964125
- North American machines from serial no. 912262

Relief Valve Pressures: ⇨ *Fig 27. (E-22)*	**bar**	**kgf/cm²**	**lbf/in²**
Main Relief Valve (MRV)	252 - 259	257 - 264	3650 - 3750
Auxiliary Relief Valves (ARV)			
Shovel Ram Head Side	172 - 179	176 - 183	2500 - 2600
Shovel Ram Rod Side	310 - 317	316 - 323	4500 - 4600

Important: *Relief valves fitted to machines prior to serial no. 964125 cannot be adjusted to the high pressure.*

Note: *Instructions for pressure testing and adjustment are described in* ***Service Procedures, 214e Machines, Loader Valve - Pressure Testing****.*

Loader Valve - 3C-14 (214e) Machines

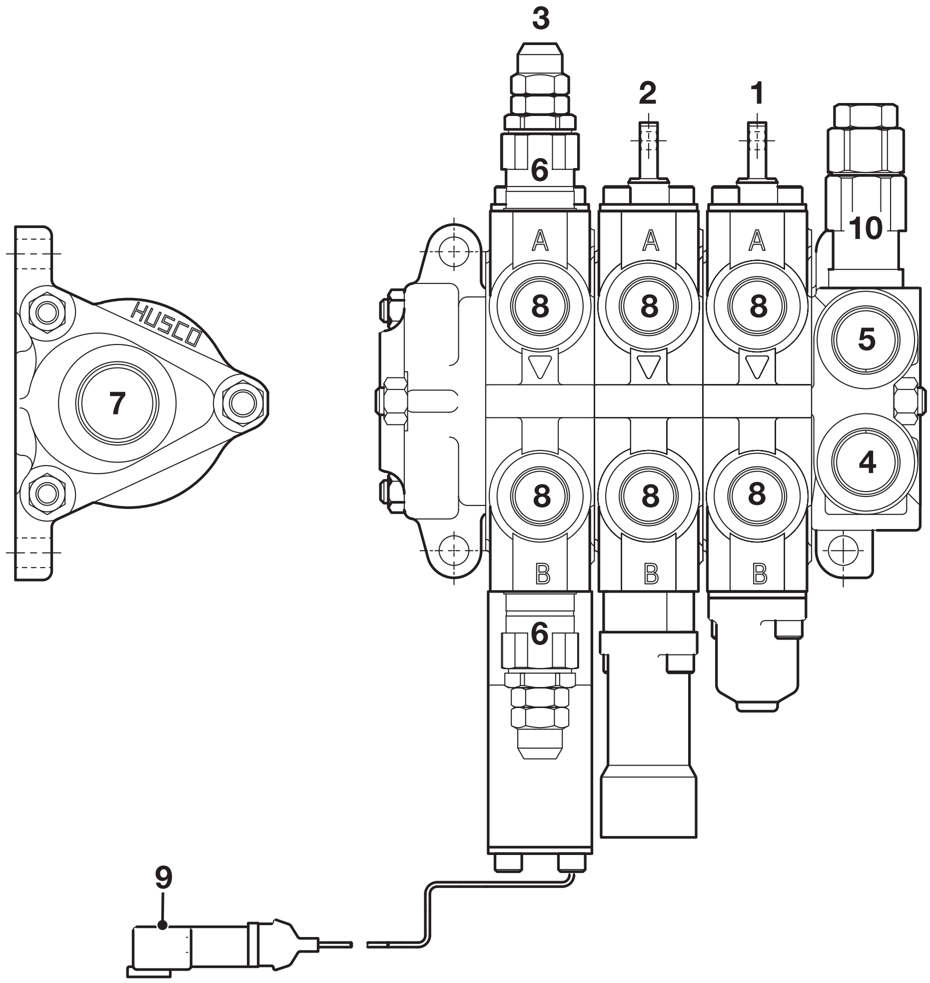


Fig 27.

Component Key:

1	Auxiliary service (optional)	6	Auxiliary relief valve (ARV)
2	Arms lift service	7	High pressure carry-over (HPCO) port
3	Shovel service	8	Service ports
4	Pump inlet	9	Connector - electric detent spool (if fitted)
5	Tank port	10	Main relief valve (MRV)

Loader Valve - 3C Machines (Sideshift)

Relief Valve Pressures: ⇨ Fig 28. (E-23)	bar	kgf/cm²	lbf/in²
Main Relief Valve (MRV)	228 - 231	233 - 236	3300 - 3350
Auxiliary Relief Valves (ARV)			
Shovel Ram Head Side	170 - 174	173 - 177	2450 - 2500
Shovel Ram Rod Side	308 - 312	314 - 318	4450 - 4500

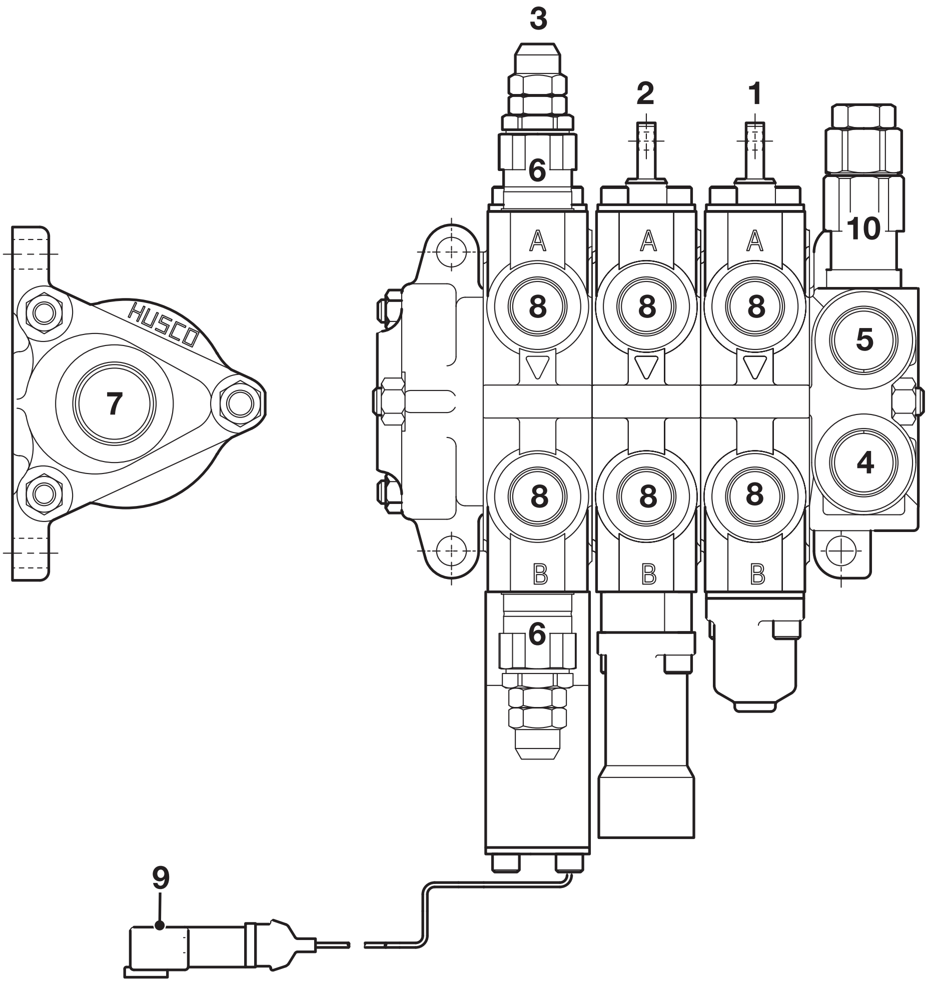


Fig 28.

Component Key:

1 Auxiliary service (optional)
2 Arms lift service
3 Shovel service
4 Pump inlet
5 Tank port
6 Auxiliary relief valve (ARV)
7 High pressure carry-over (HPCO) port
8 Service ports
9 Connector - electric detent spool (if fitted)
10 Main relief valve (MRV)

Note: *Instructions for pressure testing and adjustment are described in* ***Service Procedures, 3C Machines, Loader Valve - Pressure Testing****.*

Excavator Valve - 3CX, 4CX Machines

Standard

- Machines up to serial no. 964124
- North American machines up to serial no. 912261

Relief Valve Pressures: ⇒ Fig 29. (E-25)	Bar	kgf/cm²	lbf/in²
Boom Ram Head Side	248 - 255	253 - 260	3600 - 3700
Boom Ram Rod Side	345 - 352	351 - 358	5000 - 5100
Bucket Ram Head Side			
Centremount (17' , 15' 6" backhoe - except knuckle)	310 - 317	316 - 323	4500 - 4600
Centremount (14' backhoe, 15' 6" backhoe with a knuckle fitted)	248 - 255	253 - 260	3600 - 3700
Sideshift	248 - 255	253 - 260	3600 - 3700
Bucket Ram Rod Side (Machines with Rockbreaker only)	248 - 255	253 - 260	3600 - 3700
Dipper Ram Head Side	248 - 255	253 - 260	3600 - 3700
Dipper Ram Rod Side	248 - 255	253 - 260	3600 - 3700
Slew Left and Right	262 - 269	267 - 274	3800 - 3900

Weight: 44 kg (97 lbs) - Centremount
46 kg (101 lbs) - Sideshift

High Pressure Type

- Machines from serial no. 964125
- North American machines from serial no. 912262

Relief Valve Pressures: ⇒ Fig 29. (E-25)	Bar	kgf/cm²	lbf/in²
Boom Ram Head Side	262 - 269	267 - 274	3800 - 3900
Boom Ram Rod Side	345 - 352	351 - 358	5000 - 5100
Bucket Ram Head Side			
Centremount (17' , 15' 6" backhoe - except knuckle)	310 - 317	316 - 323	4500 - 4600
Centremount (14' backhoe, 15' 6" backhoe with a knuckle fitted)	262 - 269	267 - 274	3800 - 3900
Sideshift	262 - 269	267 - 274	3800 - 3900
Bucket Ram Rod Side (Machines with Rockbreaker only)	262 - 269	267 - 274	3800 - 3900
Dipper Ram Head Side	262 - 269	267 - 274	3800 - 3900
Dipper Ram Rod Side	262 - 269	267 - 274	3800 - 3900
Slew Left and Right	262 - 269	267 - 274	3800 - 3900

***Important:** Relief valves fitted to machines prior to serial no. 964125 cannot be adjusted to the high pressure.*

***Note:** Instructions for pressure testing and adjustment are described in **Service Procedures, Loader Valve - Pressure Testing**.*

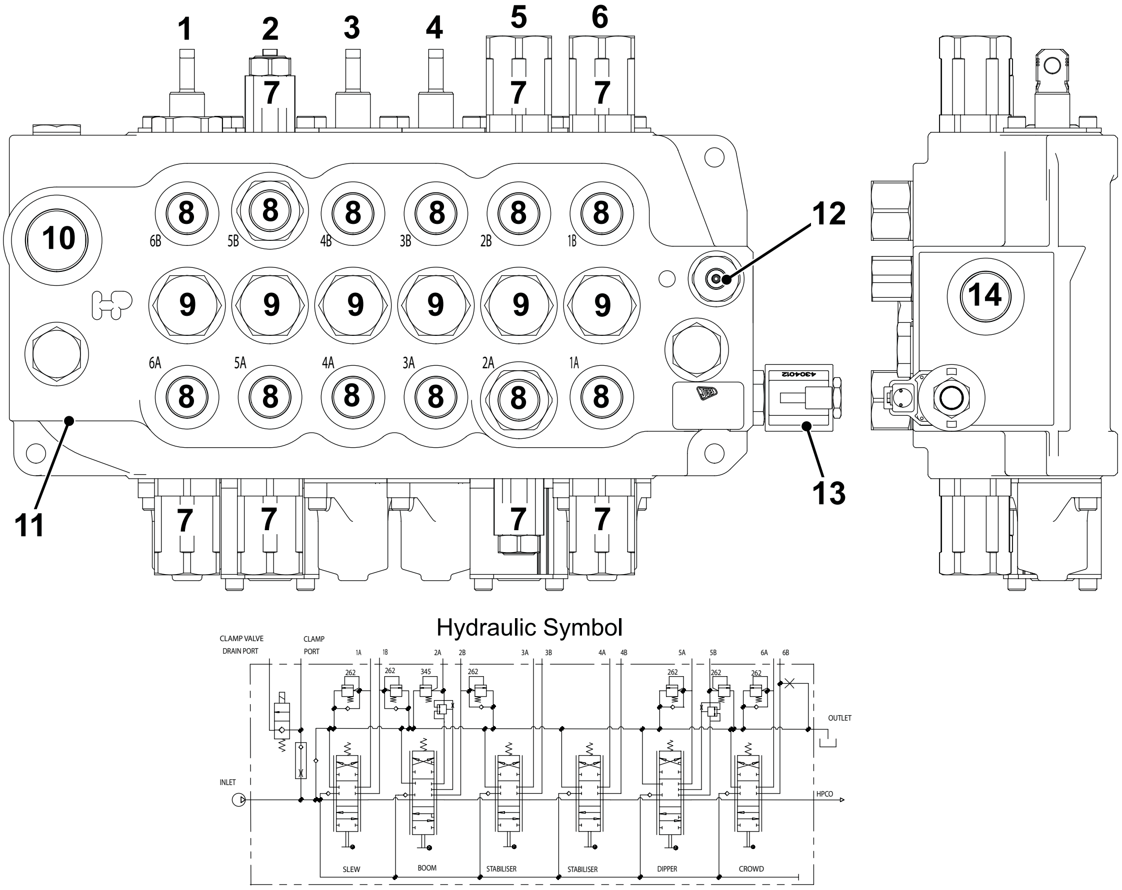


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Fig 29.

Component Key:

1 Bucket service
2 Dipper service [1]
3 Stabiliser service
4 Stabiliser service
5 Boom service [1]
6 Slew service
7 Auxiliary relief valve (ARV)
8 Service ports
9 Load hold check valve assemblies
10 Tank port
11 High pressure carry-over (HPCO) port
12 Hydraclamp port (Sideshift)
13 Hydraclamp solenoid (Sideshift)
14 Inlet port

(1) System shown is for JCB plus pattern and JCB diagonal pattern. For ISO system, the boom and dipper spools change position, i.e. boom is position 2 and dipper is position 5. The bottom ARV from spool 5 will also be swapped with the bottom ARV from spool 2.

Excavator Valve - 3C-14 (214e) Machines

Relief Valve Pressures: ⇨ *Fig 30.* (E-26)	Bar	kgf/cm^2	lbf/in^2
Slew Left and Right	248	253	3600
Boom Ram Rod Side	345	351	5000
Boom Ram Head Side	248	253	3600
Dipper Ram Head Side	248	253	3600
Dipper Ram Rod Side	248	253	3600
Bucket Ram Head Side	248	253	3600
Bucket Ram Rod Side	248	253	3600

Weight: 44 kg (97 lbs)

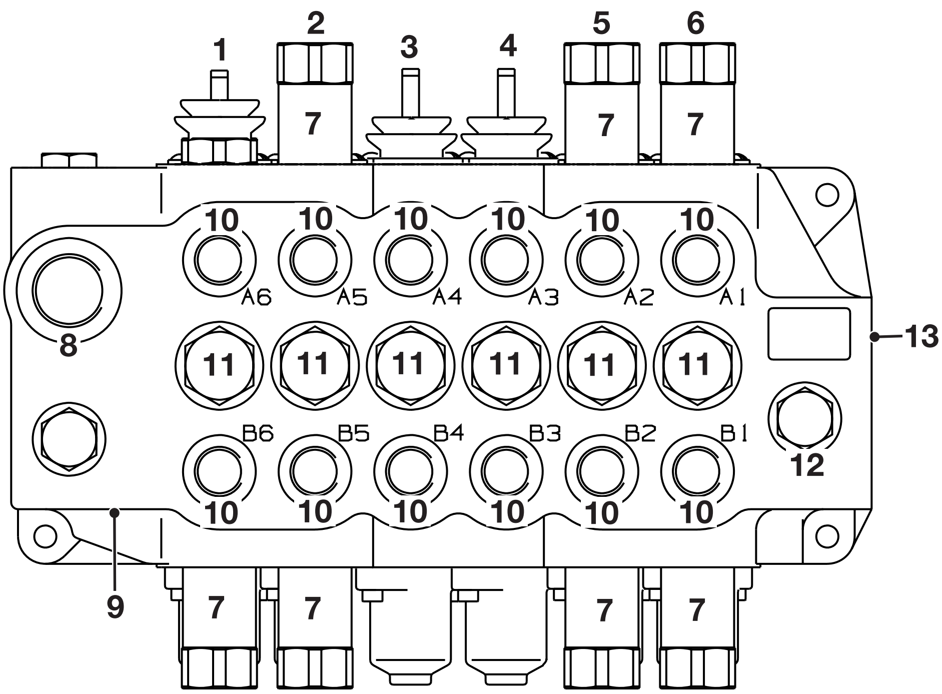


Fig 30.

Component Key:

1	Bucket service	7	Auxiliary relief valve (ARV)
2	Dipper service	8	Tank port
3	Stabiliser service	9	High pressure carry-over (HPCO) port
4	Stabiliser service	10	Service ports
5	Boom service	11	Load hold check valve assemblies
6	Slew service	12	Make-up check valve assembly
		13	Inlet port

Excavator Valve - 3C Machines (Sideshift)

Relief Valve Pressures: ⇒ *Fig 31. (E-27)*	**Bar**	**kgf/cm²**	**lbf/in²**
Slew Left and Right	262	267	3800
Boom Ram Rod Side	345	351	5000
Boom Ram Head Side	248	253	3600
Dipper Ram Head Side	248	253	3600
Dipper Ram Rod Side	248	253	3600
Bucket Ram Head Side	248	253	3600
Bucket Ram Rod Side	248	253	3600
Auxiliary - Extending Dipper Head Side	138	140	2000
Auxiliary - Extending Dipper Rod Side	206	210	3000

Weight: 28.4 kg (62 lbs)

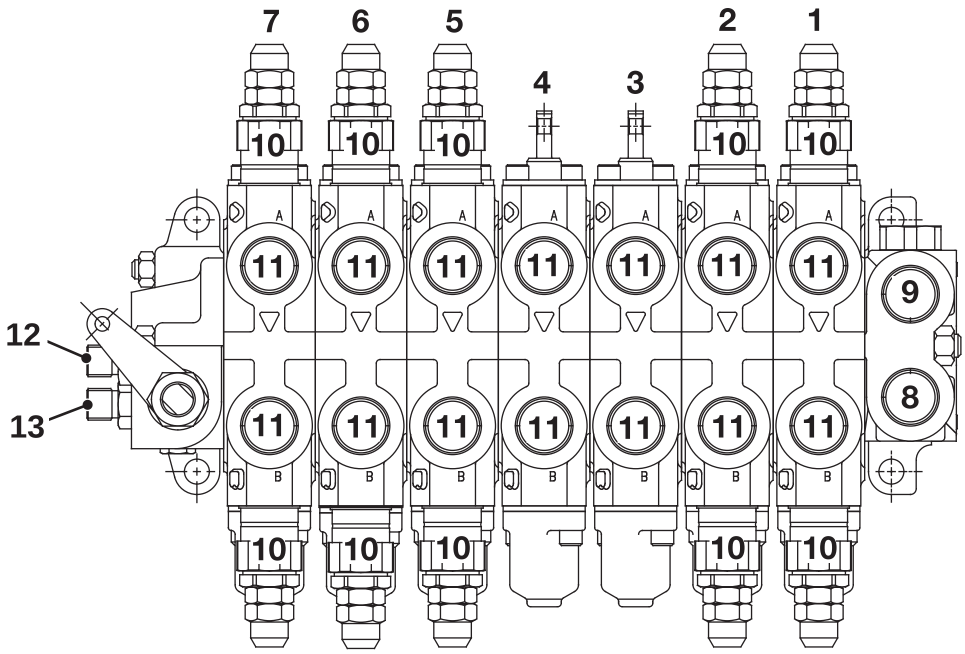


Fig 31.

Component Key:

1	Slew service	7	Auxiliary service (optional) - Extending dipper
2	Boom service	8	Inlet port
3	Stabiliser service	9	Outlet port
4	Stabiliser service	10	Auxiliary relief valve (ARV)
5	Dipper service	11	Service ports
6	Bucket service	12	Hydraclamps - feed (Sideshift)
		13	Hydraclamps - drain (Sideshift)

Auxiliary Valve - if fitted

Relief Valve Pressures: *⇨ Fig 32. (E-28)*	**Bar**	**kgf/cm²**	**lbf/in²**
Extradig Ram Head Side	138 - 145	141 - 148	2000 - 2100
Extradig Ram Rod Side	207 - 214	211 - 218	3000 - 3100
Jaw Bucket Ram Head Side	138 - 145	141 - 148	2000 - 2100
Jaw Bucket Ram Rod Side	207 - 214	211 - 218	3000 - 3100
Knuckle Ram Head Side	138 - 145	141 - 148	2000 - 2100
Knuckle Ram Rod Side	207 - 214	211 - 218	3000 - 3100
Hammermaster	207 - 214	211 - 218	3000 - 3100
Power Sideshift (both)	207 - 214	211 - 218	3000 - 3100
Hand Held Tools	138 - 150	141 - 153	2000 - 2200

Weight: 5.6 kg (12.3 lbs)

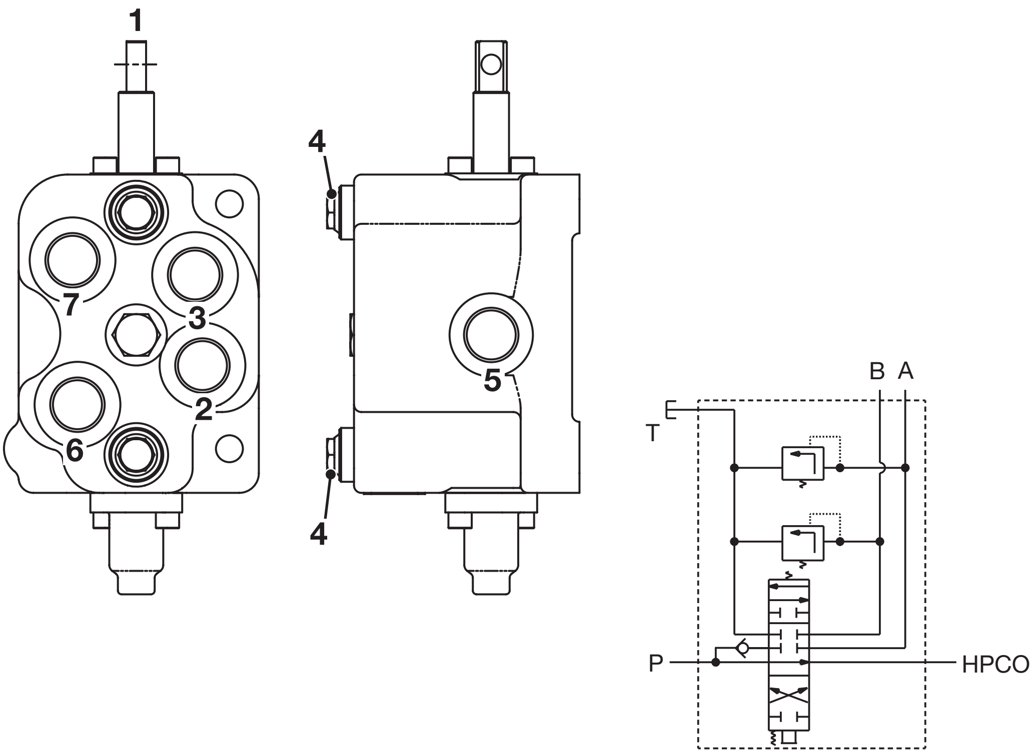


Fig 32.

Component Key:

1 Auxiliary Spool
2 Inlet port `P'
3 Outlet port `T'
4 Auxiliary relief valve (ARV)
5 High pressure carry-over (HPCO) port
6 Service port `A'
7 Service port `B'

Smooth Ride System (SRS) - if fitted

Accumulator

A piston type accumulator operates as a liquid spring absorbing displaced fluid from the lift rams. Selectable from a switch in the cab.

Charging Gas	Air Free Dry Nitrogen
Accumulator Capacity	1.0 litre (58 cu/in)
Accumulator Weight	4.4 kg (9.75 lb)

Accumulator Nitrogen Precharge Pressures

As a general guide for given shovel weights (loaded) see below:-

	Bar	**kgf/cm²**	**lbf/in²**
Shovel weights up to 700 kg (1540 lb)	13.8	14	200
Shovel weights 700 kg to 950 kg (1540 - 2100 lb)	19	19.4	275
Shovel weights over 950 kg (2100 lb)	24	24.5	350

Note: *Replacement accumulators will only be supplied in an uncharged, non-pressurised condition to meet Health and Safety, and Airfreight hazardous goods requirements.*

Basic System Operation

Component Location and Neutral Circuit Descriptions

Gearpump - Double Pump

Fig 33. (E-31). Oil is drawn from the hydraulic tank **T** by the hydraulic pump. The pump has two sections, **P1** and **P2**.

The hydraulic pump is mounted on the rear of the gearbox and is driven by the engine via a driveshaft.

Oil from the larger section **P1** flows direct to the loader valve **3**. Oil from pump section **P2**, flows to steering priority valve **7**, and in neutral circuit flows through the priority valve to the auxiliary valve **5** and then to join the flow from **P1** at the loader valve.

From the loader valve neutral gallery, oil flows via a high pressure carry-over line **1B** to the excavator valve **4**.

Some of the exhaust oil flows directly back to the tank through an in-tank filter **6**, and some of the exhaust oil returns to tank via the hydraulic oil cooler **26**.

To help prevent excavator dipper ram and loader lift ram cavitation, there is a check valve **13** fitted to the return line. The check valve raises approximately 5 bar (75 lbf/in^2) of pressure in the line, which improves the operation of the respective anti-cavitation valves.

On sideshift machines only, hydraclamp exhaust hose **62** is fitted. The hose connects the hydraclamp spool directly into the exhaust circuit. This prevents the clamps from `locking-up' when the sideshifting operation is required.

Component Key:

T	Hydraulic Tank
P1	Hydraulic Pump (main section)
P2	Hydraulic Pump (secondary section)
1B	High Pressure Carry-over
3	Loader Valve Block
4	Excavator Valve
5	Auxiliary Valve
6	Return Line Filter (inside hydraulic tank)
7	Steer Circuit Priority Valve
13	Return Line Check Valve
26	Hydraulic Oil Cooler
62	Hydraclamp exhaust hose

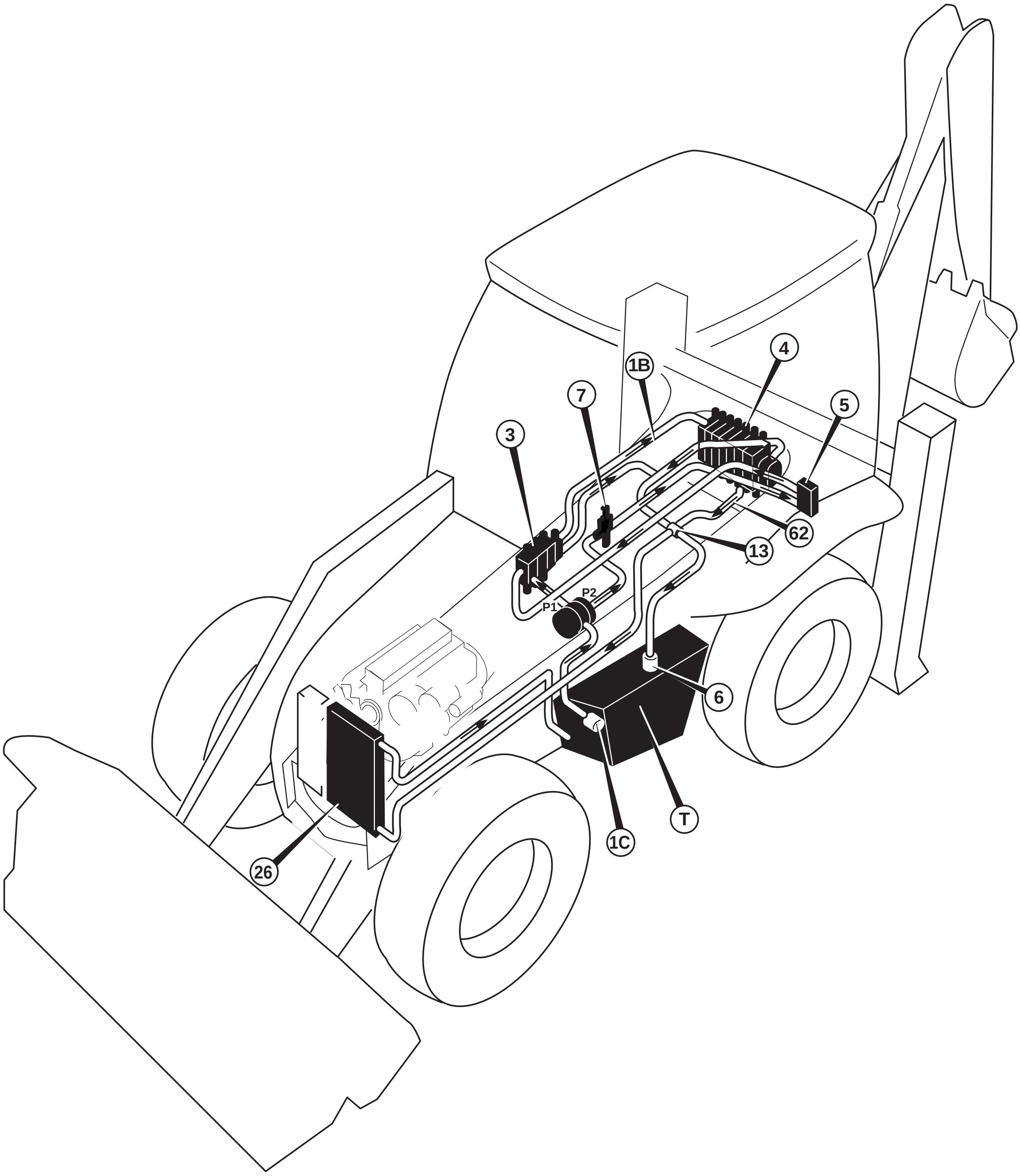


Fig 33. Gearpump - Double Pump

Variable Flow Pump

⇨ *Fig 34. (E-33)*. The variable flow displacement pump **P** is mounted on the rear of the gearbox and is engine driven via a driveshaft.

With variable flow hydraulics, there is no `neutral' circuit. This is because the pump **P** operates on a demand signal from the services, see ***Circuit Descriptions, Variable Flow Pump - Operation***. If there is no demand, then the pump does not draw oil from the tank and no oil is delivered, there is no pump flow in the neutral position.

When a service is selected, the pump senses the demand and oil is drawn from the hydraulic tank **T**. Pressurised oil from the pump flows to the loader valve **3** and the excavator valve **4** via hose and pipe assembly **1A**.

The loader valve **3** is fitted with a priority inlet manifold, oil entering the loader valve is distributed to the (priority) steer circuit and the loader services as required, see ***Circuit Descriptions, Loader Valve - Variable Flow Operation***.

Some of the exhaust oil flows directly back to the tank through an in-tank filter **6**, and some of the exhaust oil returns to tank via the hydraulic oil cooler **26**.

To help prevent excavator dipper ram and loader lift ram cavitation, there is a check valve **13** fitted to the return line. The check valve raises approximately 5 bar (75 lbf/in^2) of pressure in the line, which improves the operation of the respective anti-cavitation valves.

Component Key:

T	Hydraulic Tank
P	Hydraulic Pump (engine driven)
1A	Pump Outlet Pipe
3	Loader Valve Block
4	Excavator Valve
6	Return Line Filter (inside hydraulic tank)
13	Return Line Check Valve
26	Hydraulic Oil Cooler

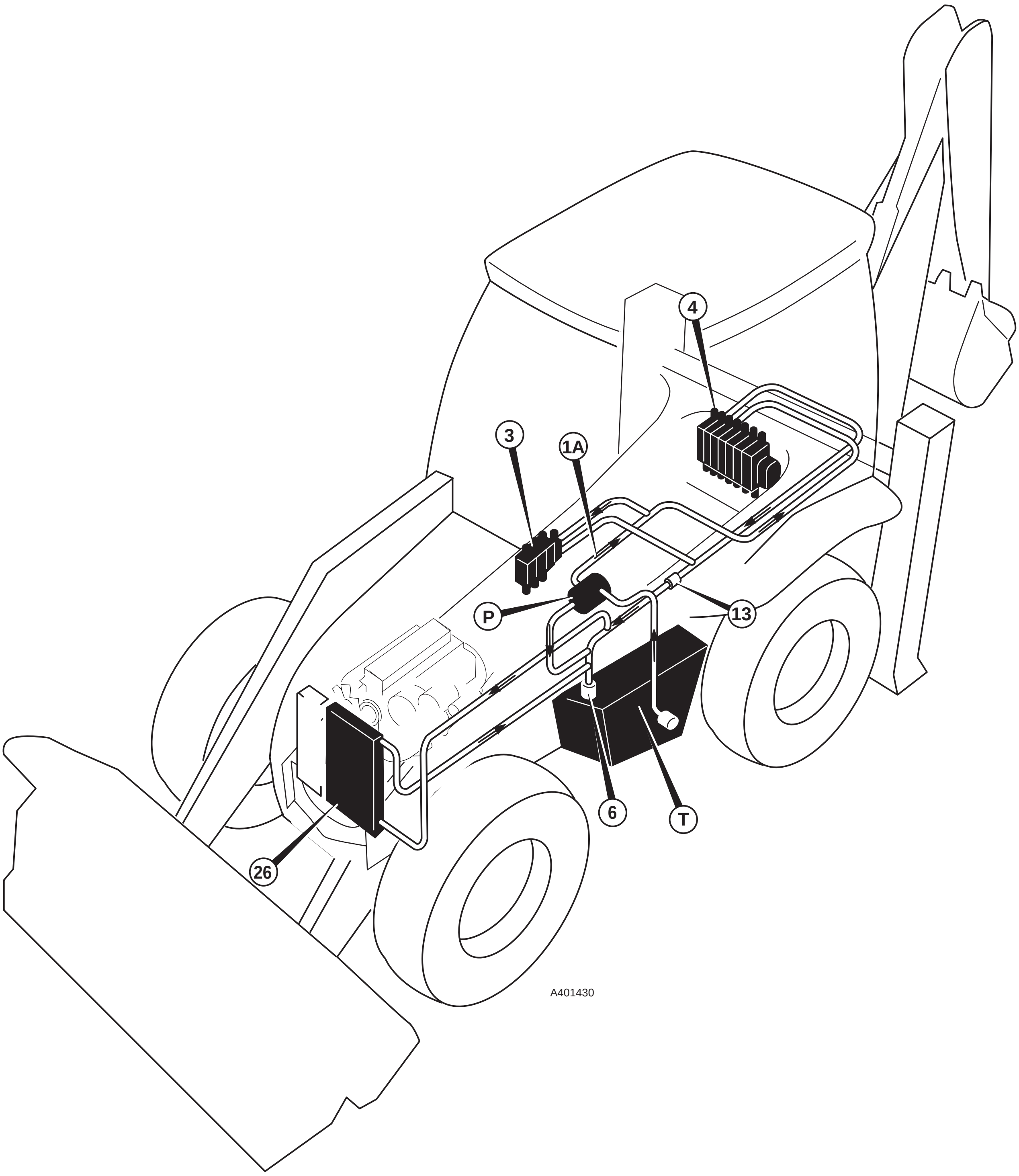


Fig 34. Variable Flow Pump

Introduction to Hydraulic Schematic Symbols

TE-001

General (Basic and Functional Symbols)

Complex hydraulic components and circuits can be described to the engineer by using graphical symbols. The following pages illustrate and give a brief description for some of the more common symbols used.

There are many symbols in use and it would be impossible to include them all here. However it should be noted that most are only variations or refinements on the basic principles explained here. If more detailed information is required you are recommended to obtain a copy of BS2917 or IS01219.

Once familiar with the symbols, the engineer can use hydraulic circuit diagrams as an aid to fault finding. It will be possible to see the complete hydraulic circuit and decipher the relationship between hydraulic components.

Table 1. General

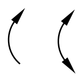
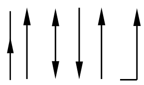
	Spring
	Flow restriction affected by viscosity
	Direction of flow
	Indication of rotation
	Indication of direction and paths of flow
	Variable control

Table 2. Rams

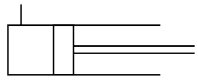
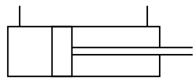
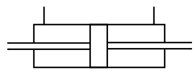
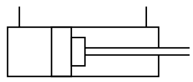
	Single acting
	Double acting
	Double ended
	Double acting with damping at rod area end

Table 3. Pumps and Motors

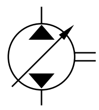
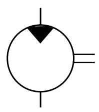
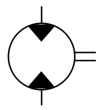
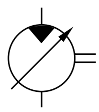
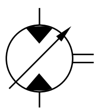
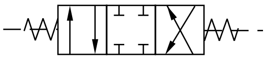
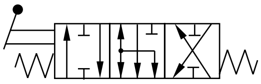
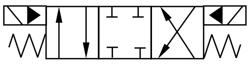
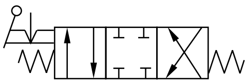
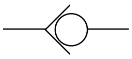
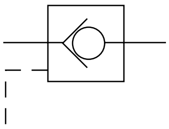
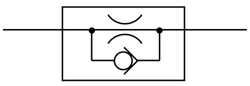
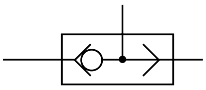
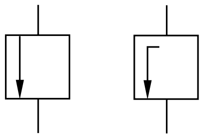
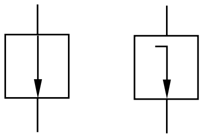
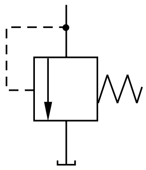
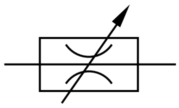
	Variable capacity pump two directions of flow
	Fixed capacity motor one direction of flow
	Fixed capacity motor two directions of flow
	Variable capacity motor one direction of flow
	Variable capacity motor two directions of flow

Table 4. Control Valves

	Used to enclose several valves indicating they are supplied as one unit
	3-Position, 4-port spring centered pilot operated valve
	3-position, 6-port spring centered pilot operated valve
	3-Position, 4-port spring centered solenoid & pilot pressure operated valve
	3-Position, 4-port spring centered detent hand operated valve
	Non-return valve
	Non-return valve with back pressure spring
	Pilot operated non-return valve
	One way restrictor
	High pressure selector (shuttle valve)

	Throttling orifice - normally closed
	Throttling orifice - normally open
	Relief valve
	Variable restrictor

Introduction to Hydraulic Schematic Symbols

Table 5. Energy Transmissions and Conditioning

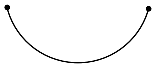
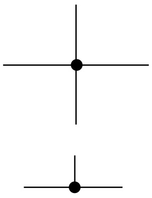
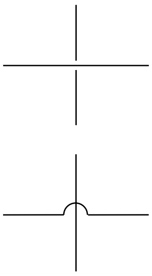
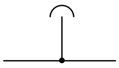
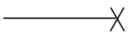
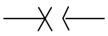
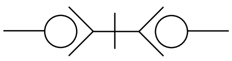
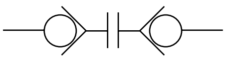
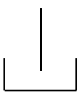
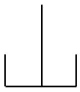
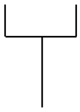
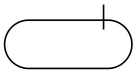
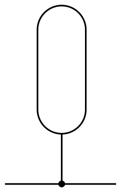
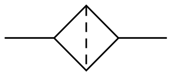
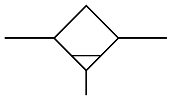
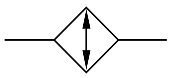
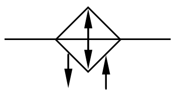
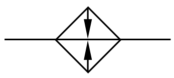
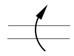
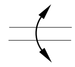
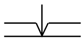
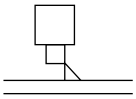
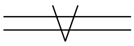
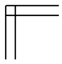
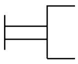
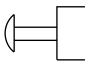
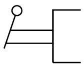
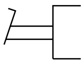
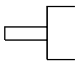
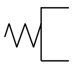
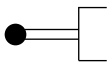
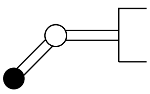
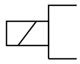
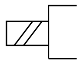
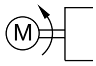
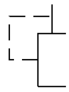
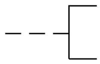
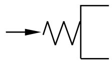
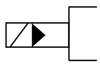
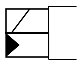
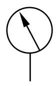
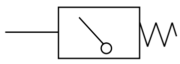
	Working line, return or feed
	Pilot control
	Drain lines
	Flexible pipe
	Line junction
	Crossing lines
	Air bleed
	Line plugged, also pressure test point
	Line plugged with take off line
	Quick release couplings - connected
	Quick release couplings - disconnected
	Reservoir - return line above fluid level
	Reservoir - return line below fluid level
	Header tank
	Pressure sealed tank
	Accumulator
	Filter or strainer
	Water trap
	Cooler - with no indication of coolant flow
	Cooler - indicating direction of coolant flow
	Heater

Table 6. Control Mechanisms

	Rotating shaft - one direction
	Rotating shaft - two directions
	Detent
	Locking device
	Over centre device
	Simple linkage
	General control
	Push button operated
	Lever operated
	Pedal operated
	Stem operated
	Spring operated
	Roller operated
	Roller trip operated (one directional)

	Solenoid one winding
	Solenoid two windings
	Electric motor operated
	Internal pressure pilot operated
	External pressure pilot operated
	Pressure operated spring release
	Pilot operated by solenoid pilot valve
	Pilot operated by a solenoid or seperate pilot valve
	Pressure guage
	Pressure switch

Control Valves

Control valves are usually represented by one or more square boxes.

⇒ Fig 35. (E-38) shows a control valve represented by three boxes. The number of boxes indicates the number of possible valve operating positions, (3 boxes - 3 positions etc).

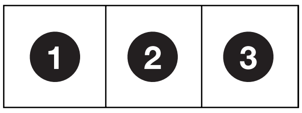


Fig 35.

⇒ Fig 36. (E-38) - In circuit diagrams the pipework is usually shown connected to the box which represents the unoperated condition. (Hydraulic circuit diagrams are usually shown in the unoperated condition).

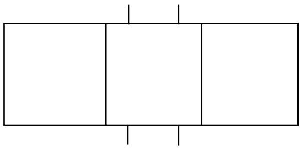


Fig 36.

⇒ Fig 38. (E-38) shows a valve described as a 3-position, 4-port control valve. Port describes the openings to and from the valve by which the hydraulic fluid enters or leaves. In the fig shown, Position **2** indicates that in an unoperated condition all 4 ports are blocked.

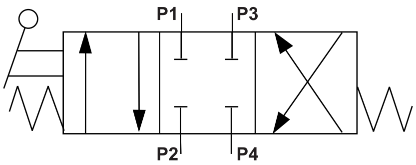


Fig 37.

If the valve spool was moved to Position **1**, movement of the spool would connect Port **P1** to Port **P2**, and Port **P3** to Port **P4**. *⇒ Fig 38. (E-38)*.

If the valve spool was moved to Position **3**, movement of the spool would connect Port **P1** to Port **P4**, and Port **P3** to Port P2. *⇒ Fig 38. (E-38)*.

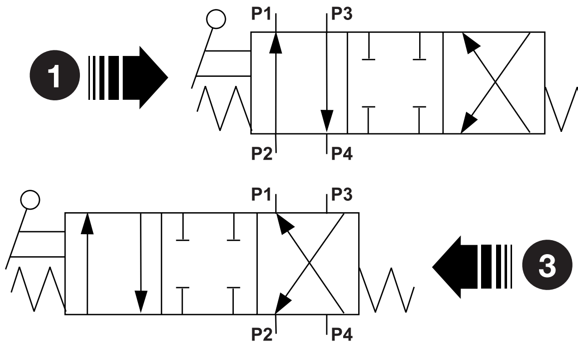


Fig 38.

It must be noted that not all spools are of the same type. Their operating designs can be seen by following the path the flow arrows take in their respective operating squares.

Three typical JCB style spools are known as 'D' spools, 'F' spools and 'N' spools.

The 'D' spools generally control rams because when in the neutral position the outlet ports are blocked, preventing ram movement. *⇒ Fig 38. (E-38)* shows a 'D' type spool.

⇒ Fig 39. (E-38) - 'F' spools are often shown as four position spools with the three normal positions for neutral and service control; and the forth position, which has a detent, connects both sides of the ram together to allow the service to 'float'.

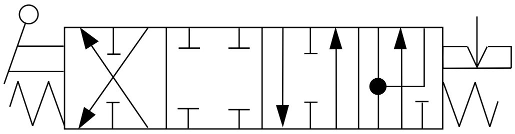


Fig 39.

⇒ Fig 40. (E-38) - 'N' spools are sometimes used to control hydraulic motors, and it can be seen from the flow arrows, that in neutral position both service ports are connected to the exhaust oil port

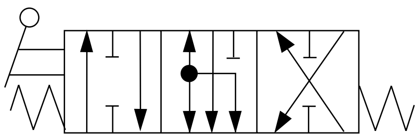


Fig 40.

Example of Schematic Circuit

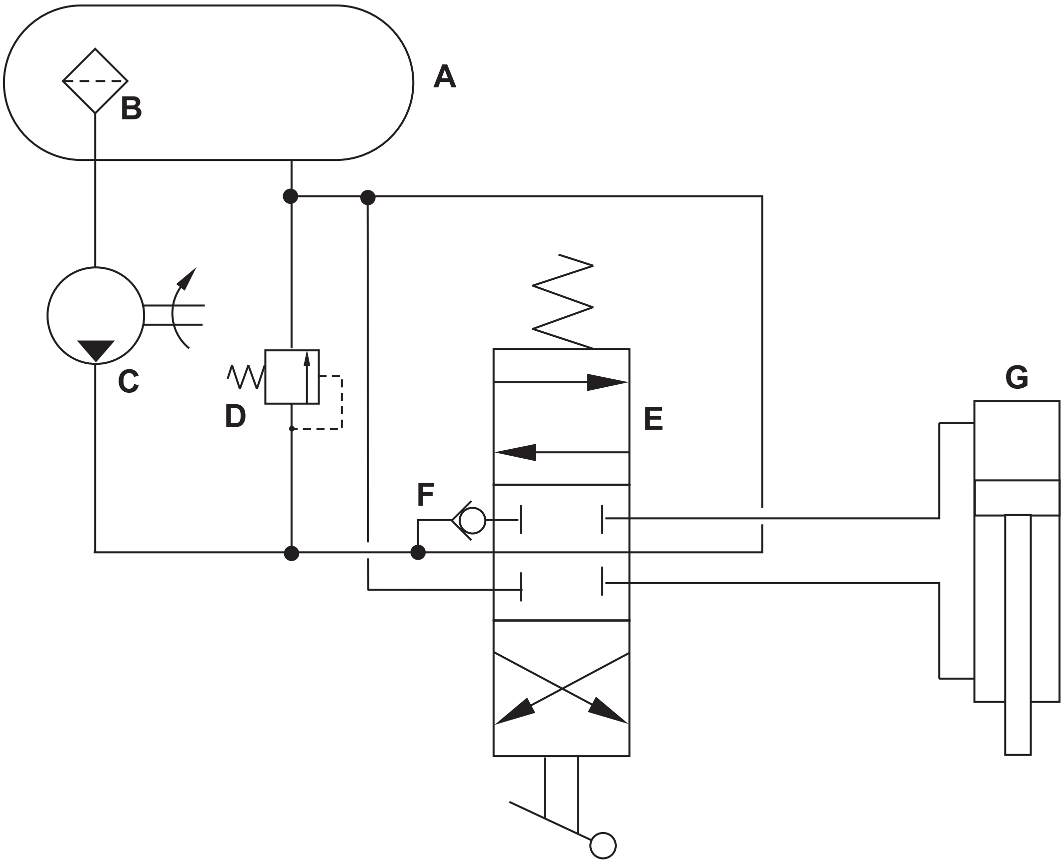


Fig 41. Simple Schematic Circuit

Some of the symbols described on the preceding pages have been arranged into a simple schematic circuit. ⇒ *Fig 41. (E-39)*.

Hydraulic tank **41-A** is a pressurised tank with an internally mounted strainer **41-B** on the suction line to the fixed displacement pump **41-C**. System pressure is limited to the setting of relief valve **41-D**.

Valve spool **41-E** is an open-centre spool that is in neutral position; flow from the pump passes through the spool and returns to the hydraulic tank.

If the lever operated spool is moved away from neutral position hydraulic fluid is directed to either head side or rod side of hydraulic ram **41-G**. Notice that the fluid must first open one way valve **41-F** before flowing to the ram.

Example Circuit Key

41-A	Hydraulic Tank
41-B	Strainer
41-C	Fixed Displacement Pump
41-D	Relief Valve
41-E	Spool
41-F	One Way Valve
41-G	Double Acting Hydraulic Ram

Schematic Circuits

3CX Gearpump Machines (up to September 2007)

⇨ Fig 42. (E-41) and ⇨ Fig 43. (E-42).

The policy of JCB is one of continuous improvement, therefore as products develop, there may be variations to the circuits.

Component Key:

C	Tank Cap
JJ	Connections (as applicable)
P1	Pump, Main Section
P2	Pump, Secondary Section
P2A	Pressure Test Point (auxiliary & unloader)
M	Connections (as applicable)
MM	Quick Release Couplings
3	Loader Valve Block
3A	Pressure Test Point (MRV)
3B	Unloader Pilot Valve
3C	Loader Lift Ram Spool
3D	Loader Shovel Ram Spool
3E	Clamshovel Spool
3F	Shovel Ram Head Side (ARV)
3G	Shovel Ram Rod Side (ARV)
3J	Load Hold Check Valve
3L	Unloader Valve Spool
3M	Main Relief Valve (MRV)
3N	Unloader Check Valve
3Q	Hydraulic Speed Control Solenoid
4	Excavator Valve Block

Excavator services shown here are to the JCB control pattern. If ISO, Case or Ford control pattern is used, the excavator spools and relief valves will apply to different services.

4A	Slew Spool
4B	Boom Spool
4C	Stabiliser Spool
4D	Stabiliser Spool
4E	Dipper Spool
4F	Bucket Spool
4G	Hydraclamp Valve (Sideshift Machines Only)
4H	Slew (ARV)
4J	Slew (ARV)
4K	Boom Ram Rod Side (ARV)
4L	Boom Ram Head Side (ARV)
4M	Dipper Ram Head Side (ARV)
4N	Dipper Ram Rod Side (ARV)
4P	Bucket Ram Head Side (ARV)
4Q	Bucket Ram Rod Side (ARV) - if fitted (hammer only)
5	Auxiliary Valve Block (foot operated)
5A	Auxiliary Spool
5B	Auxiliary (ARV)
5C	Auxiliary (ARV)
6	In-tank Filter
6A	Filter By-pass Valve
6B	Suction Strainer
7	Priority Valve
10	Diverter Valve (hammer only)
11	Sequence Valve (hammer only)
12	Flow Regulator Valve
13	Anti-cavitation Check Valve
14	Check Valve (optional)
15	Smooth Ride System Selector Valve Assembly
16	Smooth Ride System Accumulator
26	Hydraulic Oil Cooler
30	Loader Quickhitch - Changeover Solenoid (optional)
31	Shovel Ram R.H.
32	Shovel Ram L.H.
33	Lift Ram R.H.
34	Lift Ram L.H.
35	Clam Shovel Ram R.H.
36	Clam Shovel Ram L.H.
37	Loader Quickhitch Locking Ram (optional)
38	2 Wheel Steer Power Track Rod
39	AWS Rear Axle Power Track Rod
40	AWS Front Axle Power Track Rod
41	AWS Valve Assembly
42	Steer Control Valve
43	Shock Valves
44	Steer Control Valve Relief Valve
51	Bucket Ram
52	Boom Ram

53	Stabiliser Ram
54	Stabiliser Ram
55	Dipper Ram
56	Left Hand Slew Ram
57	Right Hand Slew Ram
59	Stabiliser Check Valve
59A	Stabiliser Check Valve (ARV) - if fitted (Centremount Machines Only)
62	Hydraclamps (Sideshift Machines Only)
65	Restrictor
66	Dipper Restrictor with By-Pass
67	Manual Isolation Valve
68	Manual Change Over Valve
69	Extending Dipper Ram
70	High Flow Options
71	Low Flow options

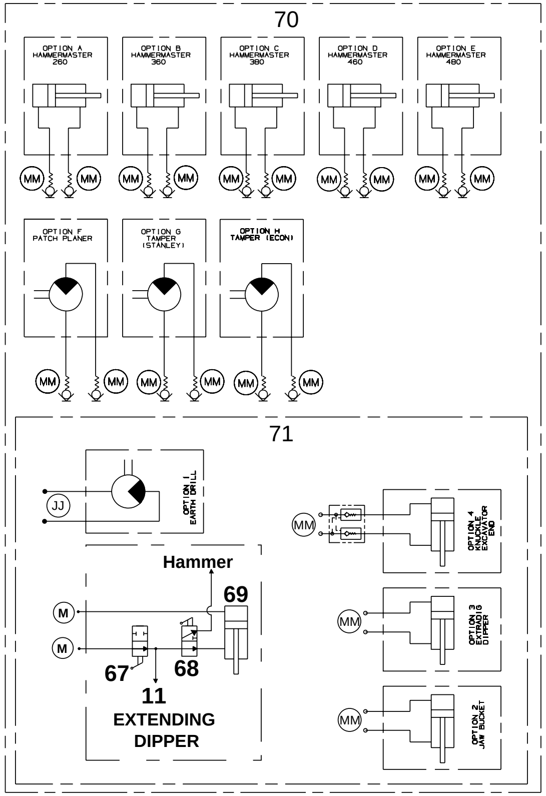


Fig 42. Options

E-41

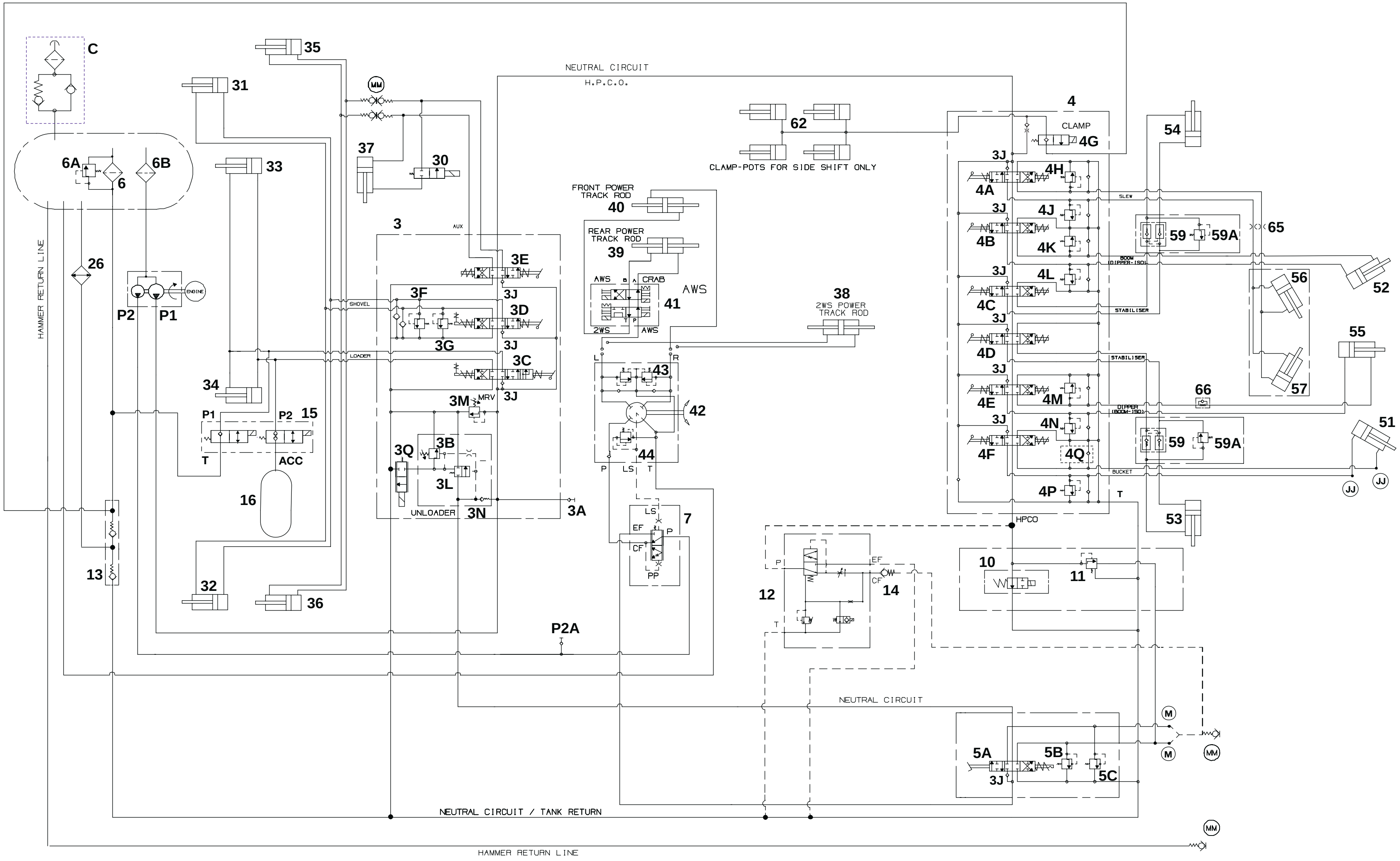


Fig 43. Machines up to September 2007

3CX `S' Series Options

Component Key:

HPCO	High Pressure Carry Over (From Excavator Valve Block 4)
M	Hydraulic Connections
MM	Quick Release Couplings
T	Hydraulic Tank Return
11	Sequence valve
69	Extending Dipper Ram
72	Change Over Valve
73	Power Sideshift Cylinder
74	Relief Valve
76	Isolation Valve
77	Hammer

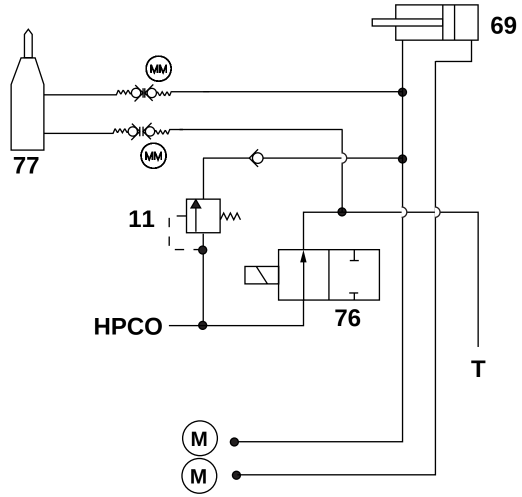


Fig 44.

This circuit shows the Low Flow Hammer and Extending Dipper, for the main hydraulic circuit see ⇨ *Fig 42. (E-41)* and ⇨ *Fig 43. (E-42)*.

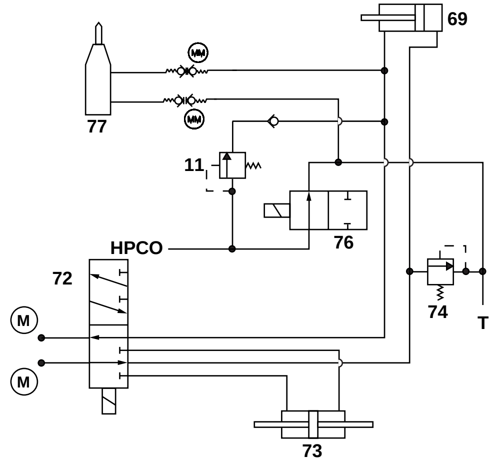


Fig 45.

This circuit shows the Low Flow Hammer, Extending Dipper and Power Sideshift, for the main hydraulic circuit see ⇨ *Fig 42. (E-41)* and ⇨ *Fig 43. (E-42)*.

3CX `S' Series and 4CX Gearpump Options

Component Key:

HPCO	High Pressure Carry Over (From Excavator Valve Block 4)
M	Hydraulic Connections
MM	Quick Release Couplings
T	Hydraulic Tank Return
10	Diverter valve
11	Sequence valve
69	Extending Dipper Ram
72	Change Over Valve
73	Power Sideshift Cylinder
74	Relief Valve
75	Manual Change Over Valve
76	Isolation Valve

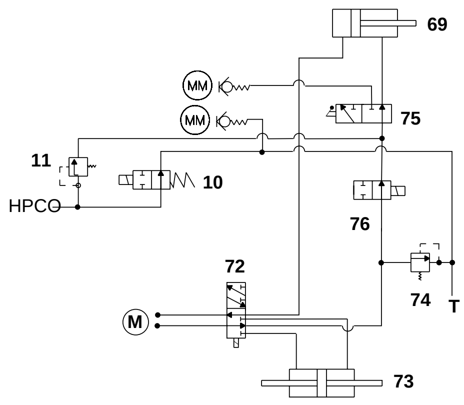


Fig 46.

This circuit shows the Extending Dipper and Power Sideshift, for the main hydraulic circuit see ⇨ *Fig 42. (E-41)* and ⇨ *Fig 43. (E-42)*.

3CX Gearpump Machines (from September 2007)

The policy of JCB is one of continuous improvement, therefore as products develop, there may be variations to the circuits.

Component Key: *Fig 47. (E-46)*

P1	Pump, Main Section
P2	Pump, Secondary Section
P2A	Pressure Test Point (auxiliary & unloader)
3	Loader Valve Block
3A	Pressure Test Point (MRV)
3B	Unloader Pilot Valve
3C	Loader Lift Ram Spool
3D	Loader Shovel Ram Spool
3E	Clamshovel Spool
3F	Shovel Ram Head Side (ARV)
3G	Shovel Ram Rod Side (ARV)
3J	Load Hold Check Valve
3L	Unloader Valve Spool
3M	Main Relief Valve (MRV)
3N	Unloader Check Valve
3Q	Hydraulic Speed Control Solenoid (HSC)
4	Excavator Valve Block

Excavator services shown here are to the JCB control pattern. If ISO, Case or Ford control pattern is used, the excavator spools and relief valves will apply to different services.

4A	Slew Spool
4B	Boom Spool
4C	Stabiliser Spool
4D	Stabiliser Spool
4E	Dipper Spool
4F	Bucket Spool
4G	Hydraclamp Valve (Sideshift Machines Only)
4H	Slew (ARV)
4J	Slew (ARV)
4K	Boom Ram Rod Side (ARV)
4L	Boom Ram Head Side (ARV)
4M	Dipper Ram Head Side (ARV)
4N	Dipper Ram Rod Side (ARV)
4P	Bucket Ram Head Side (ARV)
4Q	Bucket Ram Rod Side (ARV) - if fitted (hammer option)
5	Auxiliary Valve Block - if fitted (foot operated)
5A	Auxiliary Spool
5B	Auxiliary (ARV)
5C	Auxiliary (ARV)
6	In-tank Filter
6A	Filter By-pass Valve
6B	Suction Strainer
6C	Filler/Breather Cap
7	Priority Valve
10	Diverter Valve - if fitted (hammer option)
13	Anti-cavitation Check Valve
15	Smooth Ride System Selector Valve Assembly
16	Smooth Ride System Accumulator
26	Hydraulic Oil Cooler
31	Shovel Ram R.H.
32	Shovel Ram L.H.
33	Lift Ram R.H.
34	Lift Ram L.H.
35	Clam Shovel Ram R.H.
36	Clam Shovel Ram L.H.
38	2 Wheel Steer Power Track Rod
39	AWS Rear Axle Power Track Rod
40	AWS Front Axle Power Track Rod
41	AWS Valve Assembly
42	Steer Control Valve
43	Shock Valves
44	Steer Control Valve Relief Valve
51	Bucket Ram
52	Boom Ram
53	Stabiliser Ram
54	Stabiliser Ram
55	Dipper Ram
56	Left Hand Slew Ram
57	Right Hand Slew Ram
59	Stabiliser Check Valve
59A	Stabiliser Check Valve (ARV) - if fitted (Centremount Machines Only)
62	Hydraclamps (Sideshift Machines Only)
65	Restrictor
66	Dipper Restrictor with By-Pass
70	Slew Actuator - centremount
71	Quick Release Couplings (hammer option)
72	Power Sideshift Selector Valve - if fitted
73	Power Sideshift Ram - if fitted
74	Extending Dipper Ram - if fitted

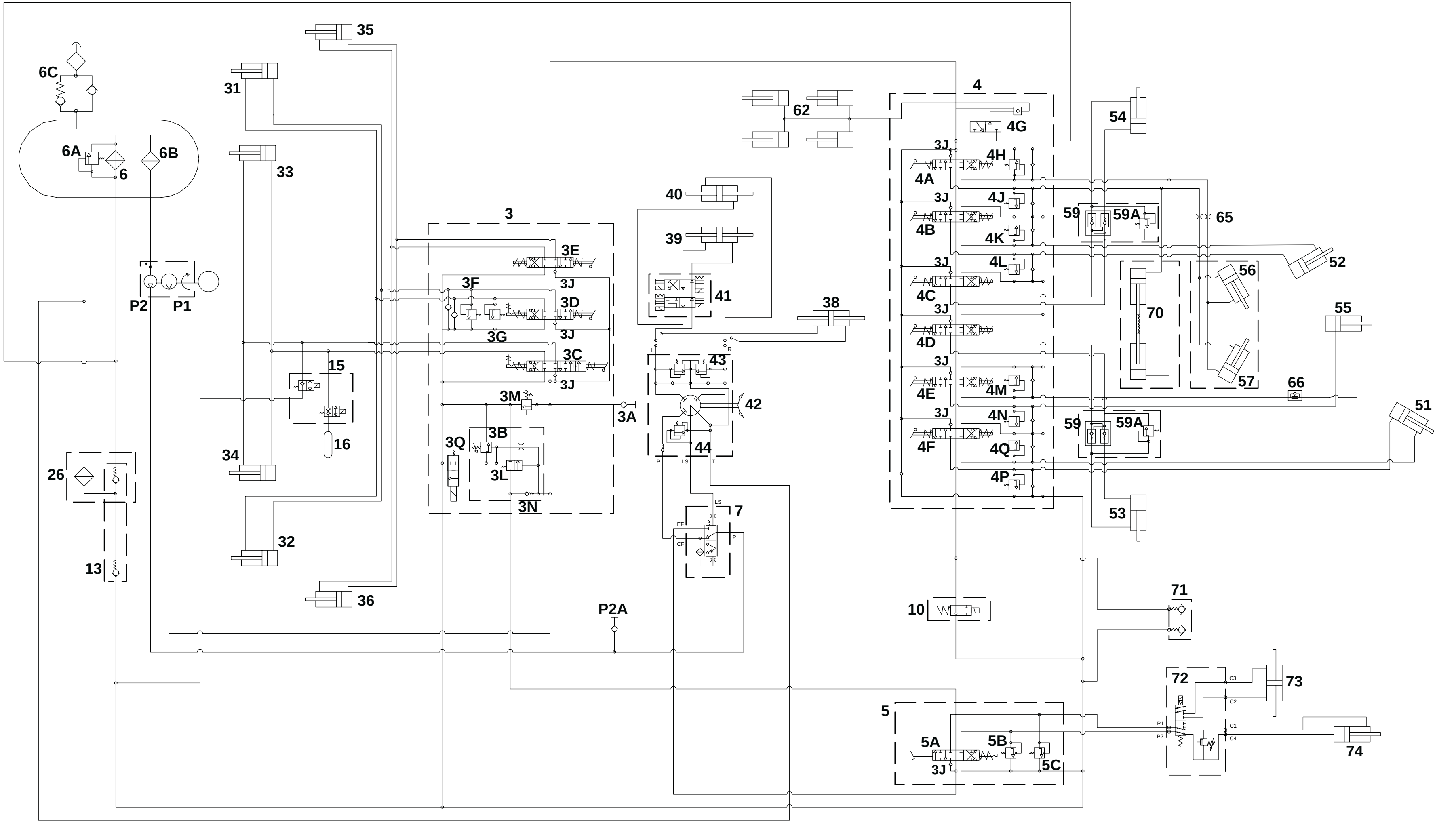


Fig 47. Machines from September 2007

4CX Variable Flow Machines

7 Spool with High Flow Options

Small letters on the schematic indicate port markings. Refer to ***Technical Data*** pages at the beginning of this section for more information. Ports **A** and **B** are always identified as service ports (feed and return from respective ram).

Component Key: *⇨ Fig 48. (E-48)*

T Hydraulic Tank

1 By-pass Filter

2 Suction Line

P Pump Variable Flow

3 Stroking Piston

4 Control Piston

5 System Pressure Spool

6 Stand-by Pressure Spool

7 Hydraclamp Valve

8 Hydraclamps

9 Loader Valve Block

10 Priority Inlet Section

11 Relief Valve

Note: *Steer circuit pressure is controlled by a relief valve housed in the hydraulic steer unit (refer to **Section H Steering**). The priority relief valve housed in the loader valve must be set at 2500 lb/in² (173 bar, 176 kgf/cm²) this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.*

12 Auxiliary Service Spool

13 Shovel Service Spool

14 Lift Service Spool

15 Auxiliary Relief Valves (anti-cavitation)

15A ARV item 16 if Rockbreaker Application

16 Auxiliary Relief Valves (direct acting)

16A ARV Only Fitted For Rockbreaker Application

17 Secondary Shuttle Valve

18 Primary Shuttle Valve

19 Load Hold Check Valve

20 Auxiliary Rams

21 Shovel Rams

22 Lift Rams

23 Smooth Ride Selector Valve

24 Smooth Ride Accumulator

25 Backhoe Loader Valve Block

26 Extradig Priority Valve

27 Extradig Service Spool

28 Compensator Valves

29 Slew Service Spool

30 Boom Service Spool

31 Stabiliser Service Spool

32 Stabiliser Service Spool

33 Dipper Service Spool

34 Bucket Service Spool

35 Extradig Ram

36 Slew Rams

37 Boom Ram

38 Stabiliser Ram

39 Stabiliser Ram

40 Dipper Ram

41 Bucket Ram

42 Accumulator

43 Oil Cooler

44 Load Sense Relief Valve

45 Steer Unit Assembly

46 Steer Valve

47 Relief Valve

48 Shock Valves

49 Quick release Couplings

50 Isolation Valve

51 Extending Dipper Isolation Valve

52 Foot Valve

53 Extending Dipper Ram

54 Hammer

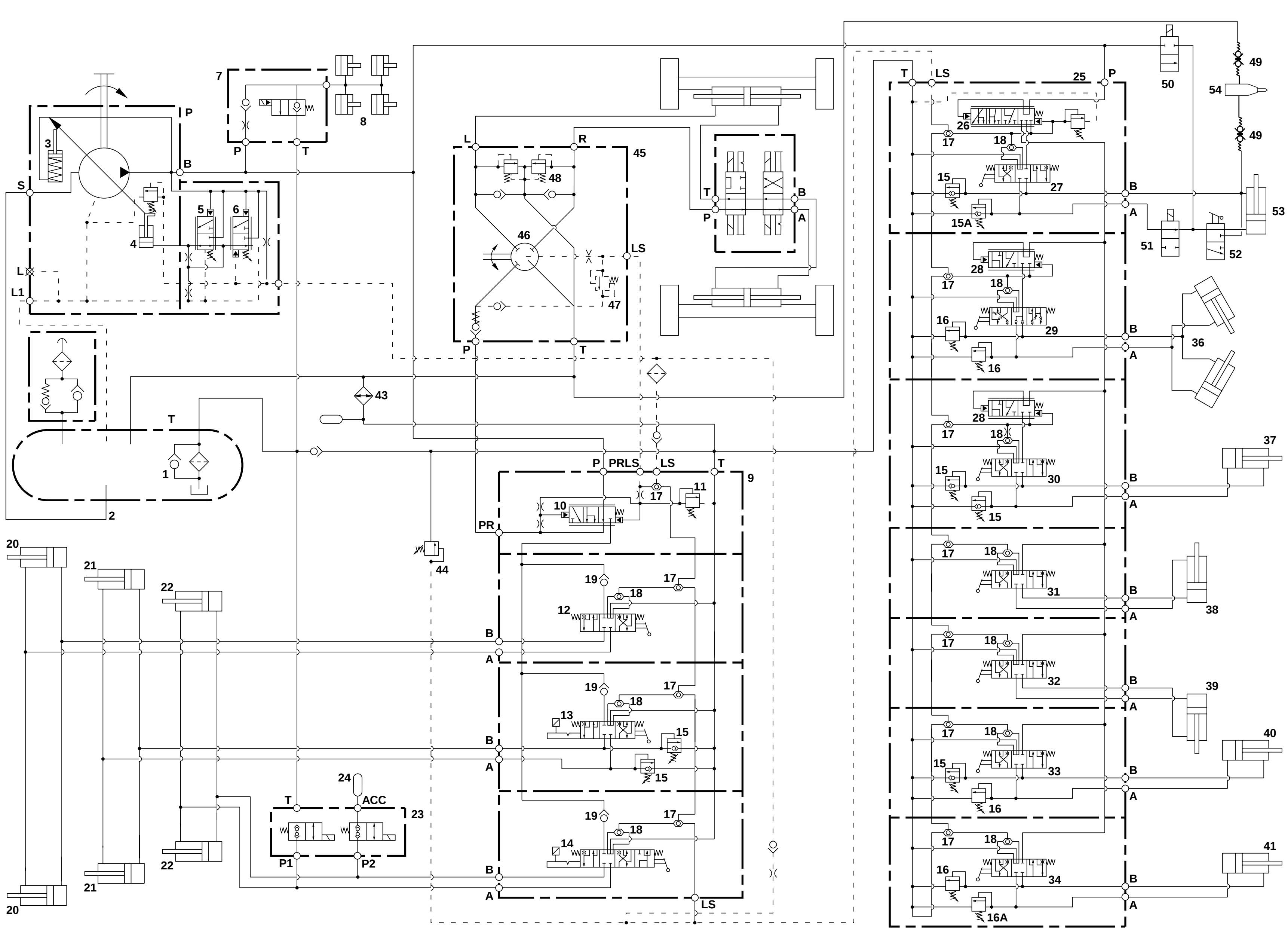


Fig 48. 7 Spool with High Flow Options

6 Spool with High and Low Flow Options

Small letters on the schematic indicate port markings. Refer to ***Technical Data*** pages at the beginning of this section for more information. Ports **A** and **B** are always identified as service ports (feed and return from respective ram).

Component Key: ⇒ ***Fig 49. (E-50)***

T Hydraulic Tank
1 By-pass Filter
2 Suction Line
P Pump Variable Flow
3 Stroking Piston
4 Control Piston
5 System Pressure Spool
6 Stand-by Pressure Spool
7 Hydraclamp Valve
8 Hydraclamps
9 Loader Valve Block
10 Priority Inlet Section
11 Relief Valve

Note: *Steer circuit pressure is controlled by a relief valve housed in the hydraulic steer unit (refer to **Section H Steering**). The priority relief valve housed in the loader valve must be set at 2500 lb/in² (173 bar, 176 kgf/cm²) this will ensure it does not interfere with the operation of the relief valve housed in the hydraulic steer unit.*

12 Auxiliary Service Spool
13 Shovel Service Spool
14 Lift Service Spool
15 Auxiliary Relief Valves (anti-cavitation)
16 Auxiliary Relief Valves (direct acting)
16A ARV Only Fitted For Rockbreaker Application
17 Secondary Shuttle Valve
18 Primary Shuttle Valve
19 Load Hold Check Valve
20 Auxiliary Rams
21 Shovel Rams
22 Lift Rams
23 Smooth Ride Selector Valve
24 Smooth Ride Accumulator
25 Backhoe Loader Valve Block
28 Compensator Valves
29 Slew Service Spool
30 Boom Service Spool
31 Stabiliser Service Spool
32 Stabiliser Service Spool
33 Dipper Service Spool
34 Bucket Service Spool
36 Slew Rams
37 Boom Ram
38 Stabiliser Ram
39 Stabiliser Ram
40 Dipper Ram
41 Bucket Ram
42 Accumulator
43 Oil Cooler
44 Load Sense Relief Valve
45 Steer Unit Assembly
46 Steer Valve
47 Relief Valve
48 Shock Valves
49 Quick release Couplings
50 Isolation Valve
54 Hammer
55 Load Sense Isolation Valve

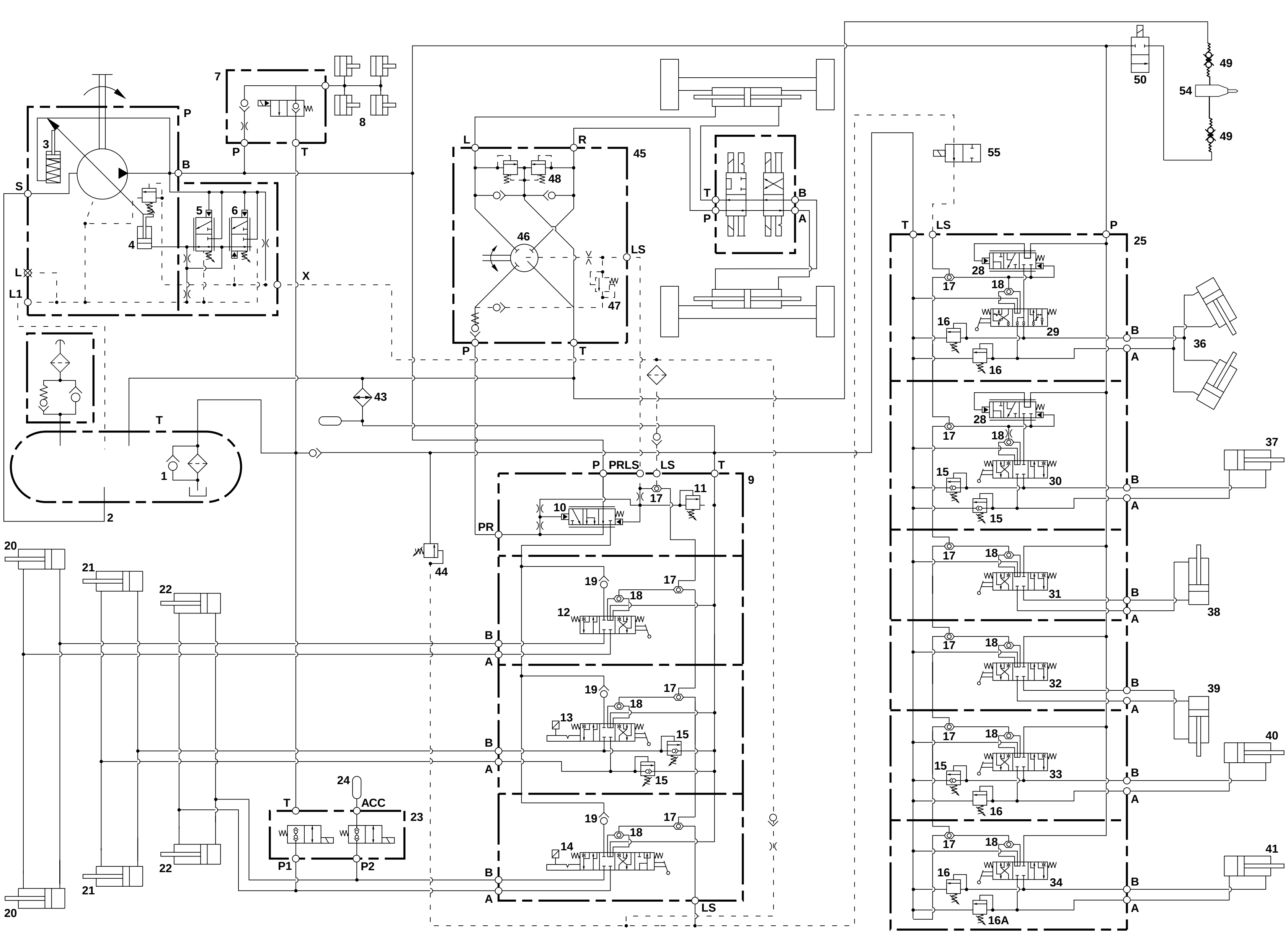


Fig 49. 6 Spool with High and Low Flow Options

Hand Held Tools Option

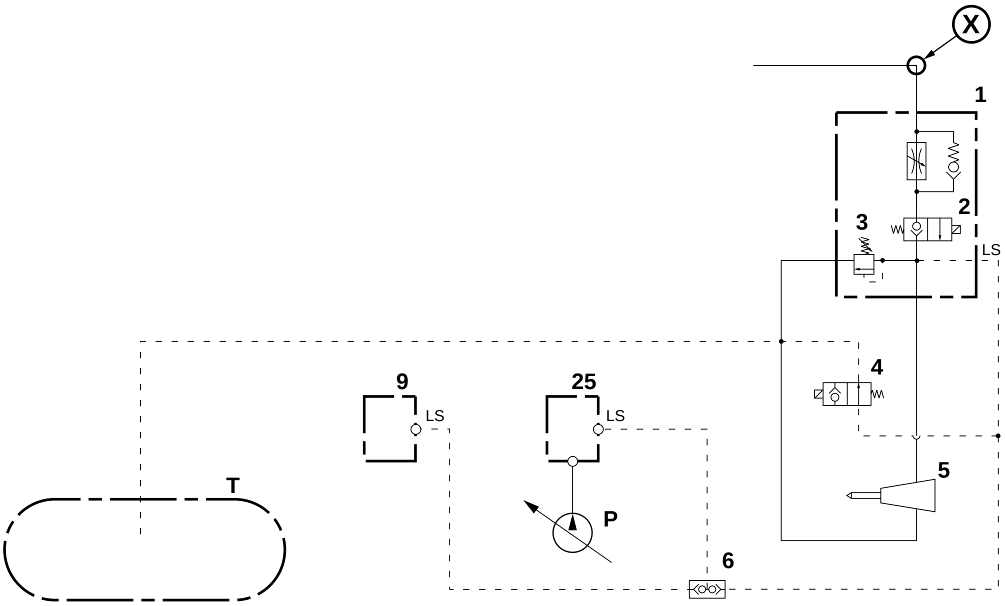


Fig 50.

Component Key:

P Pump Variable Flow
T Hydraulic Tank
X Main Circuit Connection
1 Pressure Flow Regulator
2 High Pressure Flow Spool
3 Relief Valve (2000 lb/in² - 138 bar - 146 kgf/cm²)
4 Load Sense Solenoid
5 Hand Held Tool
6 Shuttle Valve
9 Excavator Valve Block
25 Loader Valve Block

3C-14 (214e) Backhoe

Component Key: ⇨ *Fig 51. (E-53)*

A	Hydraulic Tank
B	Return filter
C	Hydraulic Oil Cooler
D	Hydraulic Pump
E	Check Valve
F	Shovel Rams
G	Quick Release Couplings
H	Lift Rams
J	Loader Valve Block (2 or 3 spool)
J1	Main Relief Valve
J2	Auxiliary Spool
J3	Lift Spool
J4	Shovel Spool
K	Flow Regulator Valve (Option)
L	Pressure Test Point
M	Auxiliary Valve Block (Option)
	Either option K or M can be fitted but not both.
N	Steer Control Valve
P	Auxiliary Rams
Q	Priority Valve
S	Excavator Valve Block
S1	Slew Spool
S2	Boom Spool
S3	Stabiliser Spool
S4	Stabiliser Spool
S5	Dipper Spool
S6	Bucket Spool
W	Stabiliser Rams
Y	One Way Restrictor
Z	Slew Rams
AA	Boom Ram
BB	Dipper Ram
CC	Bucket Ram
DD	Suction Strainer
EE	Stabiliser Check Valve (if fitted)
GG	Tank Cap
HH	Extending Dipper
1	2WS Front Power Track Rod

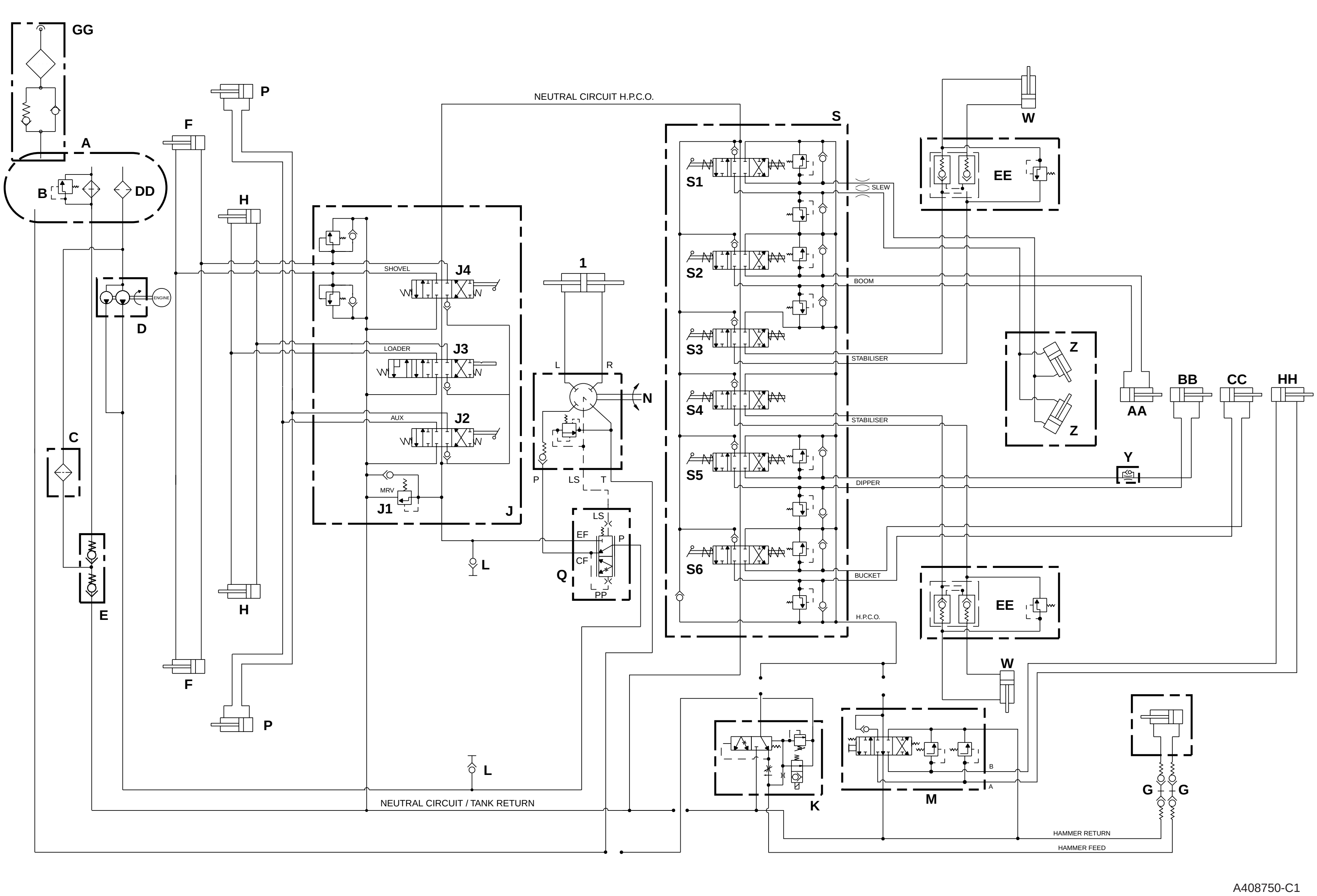


Fig 51. Centremount

3C-14 (214e) Landscaper

Component Key: ⇨ *Fig 52. (E-55)*

A	Hydraulic Tank
B	Return Filter
C	Hydraulic Oil Cooler
D	Hydraulic Pump
E	Twin Check Valves
F	Shovel Rams
H	Lift Rams
J	Loader Valve Block
J1	Main Relief Valve
J2	Auxiliary Spool
J3	Lift Spool
J4	Shovel Spool
L	Pressure Test Point
N	Steer Control Valve
P	Auxiliary Rams
Q	Priority Valve
S	3 Point Hitch Block
S1	Lift/Lower/Float Spool
S2	Pitch Spool
S3	Tilt Spool
S4	Auxiliary Spool
S5	Lift A.R.V. (Auxiliary Relief Valve)
S6	Tilt A.R.V.
W	Lift Ram
X	Pitch Ram
Y	Tilt Ram
Z	Auxiliary Ram
DD	Suction Strainer
GG	Tank Cap
1	2WS Front Power Track Rod

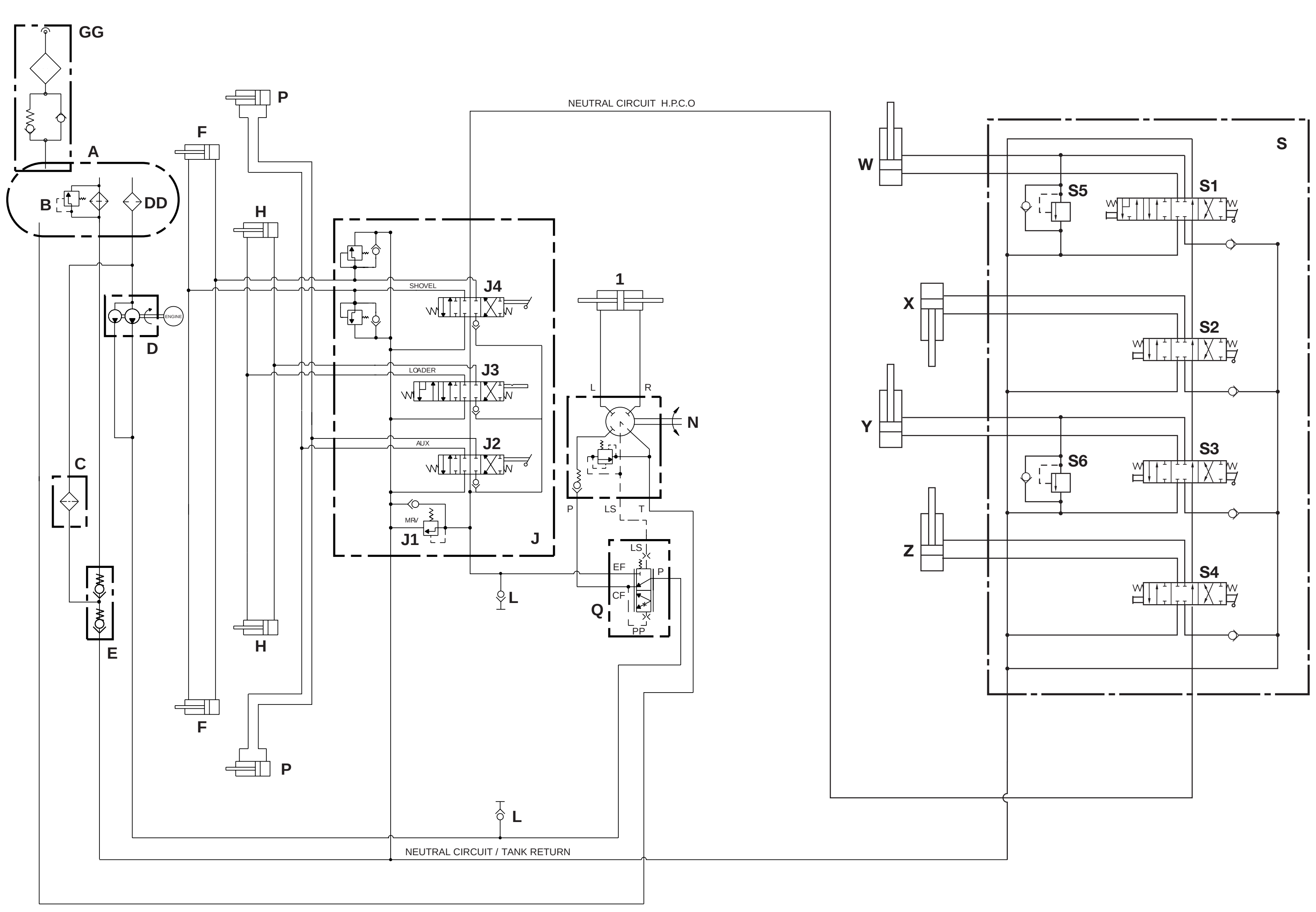


Fig 52. Landscaper

3C Machines (Sideshift)

Component Key: ⇨ *Fig 53. (E-57)*

A	Hydraulic Tank
B	Return filter
C	Hydraulic Oil Cooler
D	Main Pump/Priority Valve Assembly
E	Check Valve
F	Shovel Rams
G	Quick Release Couplings
H	Lift Rams
J	Loader Valve Block (2 or 3 spool)
J1	Main Relief Valve
J2	Auxiliary Spool
J3	Lift Spool
J4	Shovel Spool
K	Flow Regulator Valve (Option)
L	Pressure Test Point
N	Steer Control Valve
P	Auxiliary Rams
S	Excavator Valve Block
S1	Slew Spool
S2	Boom Spool
S3	Stabiliser Spool
S4	Stabiliser Spool
S5	Dipper Spool
S6	Bucket Spool
S7	Auxiliary Spool (Option)
T	Hydraclamps
W	Stabiliser Rams
Y	One Way Restrictor
Z	Slew Rams
AA	Boom Ram
BB	Dipper Ram
CC	Bucket Ram
DD	Suction Strainer
GG	Tank Cap
HH	Extending Dipper Ram (Option)
JJ	Smooth Ride System (SRS) Valve (Option)
KK	SRS Accumulator
1	2WS Front Power Track Rod

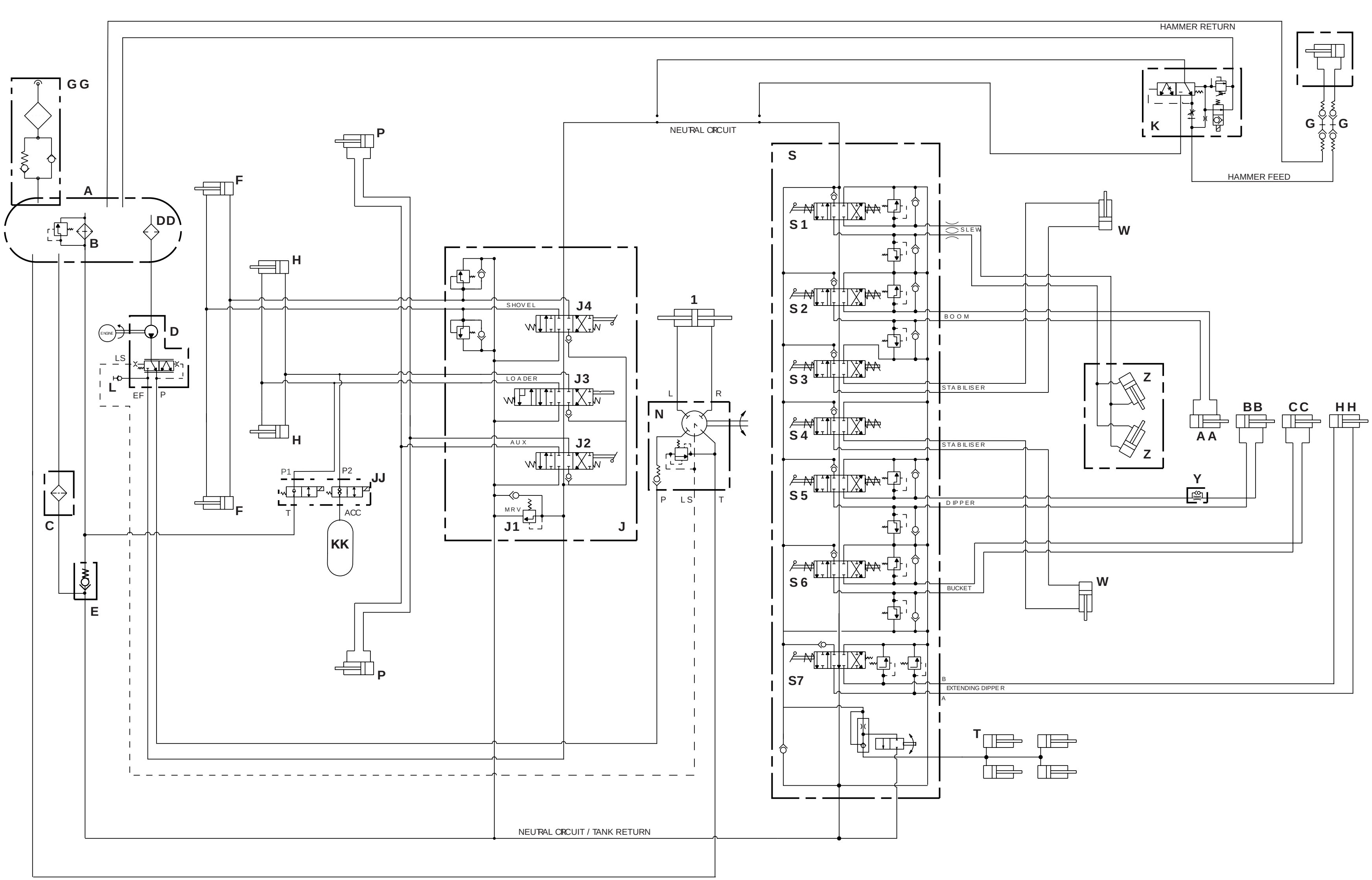


Fig 53. 3C Sideshift with SRS Option

Circuit Descriptions

Gearpump - Operation

Double Pump

⇨ *Fig 54. (E-59)*. Both sections **P1** and **P2** operate as described below:

The basic principle of the gear pump depends on the meshing of two spur gears **A**, one of which is engine driven while the other is an idler.

Oil is picked up by the gear teeth on the inlet side of the pump and carried around between the teeth and the pump body. As the gears come into mesh, the space carrying the oil is filled by a gear tooth on the mating gear, forcing the oil out of the space and the through the pump outlet.

The wear plates **B** are loaded towards the gears by pressurised oil which is fed to the backs of the wear plates via channels **C**. This ensures that the clearance between the wear plates and gears is prevented from becoming excessive as outlet pressure rises.

The side of each wear plate that faces the gears has two recesses **D**. The recess on the inlet side of the pump assists the flow of oil into the gear spaces, thus raising the cavitation threshold of the pump. The recess on the outlet side vents oil trapped between meshing gear teeth to prevent compression loads on the bearings.

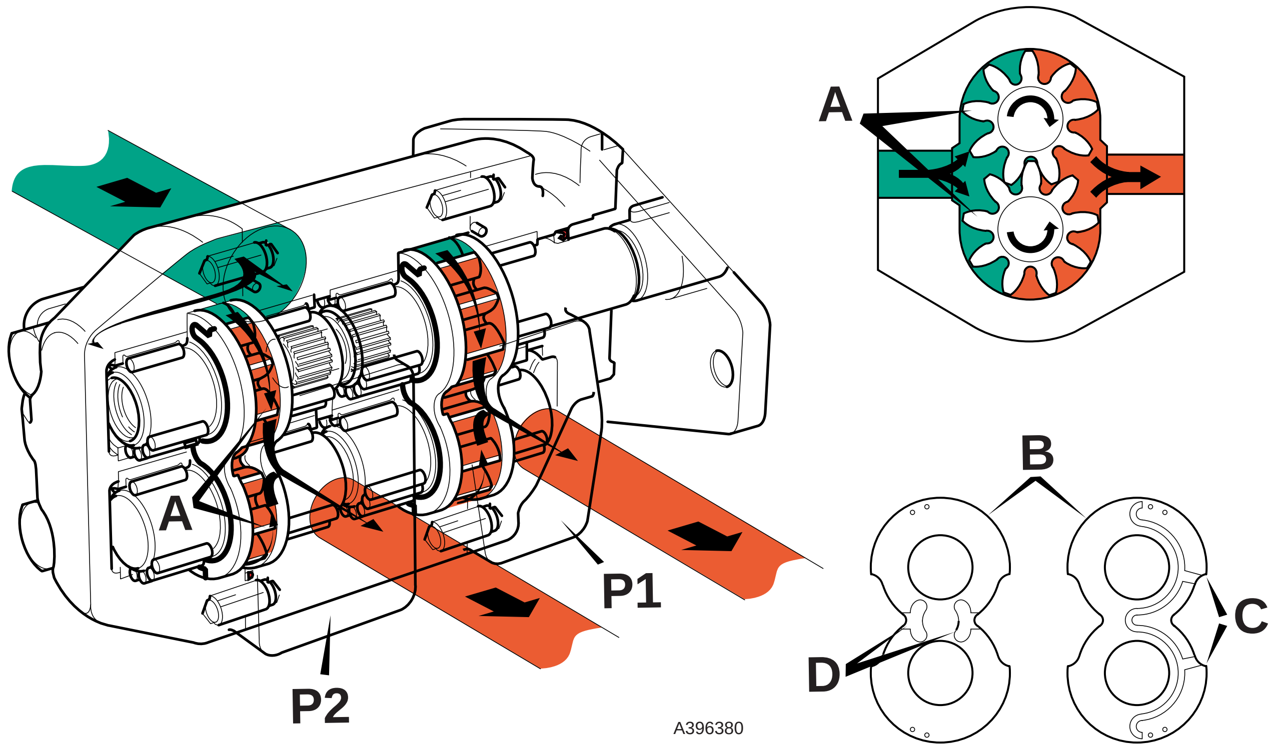


Fig 54. Double Pump

Table 7. Key to Oil Flow and Pressure

	Full Pressure
	Pressure
	Servo
	Neutral
	Exhaust
	Cavitation
	Lock Up

Component Key:

A	Spur Gears
B	Wear Plates
C	Channel
D	Recess
P1	Main Section
P2	Secondary Section

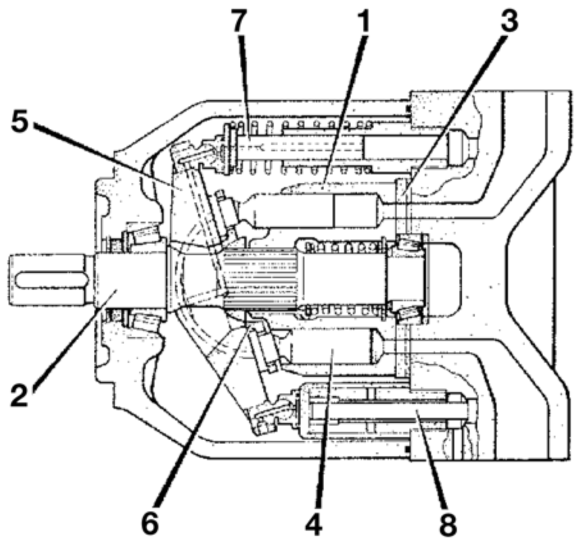
Variable Flow Pump - Operation

The pump is a variable displacement axial piston type. Displacement of oil is achieved by the continuous operation of nine pistons. Pump fluid output is controlled by a tilting cam (swashplate), the angle of which is regulated to ensure that only the amount of fluid necessary to satisfy load conditions is delivered. If a load condition is such that no flow is required, only sufficient fluid for cooling and lubrication is provided.

Main components of the pump are a cylinder barrel **1** splined to a drive shaft **2** which is held against a kidney plate **3**. Contained in the cylinder barrel are the axial pistons **4**, each having an articulated shoe that is in held contact with the swashplate **5** by an attachment plate **6**. The tilting action of the swashplate is exercised by a stroking piston **7** and a control piston **8**, the latter fed by servo pressure. Fitted to the pump exterior is the valve block housing the pressure and flow regulators that provide servo control.

Rotation of the cylinder barrel causes linear movement of the axial pistons and fluid from the suction port is drawn into the pump through the kidney plate to fill a developing vacuum behind the piston. As the cylinder barrel rotates the fluid is carried from an elongated suction kidney to an elongated pressure kidney where linear movement starts to return the piston into the cylinder barrel. Fluid is forced from the pump through the pressure port.

The stroke length of the pistons and consequently the output of fluid is directly related to the swashplate angle. The swashplate is normally held in its maximum displacement angle by the stroking piston spring and system pressure inside the stroking piston.



S271440-C1

Fig 55.

Component Key:

1 Cylinder Barrel
2 Drive Shaft
3 Kidney Plate
4 Axial Piston
5 Swashplate
6 Shoe Plate
7 Stroking Piston
8 Control Piston

Pressure and Flow Regulator Valve

The pressure and flow regulator valve assembly is mounted to the pump. The valve maintains the pump pressure and flow rate in accordance with demand at the service valve blocks.

Load Sensing - Standby Position

See also ⇒ *Fig 57. (E-62)*.

Standby is when the machine is running but the control levers are in neutral position, i.e. no implements are being used. There is no pressure or flow demands on the pump, therefore there will be no pressure signal.

With the engine switched off, spring **1** holds swashplate **2** at the maximum angle. When the engine is started and the pump begins to turn, oil begins to flow and pressure builds in the closed centre hydraulic system.

Valve **5** houses a flow regulator spool **4** and pressure regulator spool **3**. Pressure which is building in the closed centre system is sensed at port **P** of the regulator valve. The increasing pressure pushes flow compensating spool **4** up against its spring **6**. This movement creates a flow path from port **P** to port **A**. Oil now flows from the flow regulator valve (via port **A**) to swashplate control piston **7**.

The control piston now moves the swashplate **2** towards its minimum angle. As the piston moves towards its full travel position, cross-drilled holes **8** are uncovered allowing oil to drain.

The cross-drilled holes limit the travel of the control piston when the holes are exposed, pump flow is insufficient to make up for leakage through the holes and maintain the pressure behind the control piston. Therefore the piston moves back to partially cover the cross holes thus maintaining enough flow to cater for normal system leakage whilst establishing a system standby pressure (see ***Technical Data*** for pressure).

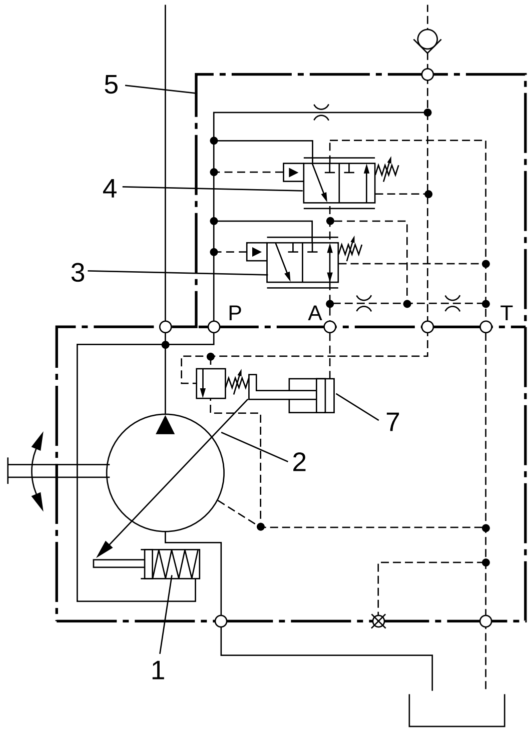


Fig 56.

Table 8. Key to Oil Flow and Pressure

(diagonal hatch)	Neutral Circuit Pressure
(cross hatch)	Pressure Generated by Operation of a Service
(reverse diagonal hatch)	Trapped Oil
(dashed)	Exhaust

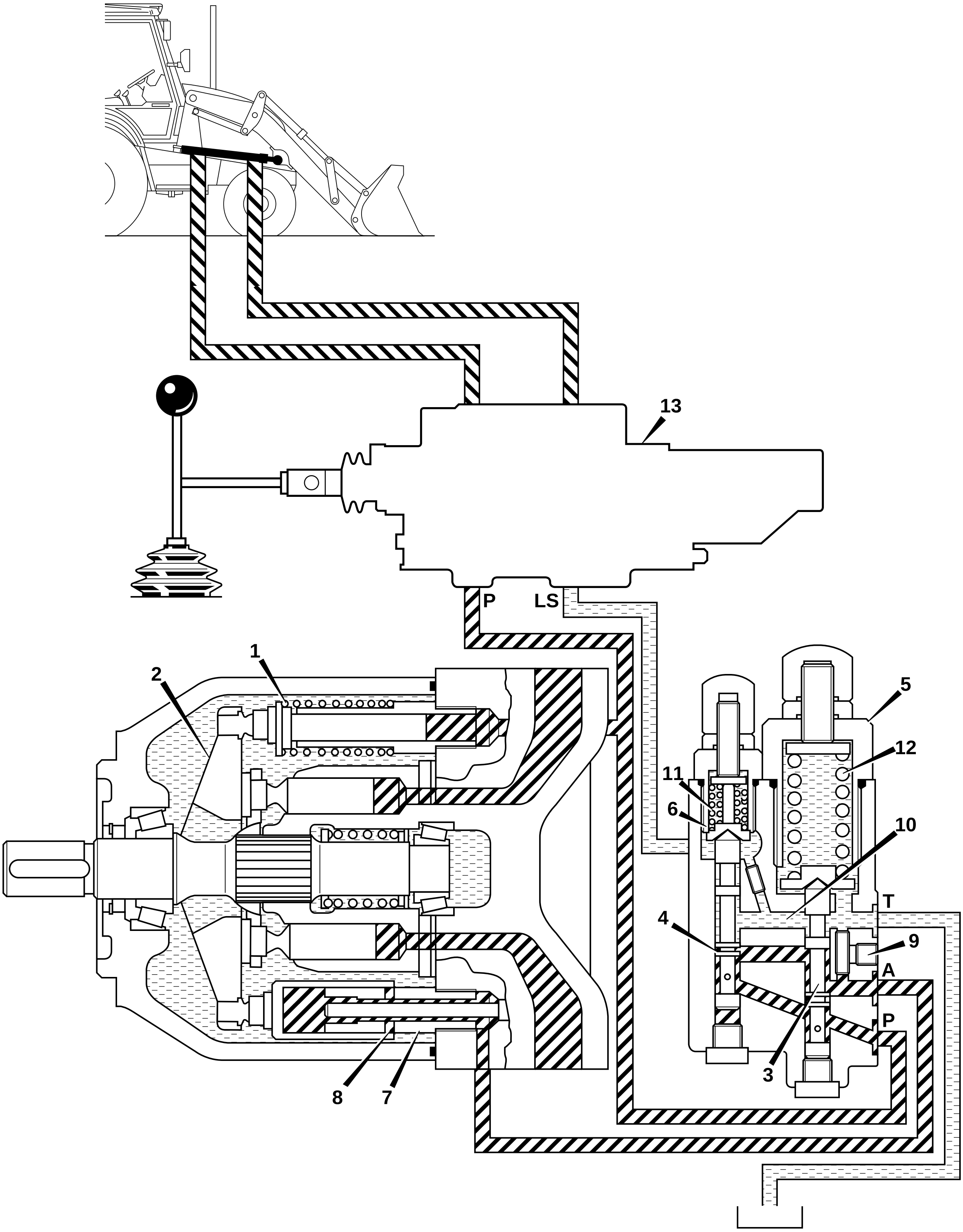


Fig 57. Load Sensing - Standby Position

Load Sensing - Maximum Flow

See also ⇒ *Fig 59. (E-64)*.

When a service is operated, the signal pressure from the loader (or backhoe) valve **13** increases. The increase in signal pressure combined with the force of spring **6** moves spool **4** down. Oil in control piston **7** is allowed to drain back to the tank via restrictor **9** and passage **10**.

The force of spring **1** is now sufficient to increase the angle of swashplate **2**. The increased angle of the swashplate increases the output of the pump.

The pump output pressure will continue to increase, eventually the pressure will move flow regulating spool **4** against the force of spring **6** and the signal pressure in cavity **11**. Pump output pressure is now sent to control piston **7** via port **A**. Control piston **7** will overcome the force of spring **1**. The pump swashplate angle decreases and therefore the pump outlet decreases. Eventually the pressure in the load sense line and the force of spring **6** will move spool **4** down and the `metering' cycle starts again.

The up and down movement of the spool **4** keeps the pressure on both ends of the spool equal. Spring **6** is equivalent to 20 bar (290 lbf/in²), therefore the pump pressure should be this amount greater than the signal pressure (except when at maximum pressure - see ⇒ *Load Sensing - Maximum Pressure (no flow) (E-65)*.

See also ⇒ *Table 8. Key to Oil Flow and Pressure (E-61)*.

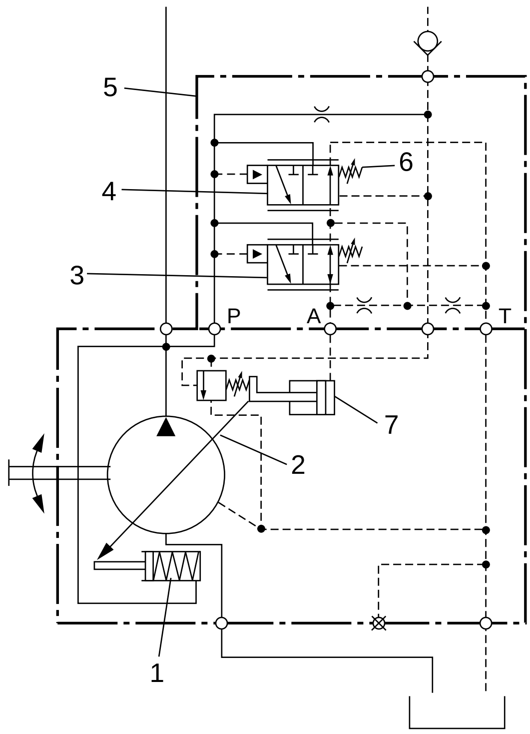


Fig 58.

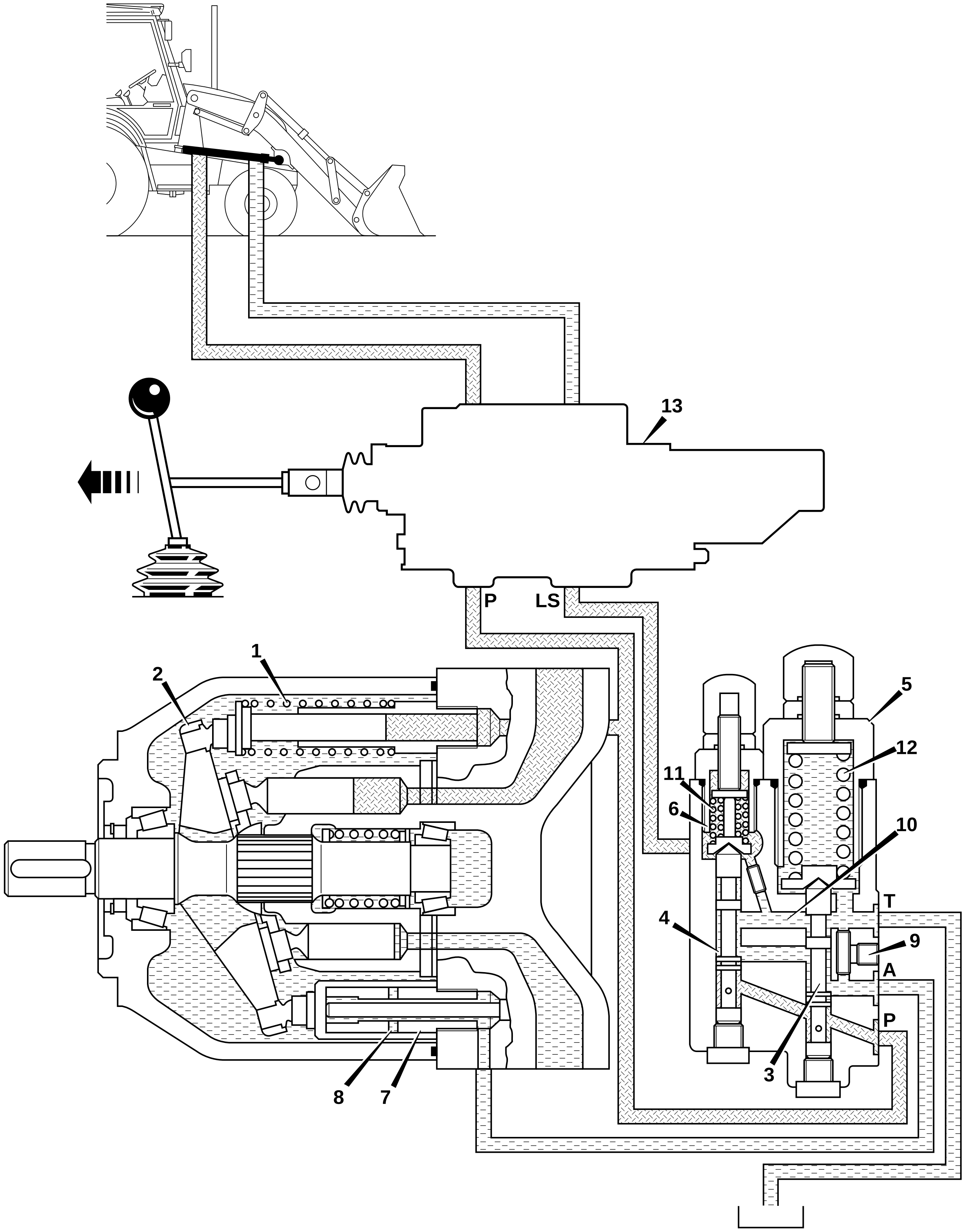


Fig 59. Load Sensing - Maximum Flow

Load Sensing - Maximum Pressure (no flow)

See also ⇨ *Fig 61. (E-66)*.

When a service ram reaches the end of its stroke or the service meets resistance (for instance tearing out), the signal pressure from the loader (or backhoe) valve **13** will increase to the same pressure as pump output pressure.

The force of spring **6** is sufficient to move spool **4** down. The pressure in the system is also sufficient to move spool **3** up against the force of spring **12**, this creates a connection from the pump outlet to control piston **7** via port **A**.

Control piston **7** moves thus decreasing the angle of swashplate **2**. Pump output flow now decreases whilst the system pressure is maintained at maximum setting. There is now no flow but maximum system pressure.

See also ⇨ *Table 8. Key to Oil Flow and Pressure (E-61)*.

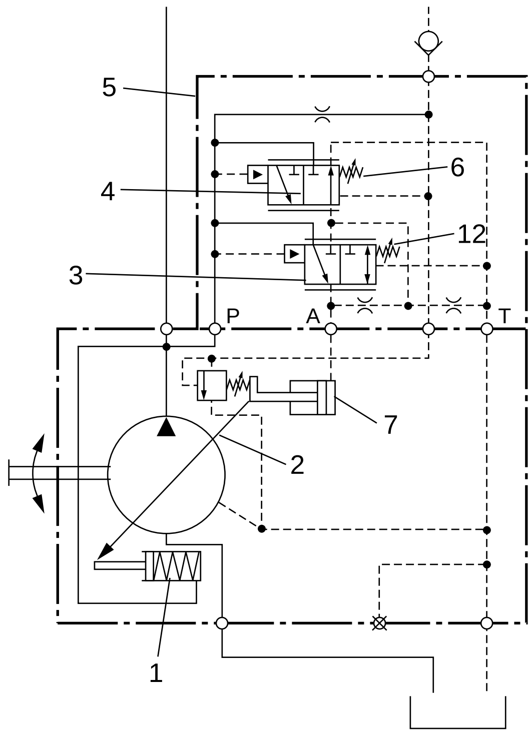


Fig 60.

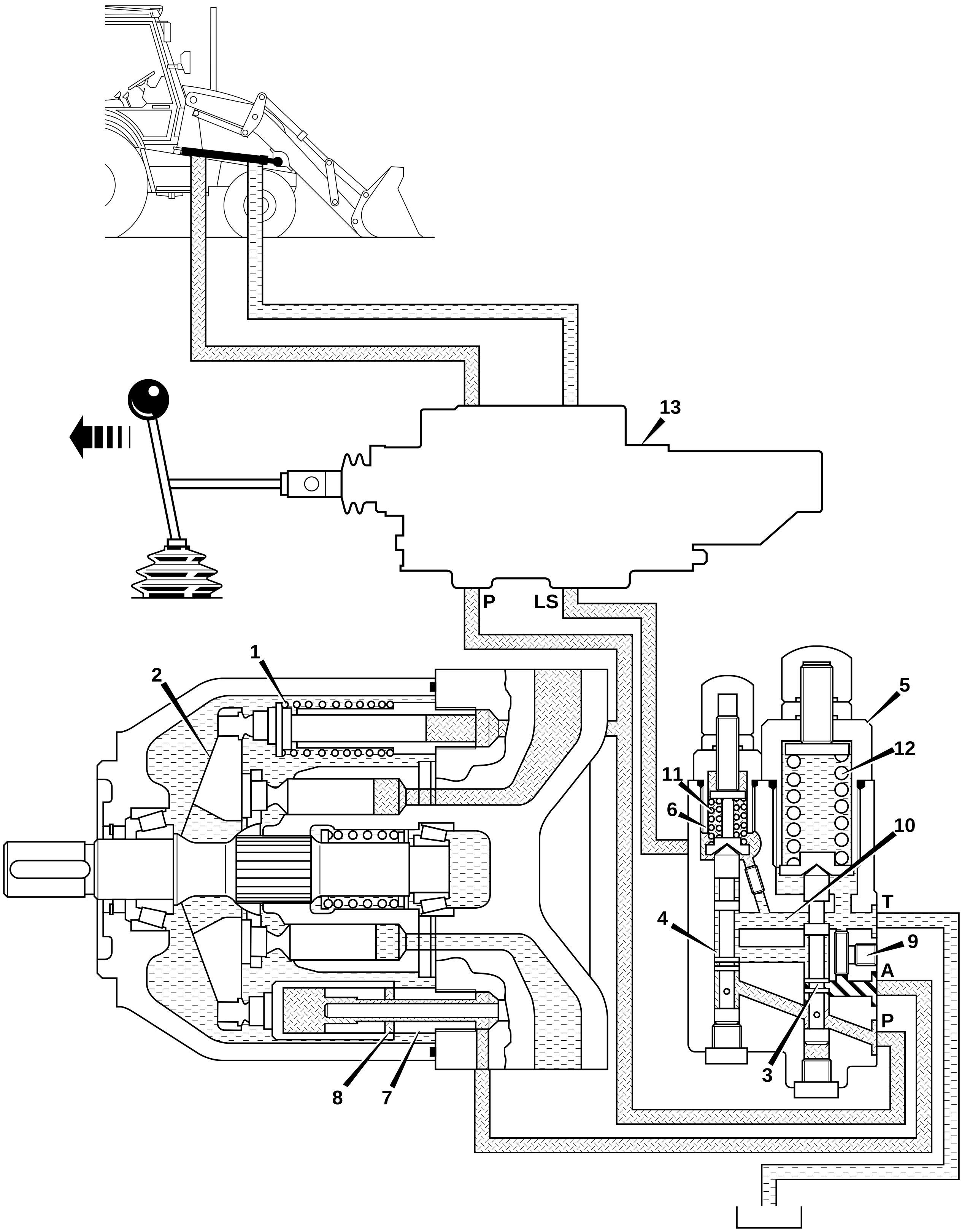


Fig 61. Load Sensing - Maximum Pressure (no flow)

Loader Valve - Manual Control

Neutral Circuit

⇨ *Fig 62. (E-69)*.

The loader valve is mounted on the chassis frame, right hand side (when viewed from the rear).

It includes the lift ram spool **3C**, shovel ram spool **3D** and auxiliary spool **3E**. Linkage rods connect the spool ends to the control levers.

In neutral circuit hydraulic oil from the pump section **P2** enters the loader valve at **1C** via the steering priority valve. On entering the valve block, oil flows around the waisted section of the unloader valve **3L**, past check valve **3N** and joins the flow from pump section **P1**.

Oil from pump section **P1** enters the loader valve at **1A**.

Combined oil flow from **P1** and **P2** passes the main relief valve (MRV) **3B** and fills the parallel gallery **B**. From the parallel gallery the oil flows around the waisted central portions of spools **3C**, **3D** and **3E** (all in neutral position) and flows on to feed the excavator valve via high pressure carry over line **1B**.

Pressure in inlet gallery **C** is sensed by pilot valve **3M** via the bore of spool **3L**. At pressures below the setting of the unloader valve, both pilot valve **3M** and spool **3L** remain closed.

See also ⇨ *Table 7. Key to Oil Flow and Pressure (E-59)*.

Unloader Operation

⇒ *Fig 63. (E-69)*.

Unloader spool operation protects the engine from being overloaded if a service is being worked particularly hard, for example when using the excavator to tear out. It does this by dumping the oil from the pump section **P2** to tank, allowing engine power to be applied fully to the main pump section **P1**.

If the pressure in the inlet gallery **C** rises to the setting of the pilot valve **3M**, this valve will open, allowing oil in spring cavity **3P** to escape more quickly than it can be replaced by oil entering through the small drilling **D**.

This creates a pressure differential between the spring cavity **3P** and gallery **C**. Higher pressure in gallery **C** acts on the face of spool **3L** causing the spool to be moved off its seat.

Oil entering the valve block from pump section **P2** now flow directly to tank **T**.

High pressure in gallery **C** also holds check valve **3N** firmly closed, preventing oil from pump section **P1** from also being dumped.

When pressure in inlet gallery **C** falls, for example if the excavator has stopped tearing out, pilot valve **3M** will close. This means oil in spring cavity **3P** will be at the same pressure as oil in gallery **C**, spring pressure will move spool **3L** back onto its seat, closing pump section **P2** connection to tank.

See also ⇒ *Table 7. Key to Oil Flow and Pressure (E-59)*.

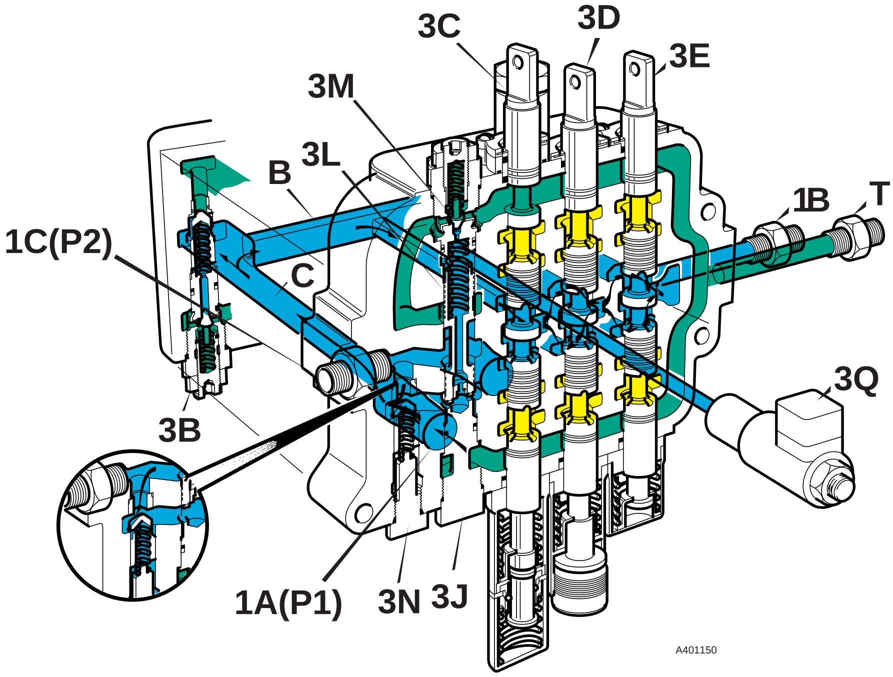

3C
3D
3E
3M
3L
B
1B
T
1C(P2)
C
3Q
3B
1A(P1)
3N
3J
A401150

Fig 62.

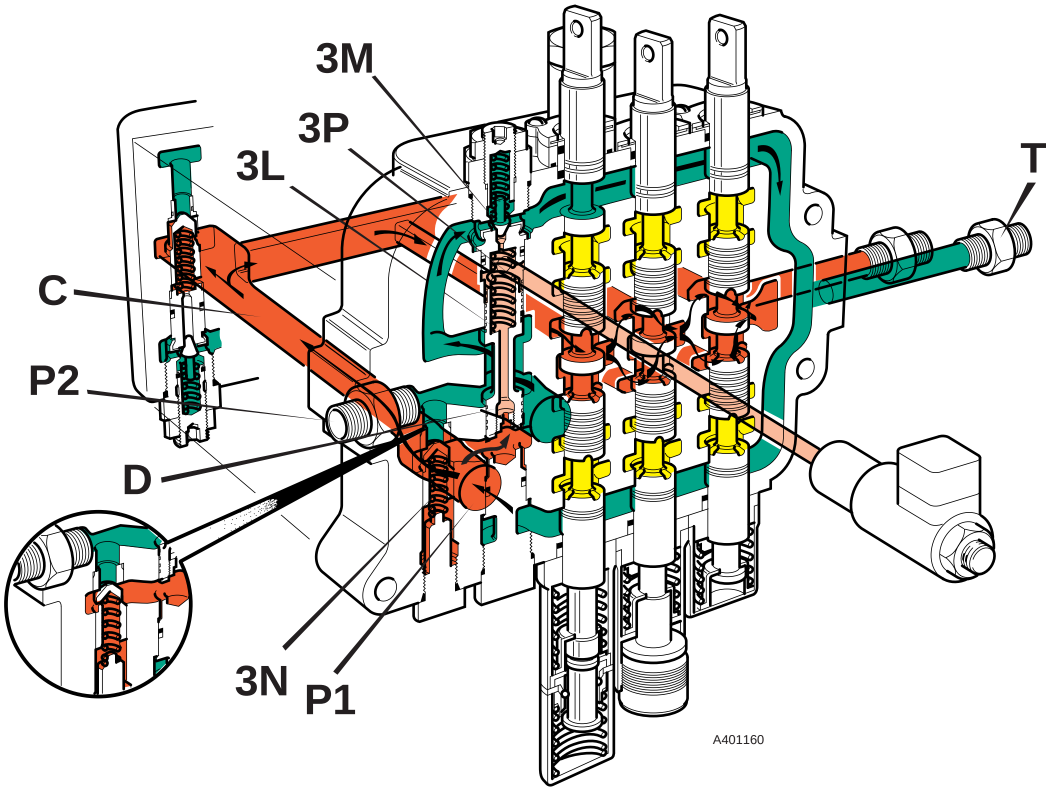

3M
3P
3L
T
C
P2
D
3N
P1
A401160

Fig 63.

Hydraulic Speed Control (HSC)

⇨ *Fig 64. (E-71)*.

Solenoid valve **3Q** allows the operator to control the unloader spool movement (to dump flow from the hydraulic pump section **P2**) using a switch in the cab. There are two main applications for this operation:

1 More tractive force can be applied to the loader end when entering a stock pile. This is because more power is available from the engine as flow from pump section **P2** is being dumped directly to tank.

2 More power can be made available from the engine whilst the machine is travelling on the highway. Again, this is because flow from pump section **P2** is being dumped directly to tank.

When the solenoid valve **3Q** is de-energised its spool is moved by spring pressure. This spool movement makes a connection from the unloader spool chamber **3P** to tank.

Because the unloader chamber is now connected to tank, and so at exhaust pressure, pressure in gallery **C** (neutral shown) acts on the face of unloader spool **3L** causing the spool to be moved off its seat. Oil entering the valve block from pump section **P2** now flows directly to tank.

When solenoid valve **3Q** is energised its spool closes the connection from the unloader valve spool chamber to tank. Spool **3L** is once again controlled by system pressure.

For a full description of the HSC electrical system and connections see ***Electrical Connections, Hydraulic Speed Control (HSC)***.

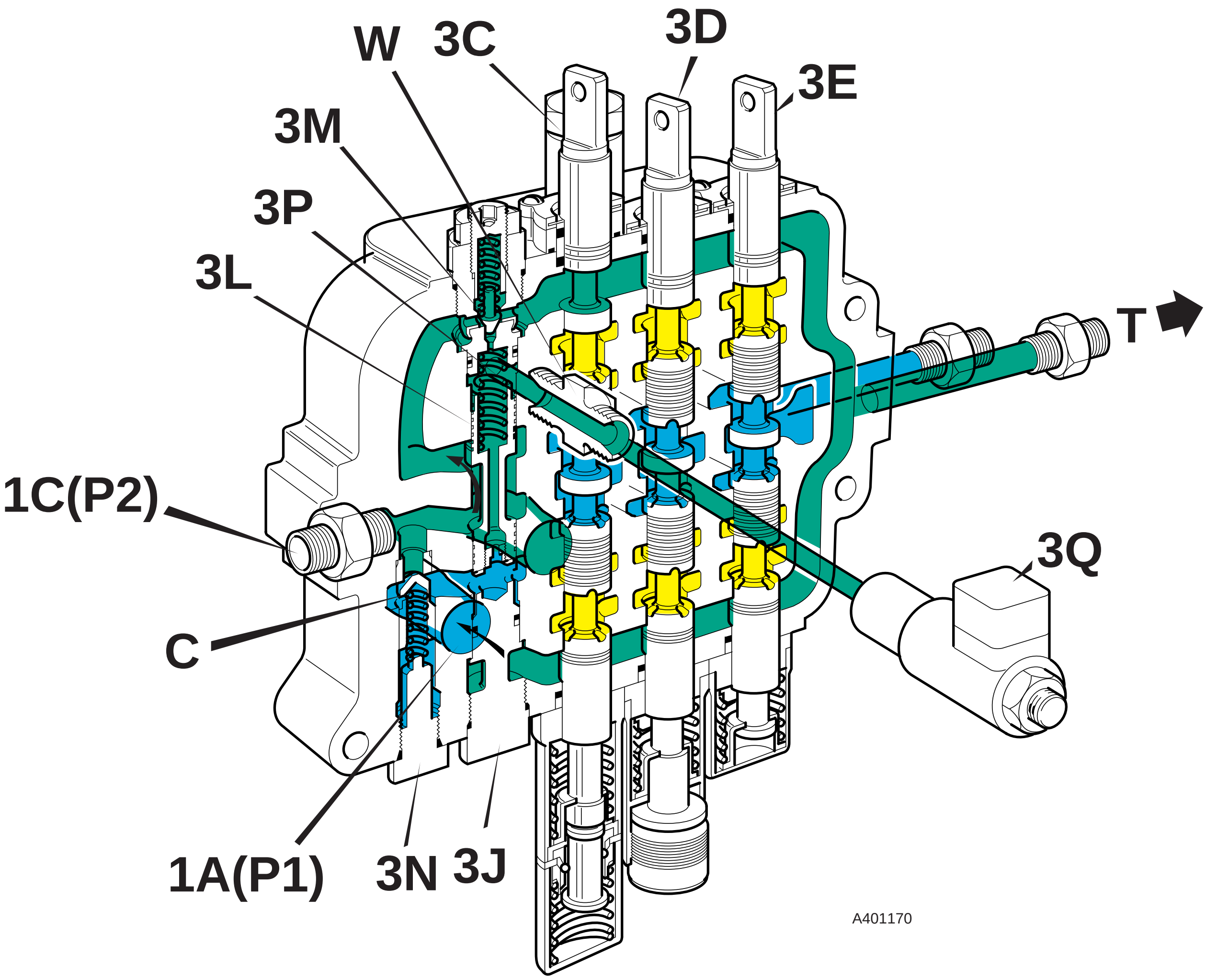


Fig 64. Hydraulic Speed Control (HSC)

See also ⇨ *Table 7. Key to Oil Flow and Pressure (E-59)*.

Load Hold Check Valves

Operation 1

⇨ *Fig 65. (E-73)*.

The illustration shows 'arms raise' being selected by the lift ram spool **3C**.

The weight of the loaded shovel, as indicated by the arrows, produces a higher pressure in service line **D** than in the parallel gallery **B**.

This pressure differential causes load hold check valve **3J** to close, thus preventing the load from dropping.

Operation 2

⇨ *Fig 66. (E-73)*.

As the neutral circuit has been blocked by the central land of the selected spool **3C**, the pressure in parallel gallery **B** increases until it is greater than that in service line **D**.

At this point, load hold check valve **3J** opens, allowing oil to flow from the parallel gallery into the service line and operate the lift rams **33** and **34**.

See also ⇨ *Table 7. Key to Oil Flow and Pressure (E-59)*.

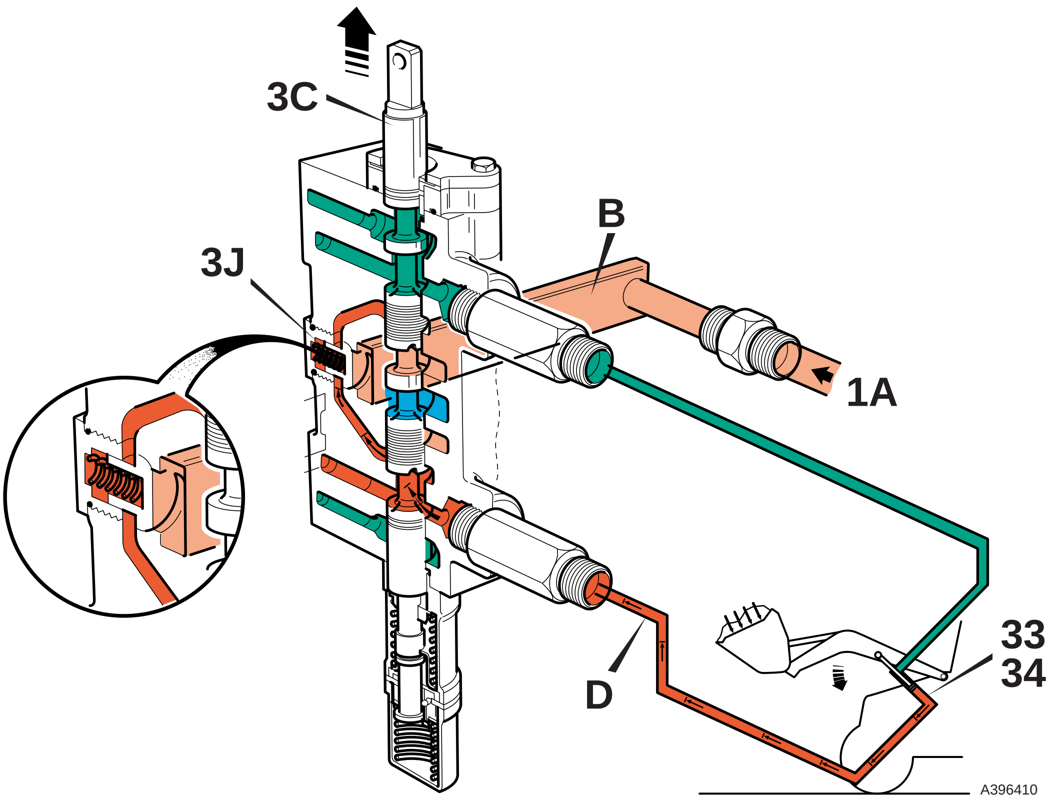


Fig 65.

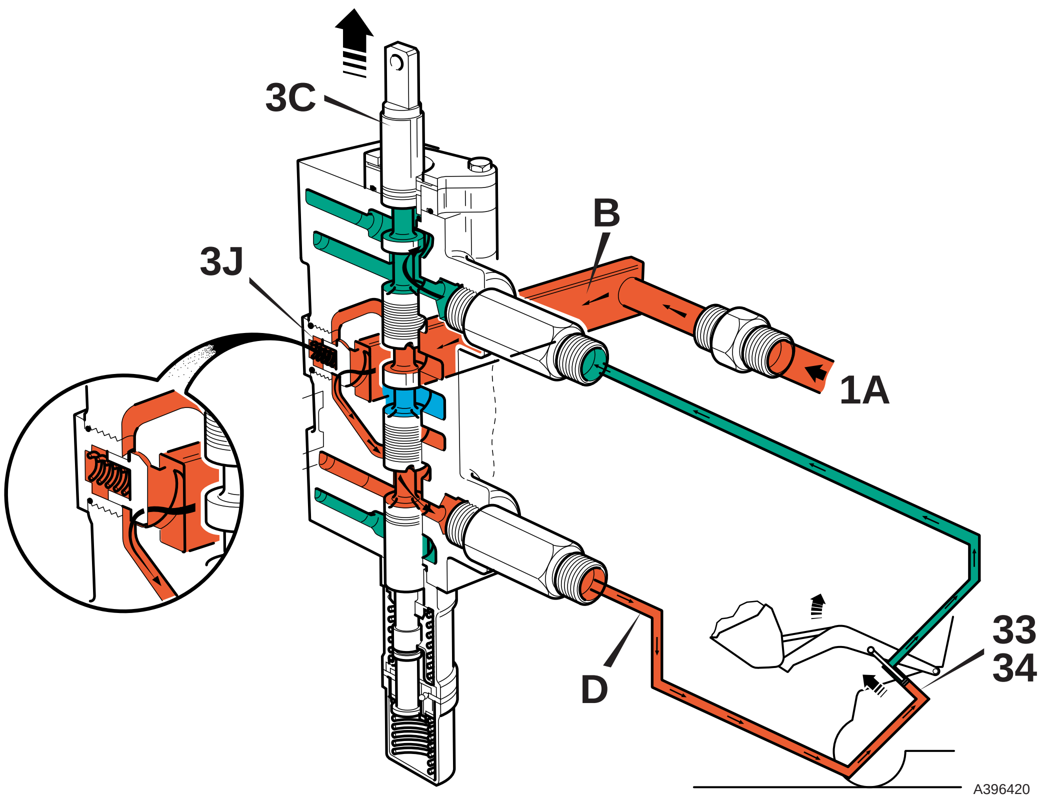


Fig 66.

Arms Lower

⇨ *Fig 67. (E-75)*.

When a spool is selected as shown at **3C**, the central land of the spool **C** blocks the neutral circuit. Oil from the pump, entering at **1A**, is diverted into the parallel gallery **B**, opens the load hold check valve **3J**, and flows around the waisted section of the spool **D** and out to the rod side of lift rams **33** and **34**.

The lower land of the selected spool **E** blocks the flow from the parallel gallery to the head side port and oil returning from the rams is diverted into the exhaust gallery.

Float

⇨ *Fig 68. (E-75)*.

The float facility is provided to allow the arms to move up and down so that the shovel can follow the surface contours as the machine is driven over uneven ground.

This is achieved by moving the lift spool **3C** down beyond 'arms lower' into the 'float' detent, when the feed from the parallel gallery to the service ports is blocked and the neutral circuit is re-opened. Both service ports are connected to exhaust via the spool waists **A**.

Oil can then be displaced from either end of the lift rams **33** and **34** into the exhaust gallery, allowing the rams to open and close as required.

See also ⇨ *Table 7. Key to Oil Flow and Pressure (E-59)*.

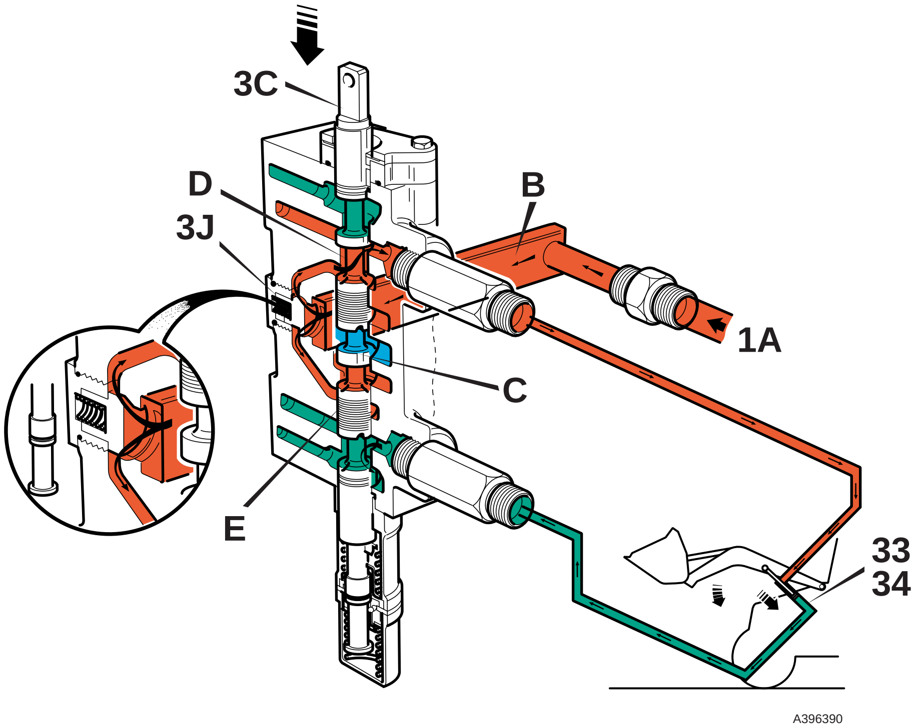


Fig 67.

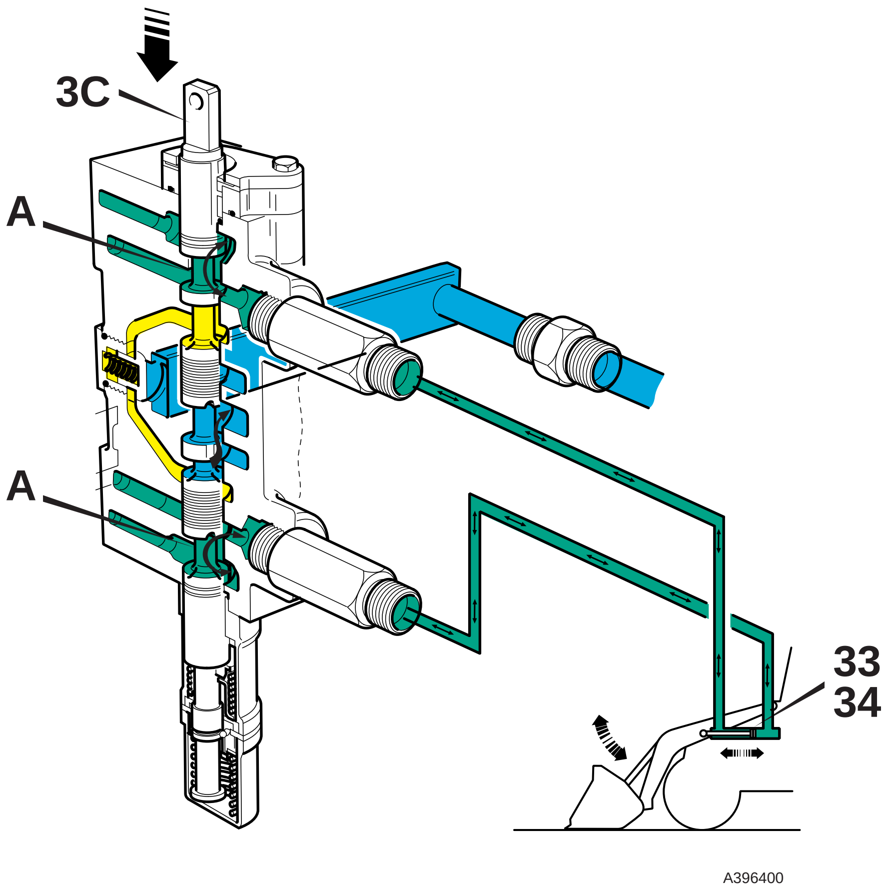


Fig 68.

Auxiliary Relief Valve (ARV) Operation

⇨ *Fig 69. (E-77)*.

Under normal operating conditions, with the shovel in the 'carry' position, the mechanical linkage keeps the shovel level as the arms are raised, to prevent spillage of the load.

If, as illustrated, the shovel is fully tipped when the arms are being raised, the shovel is unable to tip further, producing back pressure in the head side of the shovel rams **31** and **32** and cavitation in the rod side.

As the arms continue to rise, the back pressure increases until it reaches the setting of A.R.V. **3F**. This A.R.V. then opens, allowing the excess back pressure to be dumped to exhaust and prevent the rams and linkage from being damaged.

The rod side A.R.V. **3G** senses a higher pressure in the exhaust gallery than in the service port and therefore opens to allow exhaust oil to overcome the cavitation.

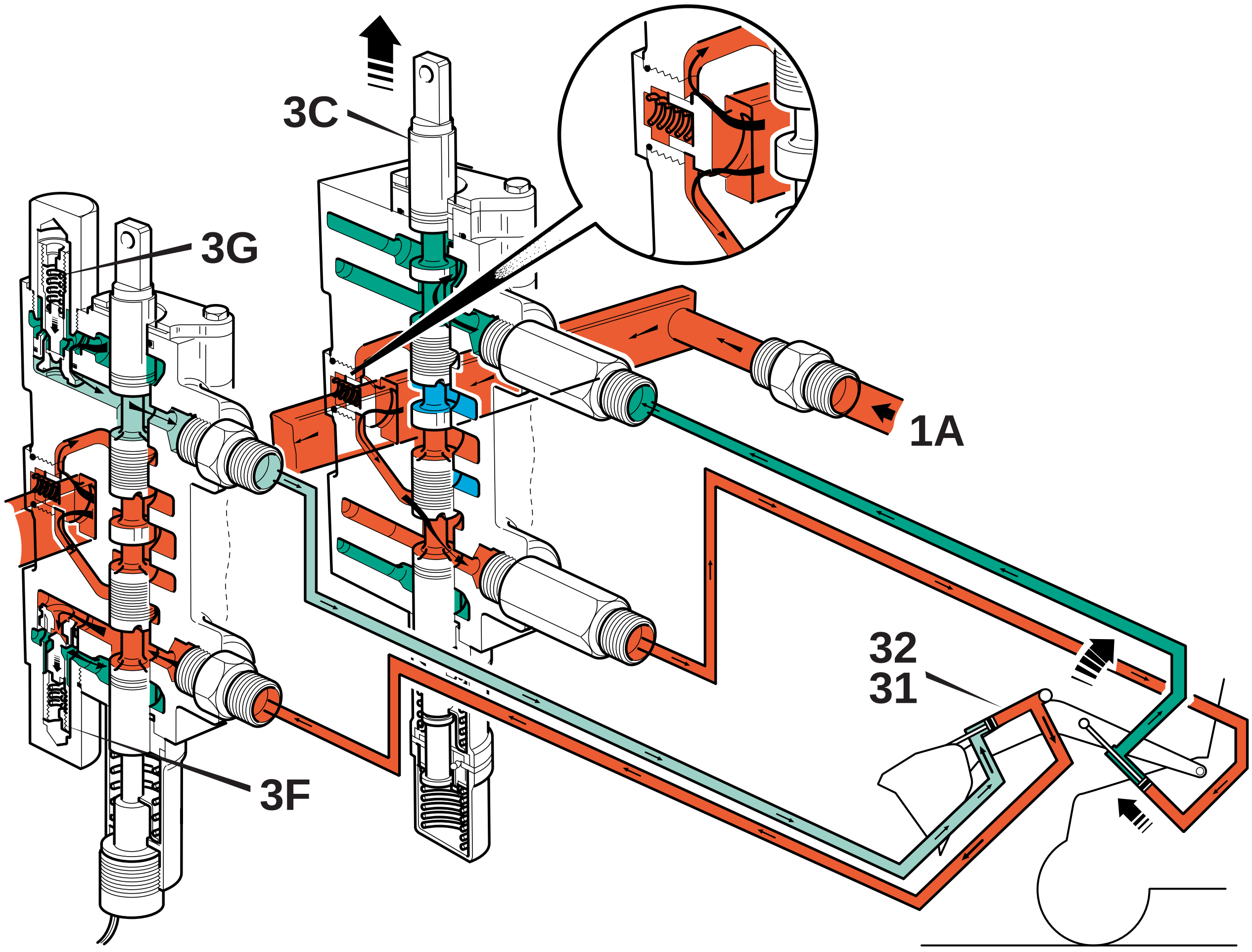


Fig 69. Auxiliary Relief Valve (ARV) Operation

See also ⇒ *Table 7. Key to Oil Flow and Pressure (E-59)*.

Main Relief Valve (MRV) Operation

⇨ *Fig 70. (E-79)*. The main relief valve (MRV) **3B**, housed in the loader valve block, sets the maximum operating pressure for both the loader and excavator hydraulic services.

1 Valve at Rest:

The view **1** shows a loader service selected by spool **3D**, causing pressure to rise in the service line and back through the loader valve to the pump via line **1A**. The service is operating under light load, therefore the pressure is not sufficient to cause any response in the MRV.

The main plunger **A** is held on its seat **B** by the combined effect of spring **C** and the pump pressure which enters chamber **D** through the small drilling **E**. Pump pressure outside the chamber is not high enough to lift the plunger off its seat.

2 Pilot Valve Poppet Opens:

In view **2**, pump pressure rises high enough to force the pilot valve **F** from its seat (against spring **G**), the pressure in chamber **D** is vented into the exhaust gallery **H**.

Unless the pressure continues to rise, plunger **A** will remain on its seat.

3 Main Valve Opens:

In view **3**, pump pressure at **1A** has risen to the setting of the main relief valve but pressure in chamber **D** has not risen because the seat orifice of pilot valve **F** is larger than small drilling **E** and oil is unable to fill the chamber as quickly as it is being exhausted.

Pressure acting on the upper faces of main plunger **A** is therefore greater than the combined force of spring **C** and the pressure in chamber **D**. The plunger then moves off its seat, allowing pressure to be released to the exhaust gallery.

As the pump pressure decreases, the pilot valve is able to reseat and pressure in chamber **D** assists spring **C** to force the main plunger **A** back onto its seat.

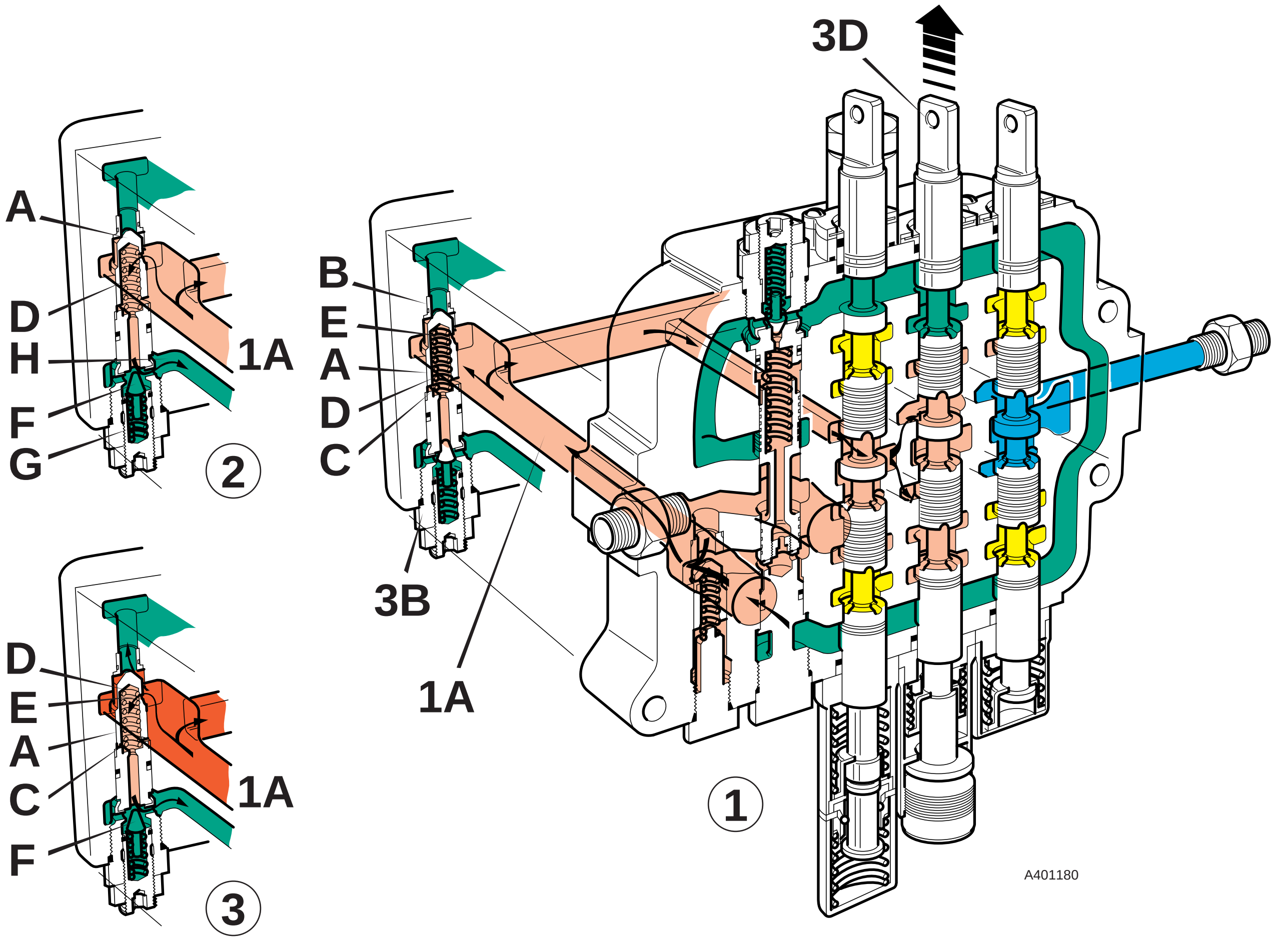


Fig 70. Main Relief Valve (MRV) Operation

See also ⇒ *Table 7. Key to Oil Flow and Pressure* *(E-59)*.

For a further detailed description of a typical pilot operated relief valve operation, see ⇒ *Pilot Operated Main Relief Valve Operation (E-80)*.

Pilot Operated Main Relief Valve Operation

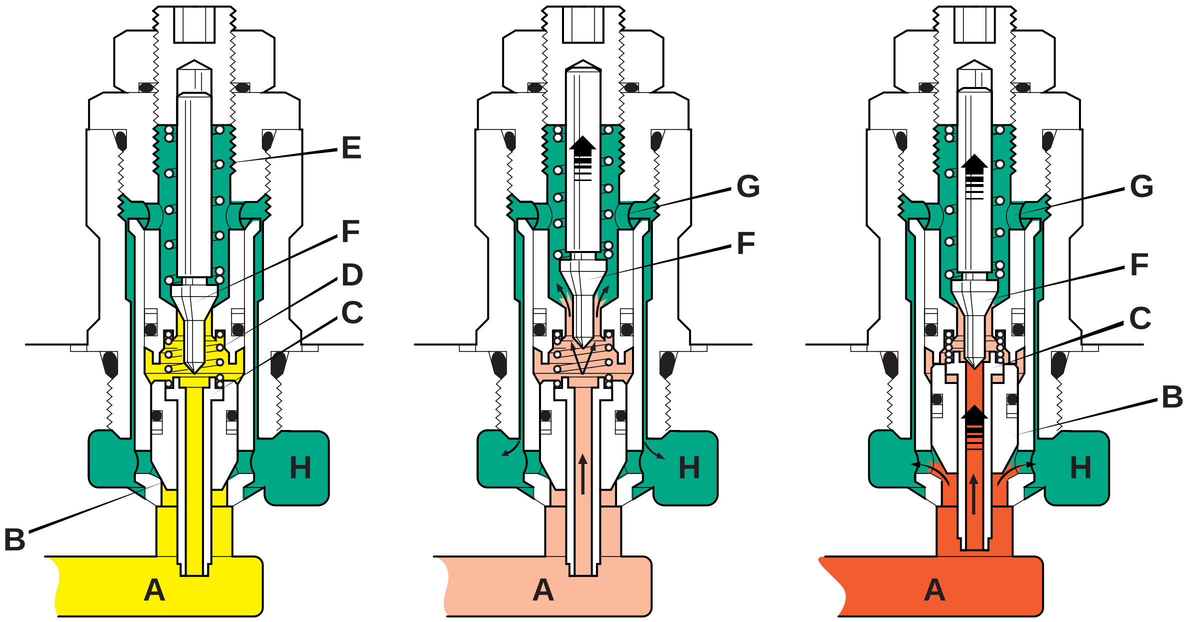


Fig 71.

1 Valve at Rest:

Oil pressure in gallery **A** will be acting on the bottom face of the main poppet **B**, and will also be felt inside the valve through the drilling in the piston **C**.

Oil pressure on the top face of the main poppet **B**, combined with the force of the springs **D** and **E**, keep the main poppet and the pilot poppet **F** tightly seated.

2 Pilot Valve Poppet Opens:

When the pressure in gallery **A** reaches the pilot setting of the valve, pilot poppet **F** lifts, allowing oil to escape through cavity **G** into the exhaust gallery **H**.

3 Main Poppet Opens:

As the pressure in gallery **A** continues to rise and oil escapes through cavity **G**, the pressure differential between the top and bottom surfaces of piston **C**, causes the piston to lift and seat against the end of the pilot poppet **F**. The oil flow through cavity **G** is then closed off. This produces a pressure drop above the main poppet **B**, causing it to lift and vent oil pressure from gallery **A** directly into the exhaust gallery **H**.

Loader Valve - Variable Flow

Operation

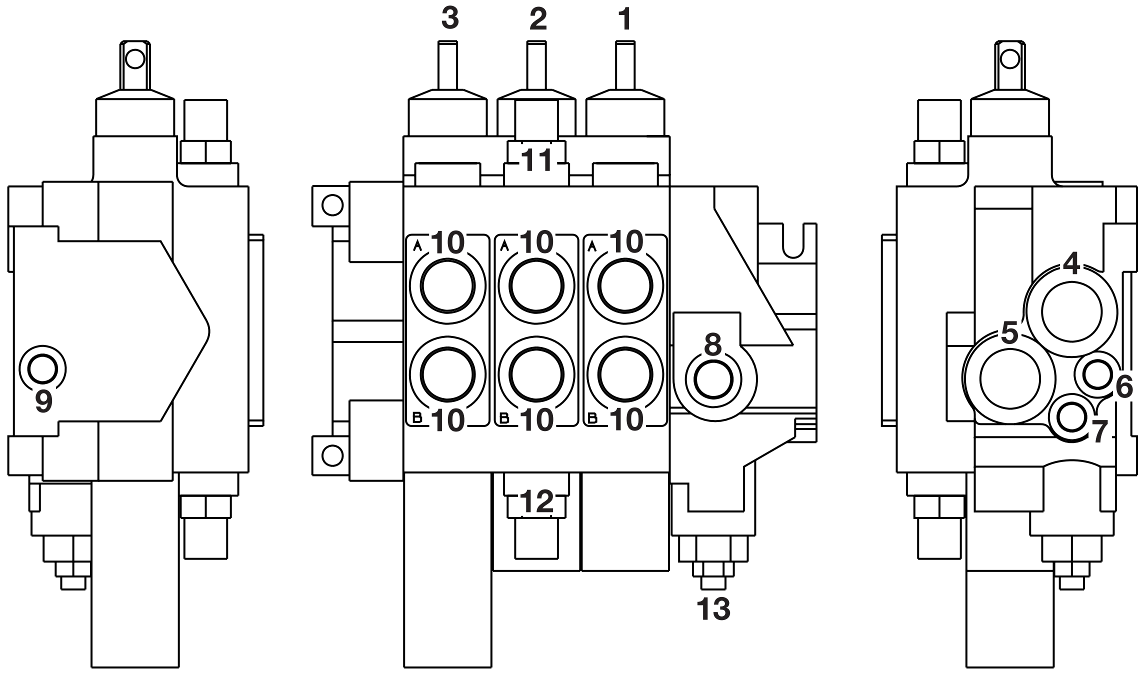


Fig 72.

The loader valve is mounted on the chassis frame, right hand side (when viewed from rear).

It is a stack type, directional control valve that is configured for closed centre operation. The valve block comprises two or three service valve sections and a priority steer inlet section.

When operated, the designated valve section controls the volume and direction of oil by way of service ports **A** or **B**. A constant flow is maintained regardless of changing load pressures.

While the spools are in neutral position, the primary shuttles and secondary shuttles are vented to tank. When a spool is operated, the load pressure sensed at the work port is directed via the primary and secondary shuttles to the hydraulic pump, where the pump subsequently `swashes' to meet this load sense demand.

Component Key:

1	Auxiliary (optional) spool
2	Shovel spool
3	Arms lift spool
4	Pump inlet
5	Tank port
6	Load sense port (from valve blocks)
7	Priority load sense port (from steer unit)
8	Priority work port (to steer unit)
9	Load sense carry over port (to backhoe valve)
10	Service ports
11	Auxiliary relief valve (rods side)
12	Auxiliary relief valve (head side)
13	Priority relief valve

Priority Inlet Section Operation

The priority inlet section houses the steering priority valve and a relief valve assembly. Operation is as follows:

Steering

See also ⇒ *Fig 74. (E-83)*.

When the steering wheel is turned, a priority pressure demand signal is sent from the hydraulic steer unit and received at the priority inlet section (port **PRLS**). The signal oil flows through port **A** into chamber **C** via gallery **B**.

The combined force of spring **D** and signal oil pressure moves spool **E** up. The position of the spool now allows oil from the pump inlet port **P** to flow out to the hydraulic steer unit via priority work port **PR**.

It must be noted that relief valve assembly **J** is redundant. This relief valve is part of the inlet section, however the hydraulic steer unit also houses a steer system relief valve. To ensure the relief valve in the hydraulic steer unit controls the steer system pressure, valve **J** is set abnormally high (172 bar; 2500 lb/in²).

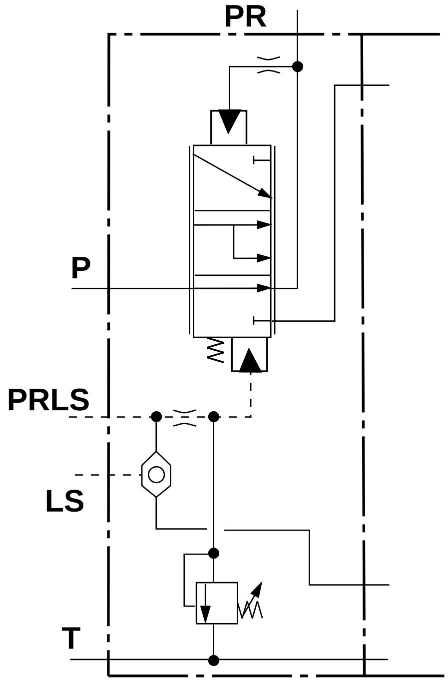


Fig 73.

Component Key:

P	Pump Inlet
T	Tank
LS	Load sense port (to pump)
PRLS	Priority Load Sense Port (from steer unit)
PR	Priority Work Port (to steer unit)

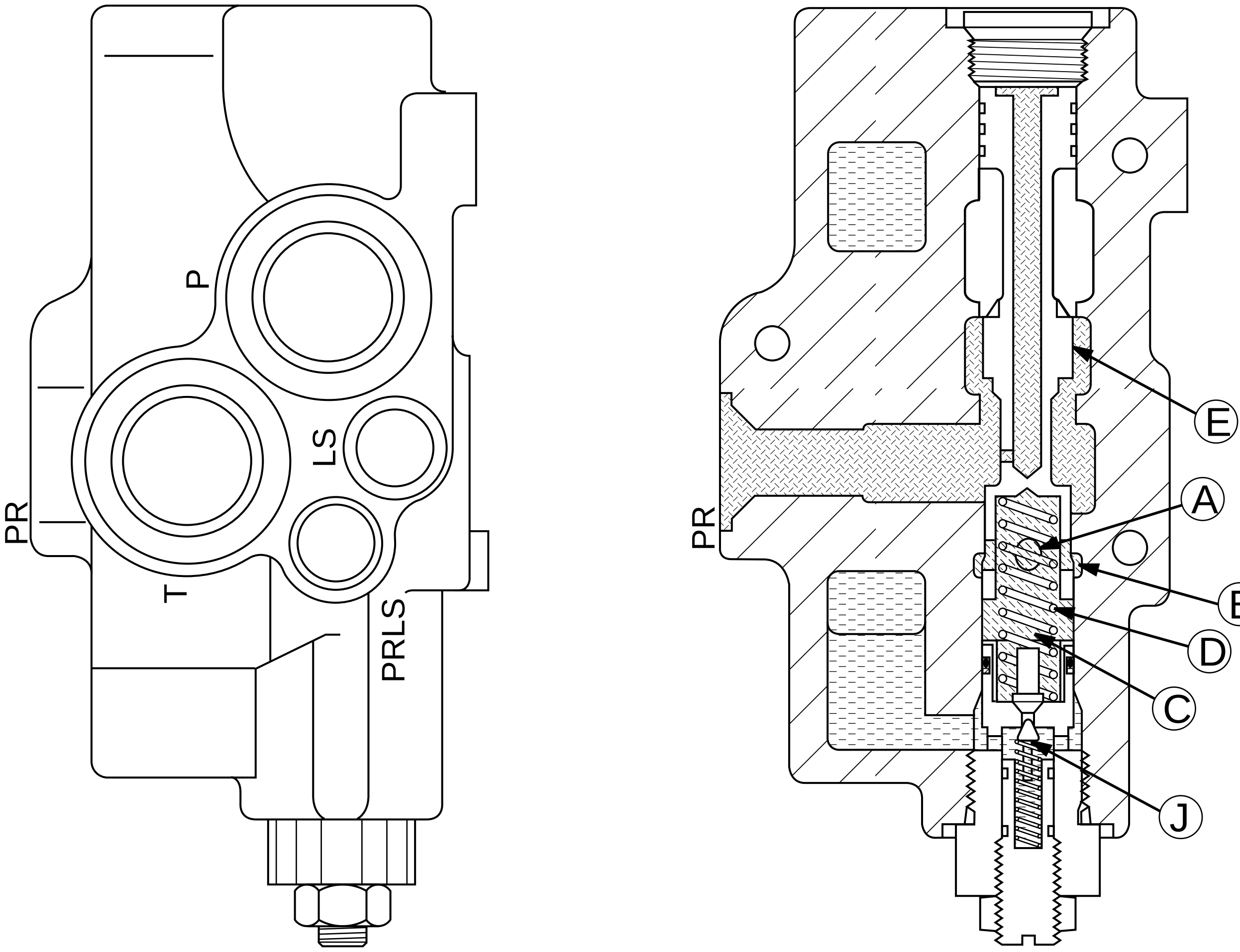


Fig 74. Priority Inlet Section (steering)

Table 9. Key to Oil Flow and Pressure

	Exhaust
	Pump
	Load Sense

Service Selected (no steering demand)

See also ⇨ *Fig 76. (E-85)*.

If the steering is not selected, there will be no pressure demand signal in chamber **C**. Pump pressure is `dead ended' at the steer unit, this pressure is felt in chamber **F** via priority port **PR** and drilling **G**. The pressure is sufficient to force spool **E** down against the force of spring **D**. The position of the spool now allows oil from the pump inlet port **P** to flow into passage **H** and on to the selected service via the valve block service ports.

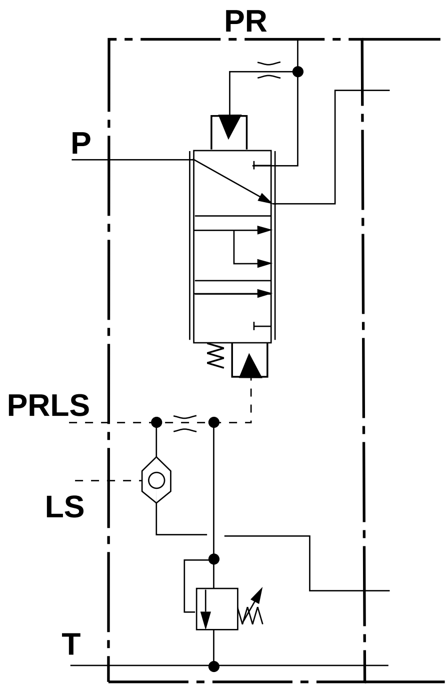


Fig 75.

Component Key:

P	Pump Inlet
T	Tank
LS	Load sense port (to pump)
PRLS	Priority Load Sense Port (from steer unit)
PR	Priority Work Port (to steer unit)

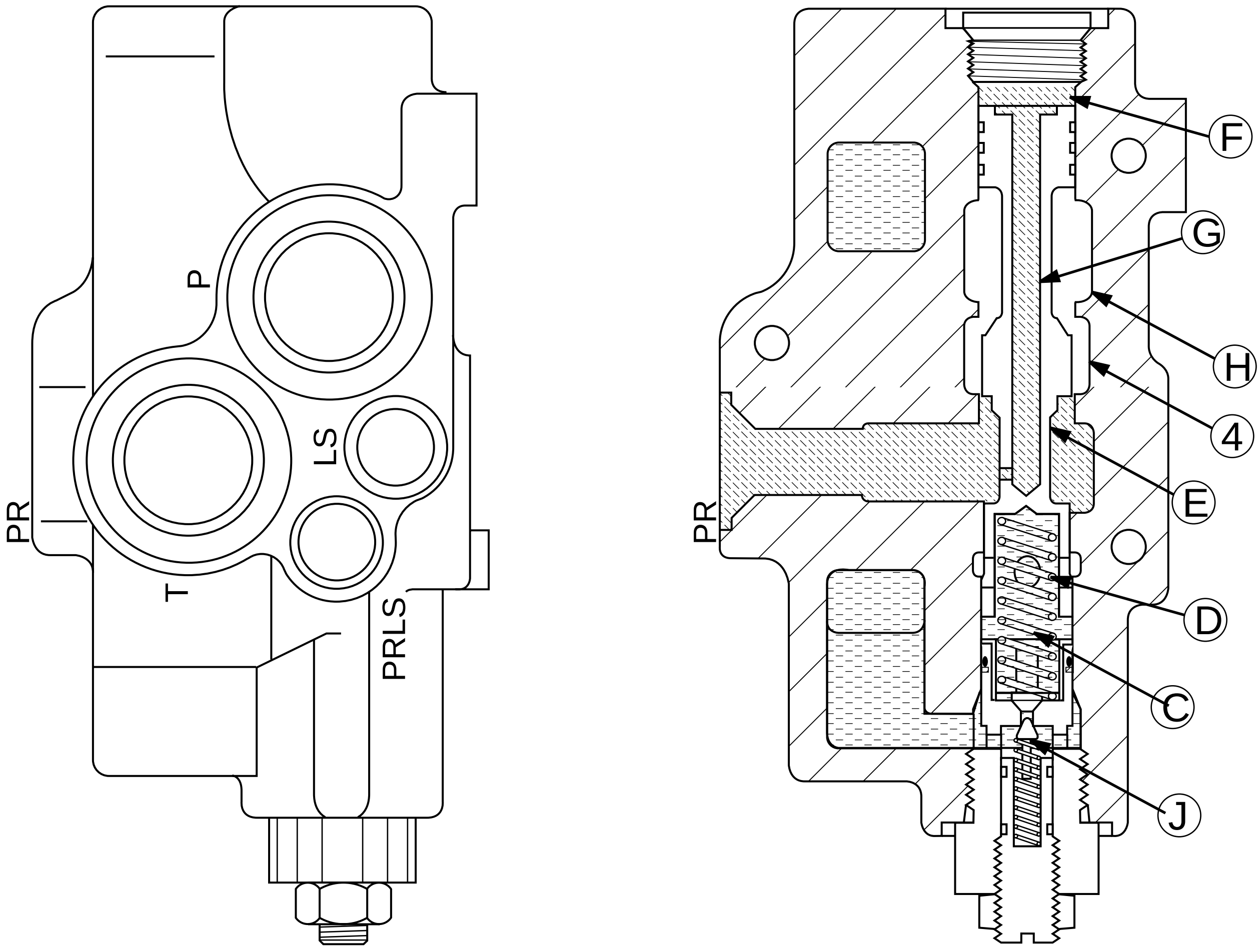
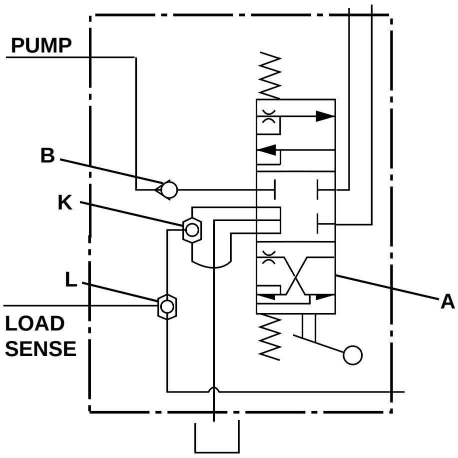


Fig 76. Priority Inlet Section (no steering demand)

See also ⇨ *Table 9. Key to Oil Flow and Pressure (E-83)*.

Auxiliary Spool



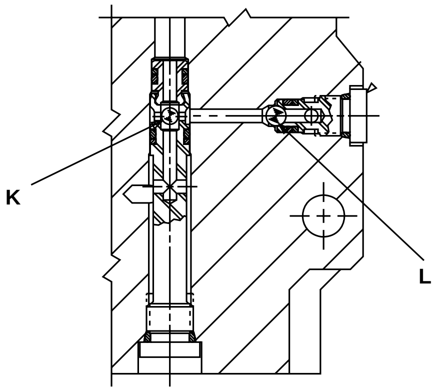


Fig 77.

The auxiliary valve section comprises the spool assembly **A**, load hold check valve assembly **B**, primary and secondary shuttles, items **L** and **K** respectively.

While the spools are in neutral position, the primary shuttles and secondary shuttles are vented to tank. When a spool is operated, the load pressure sensed at the work port is directed via the primary and secondary shuttles to the hydraulic pump, where the pump subsequently `swashes' and increases its output to meet this load sense demand.

When a service is selected (the spool moved up or down), the waisted sections of the spool connect passage **C** to one of the service ports **D**. Oil from the pump must overcome the force of spring **E** to lift poppet **F** and make the connection from the pump passage **J** to the service ports **D** via passage **C**.

In some instances there is a back pressure in the service line (e.g. generated by the weight of a loaded shovel). This pressure is felt in chamber **G** via drilling **H** in poppet **F**. The back pressure combined with the force of spring **E** keeps the load hold check valve firmly closed, preventing the load from dropping.

The pressure in pump passage **J** will increase until it is greater than that in the service line. At this point, the load hold check valve will open, as previously described.

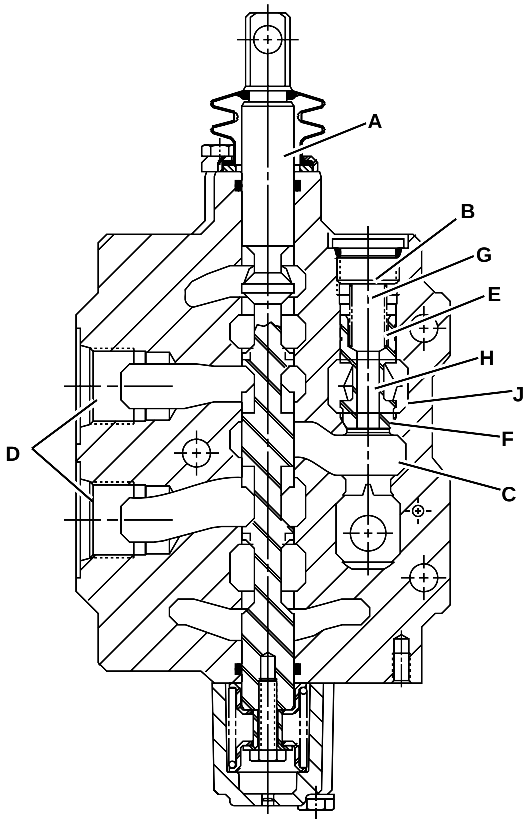


Fig 78.

Loader Shovel Spool

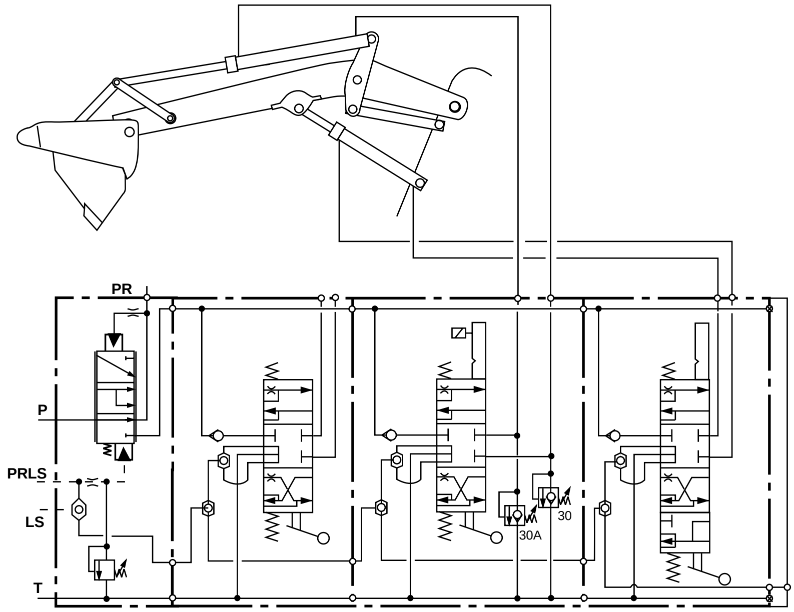


Fig 79.

The loader shovel spool operates in the same manner as the auxiliary spool, refer to ⇨ ***Auxiliary Spool (E-86)***.

The shovel valve section also houses auxiliary relief valves (items **30** and **30A**).

Under normal operating conditions, with the shovel in the 'carry' position, the mechanical linkage keeps the shovel level as the arms are raised, to prevent spillage of the load.

If, as illustrated, the shovel is fully tipped when the arms are being raised, the shovel is unable to tip further, producing back pressure in the head side of the shovel rams and cavitation in the rod side.

As the arms continue to rise, the back pressure increases until it reaches the setting of A.R.V. **30A**. This A.R.V. then opens, allowing the excess back pressure to be dumped to exhaust and prevent the rams and linkage from being damaged.

The rod side A.R.V. **30** senses a higher pressure in the exhaust gallery than in the service port and therefore opens to allow exhaust oil to overcome the cavitation.

The shovel service may also be fitted with a `return to dig' detent solenoid **12**.

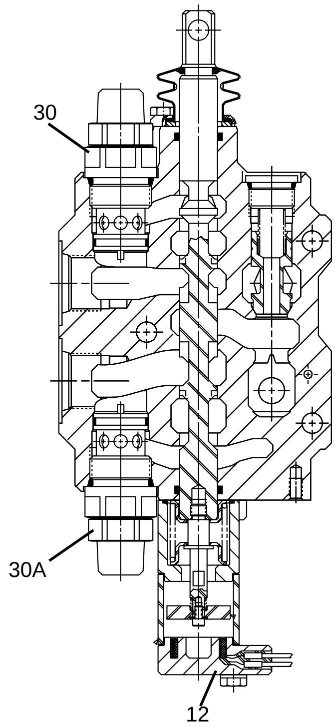


Fig 80.

Loader Lift Spool

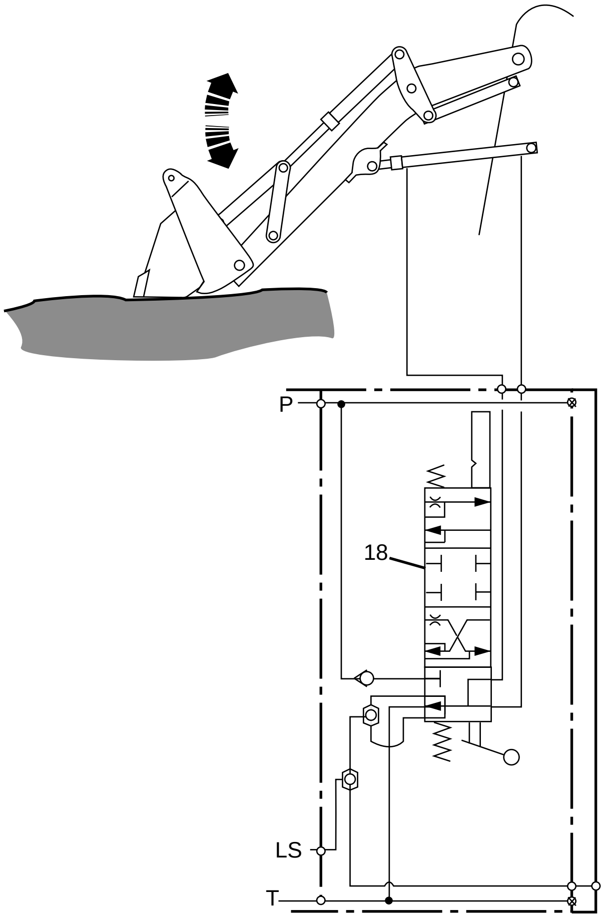


Fig 81.

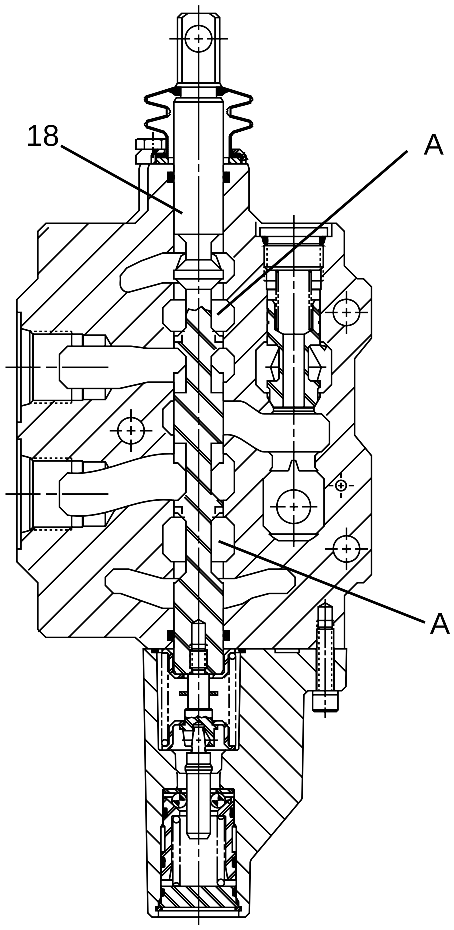


Fig 82.

The loader lift spool operates in the same manner as the auxiliary spool, refer to ⇒ ***Auxiliary Spool (E-86)***.

The lift service spool (item **18**) has a `float' detent position.

The float facility is provided to allow the arms to move up and down so that the shovel can follow the surface contours as the machine is driven over uneven ground.

This is achieved by moving the lift spool **18** down beyond 'arms lower' into the 'float' detent. Both service ports are connected to exhaust via the spool waists **A**.

Oil can then be displaced from either end of the lift rams and into the exhaust gallery, allowing the rams to open and close as required.

Shuttle Valve Signal Network

⇨ *Fig 83. (E-90)* and ⇨ *Fig 84. (E-90)*.

Each control valve section has two shuttle valves. Each valve compares two pressure signals. One of the shuttles is the primary **18** and the other is the secondary **17**.

The primary shuttle **18** compares the pressure signal between the two service ports **A** and **B** in each valve section, the head and the rod pressure of the cylinder. In the example shown the boom service **37** port **B** pressure signal is greater than port **A**. Primary shuttle **18** moves across, the pressure signal is the highest shuttle pressure. This signal pressure passes to the next shuttle.

The secondary shuttle operates the same as the primary shuttle but compares pressure signals between valve sections.

The signal network is arranged in series. It starts at loader valve block **9** inlet section which is connected to the steer valve **45**. The last secondary shuttle in the loader valve block is connected to the first secondary shuttle in the backhoe valve block **25**. The highest shuttle signal pressure from the loader valve block goes to the backhoe valve block.

The highest shuttle signal pressure is felt at the hydraulic pump which instructs the pump to vary the output to meet the highest shuttle load requirement. The stand-by pressure spool in the pump adds margin pressure to the load requirement. The single highest shuttle signal pressure plus margin pressure governs pump output.

The pump will not change output until the shuttle network identifies a different shuttle signal.

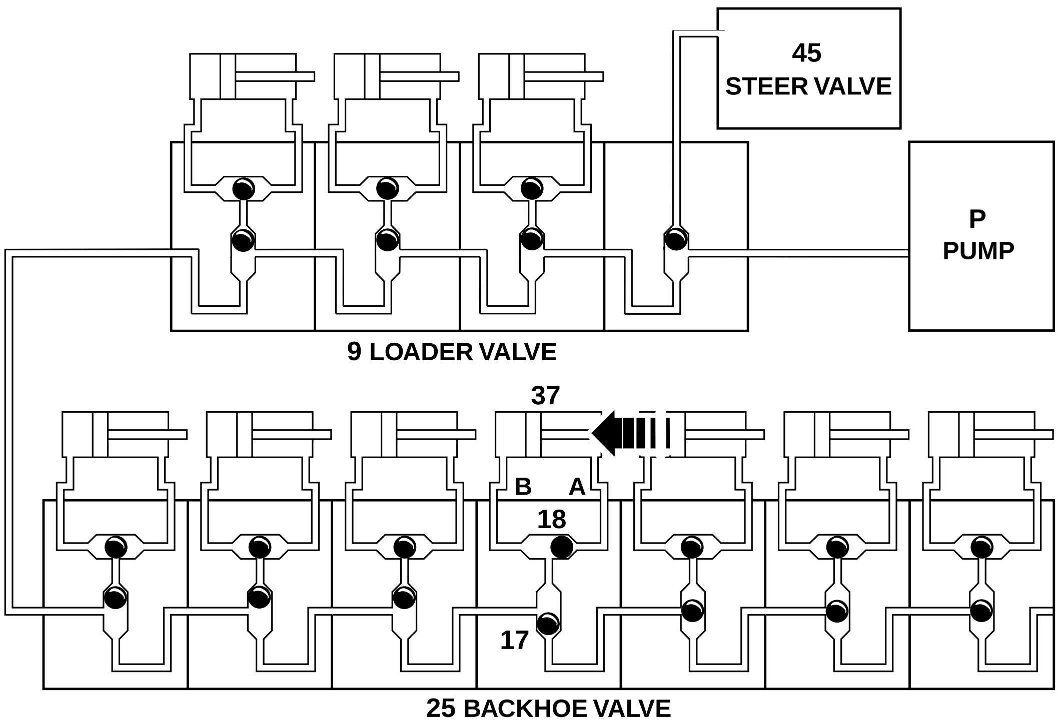

45
STEER VALVE
P
PUMP
9 LOADER VALVE
37
B
A
18
17
25 BACKHOE VALVE

Fig 83.

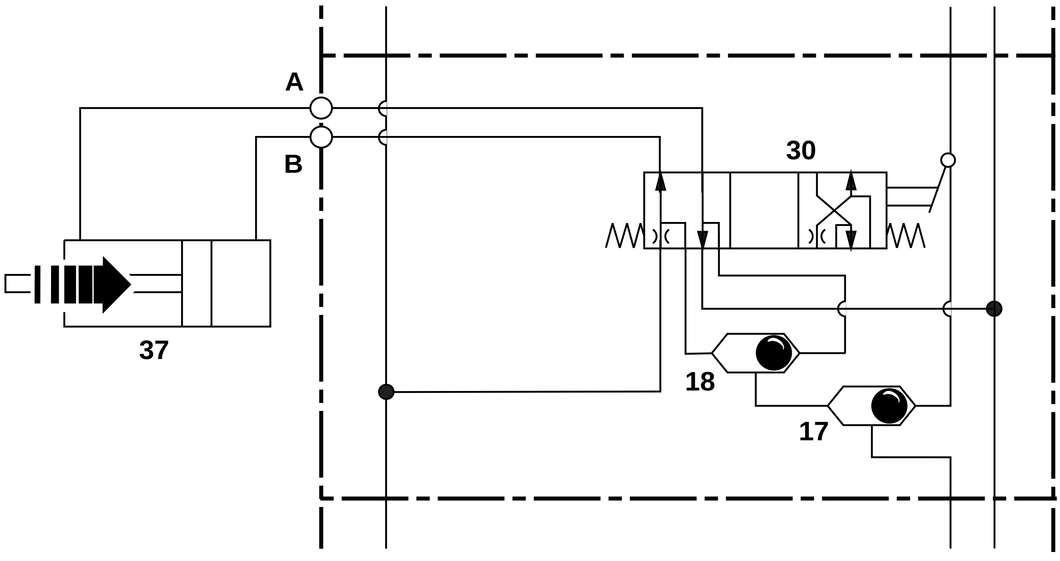

A
B
30
37
18
17
P
LS
T

Fig 84.

Excavator Valve - Manual Control

Neutral Circuit

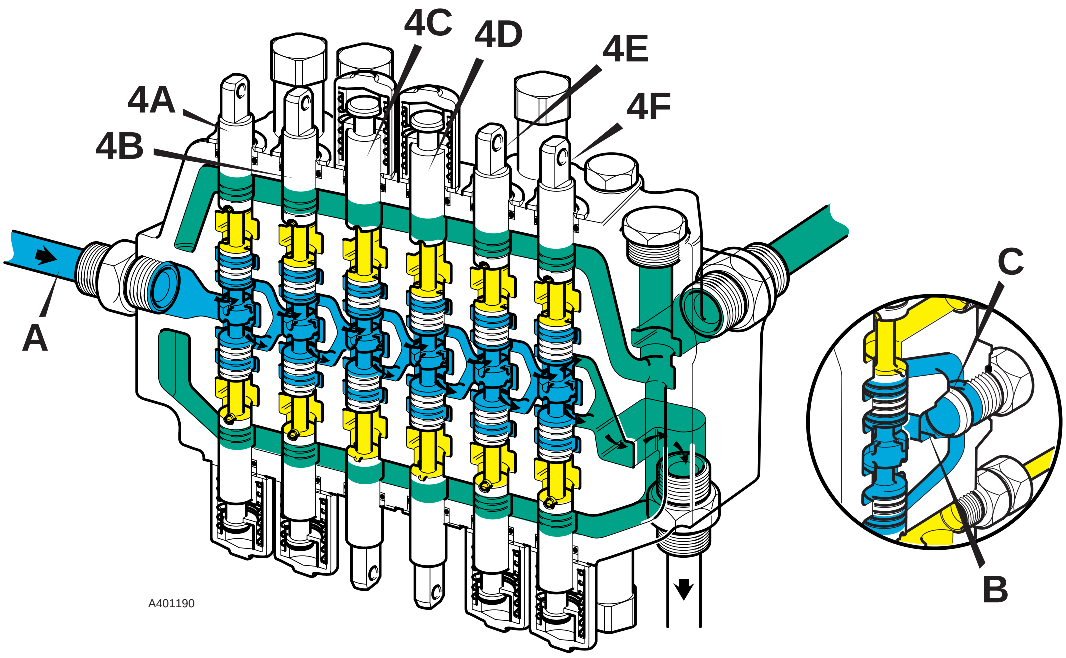


Fig 85.

Oil from the loader valve enters the excavator valve at **A** and flows through the neutral gallery and around the waists of the solid spools. It also fills the parallel gallery **B** but is not at a high enough pressure to open the load hold check valves **C**.

Note: *Machines with ISO control pattern have the boom and dipper spools interchanged.*

See also ⇒ ***Table 7. Key to Oil Flow and Pressure (E-59)***.

Component Key: (JCB 'X' Control Pattern)

A	Inlet
B	Parallel Gallery
C	Load Hold Check Valves
4A	Slew Spool
4B	Boom Spool
4C	Stabiliser Spool
4D	Stabiliser Spool
4E	Dipper Spool
4F	Bucket Spool

Load Hold Check Valves

Operation 1

⇨ *Fig 86. (E-93)*.

Flow to the service via a typical solid spool **4B** is controlled by the load hold check valve **4S** which is a spring-loaded non-return valve operating across the pressure feed from the parallel gallery **B**. The valve prevents reverse flow from the rams into the pressure feed line, so maintaining ram pressure until exceeded by system pressure. The illustration shows a service selected but back pressure **D** exceeds system pressure which closes the load hold check valve **4S**.

Operation 2

⇨ *Fig 87. (E-93)*.

When pressure in the feed line exceeds back pressure, the load check valve **4S** opens and oil operates the ram. The remaining load hold check valves are also opened by system pressure but the galleries are dead-ended because the spools are in neutral.

See also ⇨ *Table 7. Key to Oil Flow and Pressure (E-59)*.

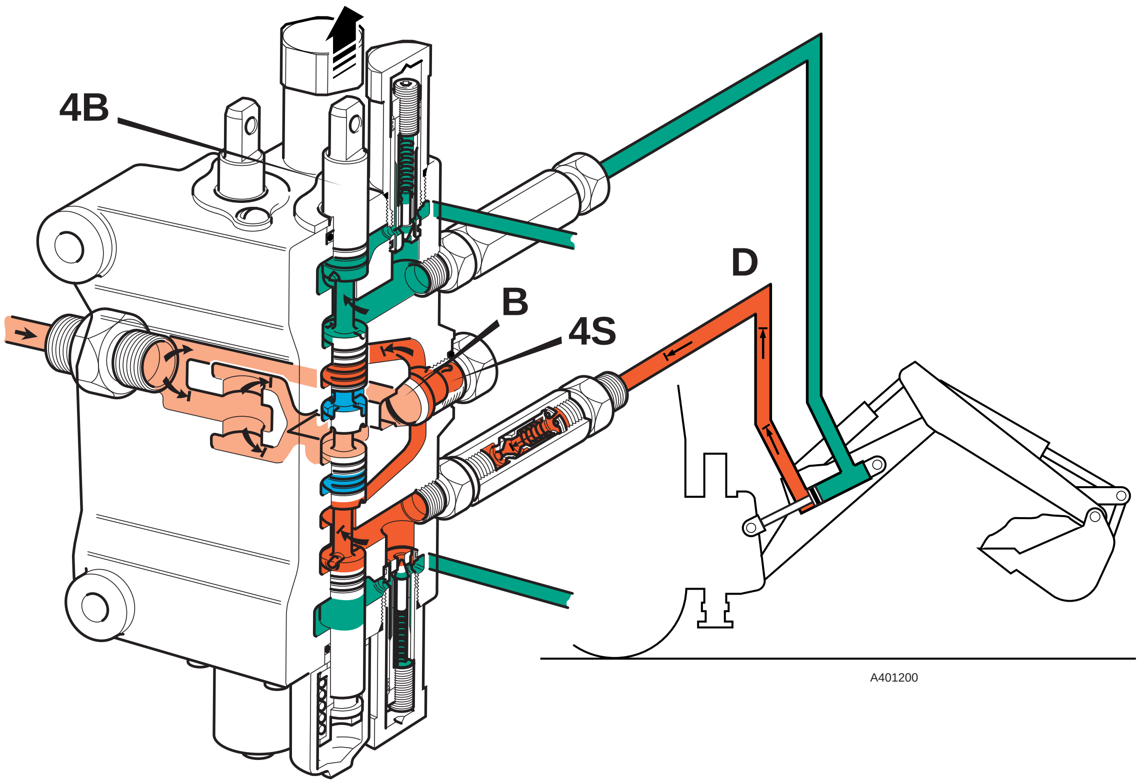


Fig 86.

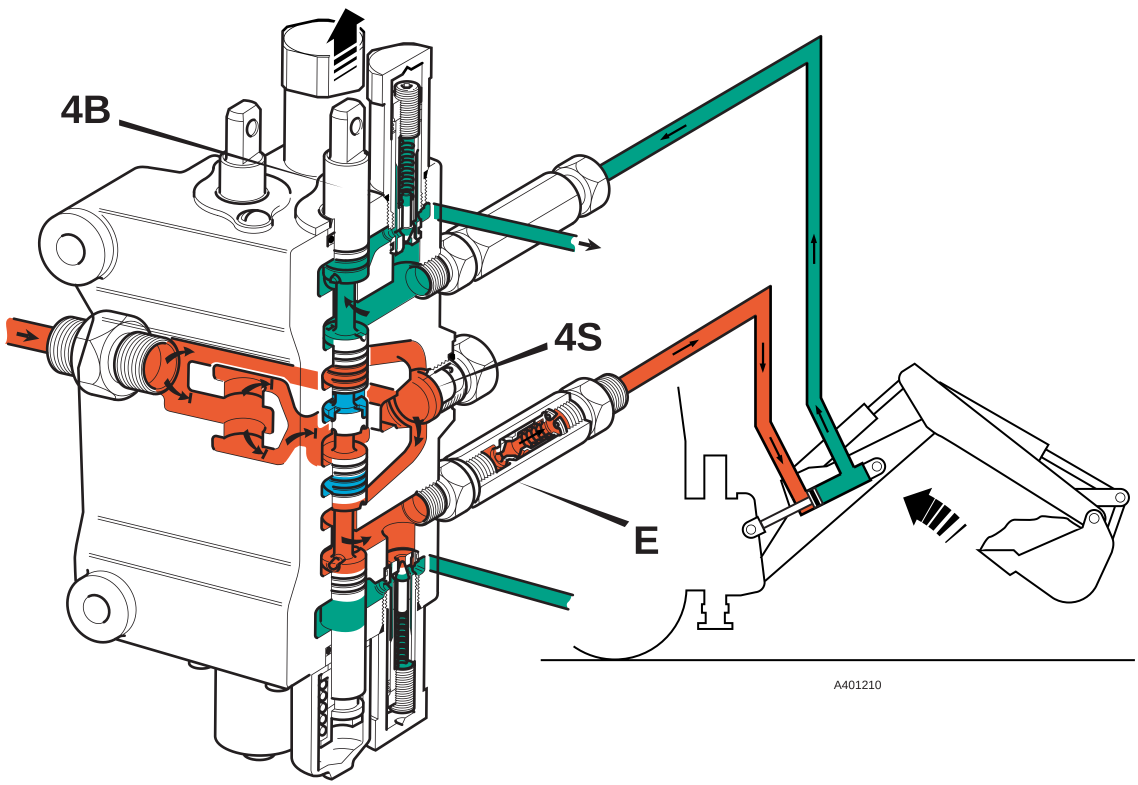


Fig 87.

One Way Restrictor Operation

⇨ *Fig 88. (E-95)*.

Because of its weight, the excavator end could take over control when boom lower was selected. The falling boom would tend to push oil out of the ram faster than the head side was being filled. Consequently, when the excavator had reached the ground, there would be a time lapse while the ram filled with oil before the service would operate again.

To prevent this from happening, the boom service is fitted with a one way restrictor. When the boom is being raised, the poppet in restrictor **E** is held off its seat by the pressurised oil flow, therefore oil delivery to the boom ram rod side is unrestricted.

When the boom is being lowered, the oil flow through the one way restrictor **E** re-seats the poppet, therefore the flow of oil is restricted through the small drilling in the base of the poppet. This slows the boom down to a controllable speed.

Slew Operation

⇨ *Fig 89. (E-95)*

The illustration shows R.H. slew selected. The lower port **C** has been pressurised by the spool. Oil flows from the parallel gallery **B**, out past A.R.V. **4H** to both the head side of the L.H. slew ram and the rod side of the R.H. slew ram. The boom therefore slews to the right hand side of the machine. Displaced oil from the rod side of the L.H. slew ram and from the head side of the R.H. slew ram flows back through the upper service port **D** and back to tank.

See also ⇨ *Table 7. Key to Oil Flow and Pressure (E-59)*.

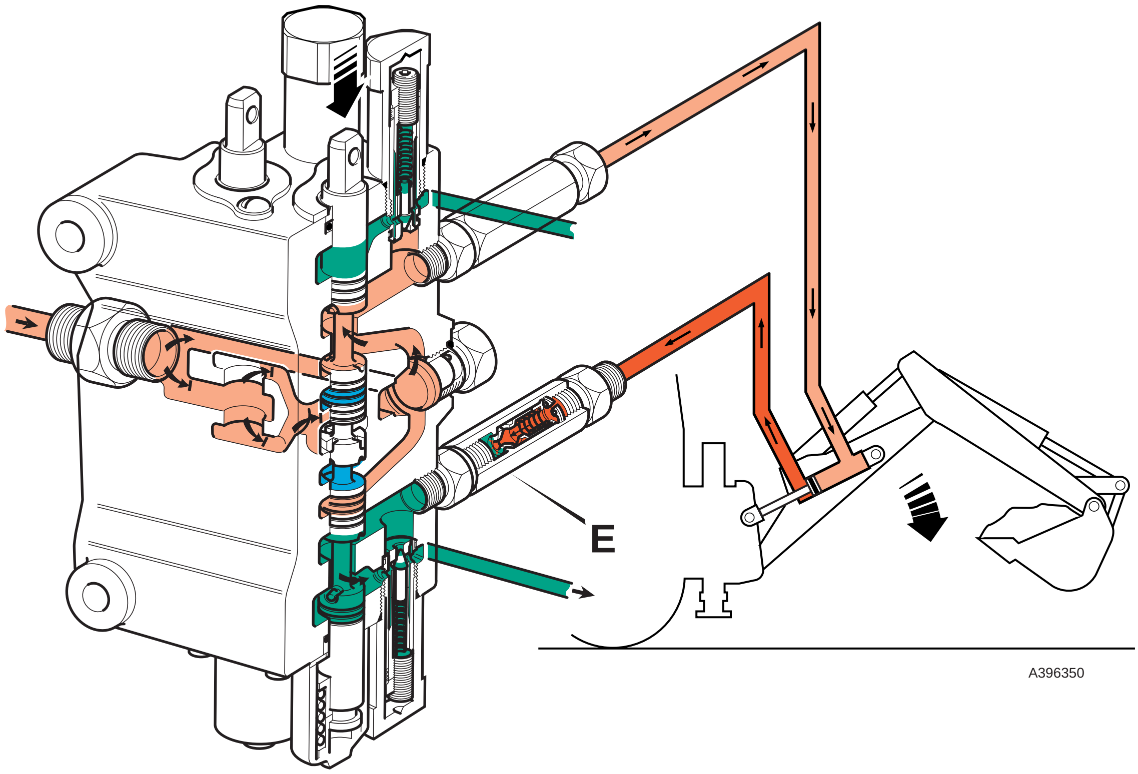


Fig 88.

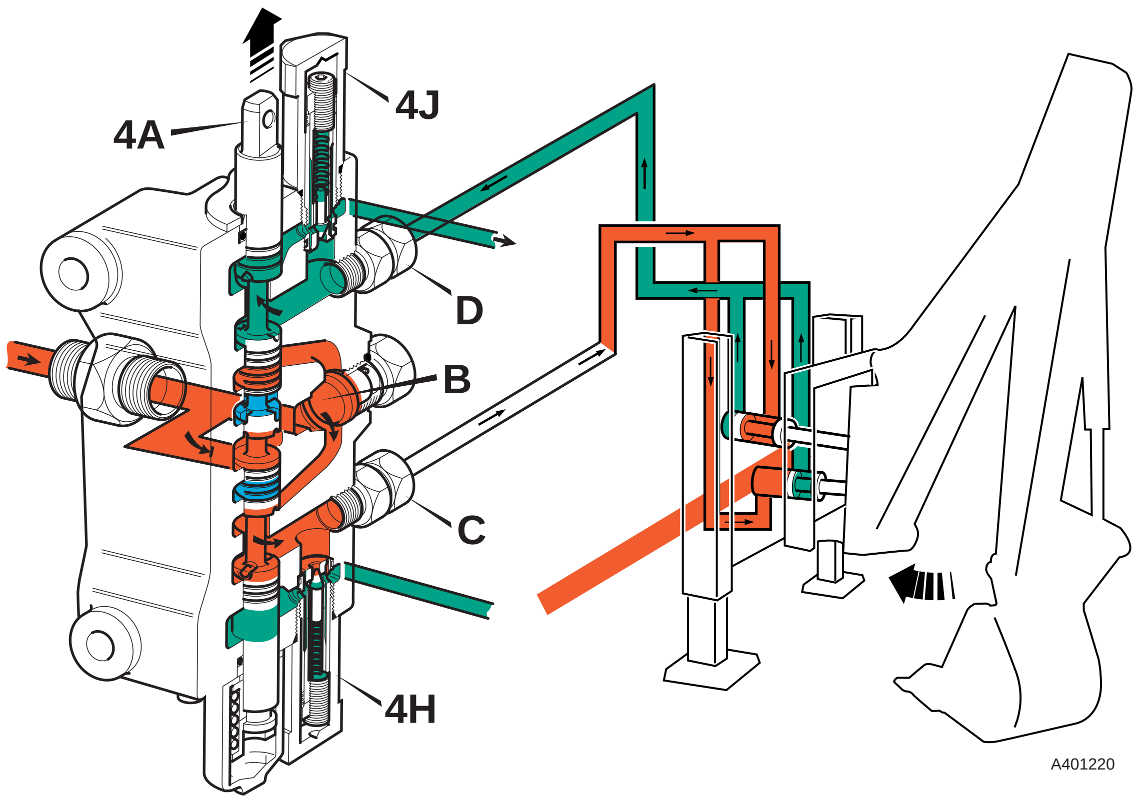


Fig 89.

Slew Ram End Damping

As ram **A** nears the closed position, damping rod **B** seats in cone **C**, where it is held by spring **D**. Tapered flutes on the end of the rod produce a restricting orifice, thus restricting the speed of the oil being exhausted from the ram. This provides a cushioning effect between the piston and the dump end of the ram, effectively damping out the shock loads which would otherwise occur when the boom reaches the end of its slewing arc.

See also ⇨ ***Table 7. Key to Oil Flow and Pressure (E-59)***.

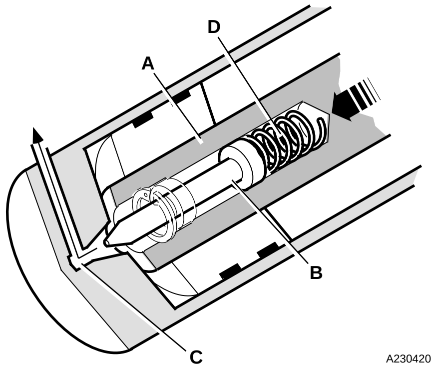


Fig 90.

Slew A.R.V. and Anti-Cavitation Operation

⇨ *Fig 91. (E-98)*.

The spool **4A** is in neutral but the momentum of the slewing excavator end creates back pressure in the head side of the R.H. slew cylinder and in the rod side of the L.H. slew cylinder. This opens A.R.V. **4J** and dumps oil to exhaust. At this point the cylinders cavitate and exhaust oil pressure causes A.R.V. **4H** to open, allowing oil from the exhaust gallery to fill the L.H. cylinder.

A.R.V. Operation

⇨ *Fig 92. (E-98)*.

The illustration shows the bucket spool **4F** selected to operate the service against an immovable object. This forces the dipper away from the obstruction and pressurises the head side of the dipper ram.

When this pressure reaches the setting of A.R.V. **4M**, this valve opens, relieving the pressure into the exhaust gallery.

Cavitation occurs in the rod side of the dipper service until A.R.V **4N** opens, allowing the higher pressure in the exhaust gallery to supplement that in the service line.

Note: *A.R.V.* ***4Q*** *is only fitted to machines with a Rockbreaker.*

See also ⇨ ***Table 7. Key to Oil Flow and Pressure (E-59)***.

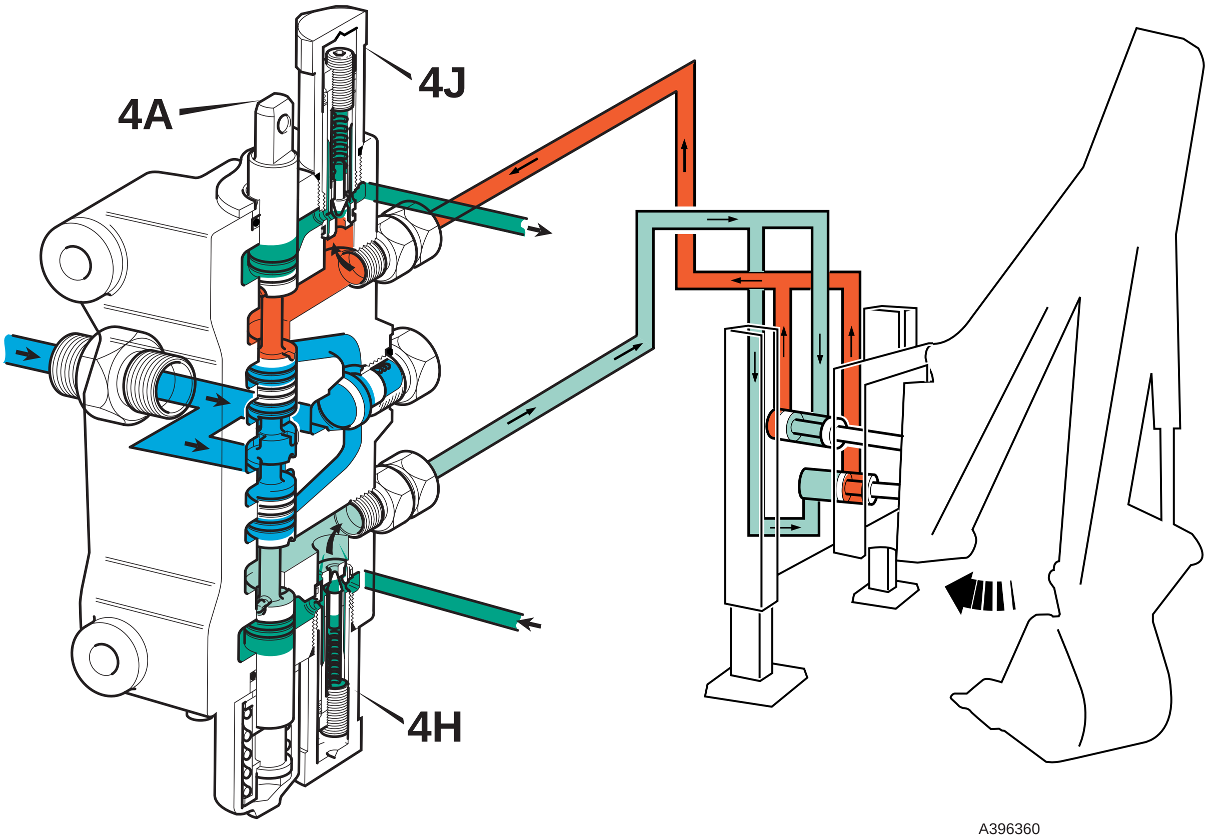


Fig 91.

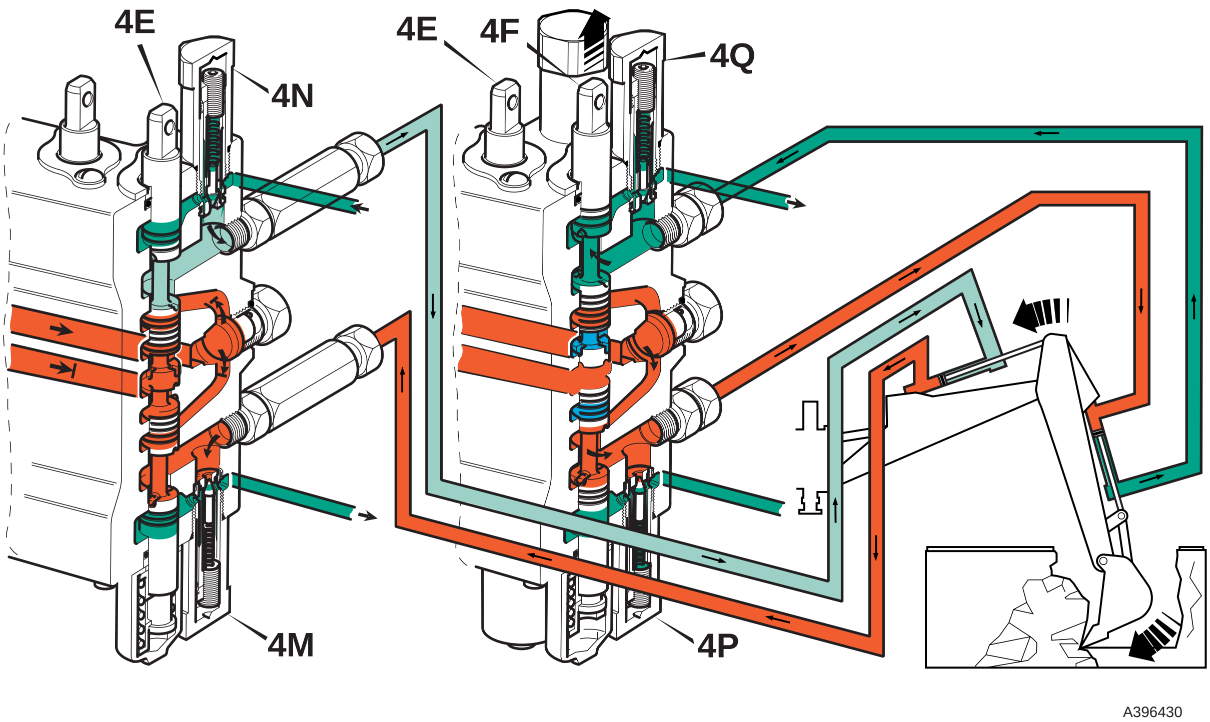


Fig 92.

Hydraclamp Valve Operation (Sideshift Machines)

⇨ *Fig 93. (E-100)*.

When the backhoe is being used for excavating duties, the kingpost assembly must be 'clamped' to the sideshift rearframe.

The hydraclamp control valve assembly (items **G**, **D** and **C**) is positioned in the inlet end of the excavator valve block and is connected directly to the parallel gallery **B**. The valve operates in conjunction with solenoid valve **E** housed in the side of the excavator valve block.

1 Clamps Pressurised

When the hydraclamp switch **A** is in the OFF position (not pressed), the solenoid valve **E** is de-energised. The solenoid valve in this de-energised state blocks the exhaust path from the parallel gallery **B** to the drain port (tank).

When an excavator service is operated, pressure is generated in parallel gallery **B**, this pressurised oil enters the clamp valve **C** and lifts poppet **D** off its seat against the force of spring **G**. The oil flows past the poppet and out to the hydra-clamps **62**.

2 Clamps Released - Not Precision Control Machines

When the hydraclamp switch **A** is in the ON position (pressed down), the solenoid valve **E** is energised. The solenoid valve in this energised state now allows a connection to be made from the parallel gallery **B** to the drain port (tank) via gallery **F**.

Oil from the hydra-clamps is vented through the clamp valve and gallery **F** to the drain port (tank).

Also, pressure resulting from the operation of an excavator service passes by poppet **D** as before but the oil takes the path of least resistance and is vented via gallery **F** to the drain port (tank).

Restrictor **H** ensures that not all oil in gallery **B** is dumped back to tank.

3 Clamps Locked Up

If no service is being operated, pressure in the parallel gallery falls to that of the neutral circuit and the force of spring **G** is sufficient to keep the poppet seated.

Pressure is therefore trapped in the line to the clamps, maintaining the excavator end in a securely clamped condition.

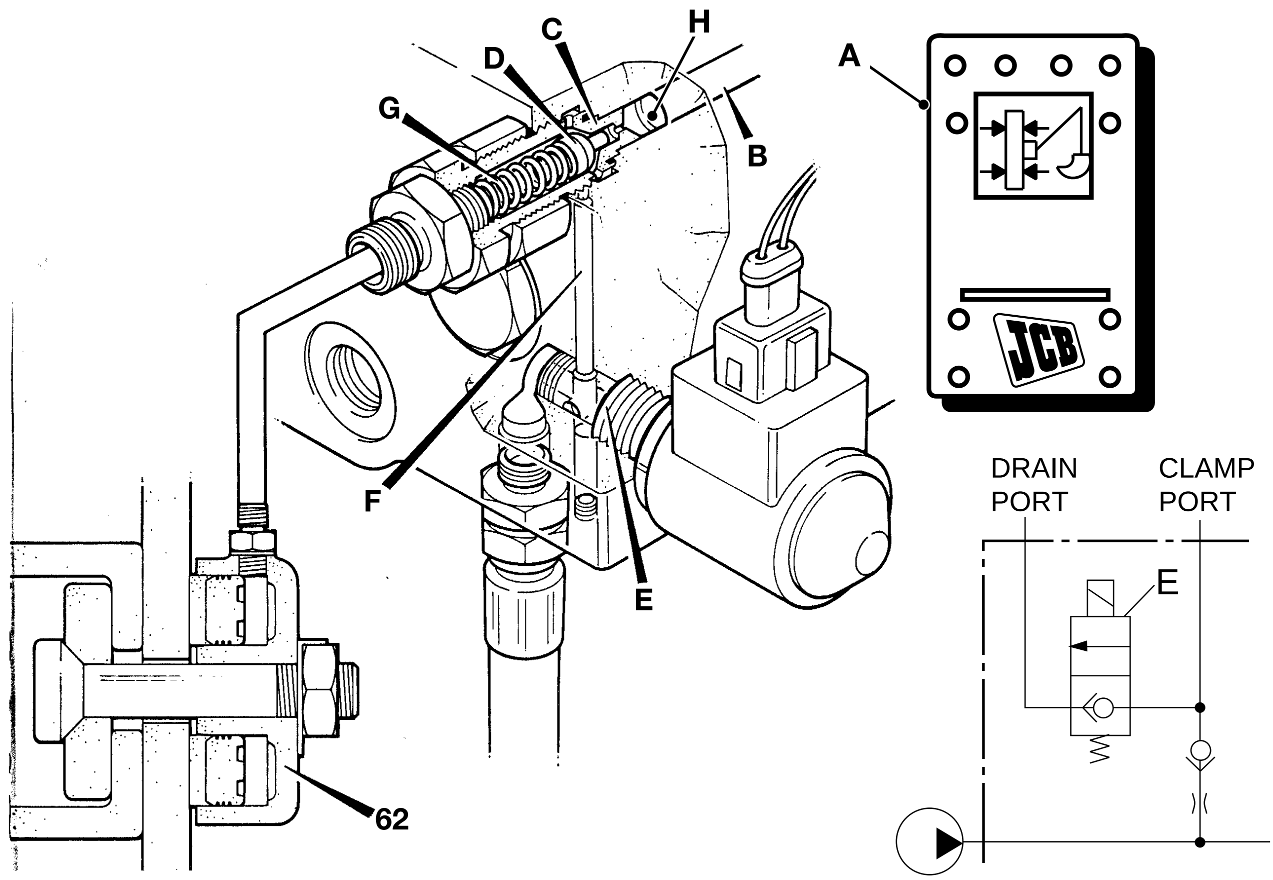


Fig 93. Hydraclamp Valve Operation

Smooth Ride System (SRS) - if fitted

Smooth Ride System

⇨ *Fig 95. (E-102)*.

The Smooth Ride System (SRS) enhances the comfort of the ride by damping out the forces imposed on the machine by the movement of the loader arms as the machine travels over uneven surfaces.

This is achieved by connecting the head side of the loader rams **1** to a pressurised piston type accumulator **4**.

When the SRS switch in the cab is operated, the solenoids on the SRS valve block **3** are energised. Hydraulic oil from the loader ram head side is dead ended at the loader valve block **2** and is connected to the accumulator. Hydraulic oil from the rod side is connected to tank **5** to make up or dissipate oil as required.

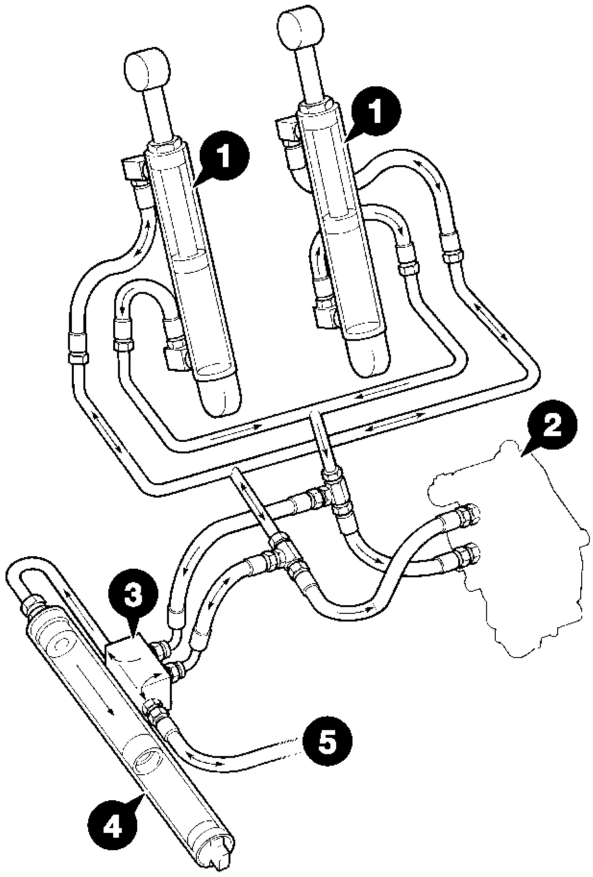


Fig 94.

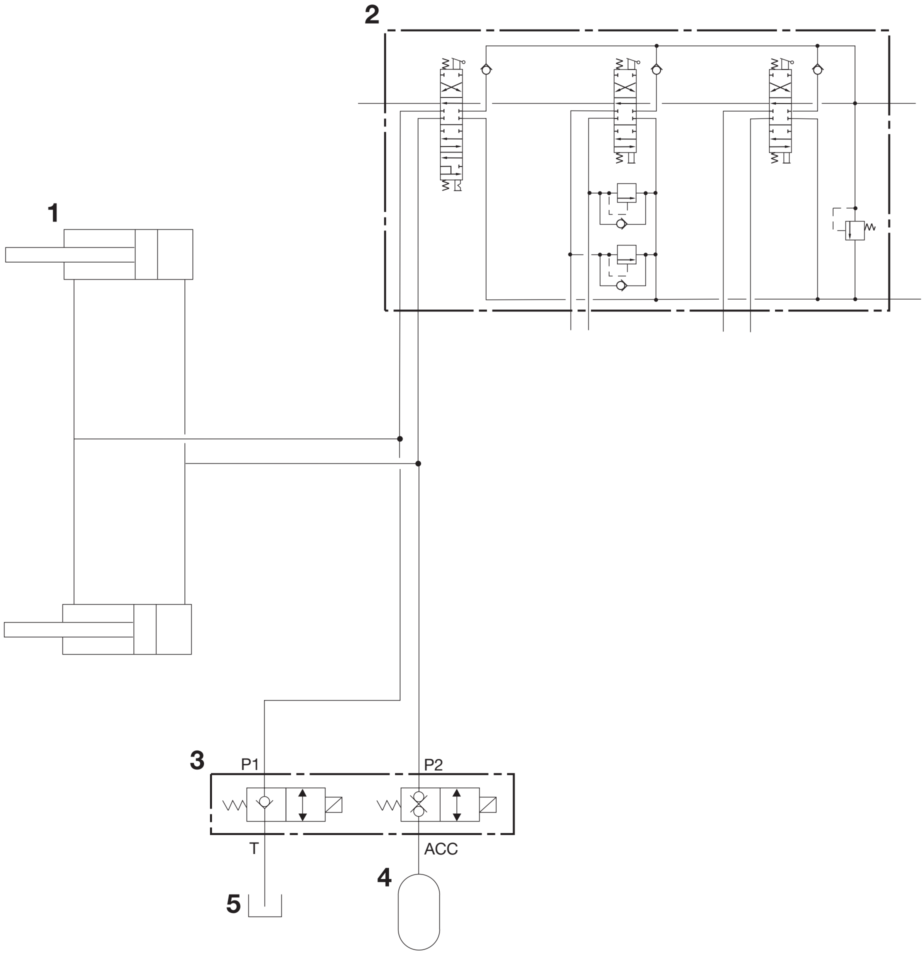


Fig 95. Schematic Circuit

Component Key:

1 Loader Lift Rams

2 Loader Valve Block

3 SRS Valve Block

4 Piston Accumulator

5 Tank

SRS with Hose Burst Protection Valves (HBPV) Option

⇨ *Fig 97. (E-104)*.

The Hose Burst Protection Valves (HPBV) **6** fitted at the loader lift rams each incorporate an integral solenoid valve **6a**. When the SRS switch in the cab is operated, the solenoids on the HBPV valves are energised together with the solenoids on the SRS valve block **3**. This allows the hydraulic oil from the loader ram head side to pass through the hose burst protection valves via an internal gallery, allowing SRS to operate as described in ⇨ *Smooth Ride System (E-101)*.

When SRS is switched OFF, or the engine or the ignition is switched OFF the solenoids **6a** de-energise and the HBPV option is activated.

CAUTION

If both Smooth Ride System (SRS) and Hose Burst Check Valve (HBCV) options are fitted on your machine, when the SRS is selected ON there will be no HBCV protection. Do not switch the SRS ON when the front loader shovel is above 600mm (2ft).

0112

For a detailed description of Hose Burst Protection Valve operation ⇨ *Hose Burst Protection Valves - if fitted (E-242)*.

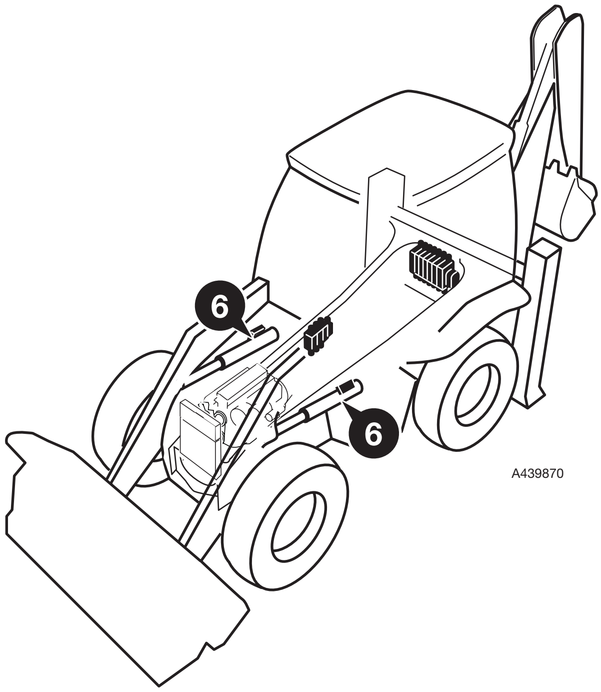


Fig 96.

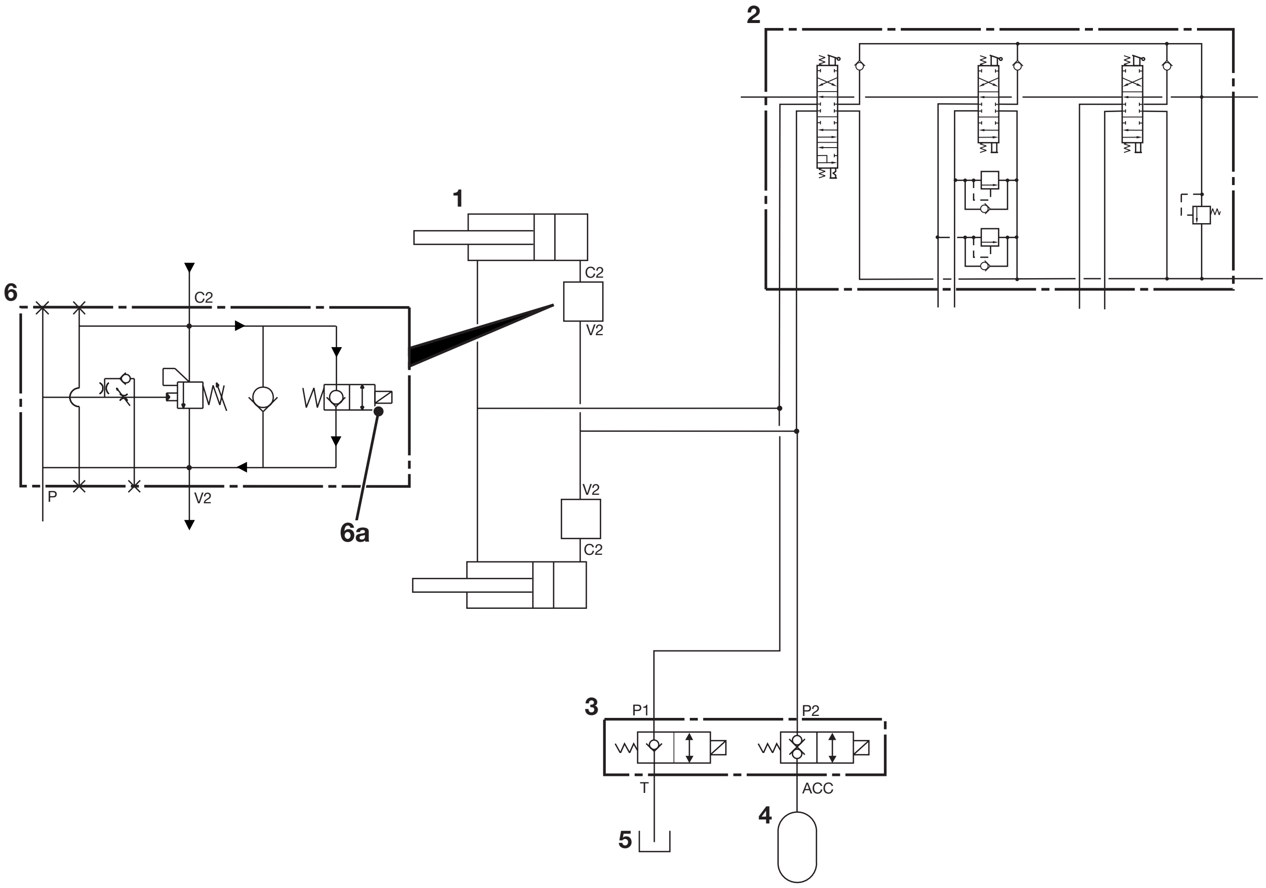


Fig 97. Schematic Circuit

Component Key:

1 Loader Lift Rams
2 Loader Valve Block
3 SRS Valve Block
4 Piston Accumulator
5 Tank
6 Hose Burst Protection Valves
6a Integral Solenoid Valve

Electrical Connections

Hydraulic Speed Control (HSC)

Quick Reference

⇨ ***Fig 98. (E-106)***. The illustration shows how the HSC electrical system works in different modes:

- HSC selector switch OFF
- HSC selector switch ON
- HSC selector switch OFF and override pushbutton pressed.
- HSC selector switch ON and override pushbutton pressed.
- HSC selector switch OFF and 4th/Auto gear selected (Powershift/Shiftmaster machines only).

When the hydraulic speed control (HSC) system is `ON', the unloader valve solenoid **NA** on the loader valve block is energised, which dumps the output flow from the secondary pump (P2) back to tank.

Dumping the P2 pump output flow in this way reduces the load on the engine, and ensures that more of the engine power is available to the machine transmission. In addition, the oil flow to the hydraulic services is also reduced, which makes the services operate slower for more precise work. See the machine ***Operator Handbook*** for full details.

For a detailed description of the HSC electrical circuit and connections, see ⇨ ***Circuit Descriptions (E-107)***. For a description of the hydraulic operation, see ***Section E, Hydraulics***.

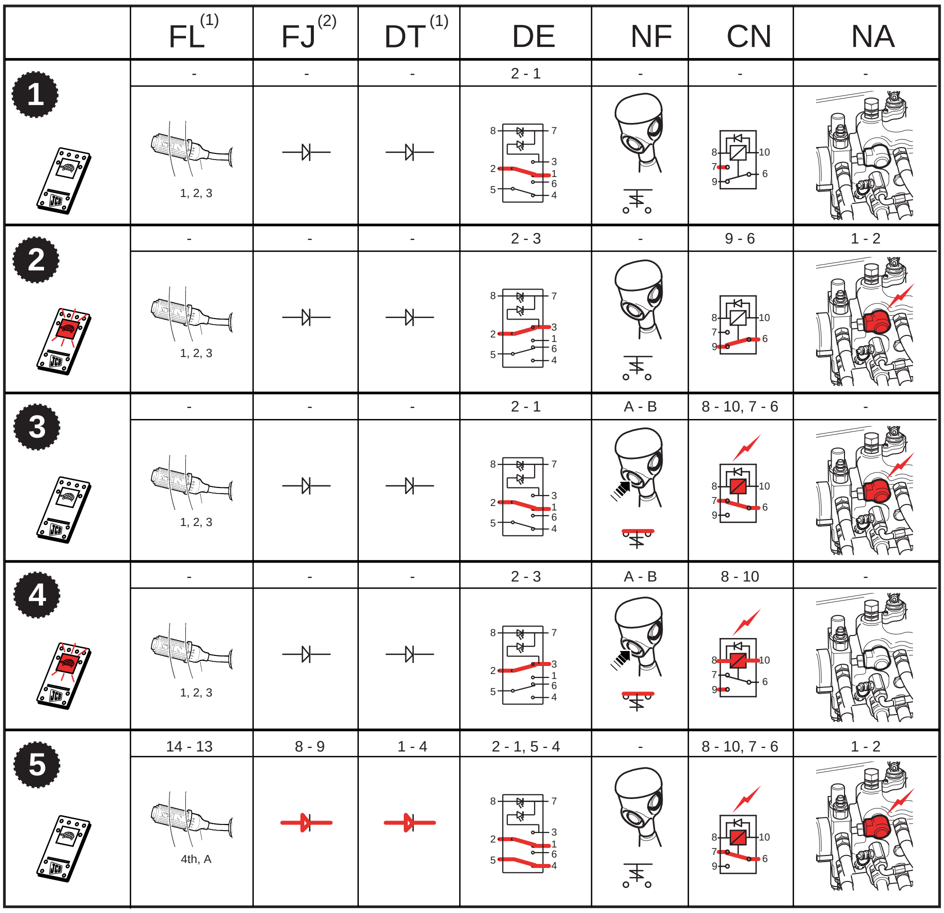


Fig 98. Quick Reference

The illustration shows the different switch positions with the HSC relay and solenoid status.

Modes of Operation:

1 HSC selector switch OFF

2 HSC selector switch ON

3 HSC selector switch OFF and override pushbutton pressed

4 HSC selector switch ON and override pushbutton pressed

5 HSC selector switch OFF and 4th/Auto gear selected (1)

Component Key:

CN HSC Relay

DE HSC Selector Switch

DT(1) Diode

FJ(2) Diode

FL(1) Column Gear Lever Switch

NA Unloader Valve Solenoid (Loader valve block)

NF HSC Override Pushbutton (Loader lever)

(1) Powershift and Shiftmaster machines only.
(2) Powershift machines only.

Circuit Descriptions

Synchro Shuttle Machines

⇒ *Fig 99. (E-108)*. The schematic diagram shows 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.

The electrical circuit enables operation of the hydraulic speed control (HSC) in several different ways:

1 **HSC switch ON:** Moving the selector switch **DE** to the ON position, energises the unloader valve solenoid **NA** on the loader valve block, which in turn dumps the output flow from the secondary pump (P2) back to tank.

   Pressing the HSC pushbutton **NF** on the loader lever energises the HSC relay **CN**. The unloader valve solenoid **NA** then de-energises, which allows the additional flow available from the secondary pump (P2) into main hydraulic system, and supplement the flow from the main pump (P1) while the HSC pushbutton **NF** is `held' pressed.

2 **HSC switch OFF:** With the selector switch **DE** in the OFF position, HSC can be switched ON when the operator presses the HSC pushbutton **NF** on the loader lever.

   Current flows through the pushbutton **NF** and energises the HSC relay **CN**. The unloader valve solenoid **NA** then energises, which in turn dumps the output flow from the secondary pump (P2) back to tank while the HSC pushbutton **NF** is `held' pressed.

Component Key:

CN	HSC Relay
DE	HSC Selector Switch
NA	Unloader Valve Solenoid (Loader valve block)
NF	HSC Override Pushbutton (Loader lever)

Hydraulic Speed Control (HSC)

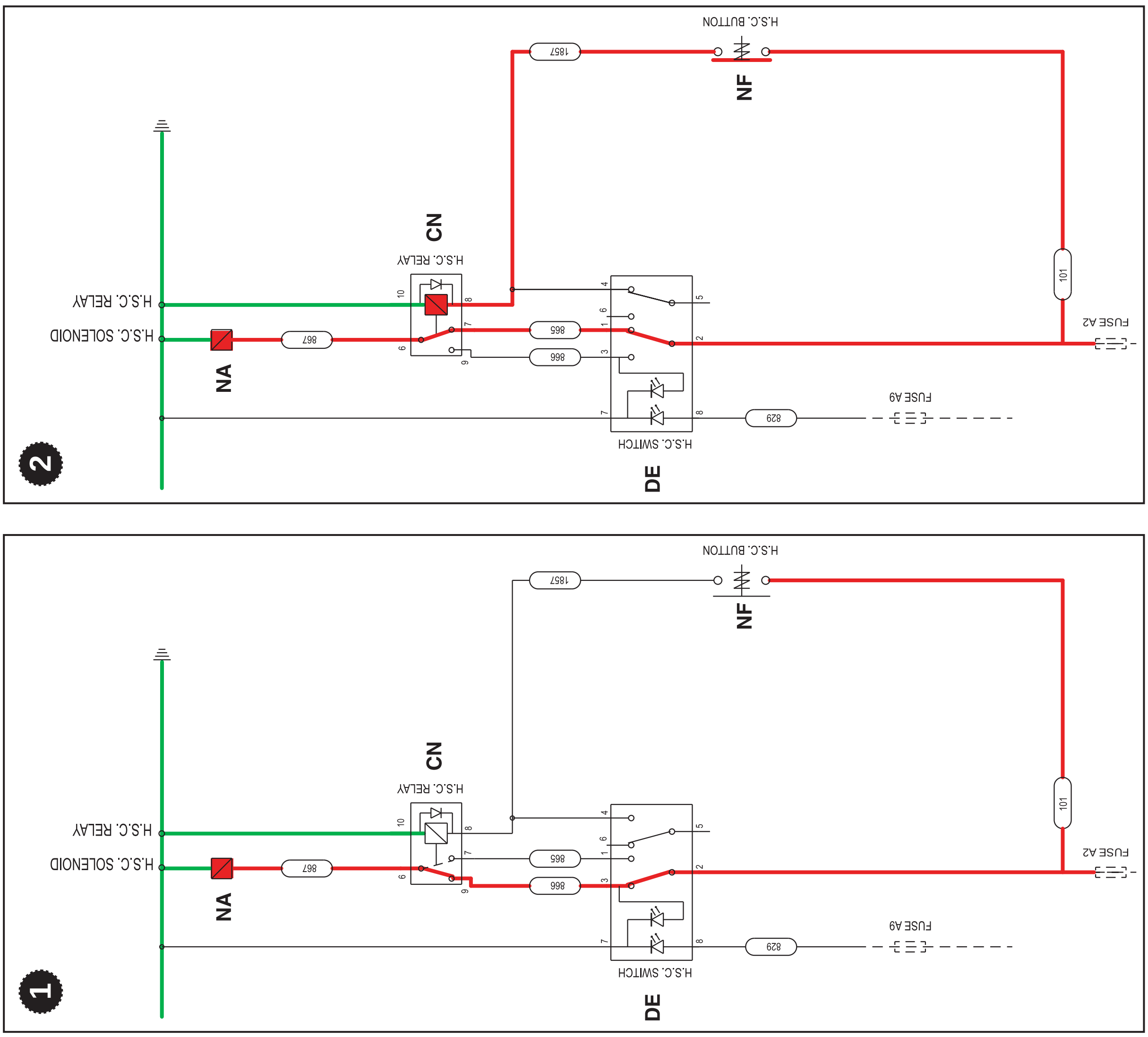


Fig 99. Schematic Diagram - Synchro Shuttle

Powershift Machines

⇨ *Fig 100. (E-110)*. The schematic diagram shows 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.

The electrical circuit enables operation of the hydraulic speed control (HSC) in several different ways:

1 **HSC switch ON:** Moving the selector switch **DE** to the ON position, energises the unloader valve solenoid **NA** on the loader valve block, which in turn dumps the output flow from the secondary pump (P2) back to tank.

   Pressing the HSC pushbutton **NF** on the loader lever energises the HSC relay **CN**. The unloader valve solenoid **NA** then de-energises, which allows the additional flow available from the secondary pump (P2) into main hydraulic system, and supplement the flow from the main pump (P1) while the HSC pushbutton **NF** is `held' pressed.

2 **HSC switch OFF and 4th/Auto gear selected:** With the selector switch **DE** in the OFF position, HSC is automatically switched ON when the operator selects 4th/Auto gear. Current flows from the 4th/Auto gear column switch **FL** and energises the HSC relay **CN**. The unloader valve solenoid **NA** then energises, which in turn dumps the output flow from the secondary pump (P2) back to tank.

   The column gear lever switch **FL** is selected to either `forward' or `reverse', so the HSC cut-out relay **FG** is de-energised. Pressing the HSC pushbutton **NF** has no effect on the circuit.

3 **HSC Cut-out Function:** With 4th/Auto gear selected, HSC is automatically switched OFF when the operator returns the column gear lever to `neutral'. Current flows from the column gear lever switch **FL** and energises the HSC cut-out relay **FG**. The HSC relay **CN** and unloader valve solenoid **NA** then de-energise, which allows the additional flow available to from the secondary pump (P2) into the hydraulic system, to supplement the flow from the main pump (P1).

Note: *The function of HSC cut-out relay* ***FG*** *is to automatically break the electrical feed to the HSC relay* ***CN*** *should the operator leave the gear column switch* ***FL*** *set to 4th gear (or Auto) with the machine stationary. This ensures that in this condition, there is the maximum flow available to achieve the best performance from the excavator (or loader lift) hydraulic services.*

Component Key:

CN	HSC Relay
DE	HSC Selector Switch
DT	Diode
FG	HSC Cut-out Relay
FJ(1)	Diode
FL6	Column Gear Lever Switch (Neutral)
FL13	Column Gear Lever Switch (4th/Auto gear)
NA	Unloader Valve Solenoid (Loader valve block)
NF	HSC Override Pushbutton (Loader lever)

(1) Not fitted on Shiftmaster machines.

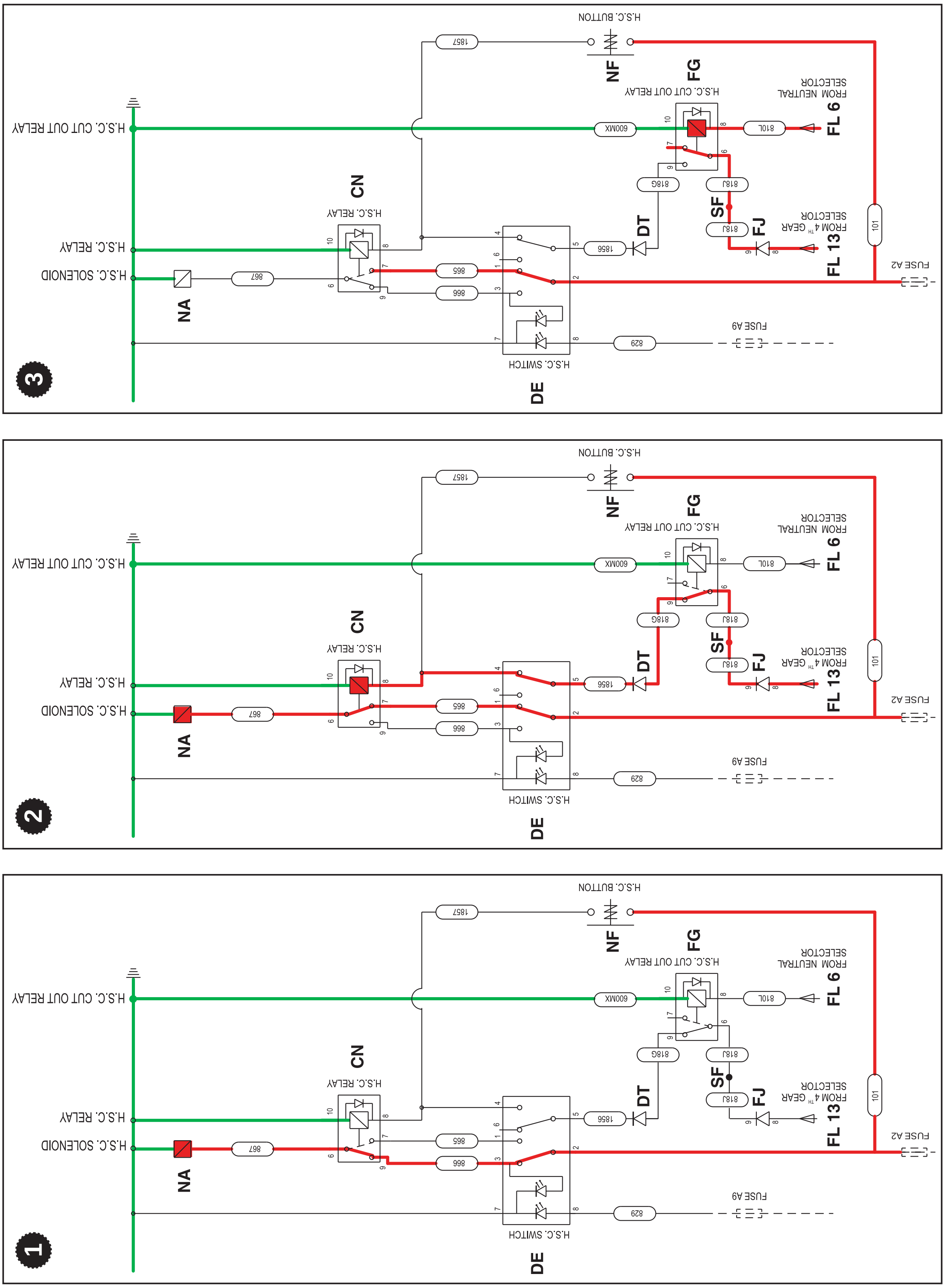


Fig 100. Schematic Diagram - Powershift

Wires and Connectors

Synchro Shuttle Machines

Components and connector locations ⇨ *Fig 101. (E-112)*.

Wires and connectors ⇨ *Fig 102. (E-113)*. On the electrical diagram the electrical connectors (example, CA to NH) are shown looking on the mating face of each connector when they are disconnected.

The circuit is shown with the HSC selector switch OFF.

Wires coloured red show the electrical live feeds. Note that the feed from fuse A9 is for switch illumination only. 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. For details of these connections see ***Section C, Machine Earth Connections***.

Component Key

The following key identifies the component connectors.

h1 Harness - Side Console
h2 Harness - Engine/Mainframe

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

Connectors (h1)

CA h1 - h2
CCA Fusebox A
CN HSC relay
DE HSC selector switch
DR Earth point
ET Diode
NF HSC override pushbutton (Loader lever)
X From auxiliary hydraulics switch

Connectors (h2)

MB1 Earth point
NA Unloader valve solenoid (Loader valve block)
NH h2 - h1

Splices (h1)

SB
SC
SH
SM

Splices (h2)

SA

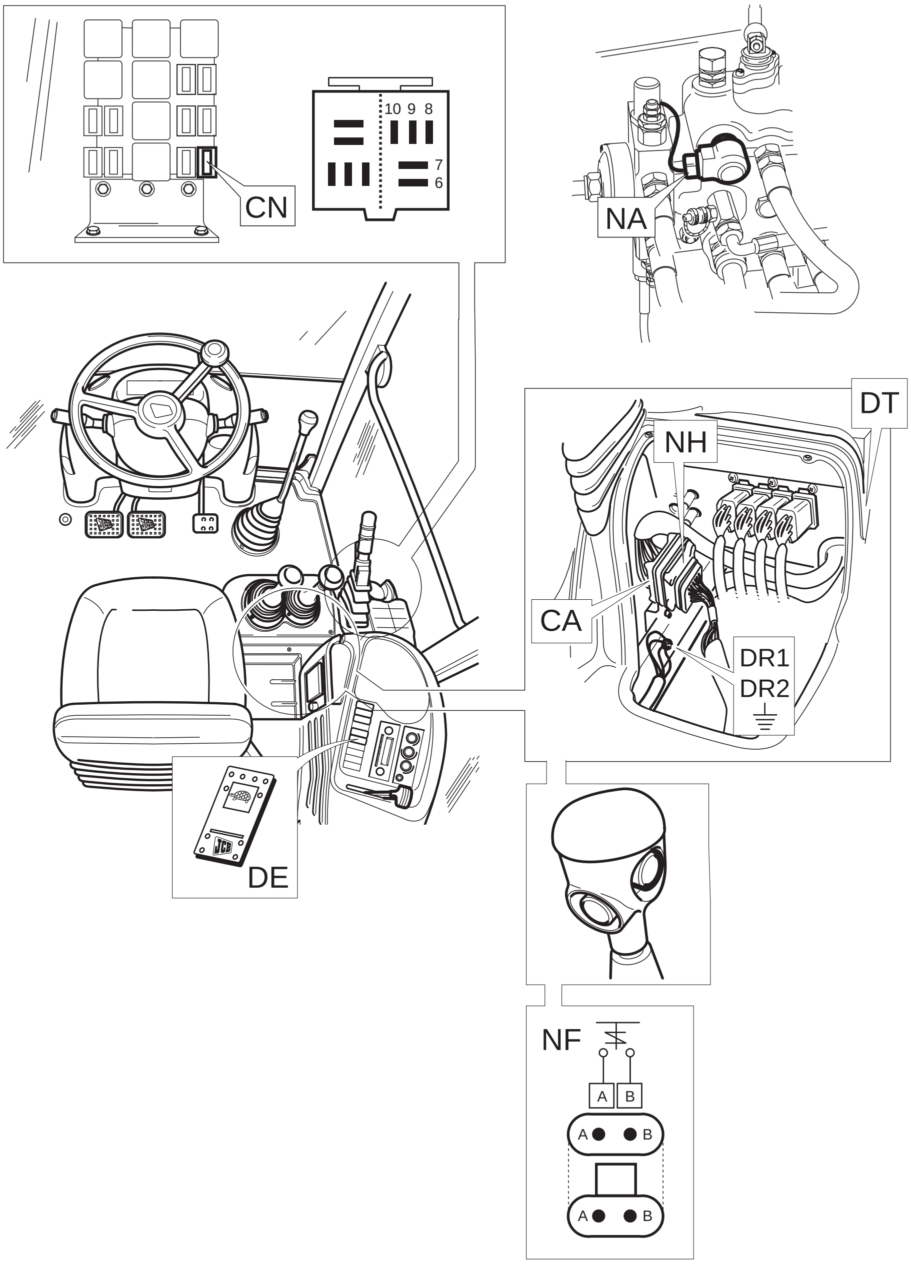


Fig 101. Connector Locations - Synchro Shuttle

⇨ Component Key (E-111)

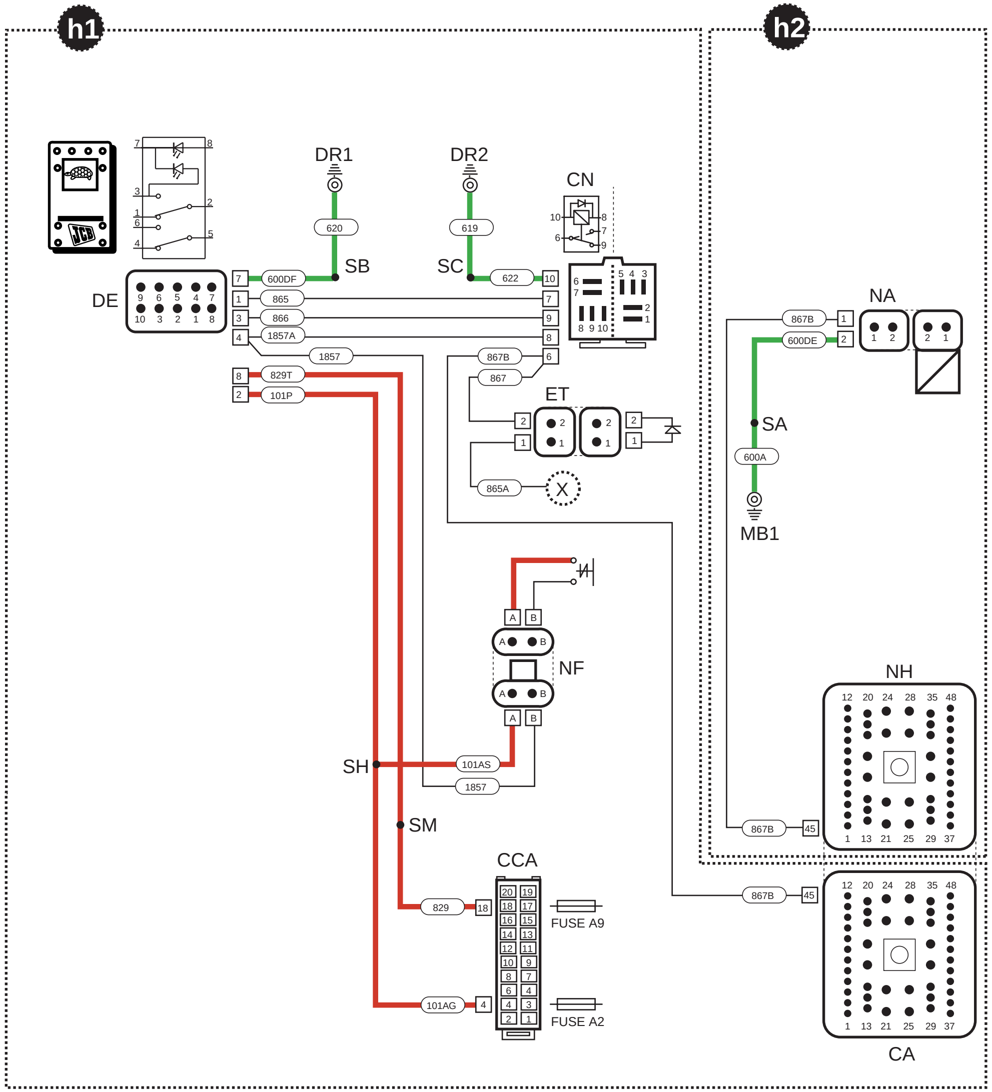


Fig 102. Wires and Connectors - Synchro Shuttle

⇒ Component Key (E-111)

Hydraulic Speed Control (HSC)

Powershift Machines

Components and connector locations ⇨ Fig 103. (E-115).

Wires and connectors ⇨ Fig 104. (E-116). On the electrical diagram the electrical connectors (example, FA to CB) are shown looking on the mating face of each connector when they are disconnected.

The circuit is shown with the HSC selector switch OFF.

Wires coloured red show the electrical live feeds. Note that the feed from fuse A9 is for switch illumination only. The wires coloured yellow show the feed when 4th/Auto is selected on the column lever. 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. For details of these connections see ***Section C, Machine Earth Connections***.

Component Key

The following key identifies the component connectors.

h1 Harness - Front Console
h2 Harness - Side Console
h3 Harness - Engine/Mainframe

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

Connectors (h1)

FA h1 - h2
FB1 Earth point
FG HSC cut-out relay
FL Column gear lever switch
FJ Diode

Connectors (h2)

CA h2 - h3
CB h2 - h1
CCA Fusebox A
CN HSC relay
DE HSC selector switch
DR Earth point
DT Diode
ET Diode
NF HSC override pushbutton (Loader lever)
X From auxiliary hydraulics switch
Y From immobiliser

Connectors (h3)

MB1 Earth point
NA Unloader valve solenoid (Loader valve block)
NH h3 - h2

Splices (h1)

SA
SF
SL
SX
SY

Splices (h2)

SB
SC
SH
SM

Splices (h3)

SA

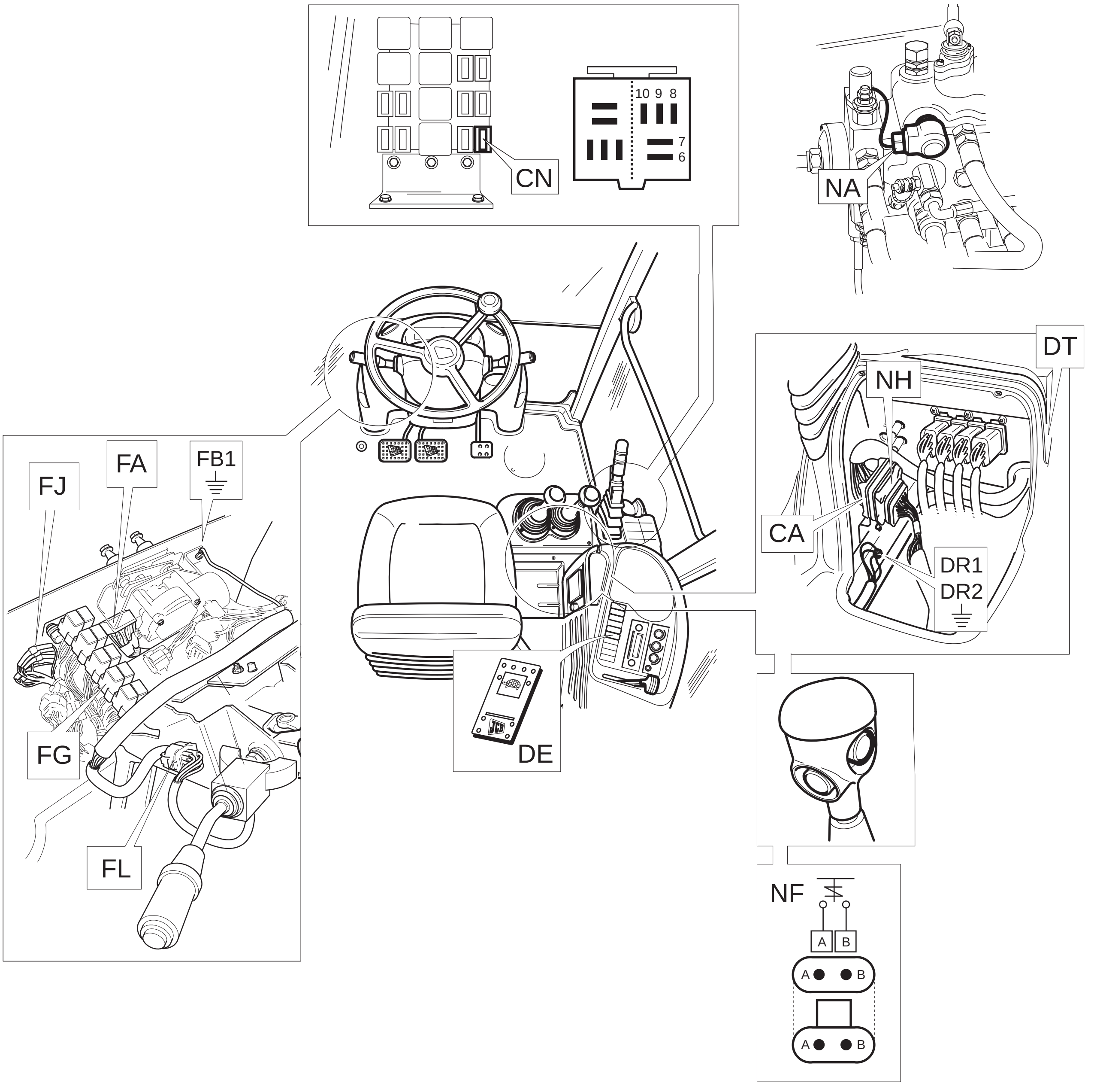


Fig 103. Connector Locations - Powershift

⇨ *Component Key (E-114)*

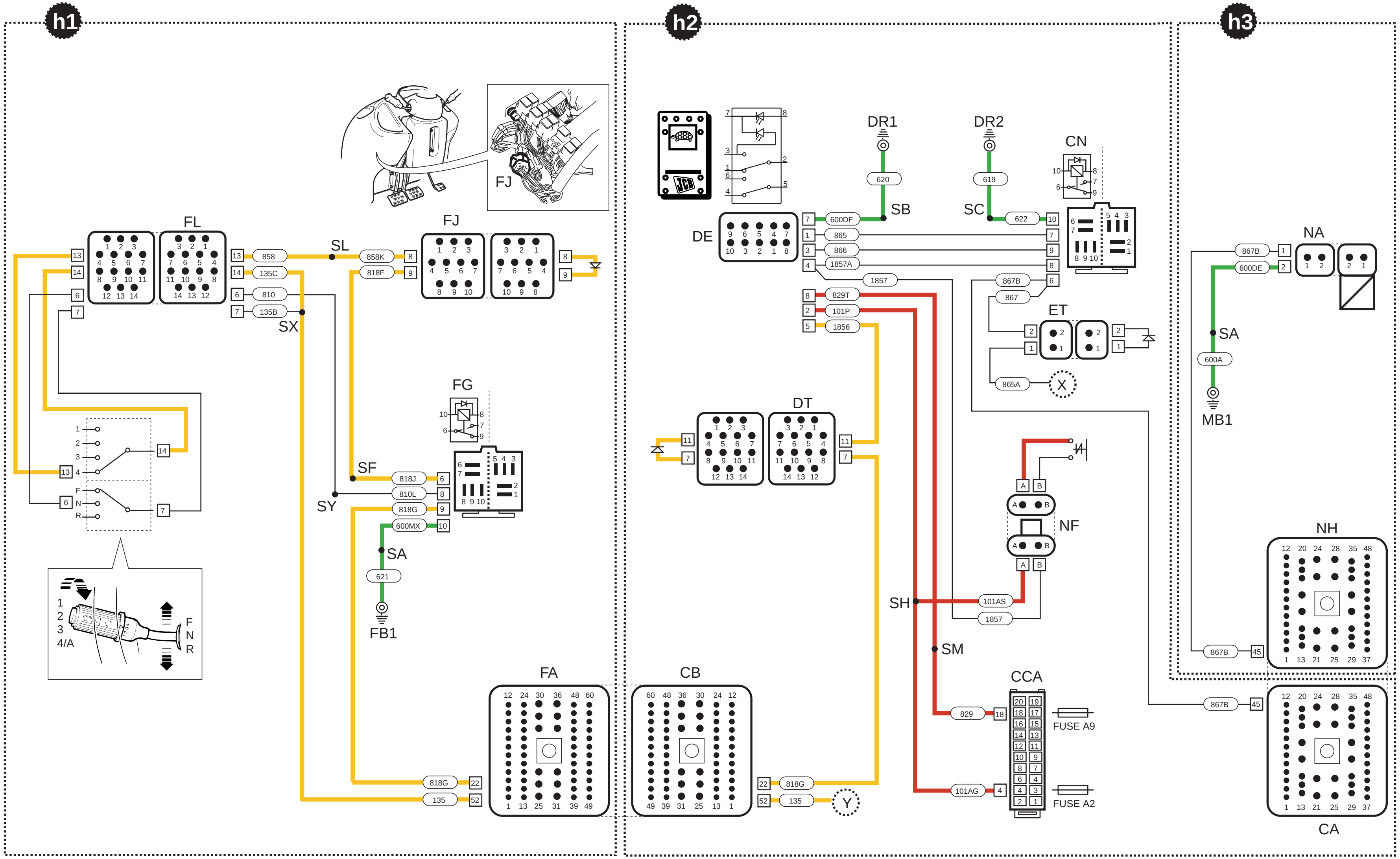


Fig 104. Wires and Connectors - Powershift

⇨ *Component Key (E-114)*

Fault Finding

Hydraulic System

Gearpump Machines

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 hydraulics 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	Lack of power in all hydraulic functions.	⇨ *Table 10.* (E-118).
2	All hydraulic rams slow to operate.	⇨ *Table 11.* (E-119).
3	One hydraulic service fails to operate or is slow to operate.	⇨ *Table 12.* (E-120).
4	The engine tends to stall when the hydraulics are under load.	⇨ *Table 13.* (E-121).
5	A spool is sticking.	⇨ *Table 14.* (E-122).
6	Leaking Oil Seal (Control Valves).	⇨ *Table 15.* (E-123).
7	Ram creep.	⇨ *Table 16.* (E-123).
8	Hydraulic oil becomes too hot.	⇨ *Table 17.* (E-123).

Table 10.

Fault	Probable Cause	Action
Lack of power in all hydraulic functions.	Insufficient hydraulic fluid.	Check for leaks and top up as required.
	Hydraulic leaks in system.	Check hoses, replace as required.
	Engine performance.	Check engine performance, see transmission section for stall speed test procedures.
	Main relief valve (MRV) setting incorrect.	Check and adjust as required.
	Low pump flow.	Check pump flow, if required service or replace pump.
	Hydraulic tank breather.	Clean or replace the breather.
	Tank filter by-pass valve.	Check condition of hydraulic filter.
	Unloader valve pressure setting too high.	Check pressure setting of the unloader valve.

Table 11.

Fault	Probable Cause	Action
All hydraulic rams slow to operate.	Neutral circuit or low pressure lines leaking, damaged, trapped or kinked.	Check pipe lines and replace as required.
	Low pump flow.	Check pump flow, if required service or replace pump.
	Main Relief Valve (MRV) setting incorrect.	Check and adjust as required.
	Unloader valve.	Check if unloader valve is sticking, i.e. dumping flow from pump section P2.
	Tank filter by-pass valve.	Check condition of hydraulic filter.
	Hydraulic tank Breather.	Clean or replace the breather.

Table 12.

Fault	Probable Cause	Action
One hydraulic service fails to operate or is slow to operate.	Associated service pipe lines leaking, damaged, trapped or kinked.	Check hoses, replace as required.
	Associated ram leaking.	Complete ram leakage check, replace seals as required.
	Auxiliary relief valve (ARV) setting incorrect.	Check and adjust as required.
	Associated valve block section leaking or not operating	Check for leaks, rectify as required. See also ***`Leaking Oil Seal (Control Valves)'***.
		Make sure that the associated load hold check valve is operating.
		Check that the control lever and associated linkage is operating the spool, rectify as required. See also ***`A Spool is Sticking'***.
	Check valve malfunctioning (if fitted), e.g. stabiliser circuit.	Test check valve, rectify as required.
	Hose burst protection valve malfunctioning (if fitted).	Test HBPV, service as required.
	Piston rod is bent.	Replace piston rod, check pressure settings of MRV and ARV.
		Check that associated pivot points are adequately greased.

Table 13.

Fault	Probable Cause	Action
The engine tends to stall when hydraulics are under load.	MRV setting incorrect.	Check and adjust as required.
	Poor engine performance.	Check engine performance, see transmission section for stall speed test procedure.
	Unloader valve pressure setting too high.	Check pressure setting of the unloader valve.

Table 14.

Fault	Probable Cause	Action
A spool is sticking.	Oil temperature abnormally high.	Check for correct fluid, see lubricants and capacities. Check oil cooler and grille for blockage.
	The hydraulic fluid is dirty.	Clean the tank strainer. If strainer badly clogged, drain and flush hydraulic system. Fill with clean hydraulic fluid.
	The service pipe connection is over tightened.	Check tightening torque.
	The valve housing was twisted during installation.	Loosen retaining bolts and tighten to correct torque figures.
	A control linkage is bent.	Disconnect the linkage. Repair the linkage if possible, or fit a new one.
	A spool is bent.	Dismantle the control valve. Renew spool as necessary.
	A return spring is broken.	Renew as necessary.
	A return spring or cap is out of alignment.	Remove the cap, check that the spring is in the correct position. Refit cap and torque tighten bolts.
	Temperature distribution within control valve not uniform.	Warm the entire system up before servicing.

Table 15.

Fault	Probable Cause	Action
Leaking Oil Seal (Control Valves)	Paint or dirt on the seal face.	Remove the seal and clean.
	The back pressure in the valve circuit is excessively high.	Check circuit pressures, adjust if possible. Otherwise investigate thoroughly.
	Spool damaged.	Dismantle. Inspect all parts. Renovate or renew as necessary.
	The seal is not secured.	Clean the seal and tighten the retaining bolts to the correct torque.
	The seal is cut or damaged.	Fit a new seal.

Table 16.

Fault	Probable Cause	Action
Ram creep.(1)	Associated ram or pipe lines from ram leaking.	Check and rectify as required.
	Check valve malfunctioning (if fitted), e.g. stabiliser circuit.	Test check valve, rectify as required.
	Associated valve section spools leaking.	Rectify, check for contamination.
	Associated ARV leaking	Rectify, check for contamination.

(1) Refer also to Service Procedures, Ram Creep Tests - All Services.

Table 17.

Fault	Probable Cause	Action
Hydraulic oil becomes too hot.	Oil cooler obstructed.	Remove debris from cooler fins.
	Restriction in neutral circuit lines.	Check hoses, replace as necessary.
	Hydraulic filter clogged and by-pass valve not working.	Change hydraulic filter.

Variable Flow Machines

This section details the possible faults that may be found with the loader and backhoe valve blocks. The faults listed only appertain to valve blocks fitted on variable flow hydraulic machine systems (Rexroth valves).

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	High or low system pressure.	⇒ Table 18. (E-125).
2	Pump stays at high pressure.	⇒ Table 18. (E-125).
3	Pressure or flow obtained at one port only.	⇒ Table 18. (E-125).
4	No pressure or flow at either port.	⇒ Table 18. (E-125).
5	High work port leakage.	⇒ Table 18. (E-125).
6	Leaks between sections.	⇒ Table 18. (E-125).
7	Sticking spool.	⇒ Table 18. (E-125).
8	Mechanical detent will not hold.	⇒ Table 18. (E-125).
9	Electrical detent will not hold.	⇒ Table 18. (E-125).
10	Poor performance, slow operating speed and or low maximum stall speed.	⇒ Table 18. (E-125).

Table 18.

	Fault	Probable Cause	Action
1	High or Low system pressure.	Wrong pressure and or flow regulator valve settings. Loss of pilot signal due to shuttle failure.	Readjust regulator valves. Operate individual services to determine which shuttle is at fault, refer to ***Service Procedures, Variable Flow Pumps, Shuttle Valve Signal Network - Testing***.
2	Pump stays at high pressure.	Sticking main spool. Sticking compensator spool.	See `7 Sticking spool' guide. Remove and clean compensator spool.
3	Can only obtain pressure or flow at one port.	Dirt in primary shuttle or damaged o-ring.	Remove and clean shuttle, inspect o-ring and replace if required.
4	No pressure or flow at either port.	Dirt in secondary shuttle.	Shift one spool at a time with blocked ports until faulty section found, remove shuttle and clean, inspect o-ring and replace if required.
5	High work port leakage.	Spool not centered. Dirt in port relief valve.	Check centring springs. Remove and clean relief valve.
6	Leaks between sections.	Missing or cut seals.	Disassemble valve stack and check for missing or cut o-rings. Replace as necessary.
7	Sticking spool.	Linkage binding. Damaged spool. Uneven torque of tie-rod. Incorrect number of shims on tie-rod.	Check linkage. Remove and inspect spool. Replace as necessary. Loosen tie-rod bolts, check and re-torque. Disassemble and check that each tie-rod has one shim.
8	Mechanical detent will not hold.	Broken detent shaft.	Remove detent and inspect. Replace as necessary.
9	Electrical detent will not hold.	Current broken.	Check current going into detent. Repair fault.
10	Poor performance, slow operating speed and or low maximum stall speed.	Blocked flow regulator valve.	Flow check, remove and clean flow regulator valve, refer to ***Service Procedures, Variable Flow Pumps - Regulator Valve Adjustment***.

Smooth Ride System (SRS) - if fitted

Table 19.

	Fault	Probable Cause	Action
1	Unable to power down loader arms with SRS switched OFF.	Rod side solenoid valve faulty. (Valve remains open)	Check, clean, renew solenoid valve as applicable.
2	Springy loader arm lift with SRS switched OFF.	Head side solenoid valve faulty. (Valve remains open)	Check solenoids are not energised. If they are, check the electrical circuit.
3	Restricted loader arm suspension movement when SRS switched ON.	Rod side solenoid valve faulty. (Valve remains closed)	Check, clean, renew solenoid valve as applicable.
4	No suspension when SRS switched ON.	Head side solenoid valve faulty. (Valve remains closed)	Check, renew solenoid coil.
		Hose Burst Protection Valve (HBPV) solenoid valve faulty. (Valve remains closed)	Inspect all relevant wiring for damage and test for open or short circuits. Repair as applicable. Refer to ***Section C, Basic System Operation, Circuit Schematics - Options.***
			Check fuses and replace as required.
		Accumulator gas pressure low. (Leak across accumulator piston)	Recharge accumulator, refer to ***Service Procedures, Smooth Ride System - Charging and Discharging the Accumulator***.
		Oil in gas side of accumulator. (Leak across accumulator piston)	Renew seals in accumulator or renew accumulator as applicable, refer to ***Smooth Ride System, Accumulator - Removal and Replacement.***

Machines with HBPV option, refer to ***Smooth Ride System - with Hose Burst Protection Valves (HBPV) Option***.

Note: *It is normal for the loader arms to lift or lower slightly, when SRS is switched ON.*

Service Procedures

Hydraulic Contamination

TE-002_3

Hydraulic Fluid Quality

This machine uses a large volume of fluid in the hydraulic system for power transmission, equipment lubrication, rust prevention and sealing. According to a survey conducted by a pump manufacturer, seventy per cent of the causes of problems in hydraulic equipment were attributable to inadequate maintenance of the quality of the hydraulic fluid. Therefore, it is obvious that control of the quality of the hydraulic fluid helps prevent hydraulic equipment problems and greatly improves safety and reliability. Furthermore from an economic angle it extends the life of the hydraulic fluid if quality is maintained.

Effects of Contamination

Once inside the system, hydraulic circuit contaminants greatly effect the performance and life of hydraulic equipment. For example, contaminants in a hydraulic pump develop internal wear to cause internal leakage and hence lower discharges. Wear particles generated will circulate with the hydraulic fluid to cause further deterioration in the performance of this and other equipment. Contaminants also enter principal sliding sections of the equipment causing temporary malfunction, scuffing, sticking and leakage and can lead to major problems.The main contaminants can be classified as follows:

1 **Solid Particles** - sand, fibres, metallic particles, welding scale, sealing materials and wear particles etc.

2 **Liquid** - usually water and incompatible oils and greases.

3 **Gases** - Air, sulphur dioxide etc. which can create corrosive compounds if dissolved in the fluid.

These contaminants can appear during manufacture, assembly and operation.

Cleaning Operation

The purpose of cleaning oil is to remove contaminants of all types and sludge by filtering hydraulic fluid through a cleaning unit. ⇨ *Fig 105. (E-127)*. General Bulletin 011 also refers.

Procedure

Connect the cleaning unit in place of the hydraulic filter. ⇨ *Fig 105. (E-127)*. Run the system for sufficient time to pump all the hydraulic fluid through the unit. Disconnect the cleaning unit and reconnect the filter. Top up the system with clean hydraulic fluid as required.

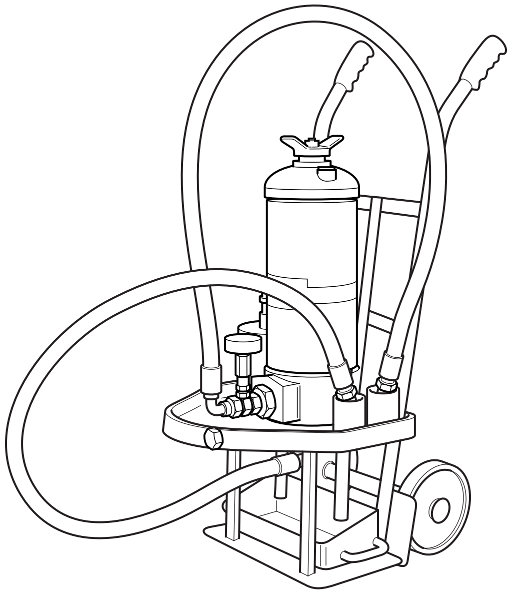


Fig 105. Cleaning Unit

Contaminant Standards

Dirt that damages your system is in many cases too small to be seen with the eye. The particle size is measured in microns.

1 micron = 0.001 mm (0.0000394 in).

Listed below are a few typical comparisons:

– Red Blood Cell = 8 microns (0.008 mm, 0.000315 in)
– Human Hair = 70 microns (0.07 mm, 0.00275 in)
– Grain of Salt = 100 microns (0.1 mm, 0.00394 in)

Smallest particle visible to the naked eye is 40 microns (0.00157) approximately.

Standards will often be quoted to ISO (International Standards Organisation) for which literature can be obtained.

Filters

The filter assembly fitted to all product ranges is designed to filter all the contamination that is generated through use to the required level of cleanliness. The filter must be serviced to the requirements of the machine Service Schedules.

To ensure optimum performance and reliability it is important that the machines hydraulic system is serviced periodically in accordance with the manufacturers requirements.

Gearpump

Flow and Pressure Testing

See ⇒ *Fig 106. (E-130)* and ⇒ *Fig 107. (E-130)*.

Before removing the pump it is necessary to determine the source of any problem by measuring the output flow at system pressure from both of the pump outlet ports.

To check flow it is necessary to fit flow meter **A** into the output line of each pump section in turn. If available, load valve **B** (service tool 892/00270) should also be installed (see **Note 1**). Make sure the flow meter is installed with its arrow pointing away from the pump and, if applicable, located between the pump and the load valve.

Note: *1) If no load valve is available, ignore the references to the load valve in Fitting and Removing a Flow Meter and Load Valve below. An alternative method of determining flow is included in the Checking Flow procedures following.*

Fitting and Removing a Flow Meter and Load Valve

Before fitting or removing a flow meter and load valve, switch off the machine and operate the loader and excavator controls a few times to vent system pressure.

⚠ 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.

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⚠ WARNING

Take care when disconnecting hydraulic hoses and fittings as the oil will be HOT.

TRANS-1-2

Fitting

1 **Pump section 1** - disconnect hose **C** from the pump. Fit the flow meter and load valve (see **Note 2**) between hose **C** and the pump.

2 **Pump section 2** - disconnect hose **D** from the pump. Fit the flow meter and load valve (see **Note 2**) between hose **D** and the pump.

Note: *2) Make sure the load valve is in the open position, i.e. with the adjusting knob screwed fully out, before carrying out the Checking Flow procedure.*

Removing

Removing is the reverse of fitting.

Checking the Pump Flow

1 Check the setting of the Main Relief Valve (MRV) as described in ***Loader Valve, Pressure Testing***. Adjust if necessary.

2

a **Using a load valve** - fit a flow meter and load valve, as described in Fitting, to each pump outlet in turn. Fit a 0-400 bar (0-6000 lbf/in^2) pressure gauge to the load valve pressure test connector.

b **If no load valve is available** - fit a flow meter, as described in Fitting, to each pump output in turn.

3 Start the engine and bring the hydraulics up to working temperature 50ºC (122ºF). Set the engine speed to 2200 rpm.

4

a **Using a load valve** - adjust the load valve so that the pressure gauge reading is just below the MRV setting.

b **If no load valve is available** - raise or lower the loader arms until the rams are fully open or closed. Continue to operate the raise or lower control so that system pressure builds up. Watch the flow meter and note its reading at the moment the MRV operates.

5 The flow reading should be as listed in ***Technical Data.***

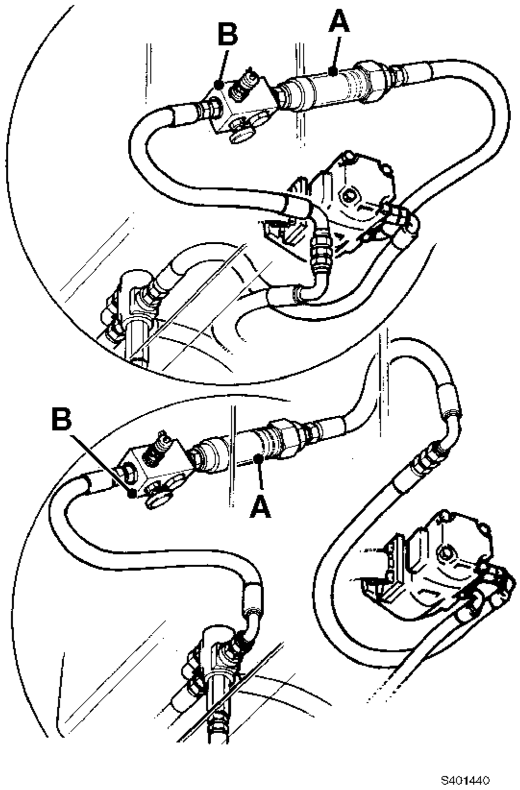


Fig 106.

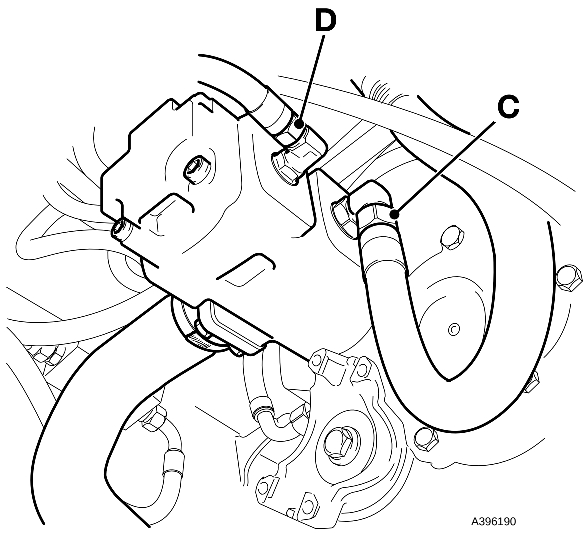


Fig 107.

Variable Flow Pump

Flow and Pressure Testing

Load Sensing Pressure

⇨ *Fig 109. (E-133)*.

With no services operating, there should be no pressure in the load sense line, this is because hydraulic oil flows through the load sense circuit back to the hydraulic tank. If a shuttle valve is `stuck', or a hose kinked, then a pressure could be induced in the load sense lines, this will have an effect on the hydraulic system. To check load sense pressure:

1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):

  a Set the engine speed to 2200 rev/min.

  b Operate the loader shovel dump service to blow off the auxiliary relief valve.

2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

3 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to pressure test connector **A** located on the load sense line from the loader valve.

4 Start the engine and run at 2200 rev/min.

5 Do not move the steering wheel and make sure that all control levers remain in `neutral' position.

6 Check the pressure gauge reading, which should be as specified in ***Technical Data.***

7 If the pressure is higher than specified, first move the steering wheel and then any of the service levers. If this does not reduce the pressure, physically check the load sense lines for trapping or kinking. As a last resort, the service valves may have to be removed and checked for sticking shuttle valves. However, this should not be done until all other checks have been completed.

8 Machines with the load sense pressure relief valve: Adjust the load sense pressure relief valve **E**. Machines without a load sense pressure relief valve adjust the regulator valve.

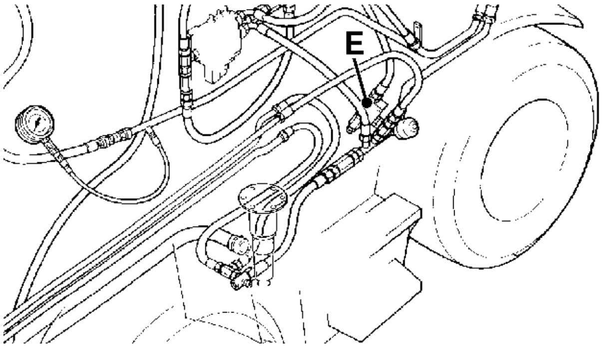


Fig 108.

Standby Pressure

⇨ *Fig 109. (E-133)*.

With the engine switched off, the pump swashplate is spring loaded to the full flow position. On engine start up standby pressure moves the swash plate to minimum flow position (see ***descriptions***). To check standby pressure:

1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):

- **a** Set the engine speed to 2200 rev/min.
- **b** Operate the loader shovel dump service to blow off the auxiliary relief valve.

2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

3 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to pressure test connector **B** located on the pump pressure out line.

4 Start the engine and run at 2200 rev/min.

5 Do not move the steering wheel and make sure that all control levers remain in `neutral' position.

6 Check the pressure gauge reading, which should be as specified in ***Technical Data***.

7 If the pressure is not as specified, do not make any adjustments at this stage. Complete the other checks detailed in this section.

8 Refer to ⇨ *Regulator Valve Adjustment (E-137)*.

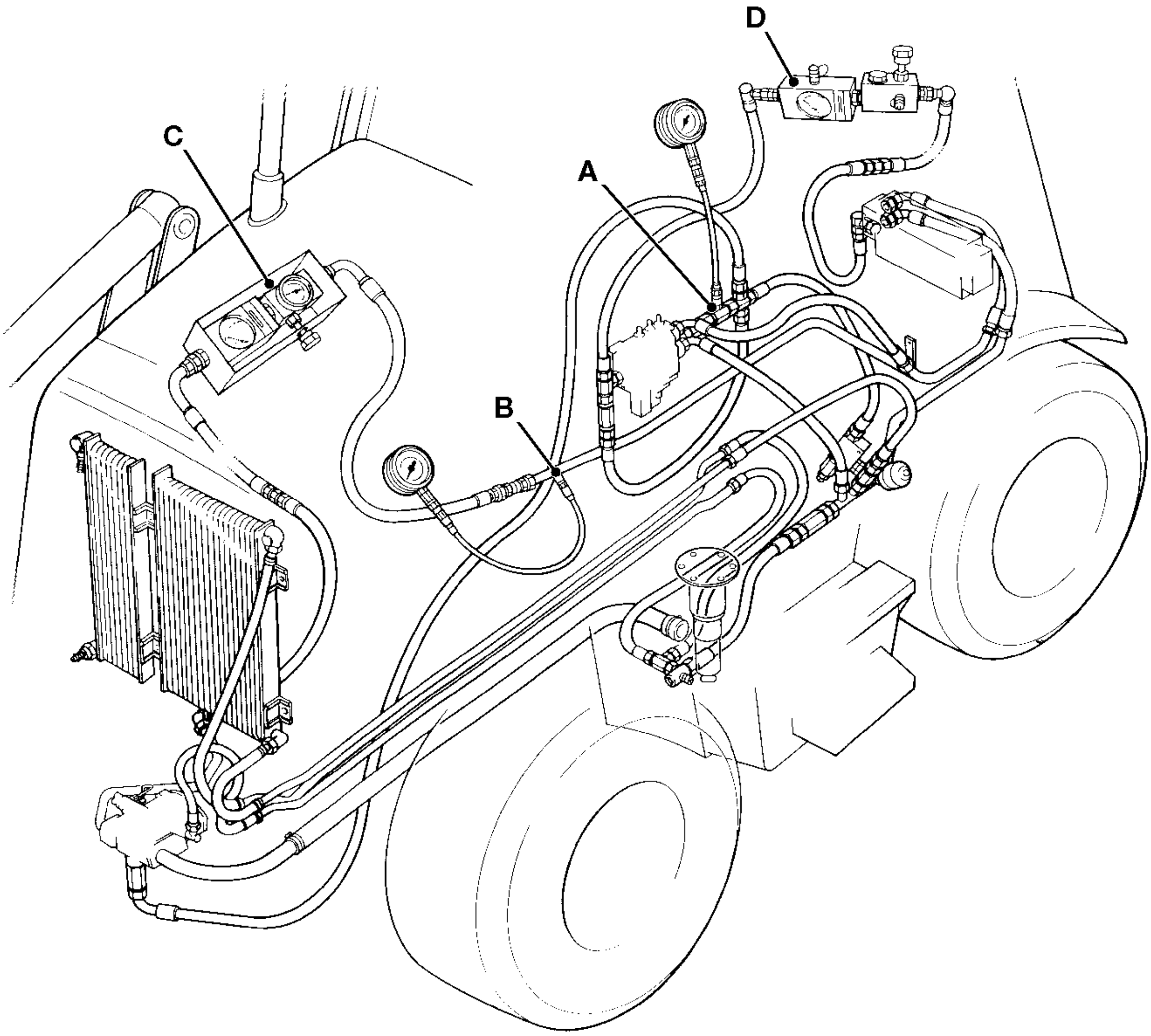


Fig 109. Flow and Pressure Testing

Maximum Hydraulic Stall

⇨ Fig 110. (E-136).

With variable flow hydraulics the pump swashplate angle will increase or decrease according to pressure demand. However in situations of maximum hydraulic stall, i.e. ram full travel, the pressure in the circuit will achieve the setting of the pressure regulator spool. To check the setting:

Note: *Machines with a load sense relief valve, disconnect and blank the load sense relief valve* ***E*** *at* ***F****.*

1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):

- **a** Set the engine speed to 2200 rev/min.
- **b** Operate the loader shovel dump service to blow off the auxiliary relief valve.

2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

3 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to pressure test connector **B** located on the pump pressure out line.

4 Start the engine and run at 2200 rev/min.

5 Raise the loader arms to achieve full travel, hold the arms in this position and note the gauge reading, which should be as specified in ***Technical Data***.

6 If the pressure is higher than specified, the pressure compensator spool may be set incorrectly or the swashplate may not be moving. If the pump pressure is lower than specified, the flow spool may be set incorrectly, or there may be a leak in the load sense line. Do not make any adjustments at this stage. Complete the other checks detailed in this section.

7 Refer to ⇨ Regulator Valve Adjustment (E-137).

Pump Flow

⇨ Fig 110. (E-136).

It is not possible to test full pump flow at system pressure whilst the pump is installed on the machine. This is because the pump swashplate angle will return to minimum angle (zero flow) when the system reaches full pressure (see ***descriptions***).

However, it is possible to test the pump flow whilst `blowing off' an auxiliary relief valve which is set lower than system pressure. In the example below, the shovel head side A.R.V. is used. The readings taken in this test give a `snapshot' of pump performance and can be used to establish if major pump maintenance is required.

1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):

- **a** Set the engine speed to 2200 rev/min.
- **b** Operate the loader shovel dump service to blow off the auxiliary relief valve.

2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

3 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to pressure test connector **B** located on the pump pressure out line.

4 Connect a flowmeter to the pump pressure out line as shown at **C**.

5 Start the engine and run at 2200 rev/min.

6 Raise the loader arms and fully dump the loader shovel.

7 Hold the shovel in the dump position (to blow off the A.R.V.) and check the flow and pressure gauge readings, which should be as specified in ***Technical Data.***

8 If the pump flow is not as indicated, do not make any adjustments at this stage. Complete the other checks detailed in this section.

9 Refer to ⇨ Regulator Valve Adjustment (E-137).

Load Sense Line Flow

⇨ *Fig 110. (E-136)*.

The load sense line communicates the load pressure required at a service to the pump. If there is a blockage or leak in the line, the hydraulic system will not operate effectively.

Load sensing is a `dynamic flow' type. That is, there is a constant flow of oil from the pump to the shuttle valves. When a pressure signal is felt at the service port, the flow is interrupted and the pump immediately responds to the demand. (Unlike a `static' system where the pressure signal must move from the valve block, back up the load sense line to the pump).

1 Warm the hydraulic oil to working temperature, i.e. 50°C (122°F):

- **a** Set the engine speed to 2200 rev/min.
- **b** Operate the loader shovel dump service to blow off the auxiliary relief valve.

2 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

3 Connect a flowmeter into the load sense line, a good access point is where the LS line enters the backhoe valve as shown at **D**.

4 Start the engine and run at 2200 rev/min. Check the flow which should be as specified in ***Technical Data***.

5 If a service is selected, the flow should drop to zero (but the pressure will increase).

6 If there is no flow in the system, then check the load sense lines for being trapped or kinked, also move the service control levers and the steering wheel. If there is still no flow, then there is the possibility of a shuttle valve being stuck. Do not dismantle valves at this stage but complete all other tests listed in this section.

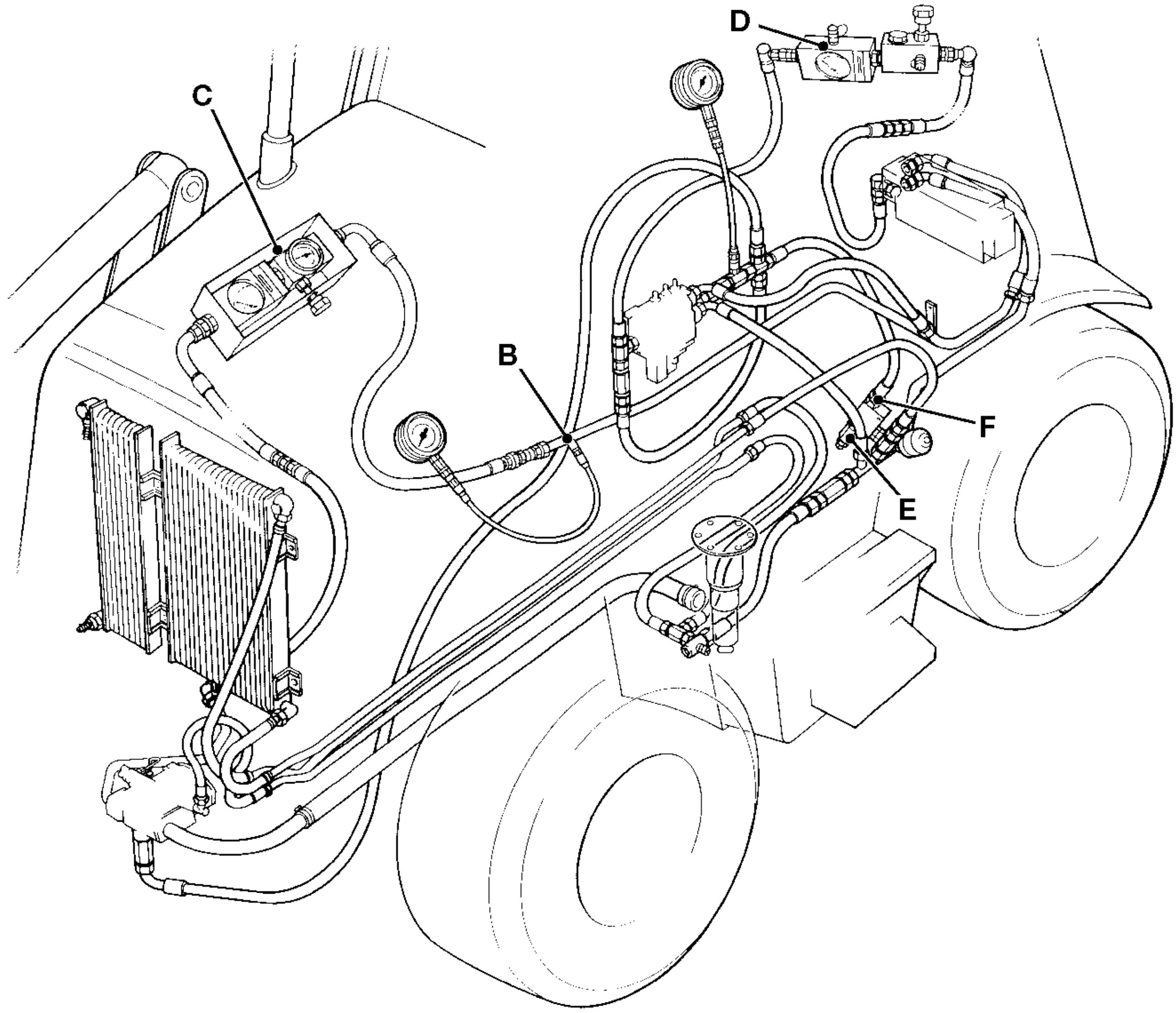


Fig 110. Flow and Pressure Testing

Regulator Valve Adjustment

Note: *If a new regulator valve is fitted, or a valve stripped, cleaned and rebuilt, then the pressure spool should be backed off to a low pressure. This will prevent inadvertent damage to the pump.*

Flow Regulator Spool

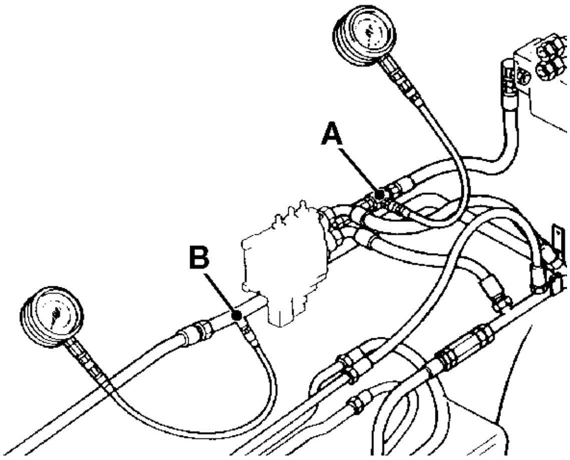


Fig 111.

The pressure in the pump out line (pressure test connector **B**) should be 20 bar (290 lbf/in^2) greater than the pressure in the load sense line (pressure test connector **A**). If not adjust the regulator flow spool as described below:

1 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

2 Gain access to the regulator valve assembly (mounted on the pump).

3 Remove cap **C** and loosen locknut **D**.

4 Turn adjusting screw **E** clockwise to increase pressure setting and anti-clockwise to decrease setting.

5 Repeat pressure test as detailed previously and establish valve is set correctly.

6 Tighten locknut, refit cap.

Pressure Regulator Spool

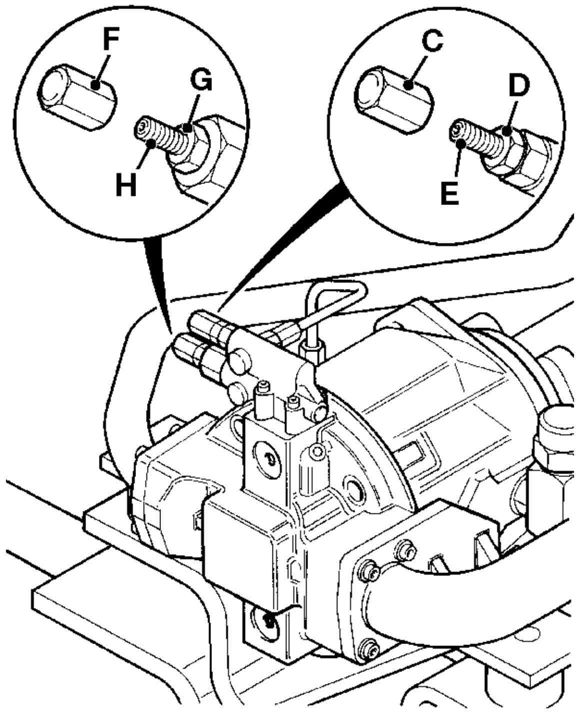


Fig 112.

As previously explained, there is no `main relief valve' to control the system pressure (the pump swashplate angle will increase or decrease according to pressure demand). However in situations of maximum hydraulic stall, i.e. ram full travel, the pressure in the circuit will achieve the setting of the pressure regulator spool. To adjust the setting:

1 Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

2 Gain access to the regulator valve assembly (mounted on the pump).

3 Remove cap **F** and loosen locknut **G**.

4 Turn adjusting screw **H** clockwise to increase pressure setting and anti-clockwise to decrease setting.

5 Repeat pressure test as detailed previously and establish valve is set correctly.

6 Tighten locknut, refit cap.

The load sense system is a dynamic type, which means a small flow (0.22 to 1.1 gall; 1 to 5 litre per minute) is circulated through the load sense line.

The flow is available due to a 0.02 in (0.6 mm) orifice in the flow regulator spool in the pump control housing. This orifice can be blocked or partially restricted which will give poor performance, slow operating speed and or low maximum stall speed. If completely blocked, margin pressure and standby pressure can be difficult to adjust and the loader services may operate intermittently even though the excavator operates correctly.

If any of the above symptoms are experienced carry out the following:

1 Lower the backhoe bucket and loader shovel to rest on the ground. Stop the engine and remove the starter key.

2 Gain access to the regulator valve assembly.

3 Disconnect the load sense line at **A**. Attach a 0.25 inch (6.35 mm) hose to pump of suitable length to route to a measuring container.

4 Start the engine and measure the flow which should be at least 0.22 gall (1 litre per minute) at 2200 RPM.

5 If the flow is below 0.22gall (1 litre per minute), remove spool **B** and clean or unblock orifice **C** as required.

6 Fit spool **B** and check the flow as described at step 3 and 4.

7 If the flow is within limits check the standby pressure. Refer to ***Flow and Pressure Testing***.

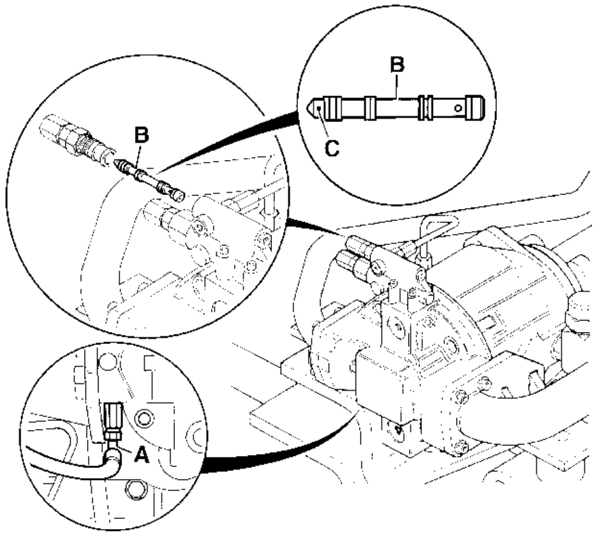


Fig 113.

Renewing Drive Shaft Seal

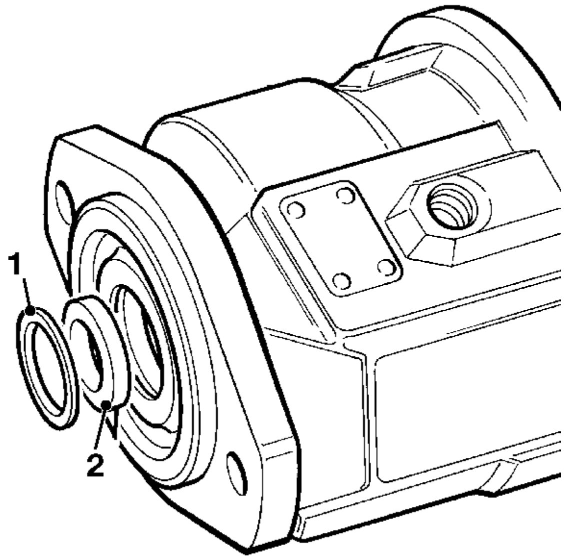


Fig 114.

Note: *The following procedure describes renewal of the shaft seal. However this is not the normal sequence, the sealing ring would normally be assembled with the taper roller bearing from inside the pump to ensure a secure sealing condition. If the shaft seal is to be renewed in this manner, it is extremely important not to scratch or damage the shaft, otherwise leakage will occur.*

1 Remove retaining ring **1** and use a special rounded tool such as a ground screwdriver to remove the drive shaft sealing ring **2**.

2 Examine the seal running area (driveshaft and housing) for wear or damage. Damage in these areas will require the pump to be further dismantled.

3 Lubricate the new seal with JCB Special MPL Moly Grease.

4 Install the new seal, it is advisable to use a tube or similar located over the driveshaft to ensure the seal enters the housing evenly. DO NOT push the seal too far into the housing. If the shaft seal touches the bearing, the seal will be damaged.

5 Assemble the retaining ring **1**.

Shuttle Valve Signal Network - Testing

The shuttle network can be easily checked. Start the engine and operate the hydraulic system until the oil is at working temperature.

With the engine at 1500 revs/min operate each service in the following order:

1 Bucket
2 Dipper
3 Right Stabiliser
4 Left Stabiliser
5 Boom
6 Slew
7 Extradig
8 Lift
9 Shovel
10 Auxiliary
11 Steering

Note: *If your machine is not equipped with these valve sections, start with the furthest section from the pump and work back to the nearest section.*

If one valve section function either fails to work or is slow to work in either one or both directions, the primary shuttle in that section may be at fault.

If two or more valve sections next to each other fail to operate correctly, check the secondary shuttles. To check the secondary shuttle operate each service in sequence, the last correctly functioning service nearest the pump may have a secondary shuttle in that section at fault.

When a shuttle is suspected of malfunctioning, do the following check:

Stall any control valve that is near the pump than the suspected control valve. This should stall the entire system. While at stall operate the malfunctioning valve section, if the section operates correctly the shuttle in question is at fault.

If section still malfunctions the shuttle is NOT at fault.

Shuttles may be removed, check the seals and the shuttle ball. Clean and refit or fit a new shuttle as required.

Loader Valve - Pressure Testing

Main Relief Valve (MRV)

Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

1 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to pressure test connector **A** on the loader valve, (refer to ***Service Tools***).

2 With the engine running at 1500 revs/min, check M.R.V. pressure by raising or lowering the loader arms until the rams are fully open or closed and noting the maximum gauge reading. **CAUTION**: Do not select 'float'. The maximum pressure should be as stated in ***Technical Data***.

Note: *The rams must be 'held' open or closed when reading gauge.*

3 If the pressure is incorrect, loosen locknut **D** and adjust screw **C**. Turn it clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut and check the pressure again. Adjust as required.

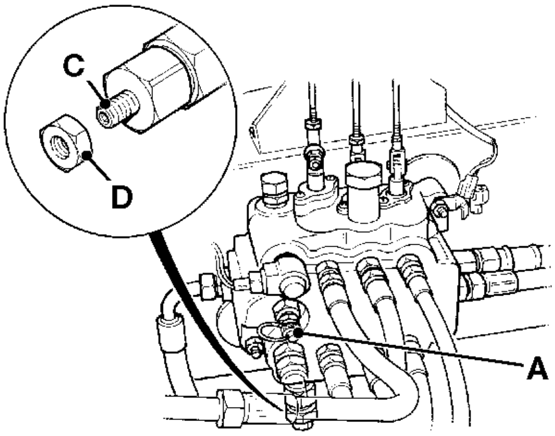


Fig 115.

Unloader Valve

Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

Make sure that the `hydraulic speed control' and `smooth ride system' facilities are NOT switched on, otherwise the correct unloader valve pressure cannot be obtained.

If the machine has a front-mounted roadbreaker, ensure that the roadbreaker control valve lever is in the 'off' position (lever down), otherwise the roadbreaker relief valve will operate and prevent unloader valve pressure from being reached.

1 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to pressure test connector **A**.

2 With the engine running at 1500 revs/min, slowly operate arms raise or lower.

Note: *The arms raise or lower service is specified because it has no auxiliary relief valve (A.R.V.). Selecting this service ensures that the pressure vents through the M.R.V. and not an A.R.V.*

3 When the service reaches full travel, return the lever to the neutral position. Select the service again, very slowly, the pressure gauge will rise until a step or kick is seen in the rate of change in the pressure increase. This is the start of unloader operation. Keep selecting the service until a sudden sharp increase in pressure is observed with a change of engine sound, this point is the unloader setting and should be as specified in ***Technical Data***.

4 If the pressure is incorrect, slacken locknut **E** and adjust cap **F**. Turn it clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut and check the pressure again. Adjust as required. If the correct pressure cannot be achieved, add or subtract shims as required, refer to ***Loader Valve - Fixed Flow, Dismantling and Assembly - Unloader Valve***.

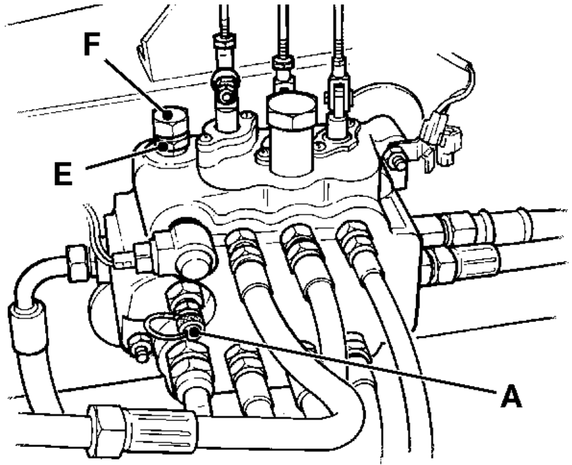


Fig 116.

Hydraulic Speed Control (HSC)

The following procedure can be used to establish if the hydraulic speed control facility is working correctly.

Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the backhoe bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

1 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to the hydraulic test point **A** at the loader valve as shown.

2 With the engine running at 1500 revs/min, slowly operate arms raise, the pressure should be approximately 138 bar (2000 lbf/in^2).

3 Make sure that the HSC rocker switch (mounted on the console) is in the OFF position. Raise the arms slowly and select the rocker switch to ON, the arms should raise slower.

4 Make sure that the HSC rocker switch (mounted on the console) is in the OFF position. Raise the arms slowly and press the button on the loader control knob, the arms should raise slower.

5 If the loader arms fail to respond, then check the HSC hydraulic and electrical circuits for any faults.

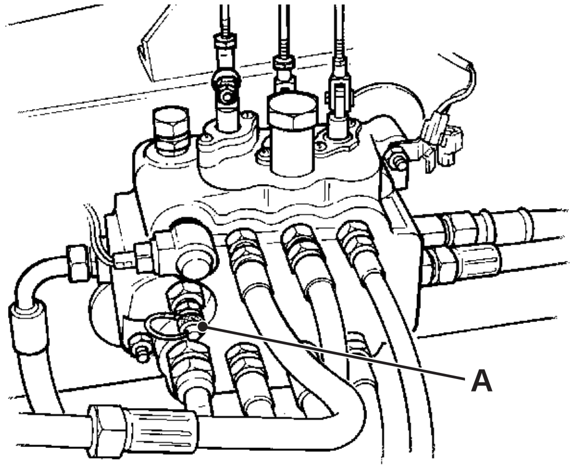


Fig 117.

Auxiliary Relief Valves - Using Hand Pump

To pressure test and re-set the auxiliary relief valves (A.R.V.'s), service kit 892/00309 must be used.

The service kit comprises; a test block **1**, a setting body **2** with adjusting pin **3**, a special spanner **4**, anti-cavitation lock out bung **5**. A.R.V. cartridge removal tool 892/00335 comprises; an extractor cap **6** and a 'C' washer **7**.

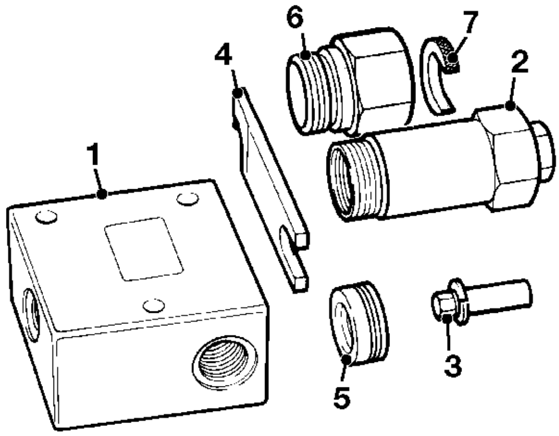


Fig 118.

1 Remove the complete A.R.V. assembly from the valve block. If the A.R.V. sub-assembly **7** remains in the valve block, proceed as follows:

- **a** Fit extractor cap **11** over the A.R.V. sub-assembly **7**, into the valve block **E**.
- **b** Fit 'C' washer **12** on top of the extractor cap, but under the anti-cavitation spring seat as shown.
- **c** Unscrew the extractor cap, - the A.R.V. sub-assembly will withdraw with the extractor cap.

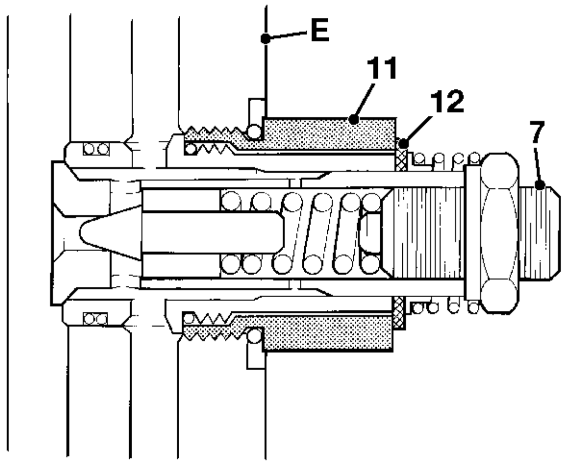


Fig 119.

2 Use special spanner **4** located in cross holes **A** and separate the A.R.V. sub-assembly **7** from its cap **8**.

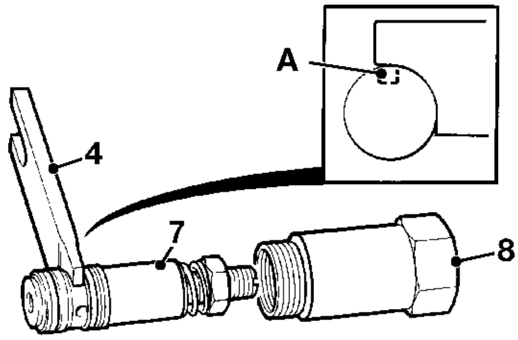


Fig 120.

3 Install adjusting pin **3** into setting body **2**.

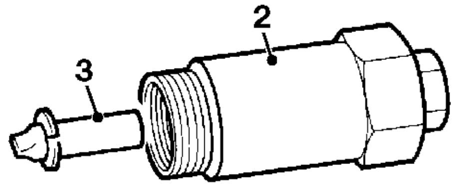


Fig 121.

4 Install the A.R.V. sub-assembly into setting body **2**. Make sure that the adjusting pin **3** correctly locates in adjusting screw **9**.

Make sure that the lock nut **10** correctly locates in the setting body socket - the anti-cavitation cone should still be closed, as shown at **B**.

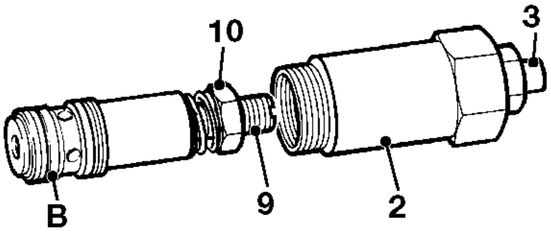


Fig 122.

5 Install the A.R.V. sub-assembly and setting body into test block **1**. Make sure that the assembly is installed in the port marked '**RV**' (relief valve).

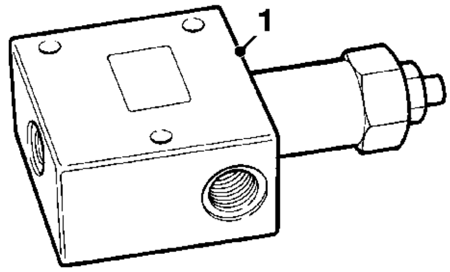


Fig 123.

6 Connect a hydraulic hand pump to port '**P**' (pump) of the test block **1**. Make sure that the hand pump is filled with JCB Hydraulic fluid.

Connect a 0 to 400 bar (0 to 6000 lbf/in²) pressure test gauge to port '**G**' (gauge) of the test block **1**.

Port '**T**' (tank) can be left open when using a hydraulic hand pump.

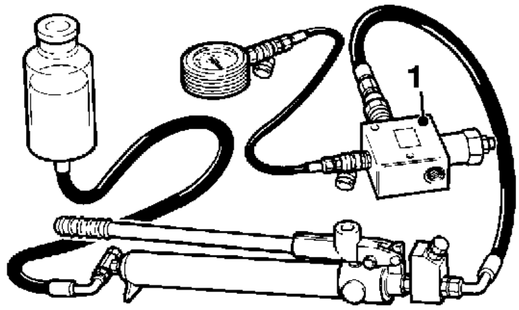


Fig 124.

7 Raise the pressure at the valve inlet using the hydraulic hand pump, when the A.R.V. 'cracks' and oil escapes from the port marked '**T**' the pressure gauge will indicate the A.R.V. setting.

If the A.R.V. setting is correct, move to step 12.

If the A.R.V. setting is not correct, move to step 8.

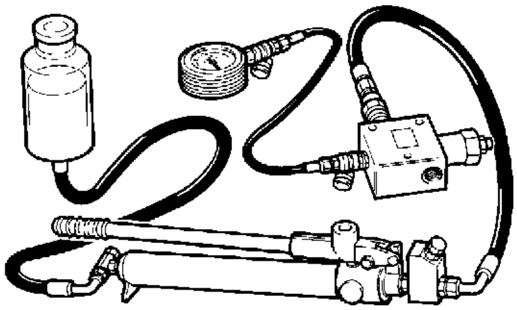


Fig 125.

8 Use the hand pump to raise approximately 172 bar (2500 lbf/in²) pressure at the valve inlet.

***Note:** Raising the pressure at the valve inlet locks the anti-cavitation cone **C** onto its seat, this allows the A.R.V. adjusting screw lock nut **10** to be loosened (step 10).*

If the pressure is maintained move to step 10.

If the pressure falls off rapidly, or if no pressure can be obtained it is possible that the anti-cavitation cone is not seating effectively, in this instance move to step 9.

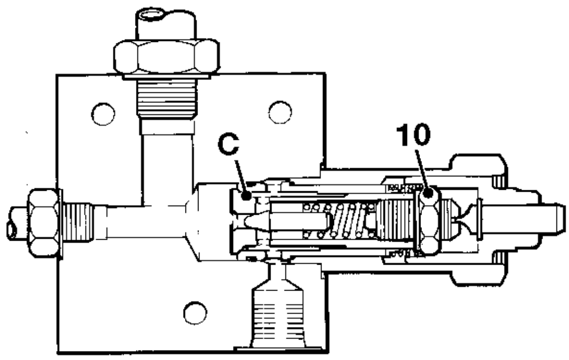


Fig 126.

9 If no pressure can be raised (see step 8) at the valve inlet, remove the A.R.V. assembly and install anti-cavitation lock-out bung **6** in the port marked '**RV**', make sure that the bung O-ring face seal **D** is facing out. Re-fit the A.R.V. assembly.

Note: *The anti-cavitation lock-out bung seals and locks the A.R.V. anti-cavitation function. The bung is only suitable for the test block application and must NEVER be fitted to the valve block.*

The bung can be extracted using a $^3/_8$ - 16 UNC threaded bolt.

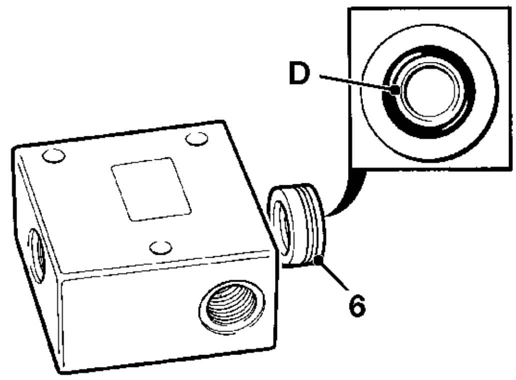


Fig 127.

10 Release the A.R.V. adjusting screw lock nut (see note):

Engage the nut at the end of setting body **2** using the slot in special spanner **4**, turn the nut anti-clockwise to release the A.R.V. adjusting screw lock nut.

Note: *Remember, it will not be possible to release the lock nut if there is not approximately 172 bar (2500 lbf/in^2) pressure at the valve inlet.*

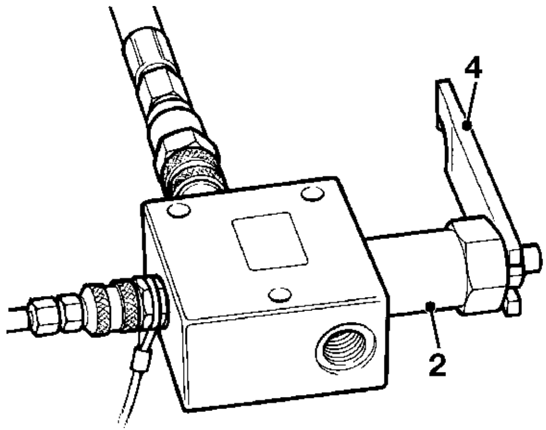


Fig 128.

11 Insert an allen key into adjusting pin **3** (T-Bar type shown). Push the adjusting pin down and make sure it has engaged with the A.R.V. adjusting screw.

Rotate the T-bar clockwise to increase the pressure setting and anti-clockwise to decrease the pressure setting.

After adjustment, use the slot in spanner **4** to lock the A.R.V. adjusting screw lock nut (see note).

Note: *Remember, pressure must be maintained at the valve inlet to ensure the lock nut is tightened.*

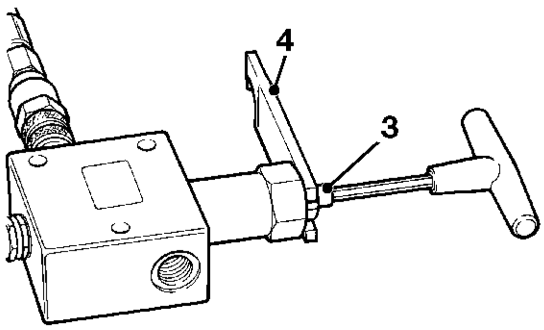


Fig 129.

12 When the correct A.R.V. setting has been attained, release the pressure in the test block. Remove the A.R.V. sub-assembly and its setting body from the test block.

Separate the A.R.V. sub-assembly from its setting body.

Install the A.R.V. sub-assembly into its cap.

Excavator Valve - Pressure Testing

Auxiliary Relief Valves - Using Hand Pump

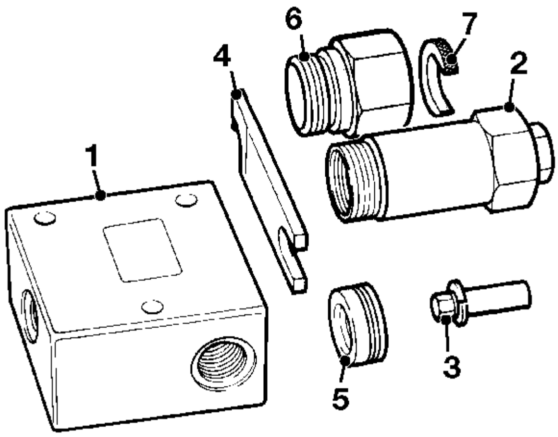


Fig 130.

The auxiliary relief valves found in the backhoe valve block are identical in design to those found in the loader valve block. For the correct pressure test procedures see ***Loader Valve - Pressure Testing,*** ***⇨ Auxiliary Relief Valves - Using Hand Pump (E-143)***.

To pressure test and re-set the auxiliary relief valves (A.R.V.'s), service kit 892/00309 must be used.

The service kit comprises; a test block **1**, a setting body **2** with adjusting pin **3**, a special spanner **4**, anti-cavitation lock out bung **5**. A.R.V. cartridge removal tool 892/00335 comprises; an extractor cap **6** and a 'C' washer **7**.

Ram Creep Tests - All Services

If ram creep is suspected the following procedures must be carried out to define if the leakage is within tolerance. Ram creep can be caused by a number of reasons: cylinder or piston leakage, spool leakage or ARV leakage.

The text and illustrations show a typical ram installation (in this instance the boom ram), the principle applies to all rams.

Note: *The procedures are not applicable for rams fitted with hose burst protection valves.*

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

WARNING

Take care when disconnecting hydraulic hoses and fittings as the oil will be HOT.

TRANS-1-2

A Test for Ram Creep

1 Operate the machine to bring the hydraulic oil to a normal working temperature of 50°C (122°F) which can be measured using a hydraulic oil temperature probe (service tool 892/00285).

2 Fit an appropriate pressure gauge **A** to a tee piece in the service hose which is pressurised when the ram in question is supported, see ⇨ *Fig 131. (E-149)*.

3 Operate the rams to ensure they are full of hot oil.

4 Apply a load to the suspect ram for example the boom ram by raising the dipper to the horizontal as at **B**.

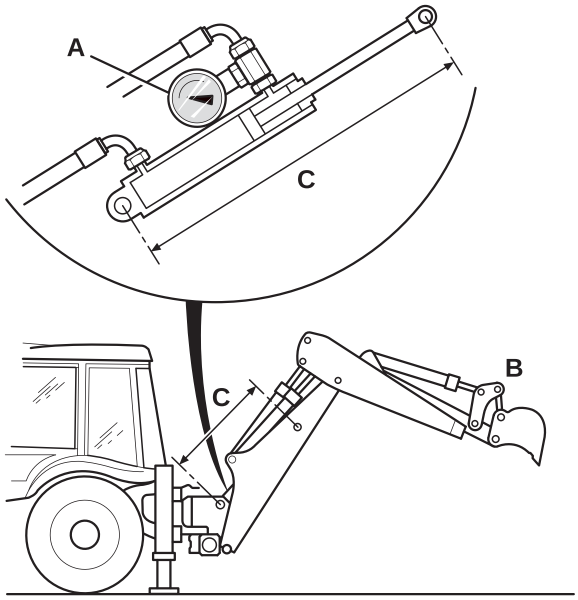


Fig 131.

5 Measure the actual piston rod movement over 10 minutes. Measure the movement by checking the pivot pin to pivot pin dimensions as at **C**. Alternatively mark the rod with a felt tip pen 150mm (5.9 in) from the end cap and check the movement after 10 minutes, this is not possible on the majority of boom extending dipper rams.

6 Using ⇨ *Table 20. Creep Rates (E-151)*, check if the piston rod movement is within the recommended tolerance. If so, the ram creep is acceptable.

Note: *The table indicates the MAXIMUM permitted ram movement.*

7 If the rate of movement is unacceptable, identify if the fault is as a result of cylinder or piston leakage, or spool leakage at the control valve, see procedures **B** and **C**.

B Test Cylinder or Piston Leakage

1 Ensure that the oil temperature is at 50°C (122°F) by using the hydraulic oil temperature probe detailed in step A1.

2 Take the weight off the ram to be tested, in this example, by positioning the backhoe with dipper vertical and bucket on the ground.

3 Use a suitable pressure gauge **A** to blank off the supporting port of the ram, ⇒ Fig 132. (E-150).

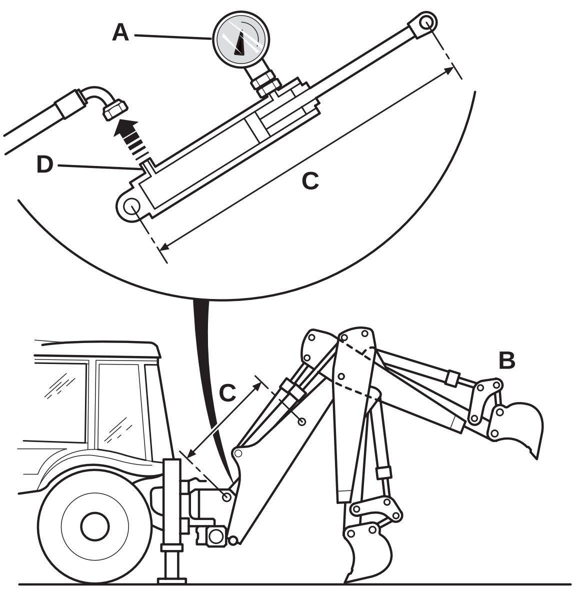


Fig 132.

4 Disconnect the hose from the opposite port **D** and leave the port open to atmosphere.

5 Apply a load to the suspect ram for example the boom ram by raising the dipper to the horizontal as at **B**.

6 After the initial movement measure the pin to pin movement as at **C** and note the rod movement over 10 minutes.

7 If rod movement is evident the ram is defective.

C Test Spool Leakage

Note: *The following procedure applies only to services fitted with A.R.V.'s. Note A.R.V.'s are not fitted to loader lift, loader auxiliary, stabilisers or to the bucket rod side service except when a Rockbreaker is fitted.*

⇒ Fig 133. (E-151).

A.R.V.	**Control Layout:**	
	JCB	**ISO**
Slew		
- Right	B1	B1
- Left	A1	A1
Boom		
- Rod	B2	B5
- Head	A2	A5
Dipper		
- Rod	A5	A2
- Head	B5	B2
Bucket		
- Rod	A6	A6
- Head	B6	B6

Note: *Bucket ram rod side ARV only fitted to machines equipped with Rockbreakers.*

1 Render the A.R.V.'s inoperative in the suspect service. This is achieved by removing the A.R.V. and replacing with a blanking plug (part no. 25/609901) and seal kit (25/610301).

2 Recheck the piston rod movement as described steps A1 to A6.

3 If the rod movement is now acceptable the A.R.V. must be at fault. The A.R.V. may only require cleaning and then resealing. If dirt is evident, the hydraulic tank should be drained and cleaned. It is recommended that when re-filling the hydraulic tank that new oil and filter be used to prevent further contamination. If the A.R.V. is worn it should be replaced.

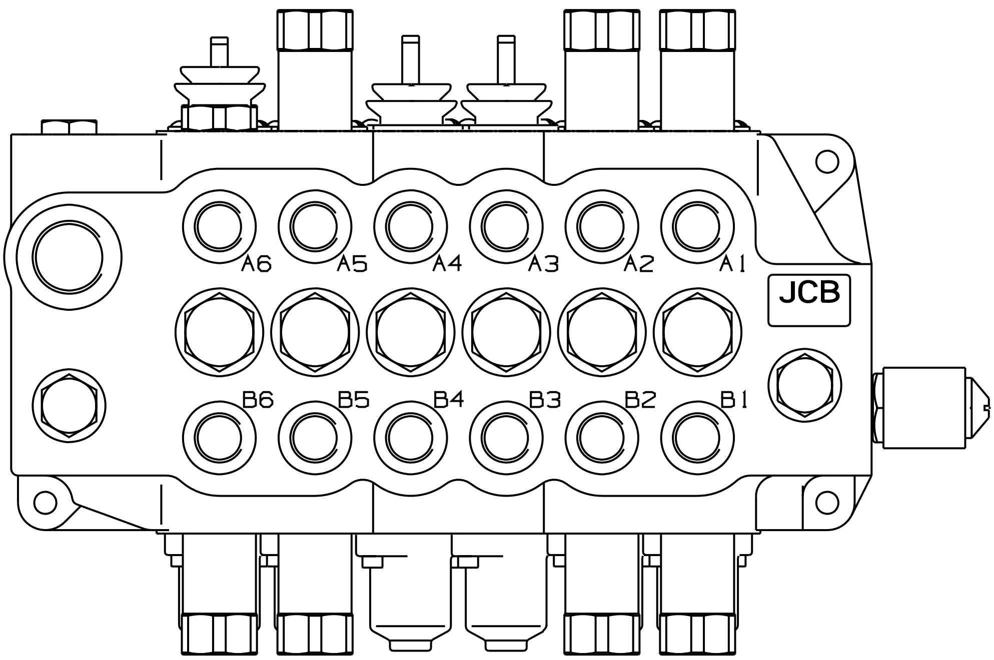


Fig 133. ARV Positions

Table 20. Creep Rates

Ram	Cylinder Dia. (mm)	Rod Dia. (mm)	Total Displacement - mm/10 minutes @ 69 bar (1000 lb/in²)	138 bar (2000 lb/in²)	207 bar (3000 lb/in²)
HEAD SIDE					
Backhoe:					
S/shift Jack Leg	70	40	13	44	91
Knuckle	100	60	6	16	32
Bucket	90	50	11	45	114
Bucket	100	60	10	40	99
Extending Dipper	70	40	13	32	65
Loader:					
Clam	70	40	6	22	45
Lift	80	50	5	17	35
Lift	90	50	4	13	28
ROD SIDE					
Backhoe:					
Boom	110	60	8	26	52

Ram	Cylinder Dia. (mm)	Rod Dia. (mm)	Total Displacement - mm/10 minutes @ 69 bar (1000 lb/in²)	138 bar (2000 lb/in²)	207 bar (3000 lb/in²)
Boom	120	65	6	22	44
Boom	130	70	5	19	37
Boom	140	75	5	16	32
Dipper	100	60	10	34	70
Dipper	110	65	8	28	57
Extending Dipper	70	40	19	66	96
Loader:					
Shovel	70	40	10	33	68

Using the figures above, a graph can be plotted and the maximum amount of movement determined. See the next page for a working example.

1 Using the figures given in the table, plot a graph for the ram to be tested. **Example:** Boom Ram 110 x 60, see *⇒ Fig 134. (E-153)*.

2 Check the pressure in the ram (induced by the applied load). In this example the pressure on the gauge reads 107 bar; 1500 lb/in².

3 Draw a vertical line from the pressure reading to the plotted graph line. Where the vertical line intercepts the graph line, draw a horizontal line and read the permitted ram displacement. In this example the permitted maximum displacement is 18 mm.

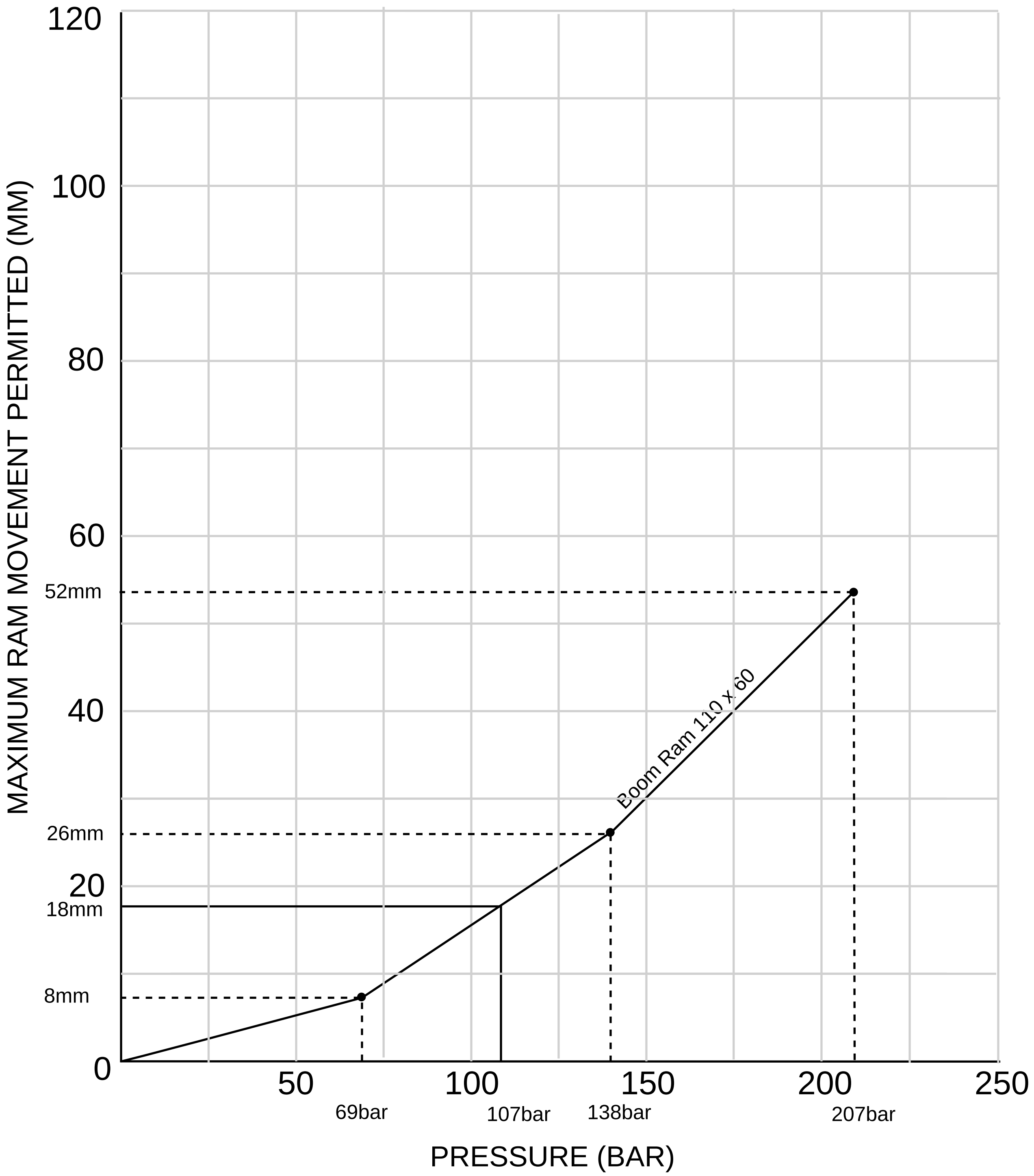


Fig 134. Example Graph - Boom Ram 110 x 60

Note: *For a blank graph sheet to copy and use as required,* *⇒ Fig 135. (E-154)*.

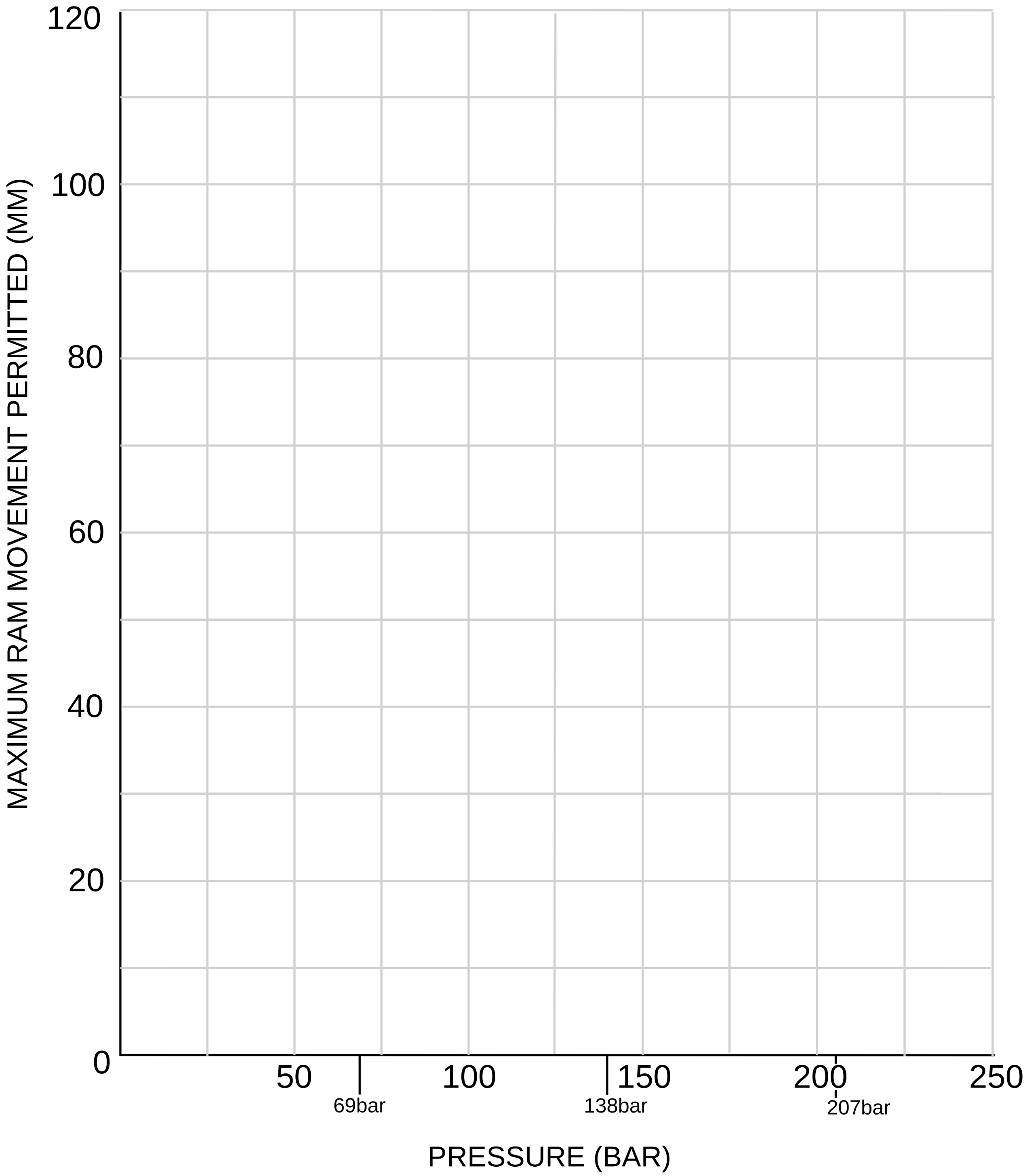


Fig 135. Blank Graph Sheet

Quick Release Couplings

Connecting and Disconnecting

⇨ *Fig 136. (E-156)*.

Flat face quick release couplings allow the operator to remove and install attachments swiftly and efficiently. Generally, your machine pipework will have female couplings **A** fitted, and the optional attachment hoses will have male couplings **B** fitted.

The quick release couplings should be trouble free and relatively easy to connect and disconnect, provided they are kept clean and used correctly. The recommendations listed below should always apply when using flat face quick release couplings.

Finally, please read the correct fitting and releasing procedures before installing or removing any optional attachment fitted with quick release couplings.

Quick Release Couplings - Do's & Don'ts

DO wipe the two faces of the coupling and make sure they are clean before connecting.

DO make sure the outside sleeve (female coupling) is pulled back when disconnecting.

DO connect and disconnect a new coupling two or three times to 'work' the PTFE seals - sometimes a new coupling will stick if the seals have not been 'worked'.

DO use a spanner on the hexagon flats of the coupling when fitting adaptors.

DO use a rubber or hide hammer to disconnect a coupling if it sticks - sticking may occur if there is dirt present in the coupling.

DON'T attempt to re-connect a damaged half coupling - this will destroy the seals and necessitate replacing both half couplings.

DON'T leave the coupling where it may be run over by a machine or otherwise crushed - this will distort the coupling sleeve and prevent correct connection and disconnection.

DON'T clamp on the smooth diameter of the coupling when fitting adaptors - always use the hexagon.

DON'T try to turn the sleeve (female coupling) when the coupling has been disconnected - the locking ball will wedge underneath the sleeve and destroy the coupling.

DON'T damage the faces of the couplings - this can prevent connection and disconnection, or damage seals and cause leakage.

DON'T try to dismantle the couplings - they are non serviceable parts. If a coupling is damaged it should be replaced with a new one.

Connecting Quick Release Couplings

⚠ WARNING

Hydraulic fluid at pressure can injure you. Make the machine safe before connecting or disconnecting quick release couplings; stop the engine and then operate the attachment control a few times to vent residual hydraulic pressure in the attachment hoses.

2-4-1-11

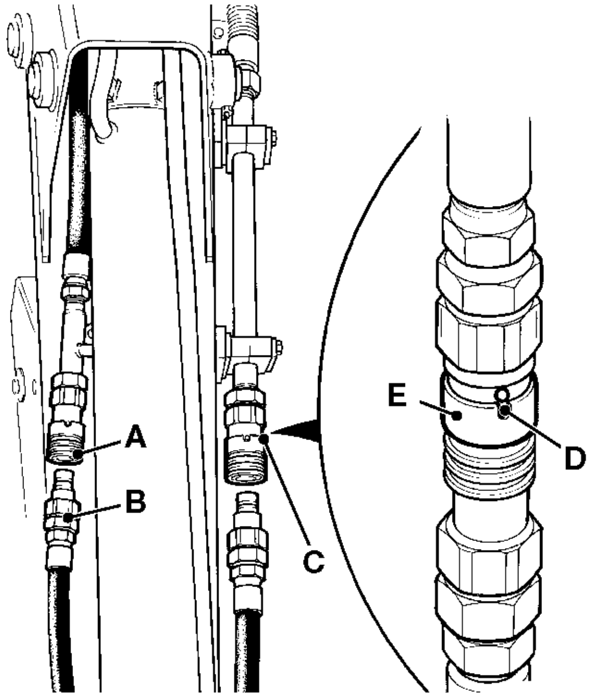


Fig 136.

Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. This is usually achieved by switching off the engine and then operating the attachment control lever several times. Make sure the hose service line has been vented before connecting or removing hoses - refer to the appropriate attachment information in this section.

1 Remove any residual hydraulic pressure trapped in the service line hose.

2 Wipe the two faces of the male and female couplings and make sure they are clean.

3 Make sure that ball **C** in the female coupling is located in one of its slots.

4 Fit the male coupling into the female coupling; To ensure that the coupling is not accidentally released, rotate sleeve **E** half a turn and make sure that the locking ball **C** does not align with the slot **D**.

Disconnecting Quick Release Couplings

1 Remove any residual hydraulic pressure trapped in the service line hose.

2 Align the slot **D** with ball **C**.

3 Pull back sleeve **E** to release the coupling.

Smooth Ride System (SRS) Accumulator

Charging and Discharging

WARNING

Use only nitrogen gas to charge accumulators. The use of any other gas can cause the accumulators to explode. Remember that although nitrogen is not poisonous you can be killed by suffocation if it displaces the air in your workplace. Do not allow excessive quantities of nitrogen to be discharged into the atmosphere.

B-3-1-6

Charging

1 Remove the accumulator from the machine, see ***Accumulator - Removal and Replacement***.

2 Remove the protective cap **A** from the accumulator gas valve **B**.

3 Connect the nitrogen charging tool kit 892/01042 and 892/01043 to the accumulator gas valve.

4 Connect the charging tool flexible hose to a bottle of compressed nitrogen gas fitted with a pressure regulator valve, set to minimum pressure.

5 Screw spindle **C** three turns anti-clockwise to open the accumulator gas valve.

6 Open the charging tool bleed valve **D**. Carefully open the nitrogen gas bottle valve **E** and confirm that nitrogen gas flows freely.

Close the gas bottle valve **E** and the bleed valve **D**.

7 Carefully open the nitrogen gas bottle valve **E** and watching the gauge, allow nitrogen to flow by increasing the pressure regulator setting until the required pre-charge pressure is achieved.

Close the gas bottle valve **E**.

8 Let the pressure settle for 10 to 15 minutes. This will allow the gas temperature to stabilise. If the charge pressure is exceeded, with the gas bottle closed, adjust the pressure in the accumulator by carefully opening and closing the bleed valve **D**.

CAUTION

To reduce pressure use the recommended charging tool or the charge valve could be damaged which may result in rapid discharge of the accumulator.

HYD-2-4

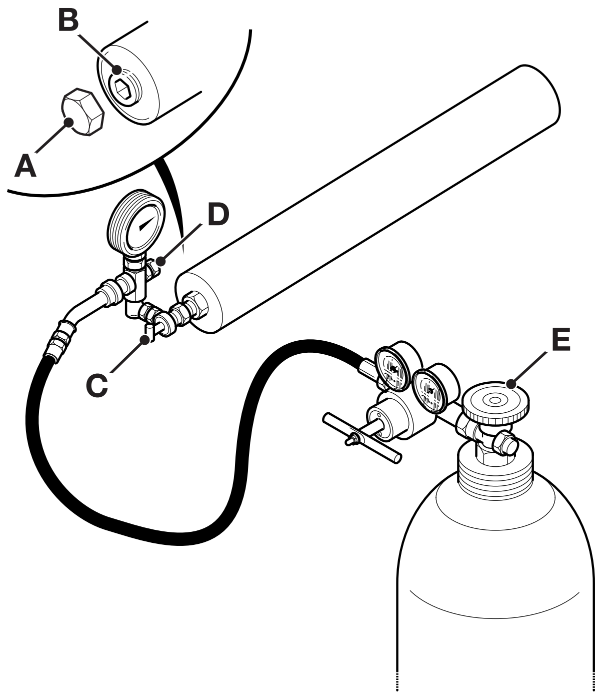


Fig 137.

9 When complete, screw spindle **C** clockwise to fully close the accumulator gas valve, then open bleed valve **D** to vent the charging hose.

10 Disconnect the charging tool from the accumulator.

11 Check the gas-tightness of the gas valve **B** by applying soapy water around it. Refit protective cap **A**.

Discharging

⚠ CAUTION

To reduce pressure use the recommended charging tool or the charge valve could be damaged which may result in rapid discharge of the accumulator.

HYD-2-4

1 Remove the accumulator from the machine, see ***Accumulator - Removal and Replacement***.

2 Remove the protective cap **A** from the accumulator gas valve **B**.

3 Connect the nitrogen charging tool kit 892/01042 and 892/01043 to the accumulator gas valve.

4 Either connect the charging tool flexible hose **F** to a bottle of compressed nitrogen gas, or remove the hose and fit at suitable high pressure blanking plug at the charging tool port.

5 Screw spindle **C** three turns anti-clockwise to open the accumulator gas valve.

6 Carefully open the charging tool bleed valve **D** until all the nitrogen gas is vented from the accumulator.

7 Disconnect the charging tool from the accumulator.

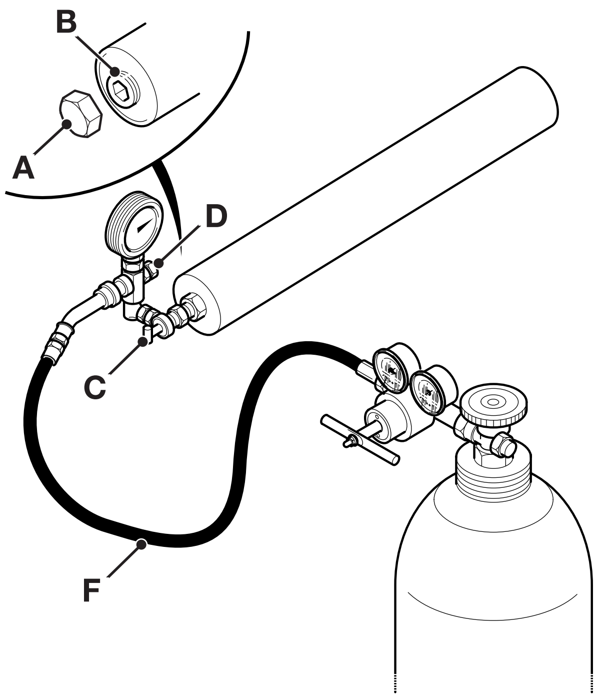


Fig 138.

Valve Block Spool Seals

Seal Fitting

⇒ *Fig 139. (E-161)*.

The following points **MUST** be avoided when dismantling and assembling the valve:

- Contamination
- Damage to Spool
- Damage to Seal Grooves

All or any of the above points may result in possible problems with the valve.

Note: *A Valve Spool Reseal Kit is available for the following procedure:*

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral.

2 Lower the loader arms and boom to the ground. Switch OFF the engine, remove the starter key and disconnect the battery.

3 Operate the controls to vent hydraulic pressure.

⚠ 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

4 The control levers will need to be partially dismantled to gain access to the loader or excavator valves (see ***Control Rods and Linkage, Dismantling and Assembly***).

Note: *Take care not to damage the rear horn or wiring.*

5 Inspect **ALL** the fittings, hoses and connecting joints etc. to ensure and confirm the leakage is clearly coming from the valve spool seals.

Note: *If a valve block is in a rusty or dirty condition, it is recommended that the complete valve block is removed, (see **Loader Valve or Excavator Valve Removal and Replacement**), and a complete spool valve kit is fitted.*

6 Disconnect control linkages.

7 Before removing the boot, clean the entire valve block, make sure that all components are free of debris, use a pressure washer to clean the valve block if available.

8 Remove the boot **4**, retaining plate and breather **2**, **CLEAN** around the top of the spool.

9 Undo capscrews **16** and remove end cap **15**. Place a container underneath to catch the oil when the spool is removed, carefully remove the spool assembly.

Note: *If all spools on the valve block are being resealed, the above operation must be done one at time.*

10 Remove the upper lip seal **5** and wiper seal **6** with a non sharp object and thoroughly **CLEAN** the spool seal cavity area. Pay particular attention to the outer seal contact area **7**. Check the spools for signs of pitting or damage, i.e. scratches from previous damaged repairs. Replace as required.

11 Fit a new boot **4** to the seal retaining plate **2** and grease the bottom of the seal plate with red lithium grease, included in the kit.

12 Carefully fit the new lipseal **5** into the valve block. Ensure squareness of the lipseal and that it is in the correct orientation, seal lip inwards.

13 Fit wiper seal **6** on top of lipseal **5**, grease the top of the valve seal plate contact area with red lithium grease.

14 Fit the new boot assembly with the breather groove **1** pointing to the rear of the valve block as illustrated, only finger tighten bolts **3** at this stage.

Note: *If the lower wiper seal **9** requires changing, it is recommended the spring end mechanism **10** - **14** is removed from the spool assembly using spool clamp tool 992/10100. Insert the wiper seal onto the spool with the bottom flat face of the wiper seal pointing along the length of the spool. Fit the seal retaining plate **10** and spring end mechanism **11 - 14**, apply JCB Threadlocker and sealer to the thread of bolt **14** and torque tighten to 9.5 Nm (0.97 kgf m, 7.0 lbf ft).*

15 Fit the lower lipseal **8** into the valve block. Ensure squareness of the lipseal and that it is in the correct orientation, wider lip to cavity base. Apply red lithium grease to bottom seal plate contact area.

16 Using clean hydraulic oil as a lubricant, from the bottom, insert spool through the valve block, do not use excessive force when fitting, a turning motion should ease the spool through the valve block.

17 Check that the tang end of the spool passes through the boot without dislodging or damaging the boot.

Ensure that the tang aligns with the control rod and that the boot is not distorted and is located in the spool land.

18 Fit end cap **15**, torque tighten cap screws **16** to 9.5 Nm (0.97 kgf m, 7.0 lbf ft).

19 Torque tighten cap screws **3** to 9.5 Nm (0.97 kgf m, 7.0 lbf ft).

⚠ 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

20 Operate the machine and check for leaks.

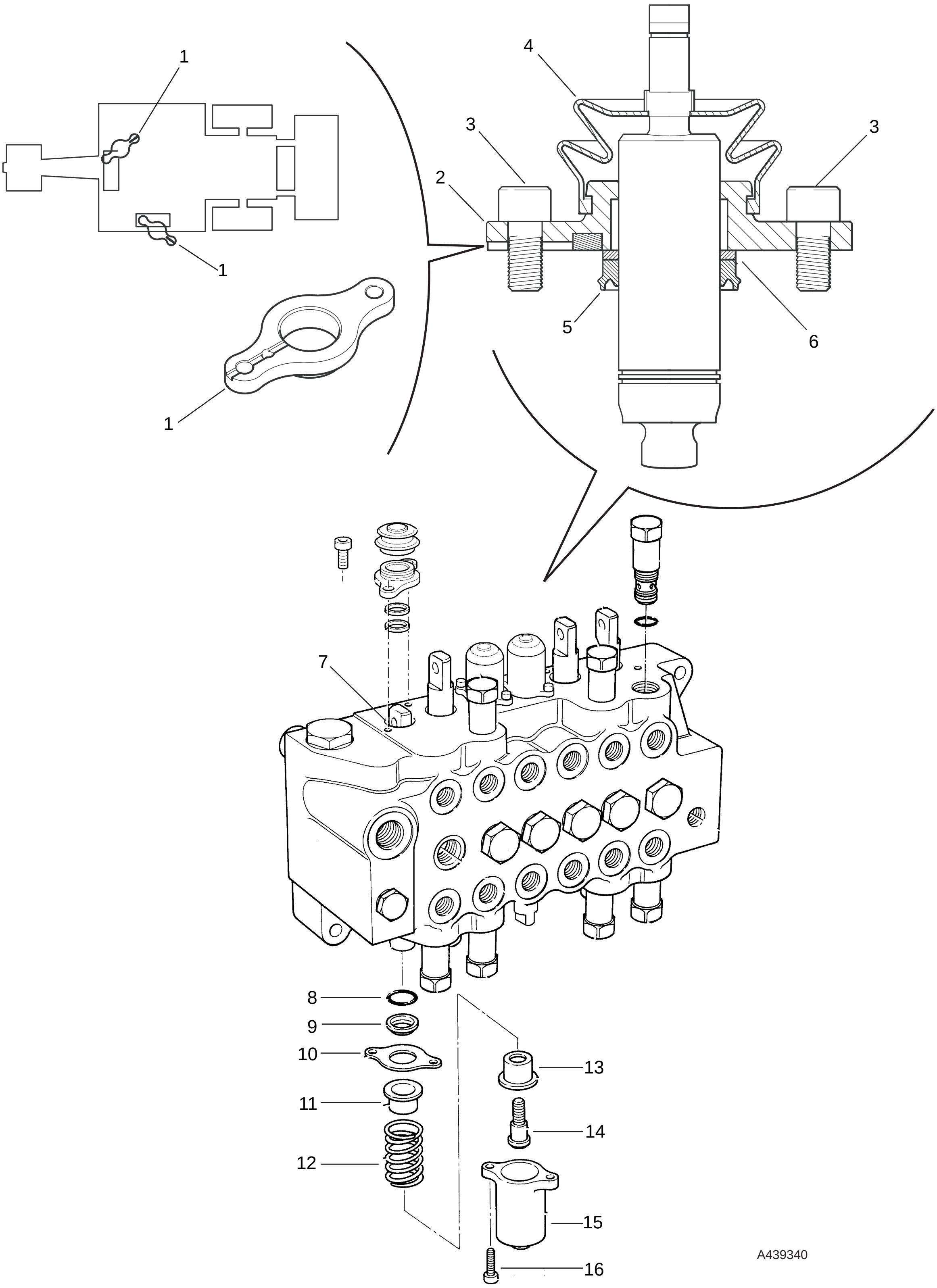


Fig 139. Valve Block Spool Seals

`Positional Type' Hydraulic Adaptors

Fitting Procedure

On a typical machine, some hydraulic components may utilise `Positional Type' SAE Hydraulic Adaptors. When fitting `Positional Type' Hydraulic Adaptors it is important to adopt the following procedure. If this procedure is not followed correctly, damage to the `O' ring seal **A** can occur resulting in oil leaks.

1 Ensure the locknut **B** is screwed back onto the body of the adaptor as far as possible as shown.

2 Check the `O' ring backing washer **C** is a tight fit on the adaptor. Note that the washer should not move freely, if the washer is slack do not use the adaptor.

3 Check the `O' ring **A** is fitted and that it is free from damage or nicks. Before fitting the adaptor, smear the `O' ring with clean hydraulic fluid.

Note: *The dimensions and shore hardness of the `O' ring is critical. Should it become necessary to replace the `O' ring, ensure that only JCB Genuine Parts are used.*

4 Screw the adaptor into the port of the hydraulic component as far as possible, so that ALL the threads engage and the `O' ring is correctly seated against the sealing face.

5 Set the angular position of the adaptor as required, then secure by tightening the locknut **B**.

Note: *When fitted correctly no more than one thread should be visible at* ***Z*** *as shown.*

6 Torque tighten the locknut to 81 Nm (60 lbf ft).

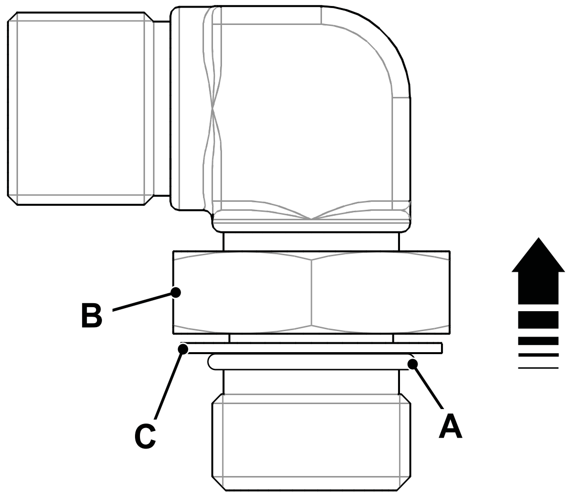


Fig 140.

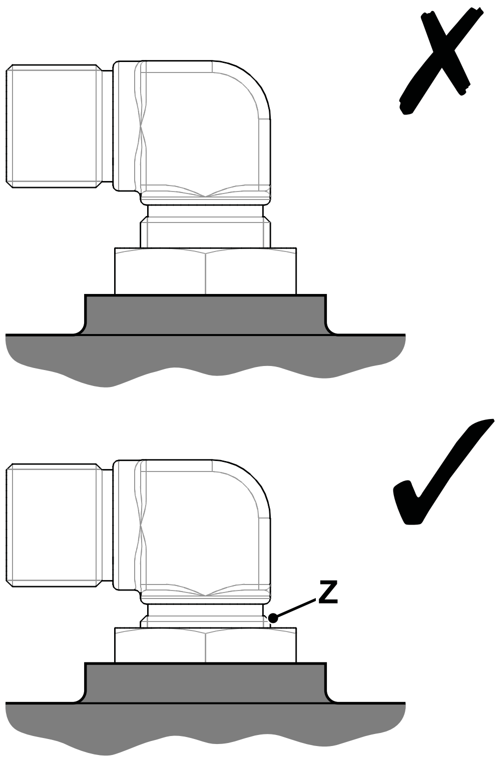


Fig 141.

3C-14 (214e) Machines

Checking Pump Flow

See ***Gearpump, Flow and Pressure Testing***.

Loader Valve - Pressure Testing

Testing Main Relief Valve (MRV)

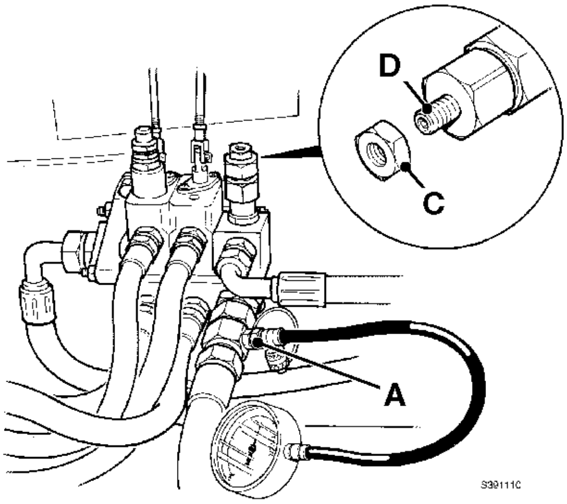


Fig 142.

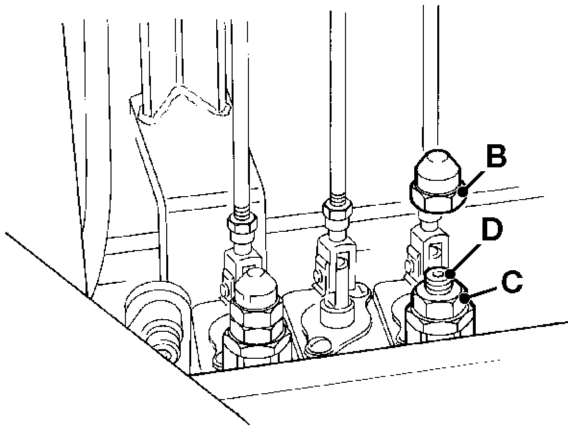


Fig 143.

The MRV is housed in the loader valve block. Make sure that the hydraulic oil is at working temperature, i.e. 50°C (122°F).

Lower the excavator bucket and loader shovel to rest on the ground; stop the engine; operate the control levers to vent residual hydraulic pressure.

1 Connect a 0 - 400 bar (0 - 6000 lbf/in^2) pressure gauge to test connector **A**, adjacent to the loader valve.

2 With the engine running at 1500 revs/min, check M.R.V. pressure by raising or lowering the loader arms until the rams are fully open or closed and noting the maximum gauge reading. **CAUTION**: Do not select 'float'. The maximum pressure should be as stated in ***Technical Data.***

Note: *The rams must be 'held' open or closed when reading gauge.*

3 If the pressure is incorrect, remove dome nut **B**, slacken locknut **C** and adjust screw **D**. Turn it clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut.

Pressure Testing - Auxiliary Relief Valves (ARV's)

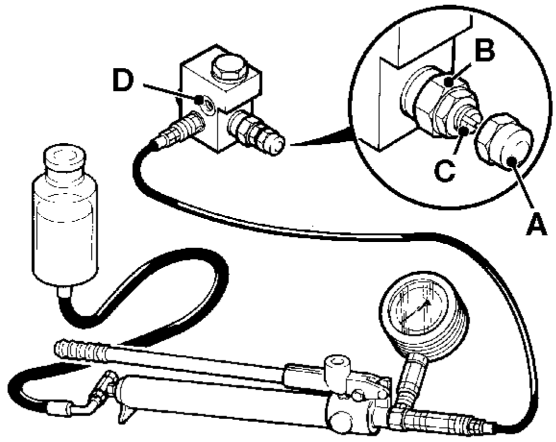


Fig 144.

Insert the A.R.V. into the test block (service tool 892/00252). Connect hand pump (service tool 892/00223) and a 0-400 bar (0-6000 lbf/in^2) pressure gauge.

Plug the two large diameter ($^3/_4$ inch B.S.P.) ports of the test block using blanking plugs (service tool 892/00059) and bonded washers (service tool 1406/0021).

Pressurise until oil begins to escape from the drain hole **D**. At this point the gauge will indicate the crack pressure of the A.R.V.

The pressure should be as given below.

If required, adjust the pressure by removing dome nut **A**, slackening locknut **B** and turning screw **C**.

Relief Valve Test Pressures

Pilot-operated relief valves - 7 bar (102 lbf/in^2) below the operating pressure given in ***Technical Data***.

Direct acting relief valves - 10 bar (145 lbf/in^2) below the operating pressure given in ***Technical Data***.

Note: *Refer to* ***Technical Data*** *for type of relief valve fitted to service.*

3C Machines (Sideshift)

Checking Pump Flow

The pump supplies hydraulic oil to the main service circuits and on demand to the steering circuit. To determine the source of a problem i.e pump, steer circuit or services circuit, measure the output flow at system pressure from the pump outlet port as described below:

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 Operate the loader control levers back and forth several times to vent any residual hydraulic pressure. Slowly release the hydraulic tank filler cap to vent any residual pressure from the tank. Refit the cap.

3 Working beneath the machine, connect a flow meter **A**, 0-400 bar (0-6000 lbf/in^2) pressure gauge **B** and load valve **C** between the pump and loader valve block inlet as shown.

Important: *Make sure the flow meter is installed the correct way round i.e. with the direction arrow pointing away from the pump.*

⚠ CAUTION

Make sure the load valve is in the OPEN position, (the adjusting knob screwed fully OUT), before starting the following pressure test. Failure to do this could damage the pump.

HYD-4-4_1

4 Start the engine and bring the hydraulic system up to working temperature 50º C (122º F).

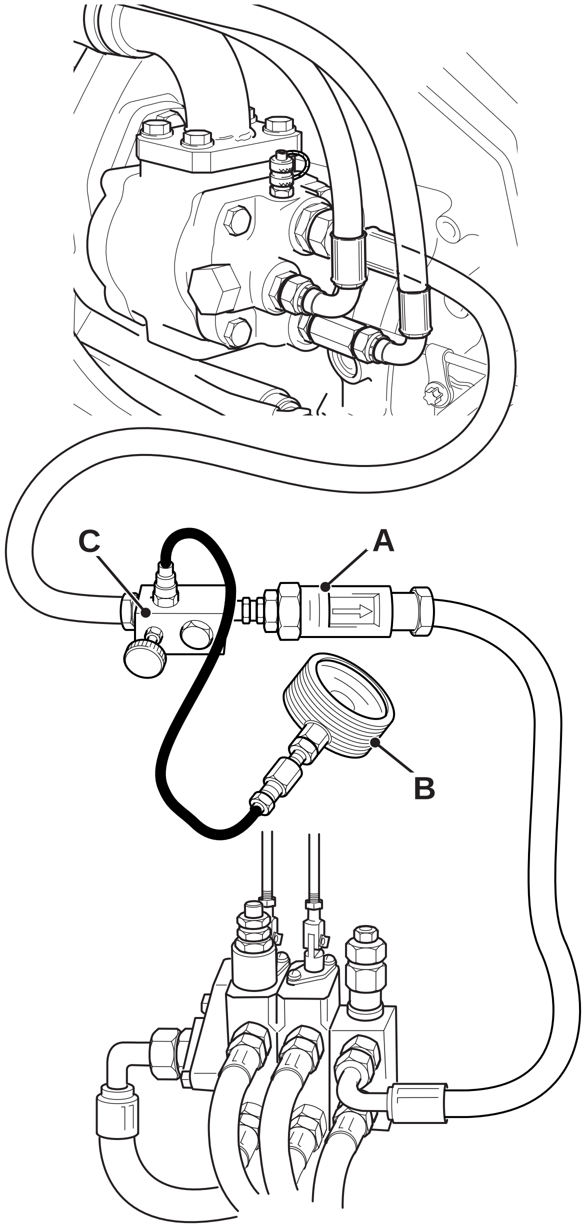


Fig 145.

5 Select the steering and valve block spools to the neutral position. Gradually increase the engine speed to 2200 rev/min while checking maximum gauge reading. This is the neutral circuit pressure.

6 With the engine at 2200 rev/min, carefully adjust the load valve **C** so that the gauge reading increases to 227 bar (3300 lbf/in^2).

7 Check the flow reading which should be as stated in ***Technical Data***.

If the flow reading is low or you are unable to obtain the pressure required, see ***Fault Finding***.

For testing the Priority Valve, see ***Section H, Steering, Service Procedures - 3C Machines***.

⚠ WARNING

Take care when disconnecting hydraulic hoses and fittings as the oil will be HOT.

TRANS-1-2

8 After completing the test, switch OFF the engine and allow to cool before reconnecting the hydraulic hoses.

Loader Valve - Pressure Testing

Testing Main Relief Valve (MRV)

The Main Relief Valve (MRV) is housed in the loader valve block.

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

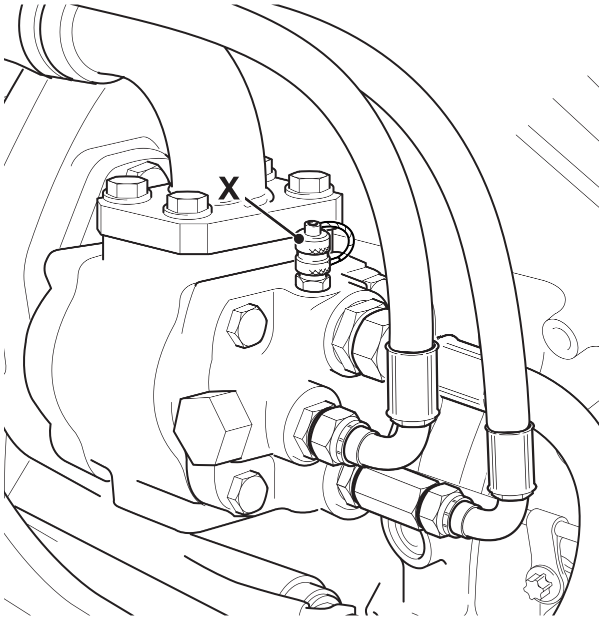


Fig 146.

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

3 Start the engine and bring the hydraulic system upto working temperature 50º C (122º F).

4 Raise the loader arms until the rams are fully open. Gradually increase the engine speed to 2200 rev/min while checking maximum gauge reading, which should be as stated in ***Technical Data***.

Note: *The rams must be `held' open when reading the gauge.*

Relief Valve Adjustment

5 If the pressure is incorrect, adjust the relief valve as described below:

a Switch OFF the engine and vent residual hydraulic pressure.

b Loosen the locknut **A** and turn the adjuster screw **B**. Turn the adjuster screw clockwise to increase pressure and anti-clockwise to decrease the pressure. When the pressure is correct, tighten the locknut and check the pressure again. Adjust as required.

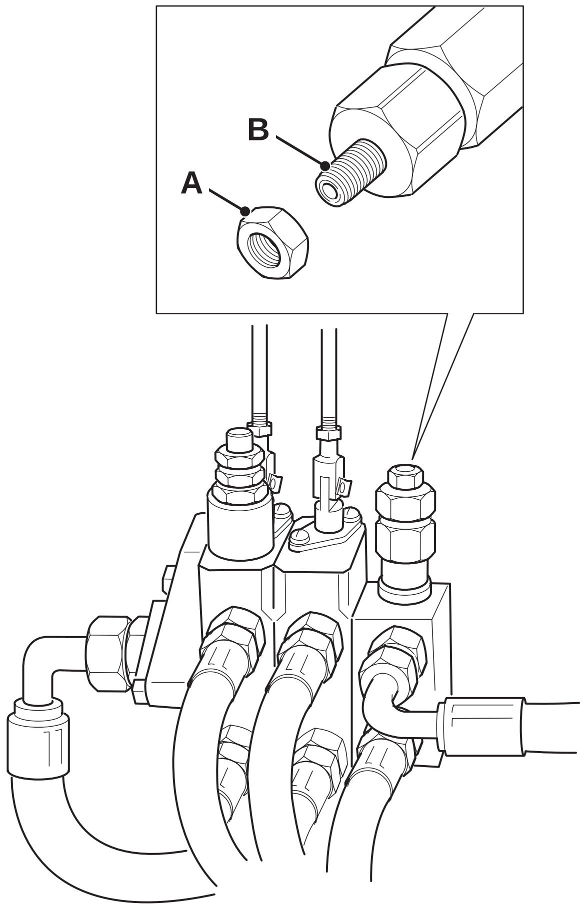


Fig 147.

Pressure Testing - Auxiliary Relief Valves (ARV's)

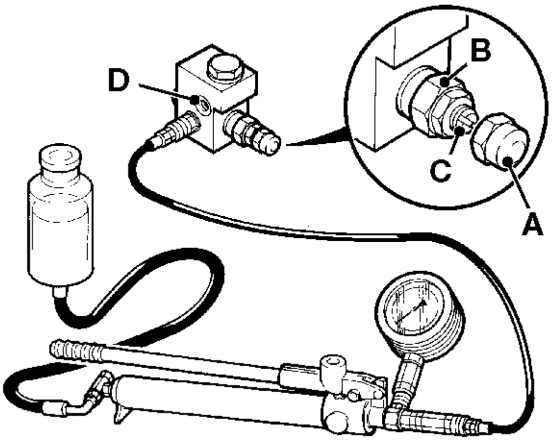


Fig 148.

Insert the A.R.V. into the test block (service tool 892/00252). Connect hand pump (service tool 892/00223) and a 0-400 bar (0-6000 lbf/in^2) pressure gauge.

Plug the two large diameter ($^3/_4$ inch B.S.P.) ports of the test block using blanking plugs (service tool 892/00059) and bonded washers (service tool 1406/0021).

Pressurise until oil begins to escape from the drain hole **D**. At this point the gauge will indicate the crack pressure of the A.R.V.

The pressure should be as given below.

If required, adjust the pressure by removing dome nut **A**, slackening locknut **B** and turning screw **C**.

Relief Valve Test Pressures

Pilot-operated relief valves - 7 bar (102 lbf/in^2) below the operating pressure given in ***Technical Data***.

Direct acting relief valves - 10 bar (145 lbf/in^2) below the operating pressure given in ***Technical Data***.

Note: *Refer to* ***Technical Data*** *for type of relief valve fitted to service.*

Main Pump

Gearpump

Removal and Replacement

⇨ *Fig 149. (E-171)*. The following procedure describes removal and replacement of a double section pump.

Removal

WARNING

Working Under the Machine
Make the machine safe before getting beneath it. Ensure that any fitments on the machine are secure; engage the park brake, remove the starter key, disconnect the battery.

INT-3-3-8_2

1. Remove the propshaft, refer to ***Section F, Transmission, Propshafts - Removal and Replacement.***
2. Drain the hydraulic fluid from the hydraulic tank.
3. Remove flange bolts **B** (4 off) and disconnect the pump inlet hose flange from the pump body. Blank off all exposed connections to prevent ingress of dirt.
4. Disconnect the pump outlet hoses **C** and **D** from the elbow fittings. Blank off all exposed connections to prevent ingress of dirt.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

5. Secure the pump using a sling around the pump body, remove the pump mounting bolts **E** and carefully withdraw the pump clear of the gearbox.

Replacement

Replacement is the reverse of the removal procedure.

1. Clean off all traces of sealant compound from the pump and gearbox mounting faces. Apply a thin bead of Loctite 5910 sealant to the gearbox mounting face.

Note: *The pump must be assembled onto the gearbox within 15 minutes of applying the sealant.*

2. Locate the splined shaft of the pump into the gearbox. Apply JCB Threadlocker and Sealer to bolts **E** and secure the pump flange to the gearbox mounting face.
3. Reconnect the pump outlet hoses **C** and **D** to the elbow fittings.

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

4. Reconnect the pump inlet hose flange to the pump body with bolts **B** (4 off).
5. Fit the propshaft, refer to ***Section F, Transmission Propshafts - Removal and Replacement.***
6. Fill the system to the correct level with recommended hydraulic fluid, see ***Section 3, Maintenance - Lubricants and Capacities.***

Note: *Replace the suction strainer and return line filter after fitting a new or serviced pump.*

7. After fitting a new or serviced pump and before starting the engine screw the main relief valve out. Run the engine and check for leaks, also check the main relief valve (MRV) operating pressure. See ***Service Procedures, Loader Valve - Pressure Testing.***

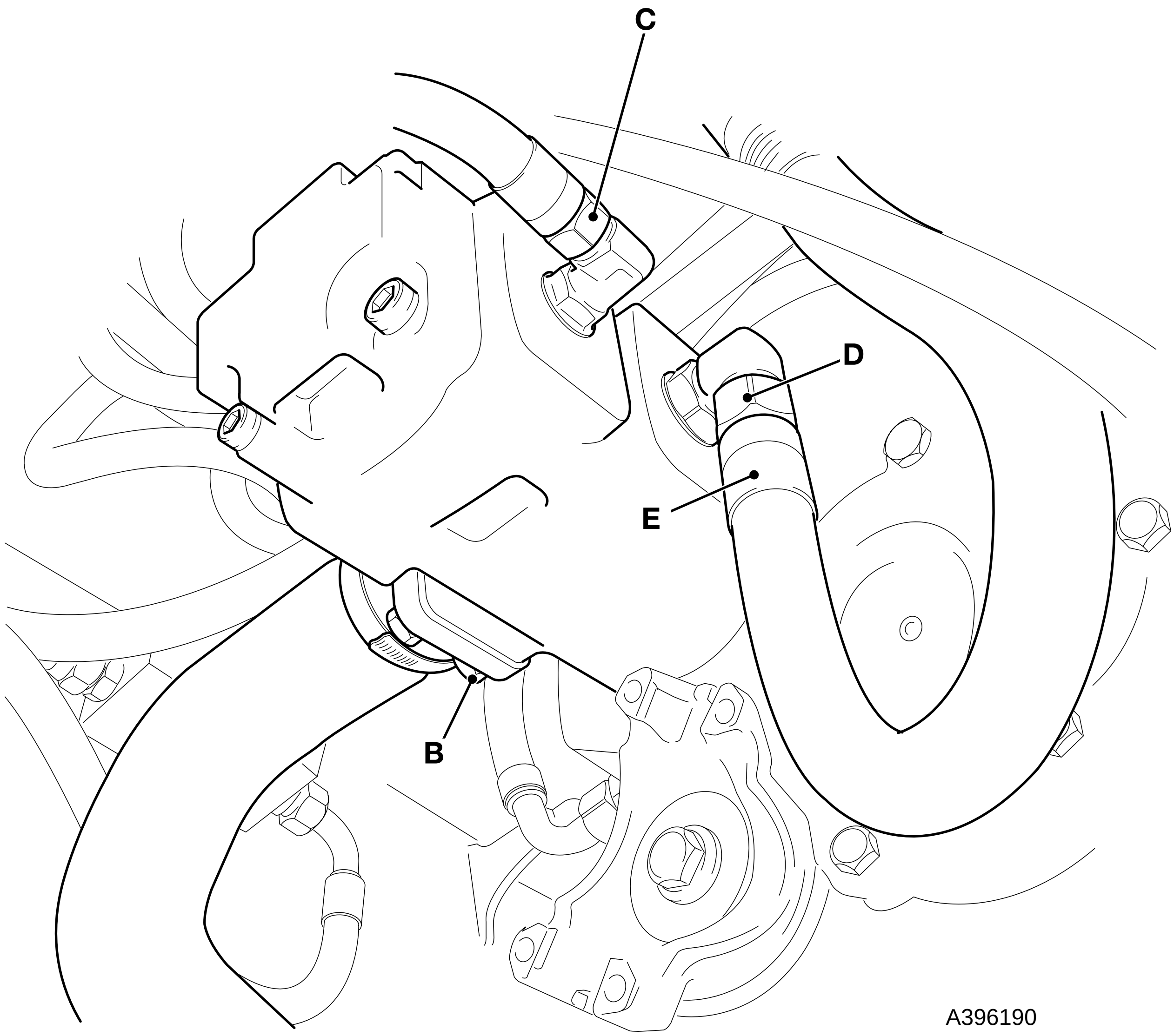


Fig 149. Removal and Replacement

Table 21. Torque Settings

Item	Nm	kgf m	lbf ft
B	TBA		
E	TBA		

Dismantle, Inspection and Assemble

Before removing and dismantling the pump, check flow and pressure. If either of these are low the pump must be changed. Renewal of components such as gears, bearings and housing will not effect a permanent cure. If the pump output is satisfactory but there is external leakage, the pump should be removed and dismantled for re-sealing only.

Before removing and dismantling the pump, make sure the exterior of the pump and working area is thoroughly cleaned and free of possible sources of contamination.

Dismantle

⇨ *Fig 150. (E-173)*.

1 Remove the four bolts **3** and serrated washers **4** which clamp the units together.

2 Use a soft faced hammer to separate front body **5** and rear body **6** after first marking them to ensure correct re-assembly.

3 Remove splined coupling **7** and O-rings **8**. Discard the O-rings.

4 Use a soft faced hammer to separate end cover **9** from rear body **6**, after first marking them to ensure correct re-assembly.

5 Remove drive gear **10** from its bore. Pushing it out of the rear body will also remove balance plate **11** complete with seal **12** and seal energiser **13**. Discard the seal and seal energiser. Note the position of the driveshaft and the balance plate to ensure correct re-assembly.

6 Remove driven gear **14**, followed by balance plate **15** complete with seal **16** and seal energiser **17**. Discard the seal and seal energiser.

7 Discard O-ring **18**.

8 Use a soft hammer to separate mounting flange **19** from front body **5**, after first marking them to ensure correct re-assembly.

9 Remove circlip **21** and shaft seals **22**. Note which way round the seal lips are fitted to ensure correct fitting of new seals on re-assembly.

10 Remove driveshaft **23** from front body **5**. Removal will also remove balance plate **28** complete with seal **29** and seal energiser **30**. Discard the seal and seal energiser.

11 Remove driven gear **27** followed by balance plate **24**, seal **25** and seal energiser **26**. Discard the seal and seal energiser.

12 Discard O-ring **31**.

13 Remove all sealant from the contact faces of the mounting flange, front body, end cover and rear body interfaces.

14 Wash all components and immediately apply a coating of hydraulic oil to prevent corrosion.

Inspection

⇨ *Fig 150. (E-173)*.

1 Generally check all pump parts for damage and or wear. The O-ring grooves, the seal recess in the mounting flange and all sealing faces must be free of burrs and scores which could result in seal damage and hence hydraulic oil leakage.

2 Renew the pump if any of the following symptoms exist:

a The PTFE coated bearings in the pump bodies, the mounting flange and the end cover are worn through to reveal the bronze backing.

b The gear side faces are scored. Often contaminated fluid results in a distinct wear step coincident with the gear root diameter. This can normally be felt by drawing a sharp point across the gear side face from the journal towards the tip of the gear.

c There is a noticeable wear groove on driveshaft **23** where seals **22** run.

d The balance plate faces are scored, particularly in the area adjacent to the gear root diameter.

e The shaft splines are worn or severely fretted.

f The gear `cut-in' area in the low pressure side of the pump body is deeper than 0.15 mm (0.006 in) or has a torn or pitted appearance.

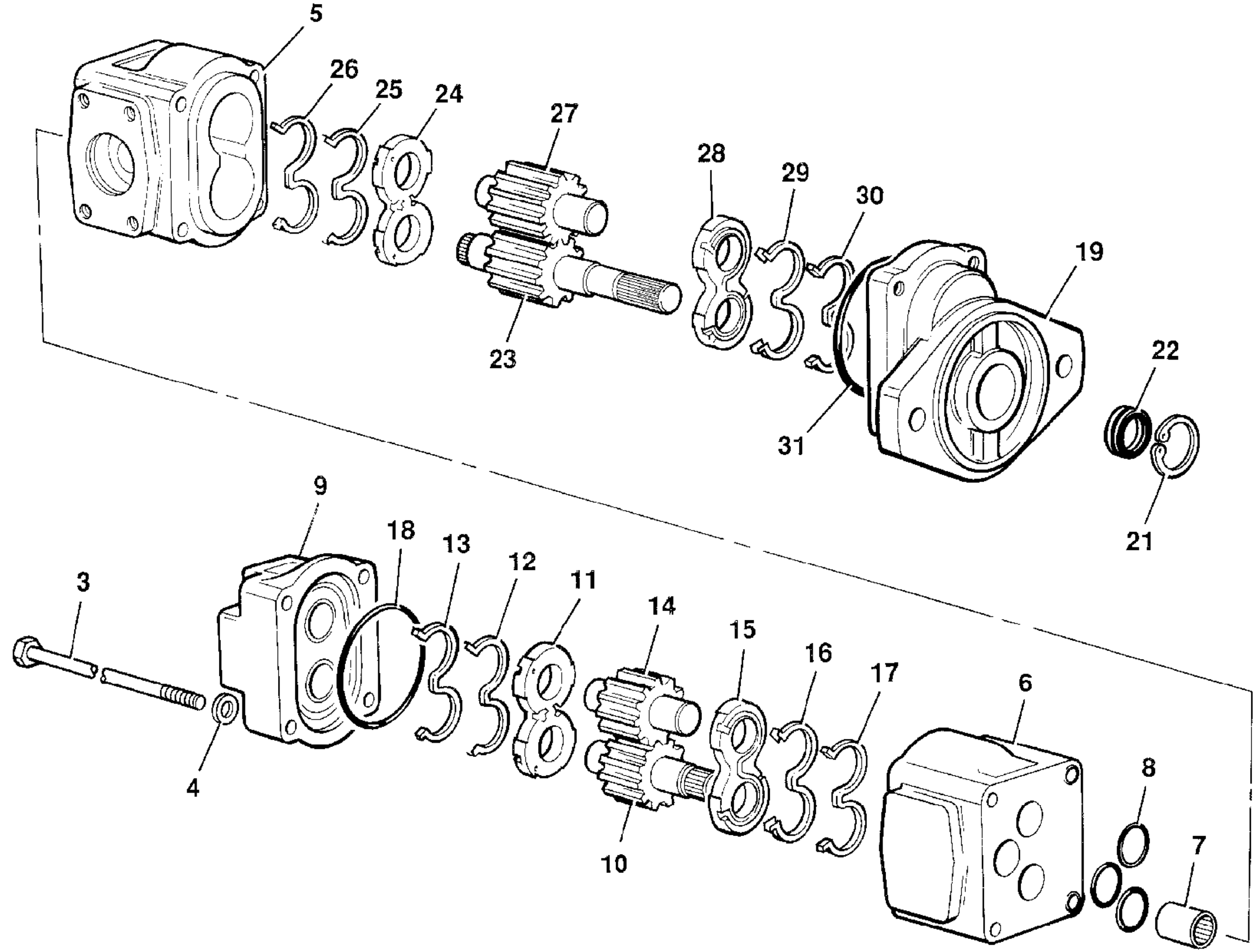


Fig 150. Dismantle, Inspection and Assemble

E-173

Assemble

⇒ *Fig 150. (E-173)*.

When carrying out the following procedure, renew all seals and O-rings. Lubricate using JCB Special Hydraulic Fluid.

1 Fit shaft seals **22** into mounting flange **19**, making sure the seal lips are the correct way round as noted in dismantling. Fit circlip **21** into its groove in the flange. Coat the seal lips with high melting point grease.

Note: *If the seal recess is scored, it is permissible to seal outside diameter with JCB Multigasket to prevent leakage.*

2 Stand front body **5** on its rear face. Fit seal **25** and seal energiser **26** into balance plate **24**.

3 Ensuring that the seals do not fall out, carefully feed the balance plate into the bores of the front body **5** with the two small holes through the balance plate to the low pressure side of the body (i.e. side with the large 4-bolt port pattern).

4 Insert driveshaft **23** and driven gear **27** into the original bores.

5 Fit balance plate **28** over the driveshaft and gear stub. Insert seal **29** and seal energiser **30** into the balance plate.

6 Fit O-ring **31** into the groove on mounting flange **19**.

7 Apply a small amount of JCB Multigasket to the face of front body **5** which seals with mounting flange **19** (i.e. the face containing the clamping bolt holes).

8 Carefully feed mounting flange **19** over driveshaft **23** in its original position, as marked earlier. Use a soft faced hammer to tap the flange onto its location spigot.

9 Support the front pump assembly on the mounting flange (but not the driveshaft). Fit O-rings **8** into the grooves on the rear face of the front body **5**. Install splined coupling **7**.

10 Fit rear body **6** onto front body **5** in its original position, as marked earlier, ensuring that it locates on the dowels and that the clamping bolt holes line up.

11 Fit seal **16** and seal energiser **17** into balance plate **15**. Ensuring that the seals do not fall out, carefully feed the balance plate into rear body **6** with the two small holes through the balance plate to the low pressure side (i.e. side without a port).

12 Fit drive gear **10** so that it locates with splined coupling **7**. Fit driven gear **14**.

13 Fit balance plate **11** in its original position (i.e. with the two small holes to the low pressure side). Fit seal **12** and seal energiser **13** into the balance plate.

14 Fit O-ring **18** into end cover **9**.

15 Apply a small amount of JCB Multigasket to the exposed face of rear body **6** (i.e. the face containing the clamping bolt holes).

16 Fit end cover **9** in its original position, as marked earlier.

17 Install the four bolts **3**, each with a serrated washer **4**, and tighten evenly and progressively. Torque tighten the bolts, ⇒ *Table 22. Torque Settings (E-174)*.

18 Pour a small amount of clean JCB Special Hydraulic Fluid into the ports. Check that driveshaft **23** rotates without undue force. If excessive force is required it is possible that one or more of the balance plate seals are trapped, in which case it will be necessary to dismantle and assemble the pump again.

Table 22. Torque Settings

Item	Nm	kgf m	lbf ft
3	90 - 100	9.2 - 10.2	66 - 74

Variable Flow Pump

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

Before commencing work, ensure that the exterior of the pump and the working area are thoroughly cleaned and free of possible sources of contamination.

Removal

1 Working beneath the machine, remove the propshaft, see ***Section F Transmission, Propshafts - Removal and Replacement.***

2 Drain the hydraulic fluid from the tank.

3 ⇨ *Fig 151. (E-176)*. Remove flange bolts **A** (4 off) and disconnect the inlet hose from the pump.

4 Remove flange bolts **B** (4 off) and disconnect the outlet hose from the pump.

5 Disconnect the load sense and case drain hoses at the pump.

Plug all open ports and cap the hose ends to prevent loss of fluid and ingress of dirt.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

6 Support the weight of the pump with suitable lifting equipment, then remove the two securing bolts **C**. Carefully withdraw the pump from the gearbox and lower to the ground.

Replacement

Replacement is the reverse of the removal procedure, but note the following:

Fit a new O-ring at the pump to gearbox casing mating face. Make sure the mating faces are clean and free from dirt.

Fit new O-rings to the inlet and outlet hose flanges. Lubricate the O-rings with clean hydraulic fluid.

Apply JCB Threadlocker and Sealer to the threads of bolts **A**, **B** and **C** before fitting. Torque tighten the bolts.

⇨ *Fig 152. (E-176)*. Fill the hydraulic tank with clean hydraulic fluid. Loosen cap **X** and allow any trapped air to escape from the pump case and drain hose **Y**.

After fitting a new or serviced pump, and before starting the engine screw the main relief valve out. Run the engine and check for leaks, also check the main relief valve operating pressure, see ***Service Procedures, Variable Flow Pumps - Flow and Pressure Testing***.

Note: *Replace the suction strainer and return line filter after fitting a new or serviced pump.*

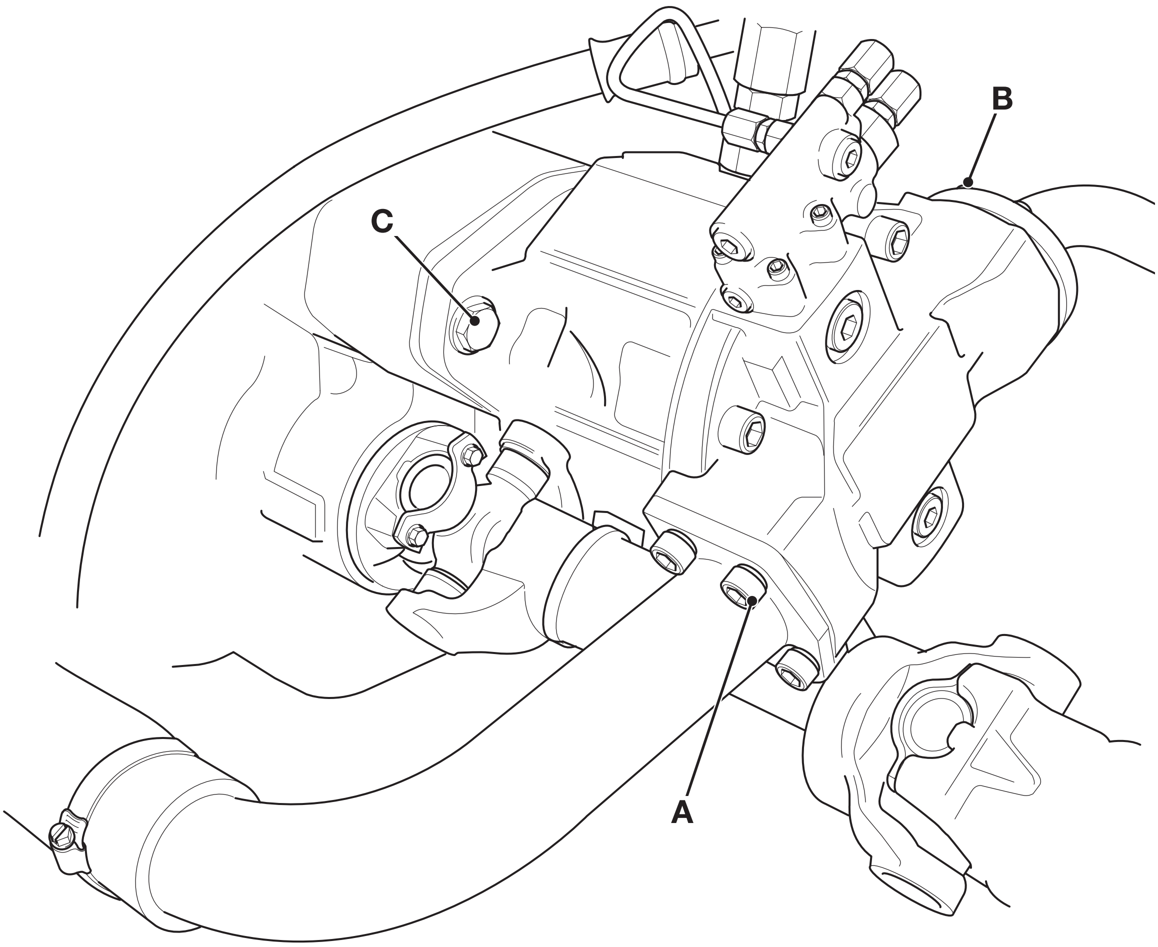


Fig 151. Removal and Replacement

Table 23. Torque Settings

Item	Nm	kgf m	lbf ft
A	139	14.17	102
B	80	8.12	59
C	205	20.9	151

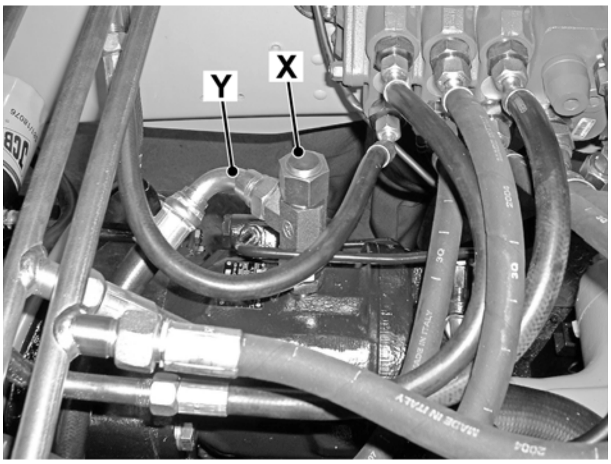


Fig 152.

Dismantle, Inspection and Assemble

⇨ *Fig 153. (E-178)*.

Before removing and dismantling the pump, make sure it is the pump that is at fault. Complete all the necessary checks as detailed in ***Service Procedures, Variable Flow Pumps***. Make sure that the exterior of the pump and working area is thoroughly cleaned and free of possible sources of contamination. Following removal of the pump from the machine, transfer it to a clean dirt free environment ready for dismantling.

The variable displacement pump has matched-ground components. For this reason, some items will only be available as a sub-assembly, for instance the barrel and piston assembly.

All the `O' rings, seals and bearings are available in a kit form from your JCB Distributor.

Dismantle

Refer also to ***Service Procedures, Variable Flow Pumps - Renewing Drive Shaft Seal***.

1 Remove capscrews **1** (4 off) and detach the regulator assembly **2** from the pump housing.

2 Mark the position of the port plate **3** to pump housing **4**.

3 Remove socket screws **5**, and remove the port plate together with the valve plate **6**, control piston **7** and stroking piston **8**. Hold the plate in position during removal.

4 Remove taper roller bearing **9** and shim **10** from the drive shaft **11**.

5 Remove the rotary piston assembly **12** from the pump housing. Assembly includes shaft **11**, bearing **15**, and cradle **16**.

6 Remove and discard port plate to pump housing `O' ring **13**.

7 Remove bearing shells **14** and disc **17**.

8 Remove the outer bearing races (not shown) from the pump housing and the port plate. Only remove the races if they are damaged and unserviceable.

9 Lift the valve plate **6** off the port plate, do not lose the dowel pins (not shown).

10 Remove and discard `O' rings **18**.

11 Remove control piston **7**. Note that the control piston is mounted on the same side as the regulator valve.

12 Remove the stroking piston assembly **8**.

Further dismantling of the pump is not recommended.

Inspection

Generally check all pump parts for damage and or wear. Any parts that are scored or damaged must be replaced with new ones.

The shaft `O' ring grooves and all sealing faces must be free of burrs and scores. During assembly, make sure that the rotary piston group move freely. Renew all `O' rings and seals.

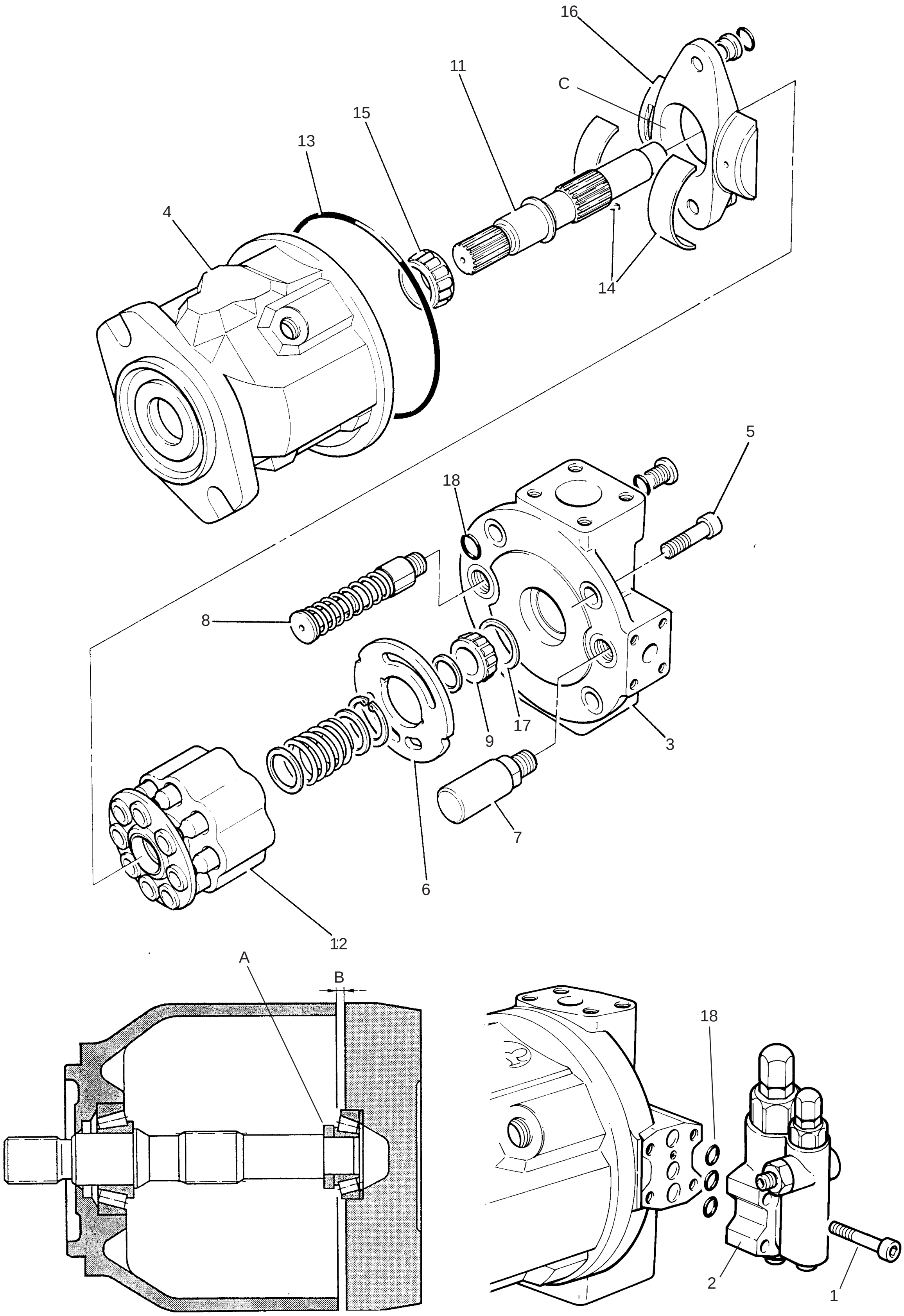


Fig 153. Dismantle, Inspection and Assemble

Assemble

➩ *Fig 153. (E-178)*.

Assembly is generally a reversal of the dismantle procedure, but note the following:

The taper roller bearing must have a preload of 0.0 to 0.05mm (0.0 to 0.002 in.). If the original bearing and shim is being fitted no preload adjustment is required. If a new bearing is installed a preload adjustment is required:

Preload Adjustment:

Install a setting shim of known thickness (as shown at **A**). The shim thickness must be manufactured to a tolerance of 0.01 mm (0.0004 in.). In this example the shim thickness is 1.5 mm.

Fit the port plate item **3** and finger tighten the socket screws. It is important that the socket screws are tightened evenly and the port plate sits square.

Using feeler gauges measure the gap **B** between the port plate and the pump housing **4**. Measure in more than one position to establish the port plate is fitted evenly. Obtain shim thickness (dimensions in mm):

Example measured gap	1.26
Subtract preload	- 0.05
Total	**1.21**
Known shim thickness	1.50
Subtract calculated preload	-1.21
SHIM THICKNESS	**0.29**

When the shim thickness has been calculated, remove the setting shim **A** and fit the required shim (in this instance the shim would be 0.29 mm).

Note: *Setting shim **A** is not currently available as a service tool. The shim (and the calculated shim) can be manufactured locally. Maintain a tolerance of 0.01 mm (0.0004 in.).*

The lubrication bore relief (item **C**) on the cradle must be fitted on the pressure side of the pump.

Check the control piston and the stroking piston move smoothly.

The regulator valve assembly is currently a non serviceable part.

Main Pump - 3C Machines (Sideshift)

Combined Gearpump/Priority Valve

Removal and Replacement

Before removing the pump, check the output flow and pressure, see ***Technical Data***. If the pump performance is below that specified and cannot be corrected at the relief valve, it should be renewed complete. Renewal of individual components such as gears, bearings and housing will not effect a permanent cure. If the pump output is satisfactory but there is evidence of external leakage, the pump should be removed and dismantled for re-sealing only.

Removal

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 Operate the loader control levers back and forth several times to vent any residual hydraulic pressure. Slowly release the hydraulic tank filler cap to vent any residual pressure from the tank. Refit the cap.

3 **IMPORTANT NOTE:** Disconnect the battery (as the starter motor terminals are situated directly below the pump).

4 Working in the engine compartment, remove the four screws **A** and disconnect the suction hose elbow **S** from the pump body. It will be necessary to locally manufacture a shortened (cut-down) allen key and a longer (extended) allen key to undo the two screws nearest the pump mounting flange.

Plug the suction hose and the open pump port to prevent loss of fluid and ingress of dirt. Tie up the suction hose out of harms way.

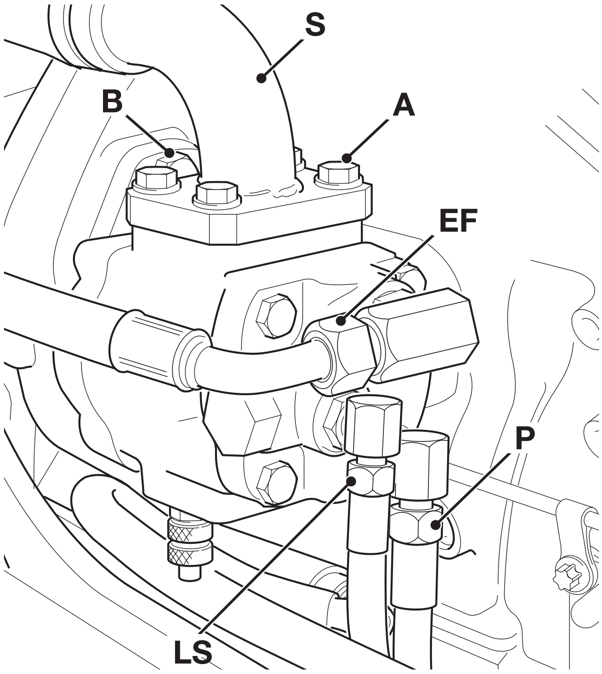


Fig 154.

5 Disconnect the load sensing hose **LS** and the two outlet hoses **P** and **EF**. Label each hose before disconnecting to ensure correct replacement. Plug the open ports and cap the hoses to prevent loss of fluid and ingress of dirt. Tie the hoses out of harms way.

6 Undo the two bolts **B** and carefully withdraw the pump from the engine.

Replacement

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

1 Ensure the pump flange and engine mating face are clean. Renew the O-ring on the pump flange spigot. Smear the O-ring with clean engine oil.

2 Torque tighten bolts **B**. ⇨ ***Table 24. Torque Settings (E-181)***.

3 Ensure the hoses are correctly installed, and phased in the same position as removal to prevent chafing.

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

4 After fitting a new or serviced pump and before starting the engine, screw the Main Relief Valve (MRV) out 4 full turns. Adjust the MRV, see ***Service Procedures, 3C Machines, Loader Valve - Pressure Testing***.

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

Table 24. Torque Settings

Item	Nm	kgf m	lbf ft
B	98	9.99	72.3

Dismantle, Inspection and Assemble

Before removing and dismantling the pump, check the output flow and pressure, see ***Technical Data***. If the pump performance is below that specified and cannot be corrected at the relief valve, it should be renewed complete. Renewal of individual components such as gears, bearings and housing will not effect a permanent cure. If the pump output is satisfactory but there is evidence of external leakage, the pump should be removed and dismantled for re-sealing only.

Before dismantling, ensure that the exterior of the pump and the working area are thoroughly cleaned and free of possible sources of contamination.

Dismantle

1 ⇨ *Fig 155. (E-183)*. Match mark the pump body **8**, priority valve body **6** and mounting flange **11** to ensure correct re-assembly.

2 Hold the input drive gear **3** in a vice fitted with soft-jaws. Bend back the lock-washer tabs flat and loosen the retaining nut **1**.

Important: *Do not hammer the pump driveshaft or the pump internal components will be damaged.*

3 Using a suitable puller, remove the input gear **3**. Retain the woodruff key **4**.

4 Remove the four screws **5** securing the priority valve assembly **6** to the pump body **8** and place the priority valve assembly to one side.

5 Remove the four nuts **9** and washers **10**, separate the mounting flange **11** from the pump body **8** using a soft faced hammer.

6 Drift out the outer shaft seal **13**, then remove the retaining circlip **14** and finally remove the inner shaft seal **15** from the mounting flange, ensuring that the shaft seal recess is not damaged.

7 Grasp the driveshaft **19** and remove complete with the driven gear assembly **20** and balance plate **16**. Mark the balance plate to ensure correct refitment.

Note: *Further dismantling of the driveshaft gear and driven gear assemblies **19** and **20** is not recommended.*

8 Remove the lower balance plate **16**. Mark the balance plate to ensure correct refitment.

9 Hold the priority valve body **6** in a soft-jaw vice and remove the spring seat **21**. Note that there may be shim(s) in the base of the valve seat under the spring (retain the shims if fitted). Withdraw the spring **23** and spool **24** taking care not to damage the spool surfaces.

Inspection

Pump

Inspect the `O' ring groove and shaft seal recess in the mounting flange, these should be undamaged and free from `burrs'.

The pump must be renewed if:

– The PTFE coated bearings in the body and/or mounting flange are worn through revealing the bronze backing.
– The gear side faces are scored; often operation with contaminated fluid results in a distinct wear step coincident with the gear tooth root diameter with corresponding wear on the balance plates.
– There is a noticeable wear groove on the driveshaft where the shaft seal lips run.
– The bronze balance plates are scored.

Note: *It is not recommended that damaged gears, body, mounting flange or balance plates are replaced individually as this will not effect a good repair.*

Priority Valve

Clean the valve body, spool and other components using clean hydraulic fluid. Examine the spool, and if the lands are scored, the complete valve assembly must be replaced.

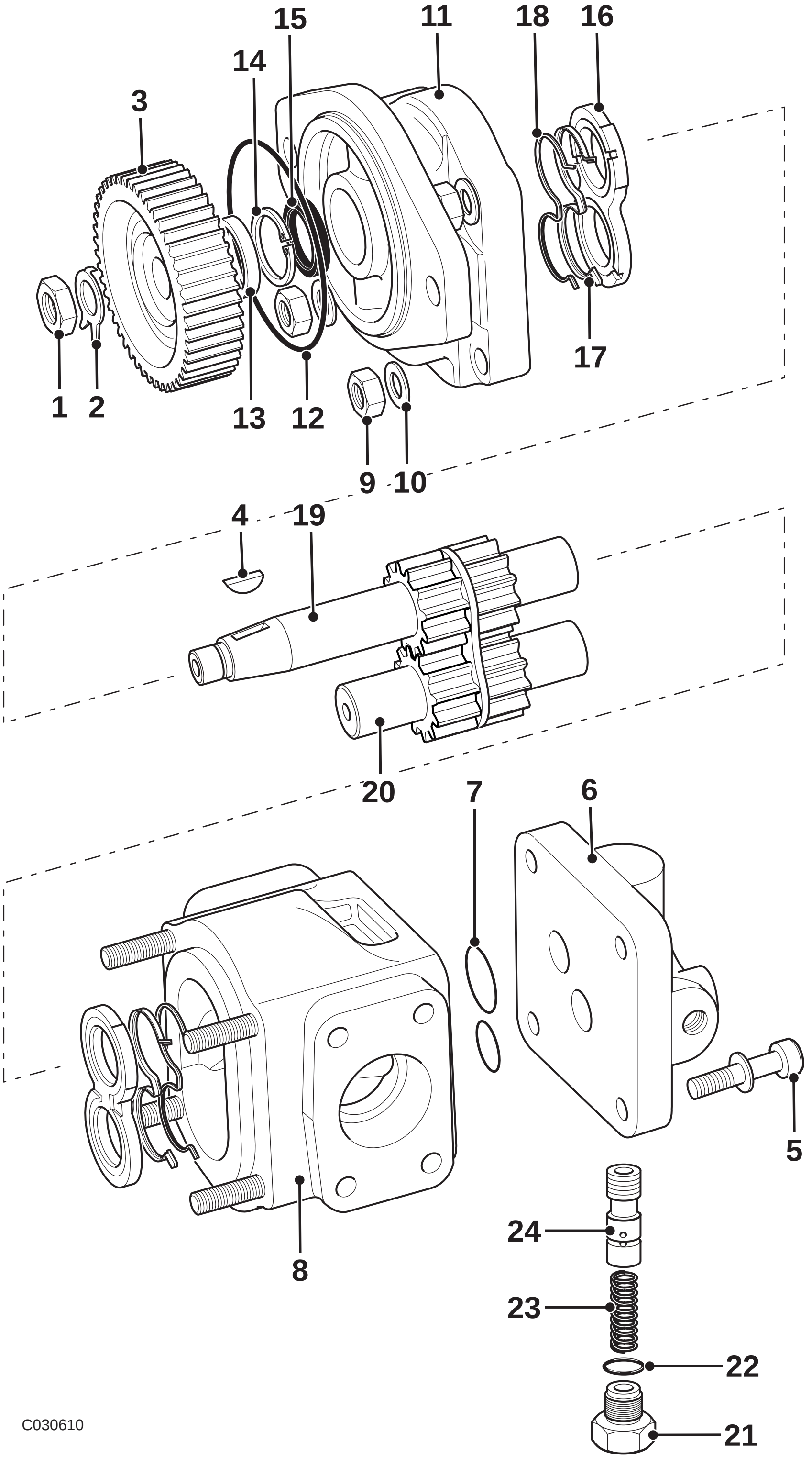


Fig 155. Pump and Priority Valve Components

Assemble

Pump

Prior to assembly all parts must be perfectly clean and lubricated with clean hydraulic fluid.

Renew all seals using clean hydraulic fluid as a lubricant.

1 ⇨ *Fig 155. (E-183)*. Fit new inner shaft seal **15** into the mounting flange **11** with the garter spring facing towards the pump, refit the circlip **14**. Fit new outer shaft seal **13** with the garter spring uppermost. Coat the seal lips with a high melting point grease.

2 Stand the pump body on its rear face. Fit new seal **18** and back-up seal **17** into the groove in the balance plate **16** and feed into the bore. Ensure that the seals remain in their groove and that the two small holes in the balance plate are to the low pressure side of the pump, i.e. the side with the largest port.

Note: *A light coating of petroleum jelly may be applied to the seal, back-up seal and balance plate face to keep the seals in place during assembly.*

3 Insert the driveshaft **19** and driven gear assembly **20** into their original bores.

4 Replace the second balance plate **16** into its original position, with the small holes towards the low pressure side, and fit new seal **18** and back-up seal **17**.

5 Fit new O-ring **12** into its groove in the mounting flange **11** and also apply a small amount Loctite 574 sealant to the body lower face, i.e. outboard of the oval location. This sealant is to prevent moisture entering this area and causing corrosion and is not a hydraulic seal.

6 Carefully fit the mounting flange **11** in its original position, the 4 mm diameter drain hole in the rear face must be to the low pressure side. Take care not to damage the seal on the shaft.

7 Fit the washers **10** and nuts **9** to the studs and tighten evenly. ⇨ *Table 25. Torque Settings (E-184)*

8 Ensure that the driveshaft taper and the input gear tapered bore are free from oil/grease. Fit the woodruff key **4** into its slot in the driveshaft. Fit the input gear **3**, new tab washer **2** and retaining nut **1**. Torque tighten the retaining nut **1**. ⇨ *Table 25. Torque Settings (E-184)*.

9 Pour a small amount of clean hydraulic fluid into the inlet port and check that the driveshaft can be turned without undue force.

Priority Valve

Prior to assembly all parts must be perfectly clean and lubricated with clean hydraulic fluid.

Renew all seals using clean hydraulic fluid as a lubricant.

1 Fit new O-ring **22** to spring seat **21**.

2 Coat spool **24** in clean hydraulic oil and slide carefully into its bore making sure it is orientated with the spring recess uppermost and that it moves smoothly. Fit the spring **23** and any shim(s) removed during dismantling to the spring seat. Fit the spring seat **21** and torque tighten. ⇨ *Table 25. Torque Settings (E-184)*.

3 Fit new O-rings **7** to the pump body, using a thin smear of petroleum jelly to hold them in place. Make sure the pump and priority valve mating faces are clean. Fit the priority valve assembly to the pump body with the four screws **5**, ensuring that the priority valve is correctly orientated using the marks made at dismantling. Torque tighten the screws **5**. ⇨ *Table 25. Torque Settings (E-184)*.

Note: *The priority valve must be fitted to the pump in the correct orientation to ensure that the pump oil feed passages align with the valve feed port.*

Table 25. Torque Settings

Item	Nm	Kgf m	lbf ft
1	75 - 85	7.6 - 8.6	55 - 62.7
5	44 - 52	4.5 - 5.3	32.5 - 38.4
9	90 - 100	9.2 - 10.2	66.4 - 74
21	72 - 80	7.3 - 8.1	53 - 59

Loader Valve

Removal and Replacement

⇨ *Fig 156. (E-186)*.

⚠ 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

1 Operate the valve block levers back and forth to vent residual pressure.

2 Remove clevis pins **A** and nuts **B** to disconnect the control levers from the valve block spools.

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

4 Uncouple the dump solenoid electrical connector **G**. Uncouple the electric detent connector **H** (if fitted).

5 Loosen and remove the three fixing nuts **J**. Remove the loader valve and spacing washers **C**.

Replacement

Replacement is a reversal of the removal sequence.

⚠ 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

After replacement check the main relief valve (M.R.V.) and auxiliary relief valve (A.R.V.) pressure settings.

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.*

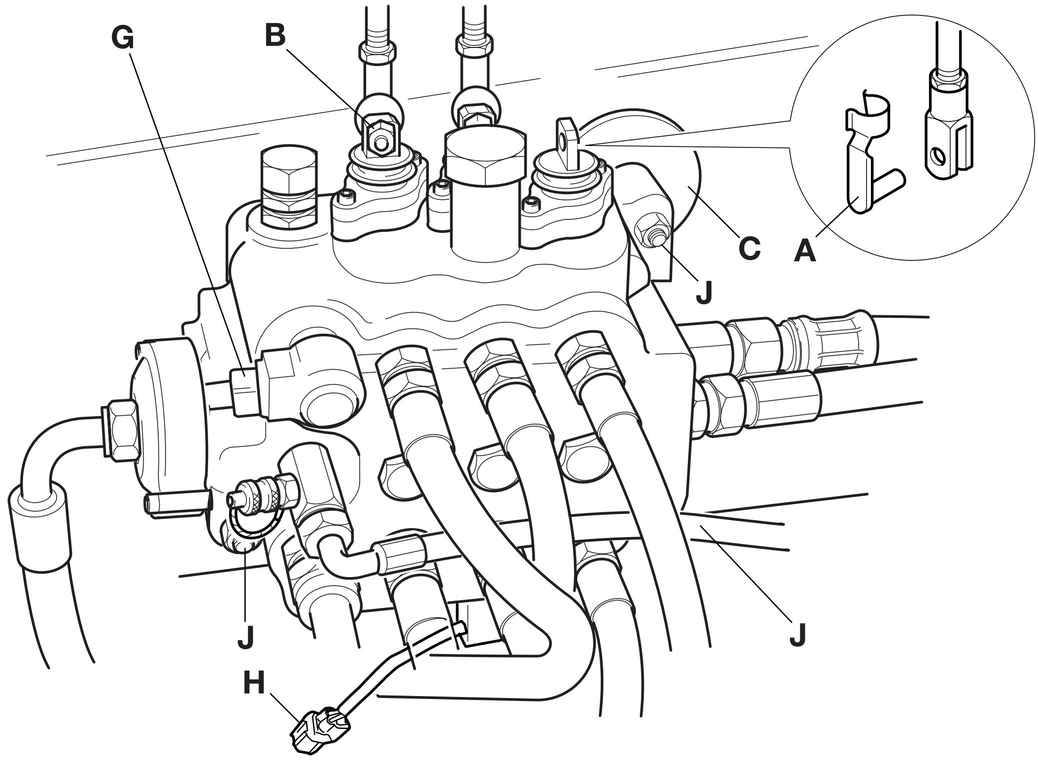


Fig 156. Loader Valve

Dismantle and Assemble

Main Relief Valve (MRV)

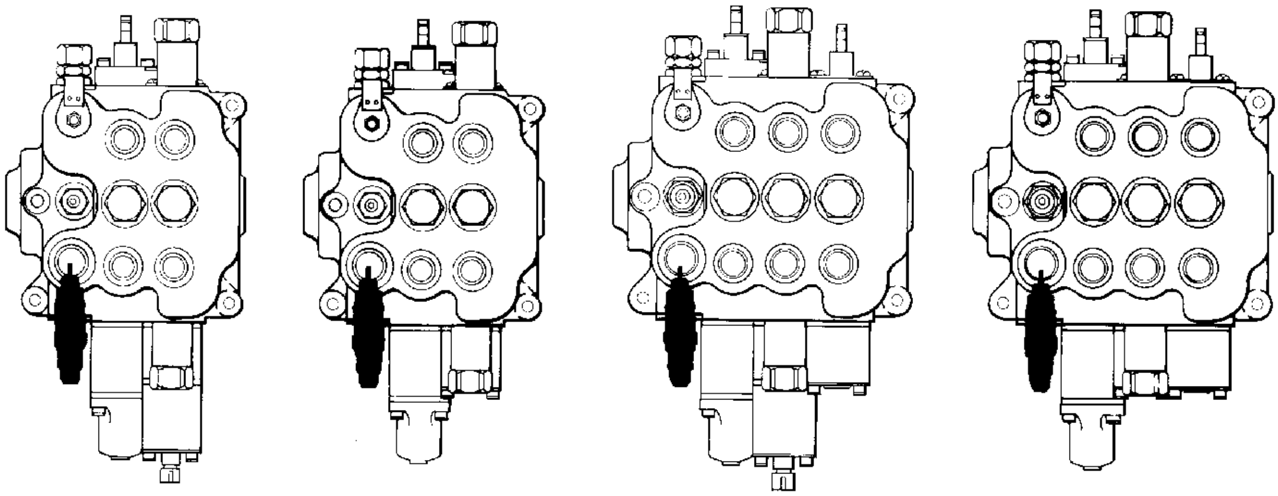


Fig 157.

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ *Fig 158. (E-188)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

– **Contamination**
– **Damage to spool**
– **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. DO NOT use worn or damaged items.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

Assemble

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **10** and **11**.

Adjust pressure setting as required, refer to ***Service Procedures, Loader Valve - Pressure Testing.***

Table 26. Torque Settings

Item	Nm	kgf m	lbf ft
3	5.4	0.6	4

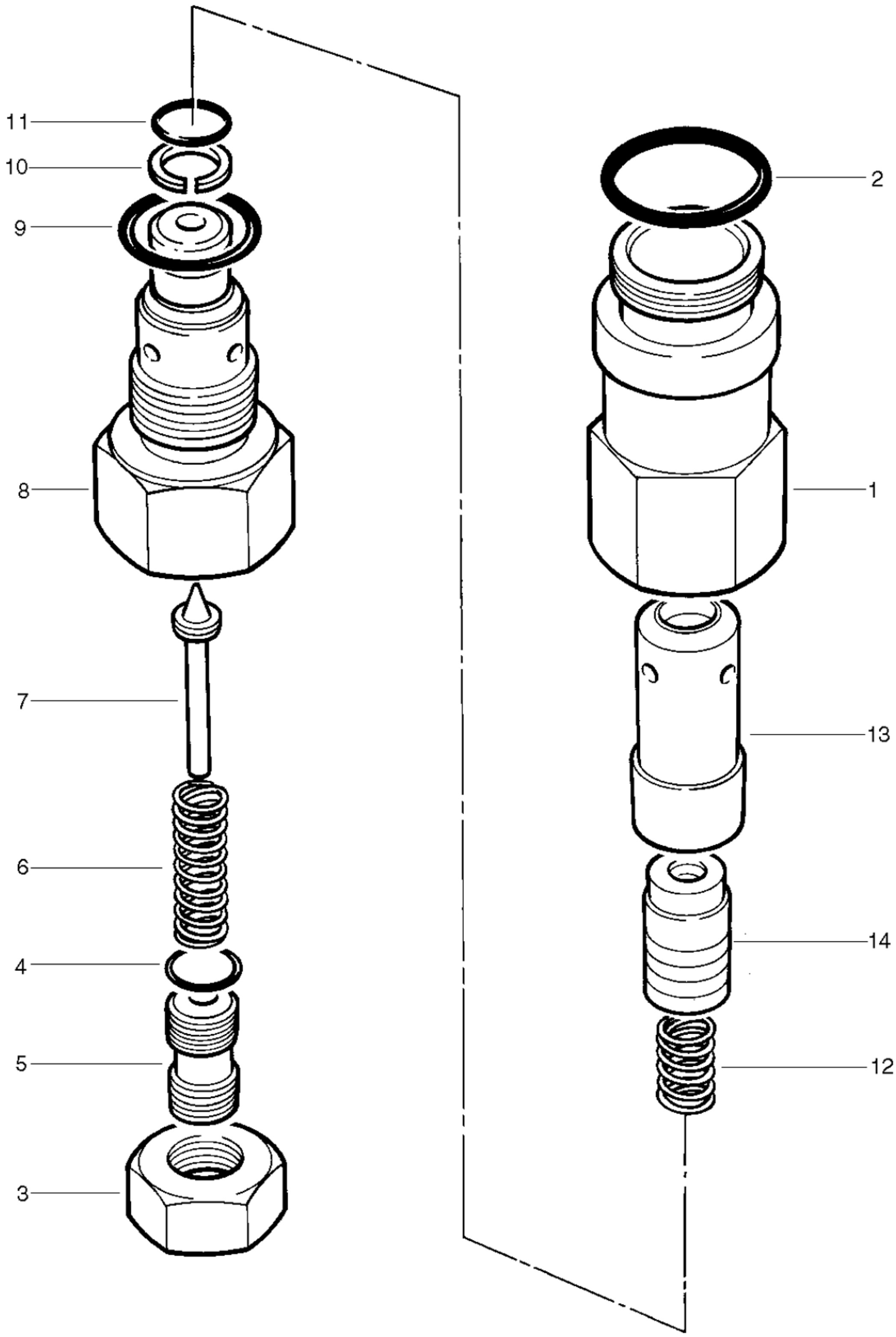


Fig 158. Main Relief Valve (MRV)

Auxiliary Relief Valves (ARV) and Load Hold Check Valves (LHCV)

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇒ *Fig 159. (E-190)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

– **Contamination**
– **Damage to spool**
– **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

The ARV's are identical in design but have different pressure settings, refer to ***Technical Data***.

The LHCV's are identical.

Dismantle

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. DO NOT use worn or damaged items.

Dismantle sub-assembly **14** from item **1** using a special tool (see ***Service Tools***). The special spanner locates in cross holes **B**.

Make sure that small drilling **A** is not blocked.

Ensure good condition of seating faces on poppet **18** and on the mating face of the valve block.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

Assemble

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Fit back-up ring **13** on the upper side of 'O' ring **12**.

Fit flat face of sleeve **9** against shoulder of poppet **10**.

Torque tighten item **14** using the special tool (see ***Service Tools***), until its shoulder seats firmly against item **1**.

Pressure test the relief valves, refer to ***Service Procedures, Loader Valve - Pressure Testing.***

Table 27. Torque Settings

Item	Nm	kgf m	lbf ft
1	65	6.6	48
3	24	2.5	18
15	81	8.3	60

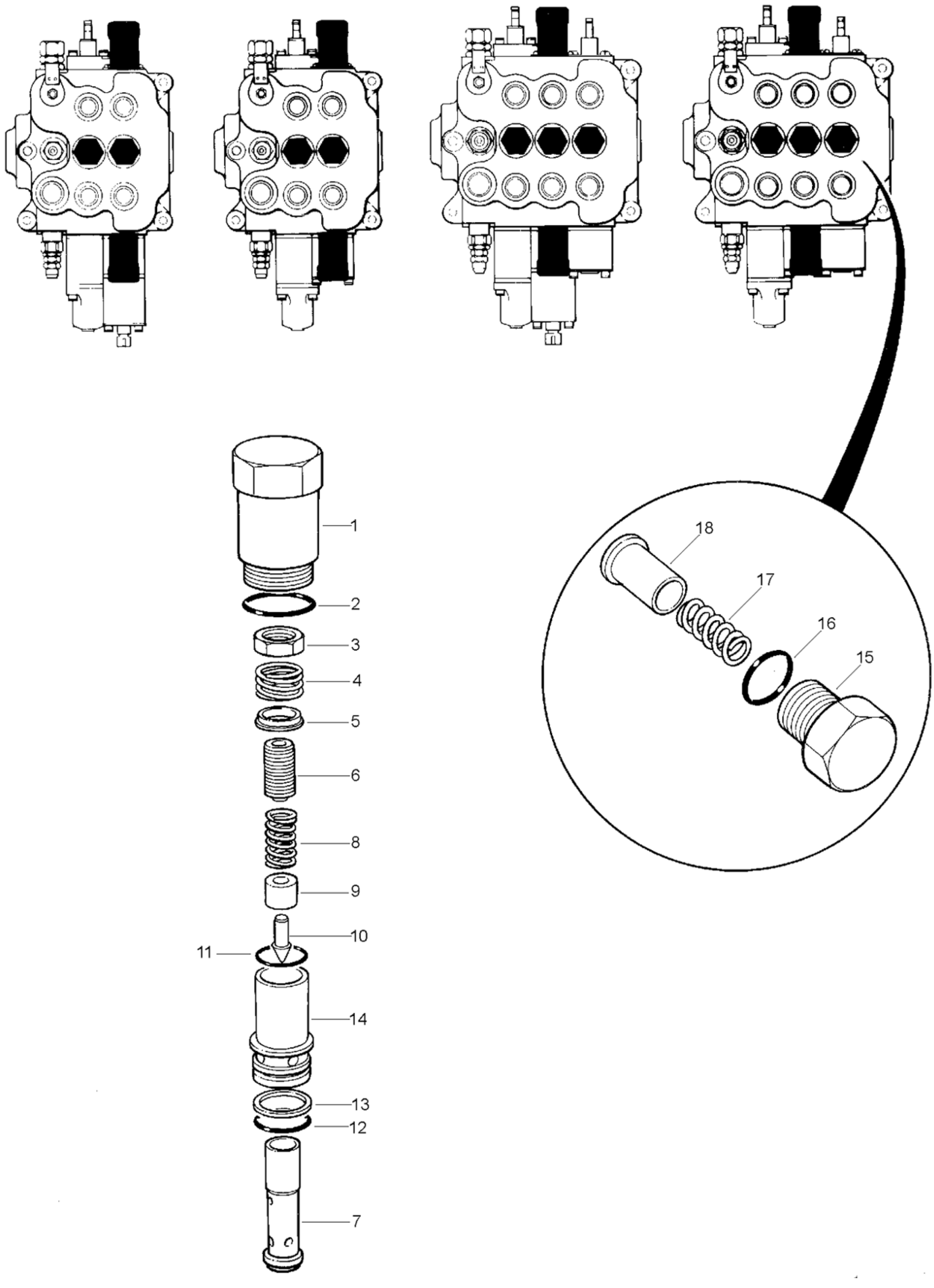


Fig 159. Auxiliary Relief Valve (ARV) and Load Hold Check Valve

Unloader Valve

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ *Fig 160. (E-192)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. DO NOT use worn or damaged items.

Use a nylon rod to push out spool assembly item **23**, DO NOT damage spool bore.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

Assemble

Renew all 'O' rings and back-up rings.Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.Ensure that the small drilling through the centre of items **23**, is clear.Shims **21** are intended to limit the maximum pressure setting, the specified pressure setting is achieved by adjusting capnut **15**. If the specified pressure cannot be achieved under test, it is permissible to add shims as required. There MUST be at least one hardened shim next to the spring item **22**.Do not over-tighten the solenoid assembly, it may effect the operation of the solenoid, use the spanner flats and torque tighten to figure indicated in the table below (items **1** and **5**).Fit chamfered end of spring **22** against head of pilot poppet item **23**.Check pressure setting after refitting, refer to ***Service Procedures, Loader Valve - Pressure Testing.***

Check the operation of the hydraulic speed control, refer to ***Service Procedures, Loader Valve - Pressure Testing.***

Table 28. Torque Settings

Item	Nm	kgf m	lbf ft
1	6.7	0.7	5
5	27	2.8	20
8	81	8.3	60
12	81	8.3	60
16	45	4.6	33
19	34	3.5	25

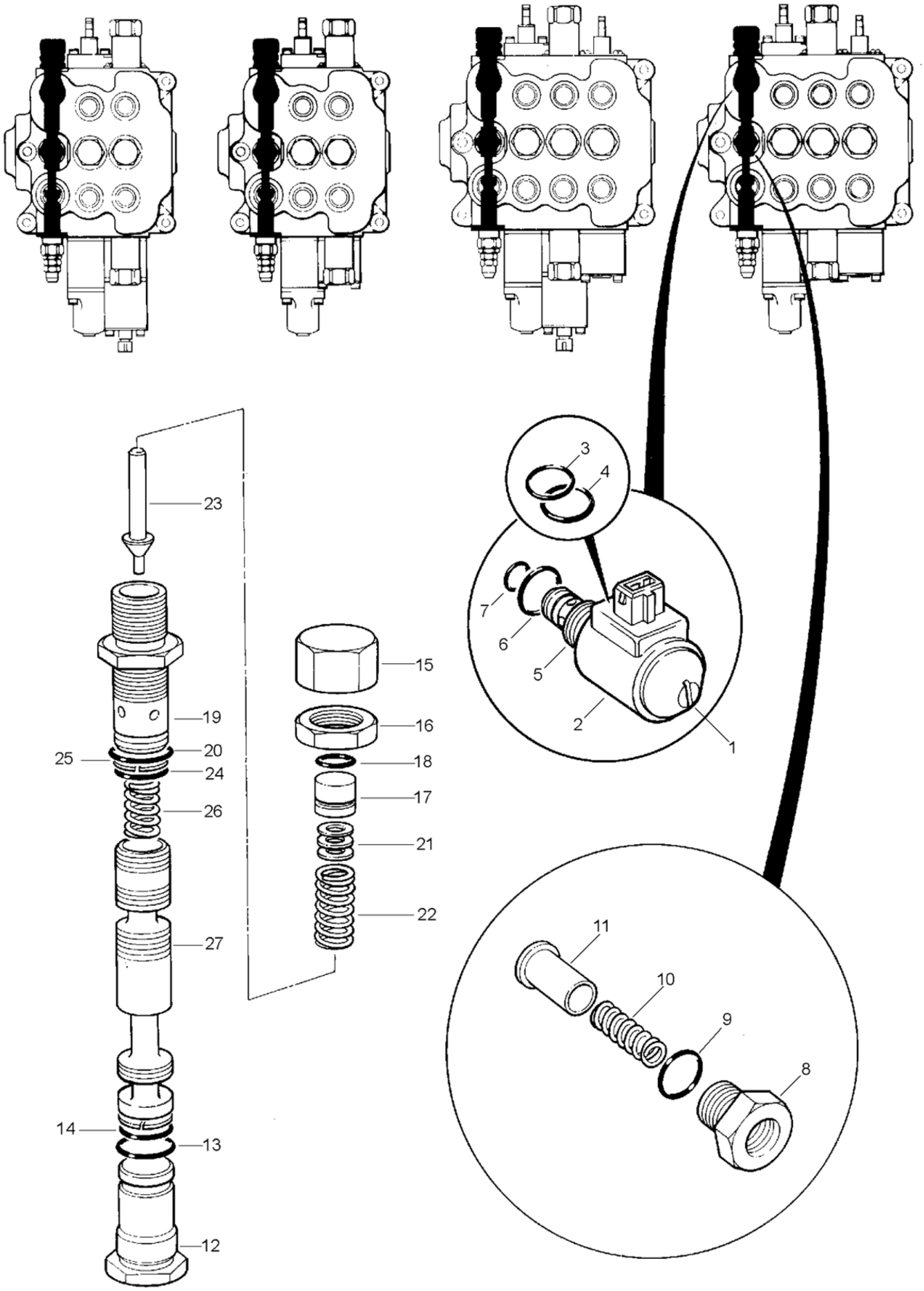


Fig 160. Unloader Valve

Standard Spool

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ *Fig 161. (E-194)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove the lever linkage from the tang (lever) end of the spool.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves, for instance, item **3**, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool **8** is not damaged when removing it from the valve block.

Hold the spool in clamp 992/10100, unscrew bolt **9** and remove spring **12**, spacer **10** and cups **11** and **13**.

Check for surface contamination on the under side of the seal plates **2** and **14**. Clean if necessary. Check for the flatness of the seal plate. If found to be bent - replace with new (any work previously carried out on this valve may have resulted in the bending of the seal plate).

Assemble

1 Fit the boot **1A** to the seal plate **2**.

2 Fit a new lipseal **4** into the valve block, ensure square. Fit wiper **3** on top of lipseal.

3 Fit the seal plate and boot assembly to valve block section but do not torque tighten capscrews **1** at this stage. Ensure wiper locates into seal plate.

4 Use clean hydraulic oil as a lubricant. From the bottom, insert spool through the valve block, do not use excessive force when fitting, a turning motion should ease the spool through the valve block.

5 Check that the tang end of the spool passes through the boot without dislodging or damaging the boot. Ensure that the tang aligns with the control rod and that the boot is not distorted and is located in the spool land.

6 Torque tighten cap screws **1**.

7 When fitting bolt **9**, clean the threads thoroughly using JCB Cleaner and Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

8 Make sure that all the parts move freely, check that item **10** does not interfere with item **13**.

9 Renew 'O' ring **15**. Make sure the 'O' ring is not trapped or damaged.

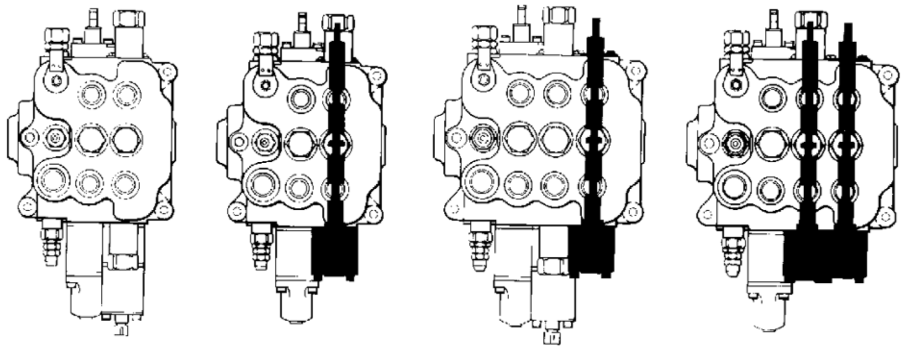
10 Fit seal **15** and seal plate **14** to the valve block section. Torque tighten capscrew **5** on completion.

Re-connect the lever mechanism to the tang (lever) end of the spool.

Run the engine and inspect the valve for external leaks.

Table 29. Torque Settings

Item	Nm	kgf m	lbf ft
1	9.5	0.96	7
5	9.5	0.96	7
9	9.5	0.96	7



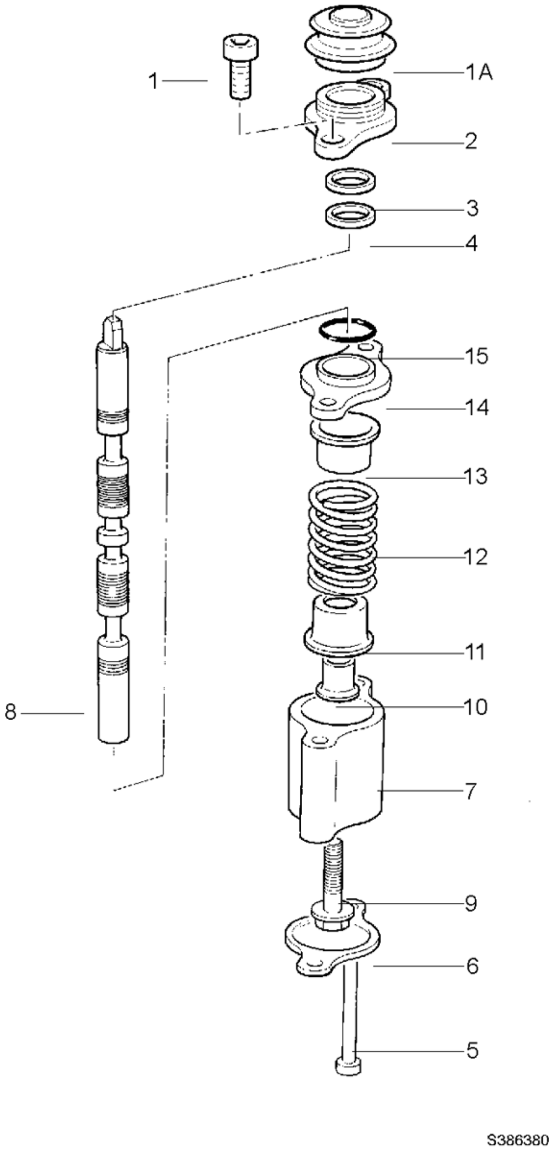


Fig 161. Standard Spool

Float Spool

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ *Fig 162. (E-196)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove the lever linkage from the tang (lever) end of the spool.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves, for instance, item **4**, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool **13** is not damaged when removing it from the valve block.

Carefully remove collar **9** and collect detent balls **10**.

Using tool 992/10100 to hold the spool, remove circlip **16**, plug **17**, ball **18** and spring **19**. Unscrew detent pin **20** and remove spring **22** and cups **21** and **23**.

Check for surface contamination on the under side of the seal plates **3** and **14**. Clean if necessary. Check for the flatness of the seal plate. If found to be bent - replace with new (any work previously carried out on this valve may have resulted in the bending of the seal plate).

Assemble

1 Fit the boot **2** to the seal plate **3**.

2 Fit a new lipseal **5** into the valve block, ensure square. Fit wiper **4** on top of lipseal.

3 Fit the seal plate and boot assembly to valve block but do not torque tighten capscrews **1** at this stage. Ensure wiper locates into seal plate.

4 Use clean hydraulic oil as a lubricant. From the bottom, insert spool through the valve block, do not use excessive force when fitting, a turning motion should ease the spool through the valve block.

5 Check that the tang end of the spool passes through the boot without dislodging or damaging the boot. Ensure that the tang aligns with the control rod and that the boot is not distorted and is located in the spool land.

6 Torque tighten cap screws **1**.

7 When fitting detent pin **20**, clean the threads thoroughly using JCB Cleaner and Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

8 Apply grease liberally balls **10**, this will help to hold the balls in position whilst assembling.

9 Renew 'O' ring **15**. Make sure the 'O' ring is not trapped or damaged.

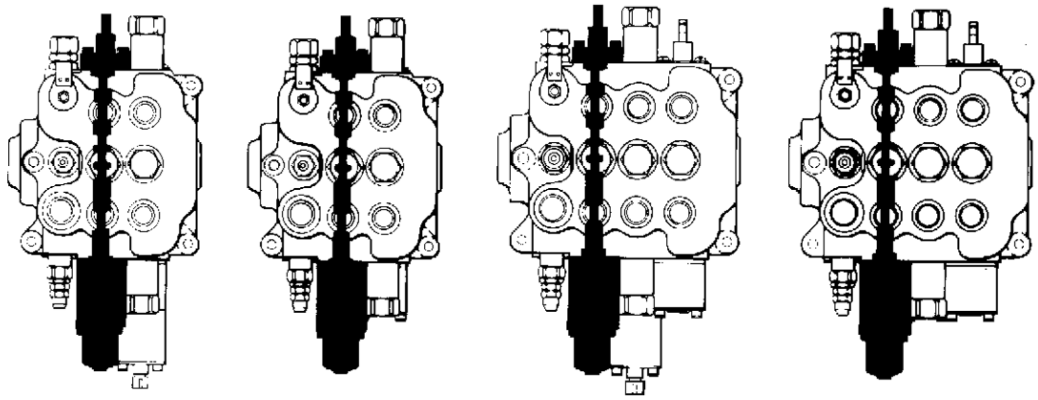
10 Fit seal **15** and seal plate **14** to the valve block section. Torque tighten capscrew **6** on completion.

Re-connect the lever mechanism to the tang (lever) end of spool.

Run the engine and inspect the valve for external leaks.

Table 30. Torque Settings

Item	Nm	kgf m	lbf ft
1	9.5	0.96	7
6	9.5	0.96	7
20	9.5	0.96	7



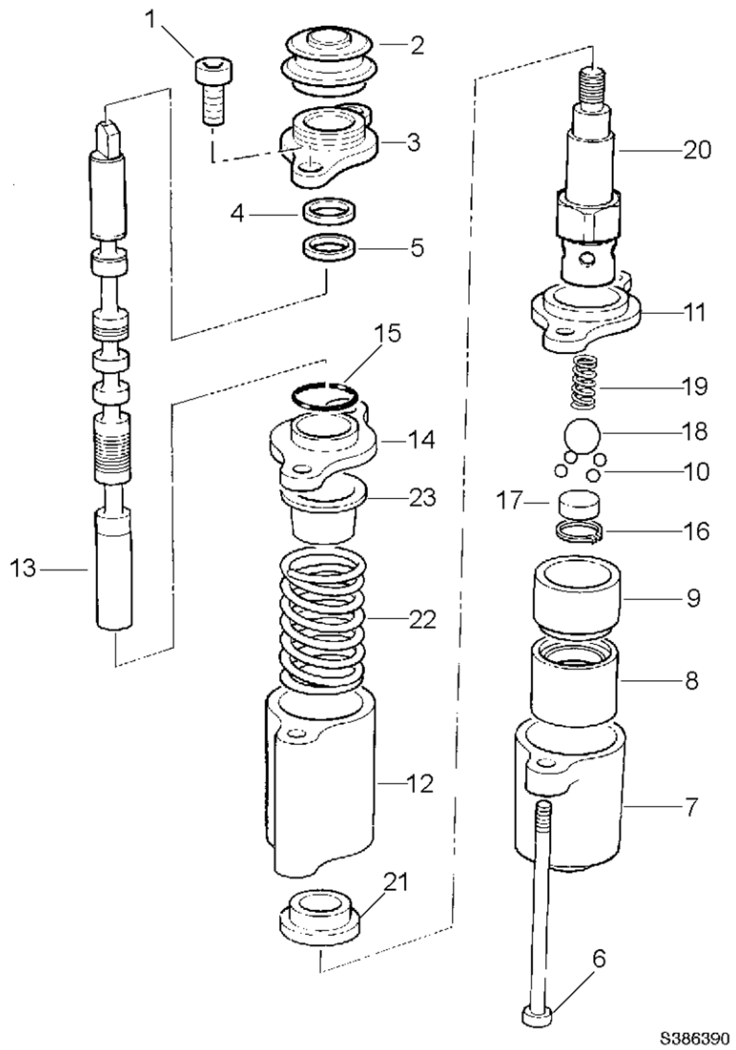


Fig 162. Float Spool

Electric Detent Spool

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ Fig 163. (E-198).

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves, for instance, item **3**, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool **12** is not damaged when removing it from the valve block.

Use tool 992/10100 to hold the spool, remove circlip **13** and 'clapper' **14**. Unscrew spool end **15** and remove spring **17** with cups **16** and **18**.

Check for surface contamination on the under side of the seal plates **2**, **8** and **10**. Clean if necessary. Check for the flatness of the seal plate. If found to be bent - replace with new (any work previously carried out on this valve may have resulted in the bending of the seal plate).

Assemble

1 Fit the boot **1A** to the seal plate **2**.

2 Fit a new lipseal **4** into the valve block, ensure square. Fit wiper **3** on top of lipseal.

3 Fit the seal plate and boot assembly to valve block but do not torque tighten capscrews **1** at this stage. Ensure wiper locates into seal plate.

4 Use clean hydraulic oil as a lubricant. From the bottom, insert spool through the valve block, do not use excessive force when fitting, a turning motion should ease the spool through the valve block.

5 Check that the tang end of the spool passes through the boot without dislodging or damaging the boot. Ensure that the tang aligns with the control rod and that the boot is not distorted and is located in the spool land.

6 Torque tighten cap screws **1**.

7 When fitting spool end **15**, clean the threads thoroughly using JCB Cleaner and Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

8 Make sure that the chamfer on item **14** faces away from the solenoid, item **6**.

9 Renew lipseal **11**. Make sure the lipseal is not trapped or damaged.

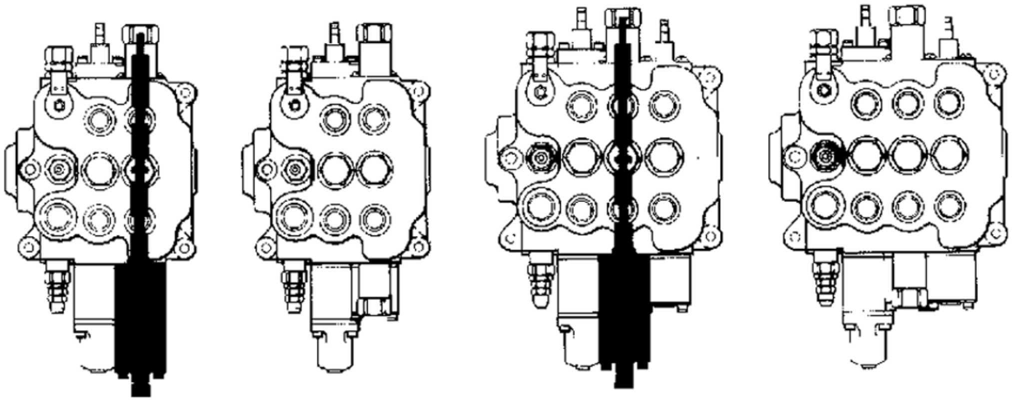
10 Fit lipseal **11** and seal plate **10** to the valve block section. Torque tighten capscrew **5** on completion.

Check the operation of the solenoid **6** after assembly by connecting a 12V supply. The spool should be held when it is pushed into the detent position and returned when the supply is disconnected.

Run the engine and inspect the valve for external leaks.

Table 31. Torque Settings

Item	Nm	kgf m	lbf ft
1	9.5	0.96	7
5	9.5	0.96	7
15	9.5	0.96	7



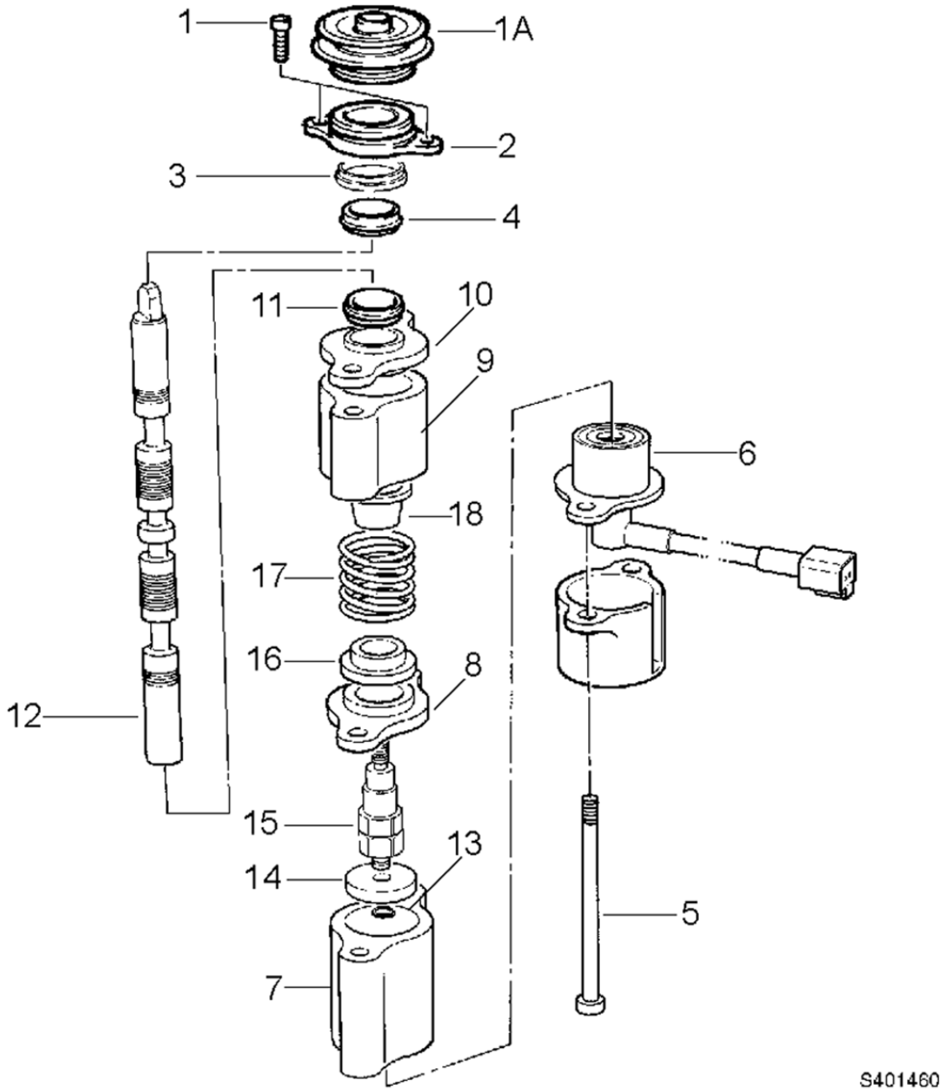


Fig 163. Electric Detent Spool

Loader Valve - Variable Flow

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

1 Operate the valve block levers back and forth to vent residual pressure.

2 Remove clevis pins **A** to disconnect the control levers from the valve block spools.

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

4 Loosen and remove nuts **B**, spacers **C**, the loader valve and resilient mounts **D**.

Inspection

Inspect the resilient mounts **D** for damage, cracking etc. If the mounts are suspect, then replace them with new ones.

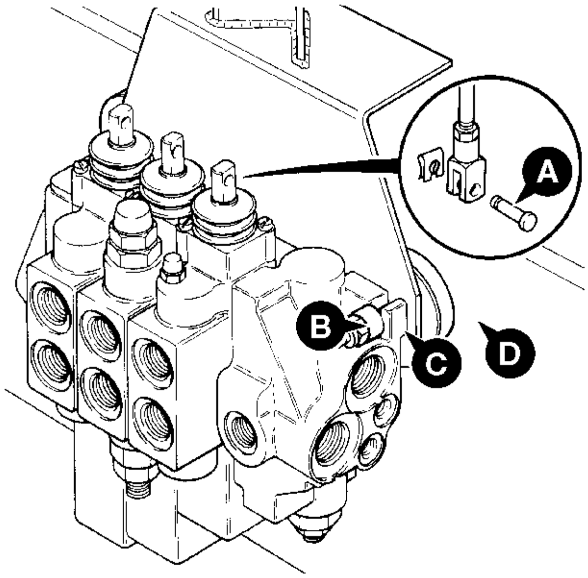


Fig 164.

Replacement

Replacement is a reversal of the removal sequence.

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

After replacement check the auxiliary relief valve (A.R.V.) pressure settings.

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

Dismantle and Assemble

Priority Inlet Section

⇨ *Fig 165. (E-201)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard `O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. DO NOT use worn or damaged items.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

Inspect screen **A**, make sure the screen is clean and free of dirt.

Take care not to lose ball bearing **17**.

If required, the relief valve assembly **9** can be dismantled for cleaning. It is important to note that this relief valve is fitted as a standard part of the inlet section. However, in this application it does not perform any duties. This is because the steer system pressure is controlled by a relief valve in the orbitrol steer unit (see ***Section H, Steering***), NOT relief valve assembly **9**.

After assembling the relief valve, screw the adjusting screw **18** fully into the valve housing. This will ensure assembly **9** does not interfere with the steer system pressure.

Assemble

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **11** and **12**.

ALWAYS fit three shim (item **5**) in between each valve block section as shown.

After assembly, make sure the steering operates correctly. The steer circuit will always have priority (see ***descriptions***).

Table 32. Torque Settings

Item	Nm	kgf m	lbf ft
1	41	4.1	30
7	67	6.9	50
9	67	6.9	50
16	13.5	1.38	10

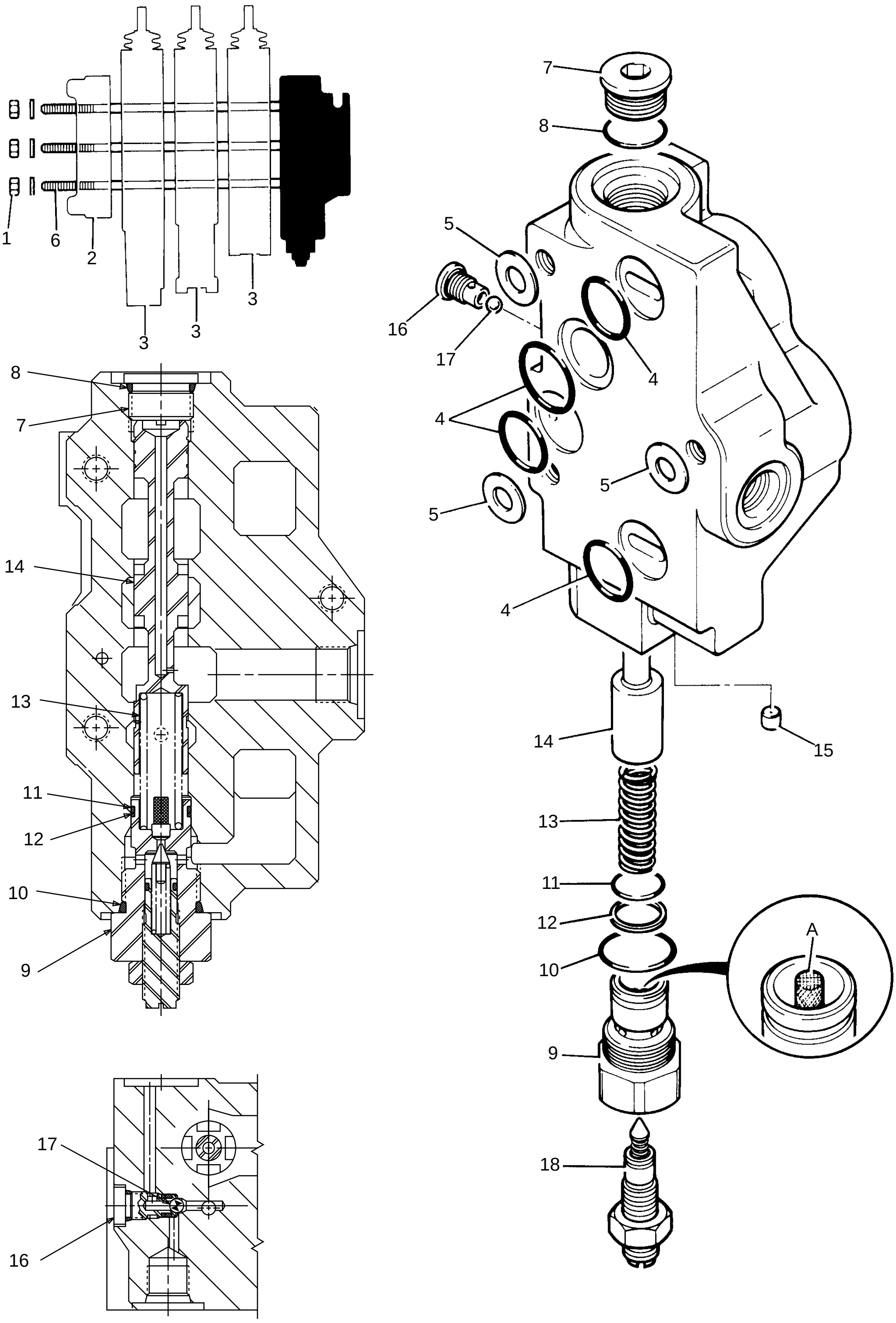


Fig 165. Priority Inlet Section

Auxiliary Spool

⇒ *Fig 166. (E-203)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard `O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves.

Care must be taken to ensure that the spool **13** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, unscrew bolt **14** and remove spring **17**, spacer **16** and cups **15** and **18**.

Assemble

Renew all 'O' rings and back-up rings.

When fitting bolt **14**, clean the threads then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

When fitting spool seals **19** and **20** refer to the procedure ⇒ *Fitting Spool Seal (E-208)*.

ALWAYS fit three shim (item **5**) in between each valve block section as shown.

Run the engine and inspect the valve for external leaks.

Table 33. Torque Settings

Item	Nm	kgf m	lbf ft
1	41	4.1	30
6	6	0.55	4
10	8	0.8	6
14	8	0.8	6
21	67	6.9	50
25	13.5	1.38	10
26	13.5	1.38	10

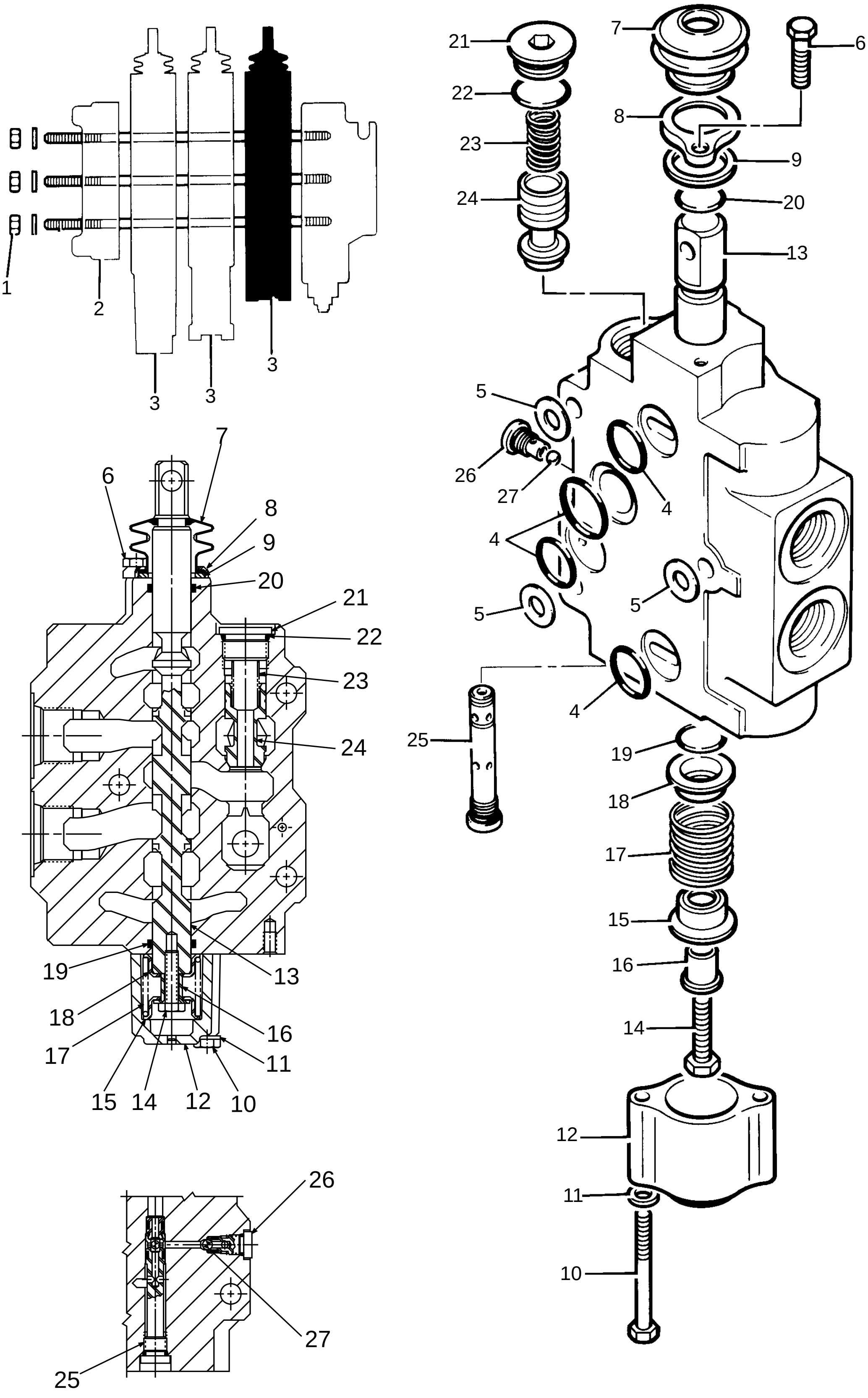


Fig 166. Auxiliary Spool

Loader Shovel Spool

⇨ *Fig 167. (E-205)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard `O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves.

Place a suitable rod through the eye end of spool **21**.

Care must be taken to ensure that the spool **21** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, Unscrew coupling **22** and remove spring **24** and cups **23** and **25**.

Relief valve assembly **30** can be dismantled for cleaning purposes only. Individual parts for the relief valve are not available (except seal kits).

Assemble

Renew all 'O' rings and back-up rings.

Inspect gasket **14**, replace with a new one if required.

When fitting coupling **22**, clean the threads then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

Check the operation of the solenoid **12** after assembly by connecting a 12V supply. The spool should be held when it is pushed into the detent position and returned when the supply is disconnected.

When fitting spool seals **34** and **35** refer to the procedure ⇨ *Fitting Spool Seal (E-208)*.

ALWAYS fit three shim (item **5**) in between each valve block section as shown.

Run the engine and inspect the valve for external leaks.

Table 34. Torque Settings

Item	Nm	kgf m	lbf ft
1	41	4.1	30
6	6	0.55	4
10	8	0.8	6
15	2.7	0.27	2
22	11	1.1	8
26, 30	67	6.9	50

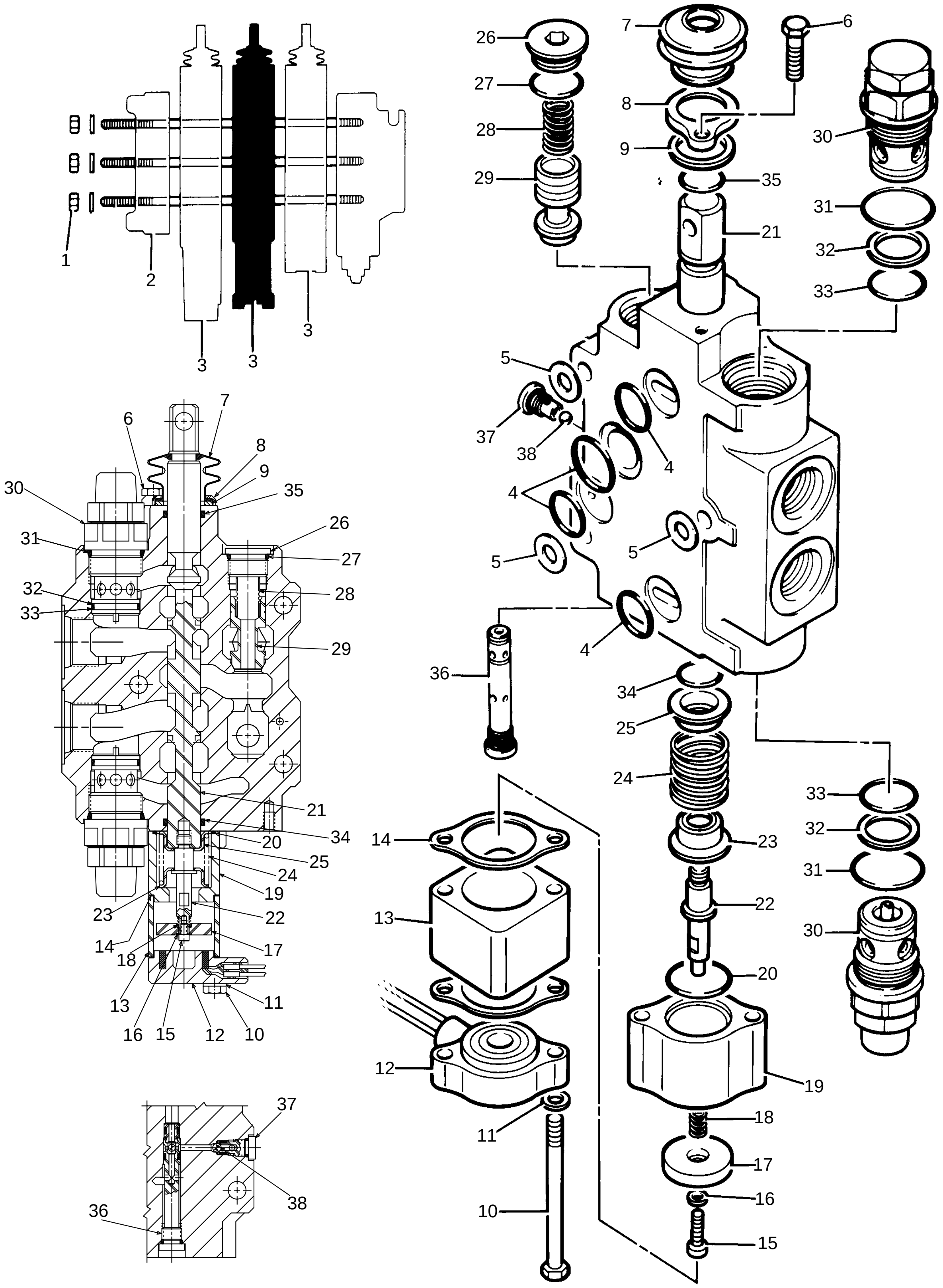


Fig 167. Loader Shovel Spool

Loader Lift Spool

⇨ *Fig 168. (E-207)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove tie rod nuts **1** and end cover **2**. Separate the valve sections **3** take care not to lose shims **5**. Remove and discard `O' rings **4**.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves.

Care must be taken to ensure that the spool **18** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, use a punch to separate detent shaft **19** from coupling **20**. Unscrew coupling **20** and remove spring **22**, spacer **23** and cups **21** and **24**.

Use a suitable press to compress spring **14** and remove retaining ring **12**. Take care not to lose detent balls **16**.

Assemble

Renew all 'O' rings and back-up rings.

When fitting coupling **20**, clean the threads then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

When fitting spool seals **26** and **27** refer to the procedure ⇨ *Fitting Spool Seal (E-208)*.

ALWAYS fit three shim (item **5**) in between each valve block section as shown.

Run the engine and inspect the valve for external leaks.

Table 35. Torque Settings

Item	Nm	kgf m	lbf ft
1	41	4.1	30
6	6	0.55	4
10	8	0.8	6
20	8	0.8	6
28	13.5	1.38	10
29	13.5	1.38	10
31	67	6.9	50

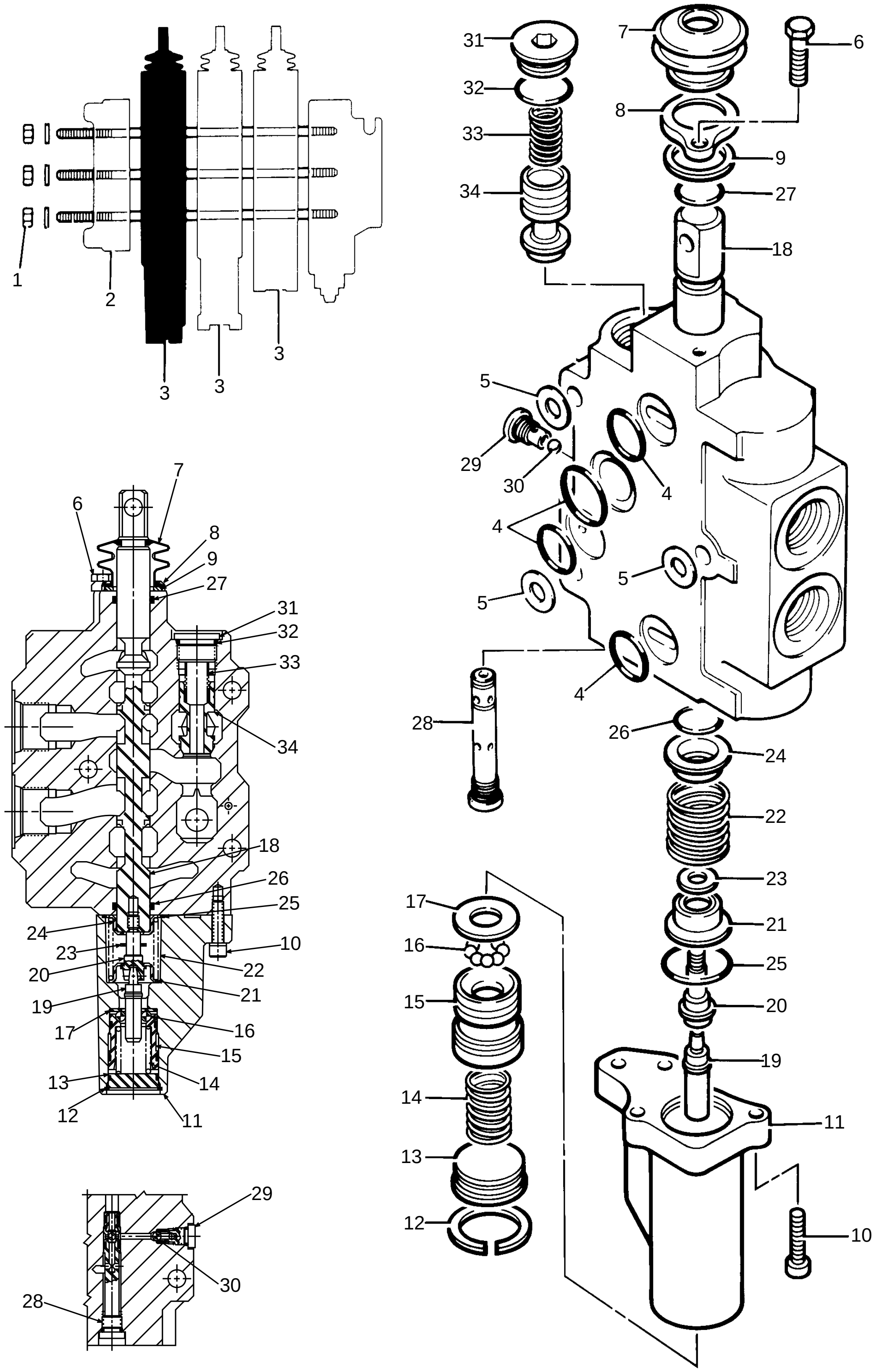


Fig 168. Loader Lift Spool

Fitting Spool Seal

Use the procedure described below to correctly install the valve spool seals:

1 ⇨ *Fig 169. (E-208)*. Lubricate the spool, bore and O-ring groove with JCB Hydraulic Fluid. Move the spool to the position shown and then install the O-ring **A** in its groove.

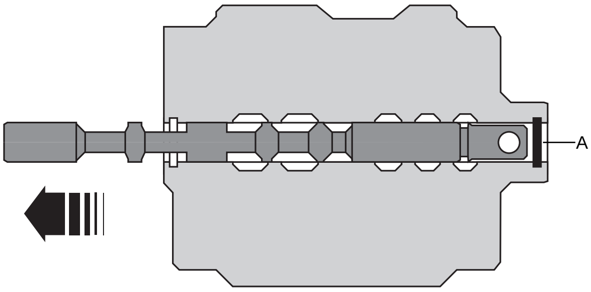


Fig 169.

2 ⇨ *Fig 170. (E-208)*. Move the spool to the position shown and then install the O-ring **B**. It is important to note that the spool must not be moved beyond the position shown, otherwise the edge of the spool (face **C**) may damage the first fitted O-ring (item **A**).

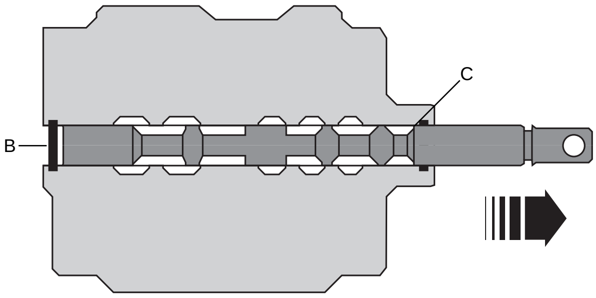


Fig 170.

3 ⇨ *Fig 171. (E-208)*. Position the spool in its central position as shown. Re-assemble the centring assembly, dust boot etc as detailed previously in this section.

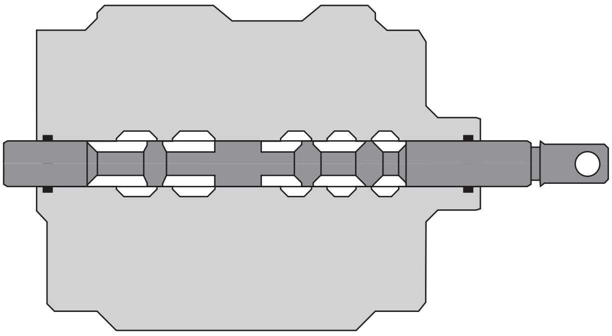


Fig 171.

Loader Valve - 3C-14 (214e) & 3C Machines

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

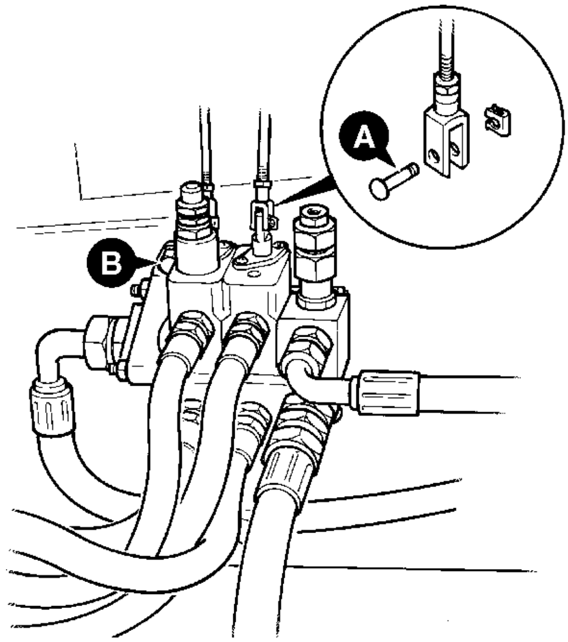


Fig 172.

Removal

1 Operate the valve block levers back and forth to vent residual pressure.

2 Remove clevis pins **A** to disconnect the control levers from the valve block spools.

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

4 Loosen and remove bolts **B**, spring washers and plain washers. Remove the loader valve.

Replacement

Replacement is a reversal of the removal sequence.

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

After replacement check the main relief valve (MRV) and auxiliary relief valve (ARV) pressure settings, see ***Service Procedures, 214e Machines*** or ***3C Machines*** as applicable.

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.*

Dismantle and Assemble

Main Relief Valve (MRV)

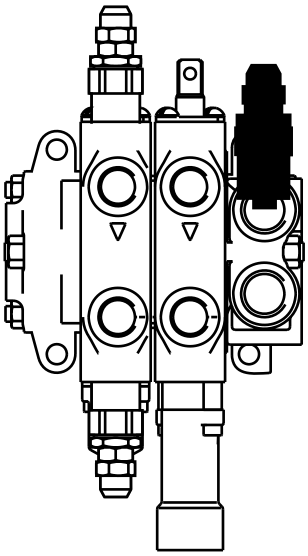


Fig 173.

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ Fig 174. (E-212).

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. DO NOT use worn or damaged items.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

Assemble

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **10** and **11**.

Adjust pressure setting as required.

Table 36. Torque Settings

Item	Nm	Kgf m	lbf ft
3	5.4	0.6	4

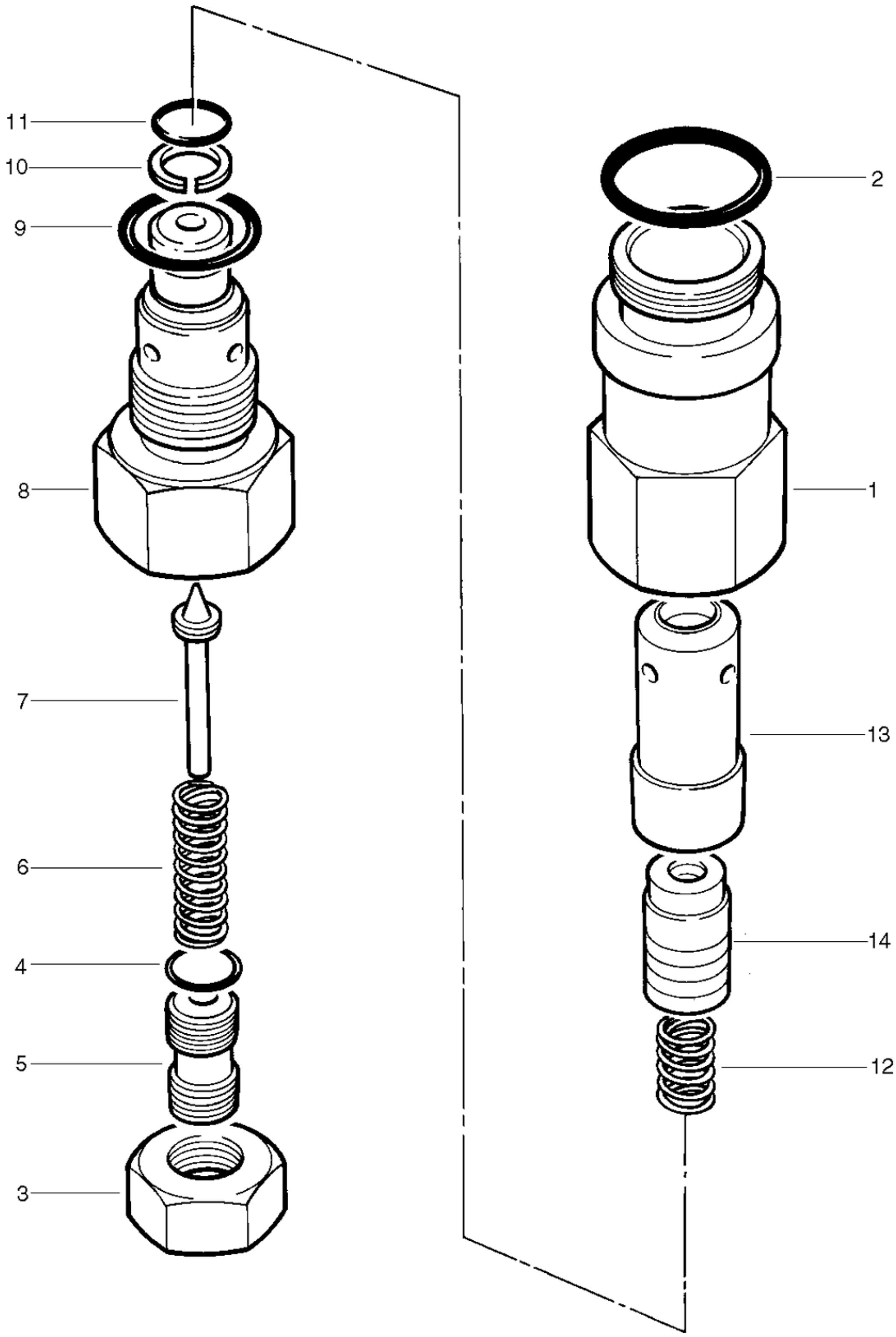


Fig 174. Main Relief Valve (MRV)

Auxiliary Relief Valves (ARV's)

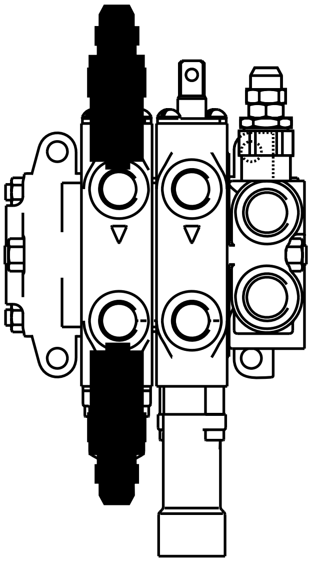


Fig 175.

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ Fig 176. (E-214).

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

– **Contamination**
– **Damage to spool**
– **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves.

Discard ALL 'O' rings and back up rings. DO NOT use worn or damaged items.

Inspect the valve components for scratches, nicks or any other type of damage, replace with new if required.

Assemble

Renew all 'O' rings and back-up rings.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Make sure that the 'O' rings and back-up rings are fitted the correct way, items **12**, **13** and **18**, **19**.

Adjust pressure setting as required.

Table 37. Torque Settings

Item	Nm	kgf m	lbf ft
1	5.4 - 8.2	0.55 - 0.83	4 - 6
3	41 - 68	4.15 - 6.9	30 - 50
5	5.4 - 8.2	0.55 - 0.83	4 - 6
10	41 - 68	4.15 - 6.9	30 - 50

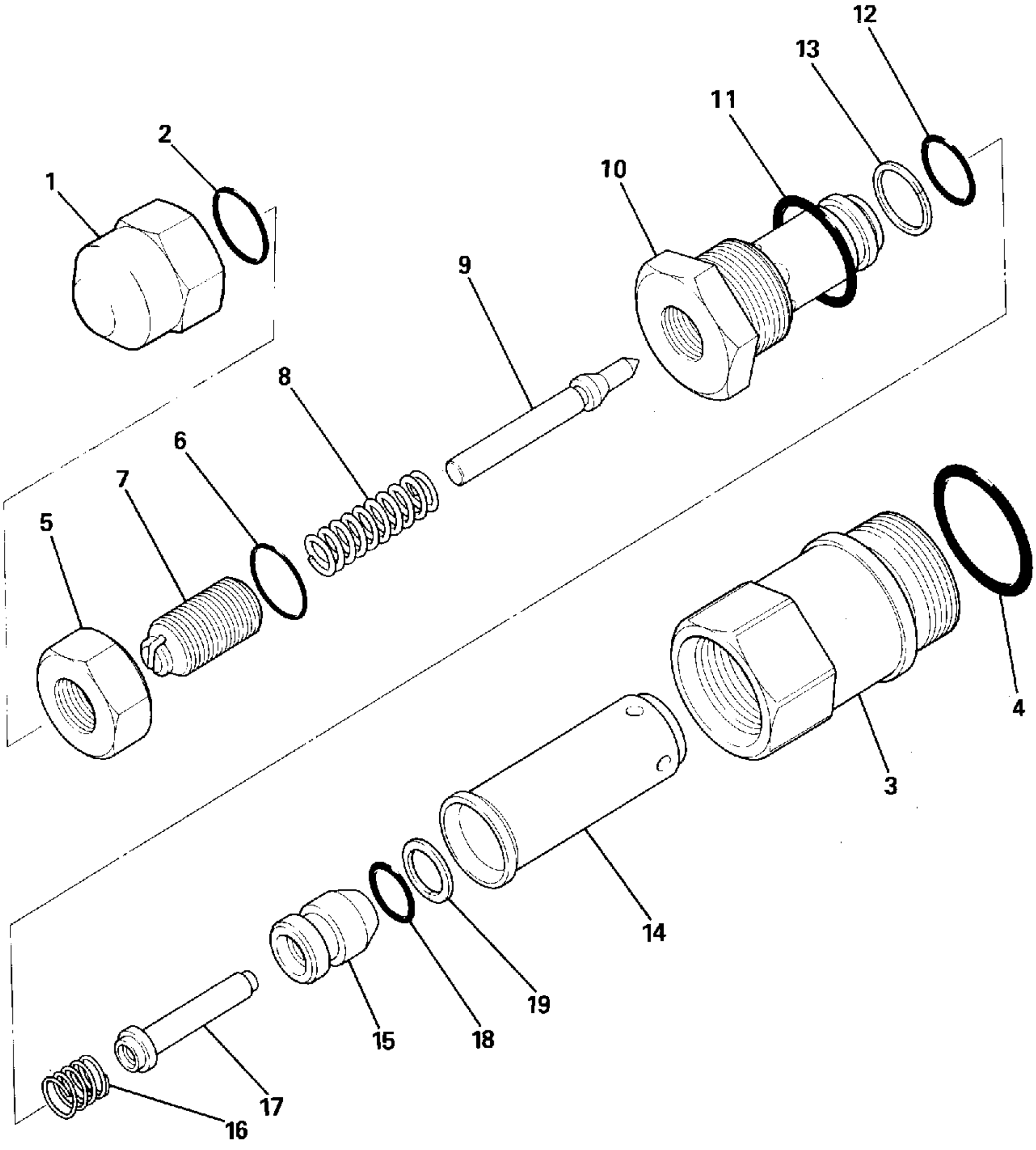


Fig 176. Auxiliary Relief Valve (ARV)

Standard Spool

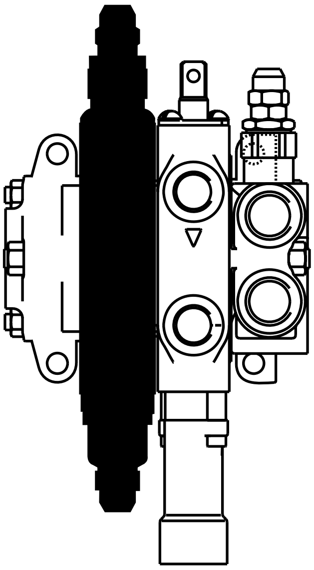


Fig 177.

The numerical sequence shown on the illustration is intended as a guide to dismantling. See *Fig 178. (E-216)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

– **Contamination**
– **Damage to spool**
– **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove the lever linkage from the tang (lever) end of the spool.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves, for instance, item **5**, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool **19** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, unscrew bolt **9** and remove spring **11** with cups **10** and **12**.

Check for surface contamination on the under side of the seal plates **4** and **13**. Clean if necessary. Check for the flatness of the seal plate. If found to be bent - replace with new (any work previously carried out on this valve may have resulted in the bending of the seal plate).

Assemble

Renew wiper seals **5** and **14** and `O' rings **6**, **15** and **18**.

When fitting bolt **9**, clean the threads thoroughly using JCB Cleaner and Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

Re-connect the lever mechanism to the tang (lever) end of the spool.

Run the engine and inspect the valve for external leaks.

Table 38. Torque Settings

Item	Nm	kgf m	lbf ft
7	6.1 - 7.5	0.62 - 0.76	4.5 - 5.5
9	9.5 - 10.9	0.97 - 1.11	7 - 8

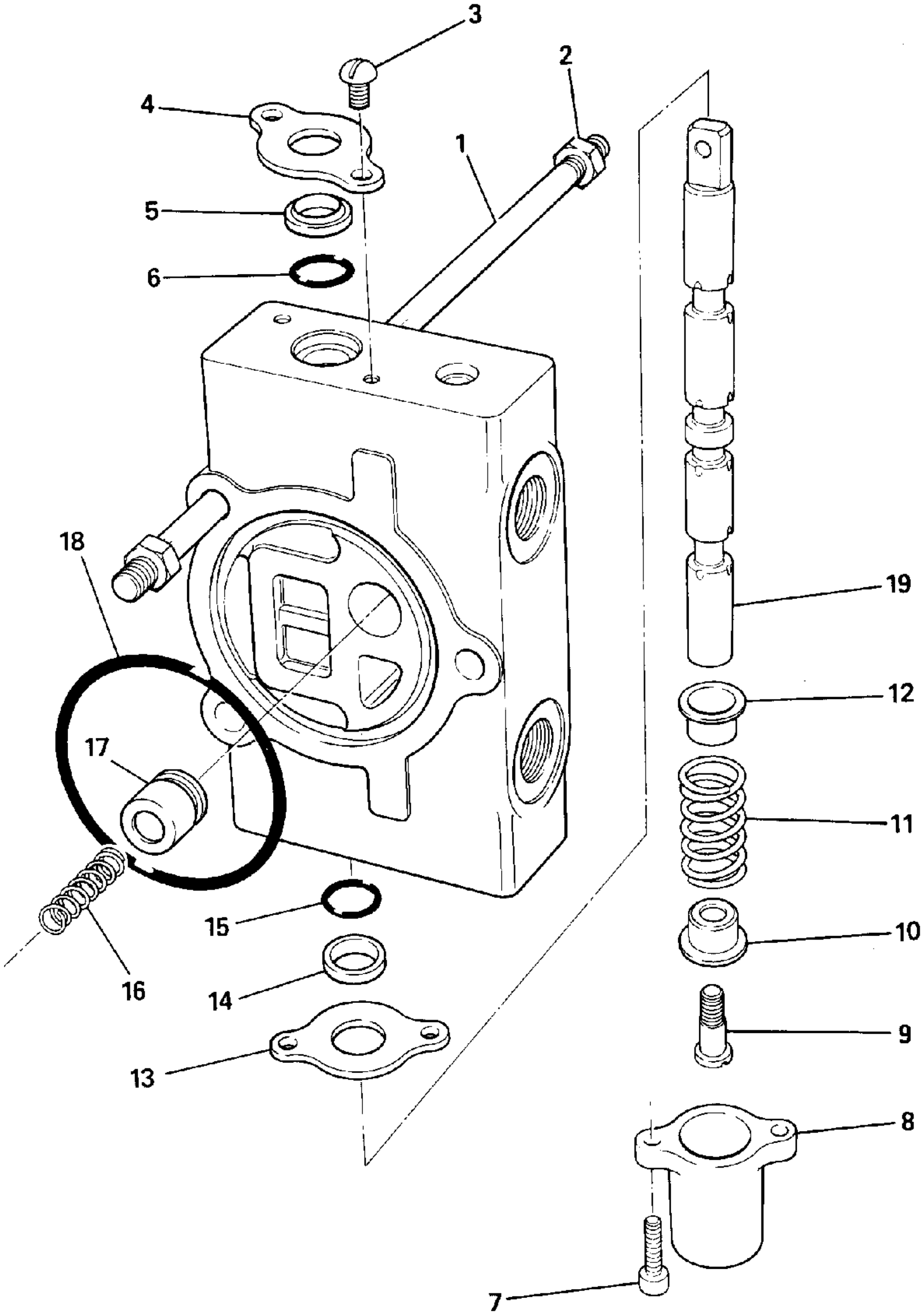


Fig 178. Standard Spool

Float Spool

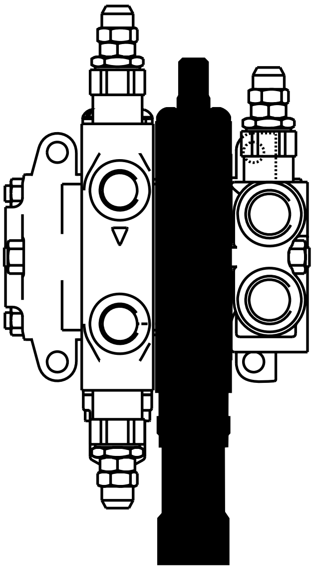


Fig 179.

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ *Fig 180. (E-218)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove the lever linkage from the tang (lever) end of the spool.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves, for instance, item **5**, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool **25** is not damaged when removing it from the valve block.

Remove retainer **7** and spacer **8**. Using a suitable tool on ball **12**, compress spring **13** and allow detent balls **11** to roll into their holes in the detent pin **14**. Carefully remove the spool cap **10** and collect detent balls **11**.

Hold the spool in a suitable clamp, unscrew detent pin **14** and remove spring **16** with cups **15** and **17**.

Check for surface contamination on the under side of the seal plate **4** and spacer **19**. Clean if necessary. Check for the flatness of the seal plate. If found to be bent - replace with new (any work previously carried out on this valve may have resulted in the bending of the seal plate).

Assemble

Renew wiper **5** and 'O' rings **6**, **20**, **21** and **24**.

Apply grease liberally to detent pin **14** to hold detent balls **11** in position during assembly and to provide lubrication.

When fitting detent pin **14**, clean the threads thoroughly using JCB Cleaner and Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

Re-connect the lever mechanism to the tang (lever) end of the spool.

Run the engine and inspect the valve for external leaks.

Table 39. Torque Settings

Item	Nm	kgf m	lbf ft
9	6.1 - 7.5	0.62 - 0.76	4.5 - 5.5
14	9.5 - 10.9	0.97 - 1.11	7 - 8

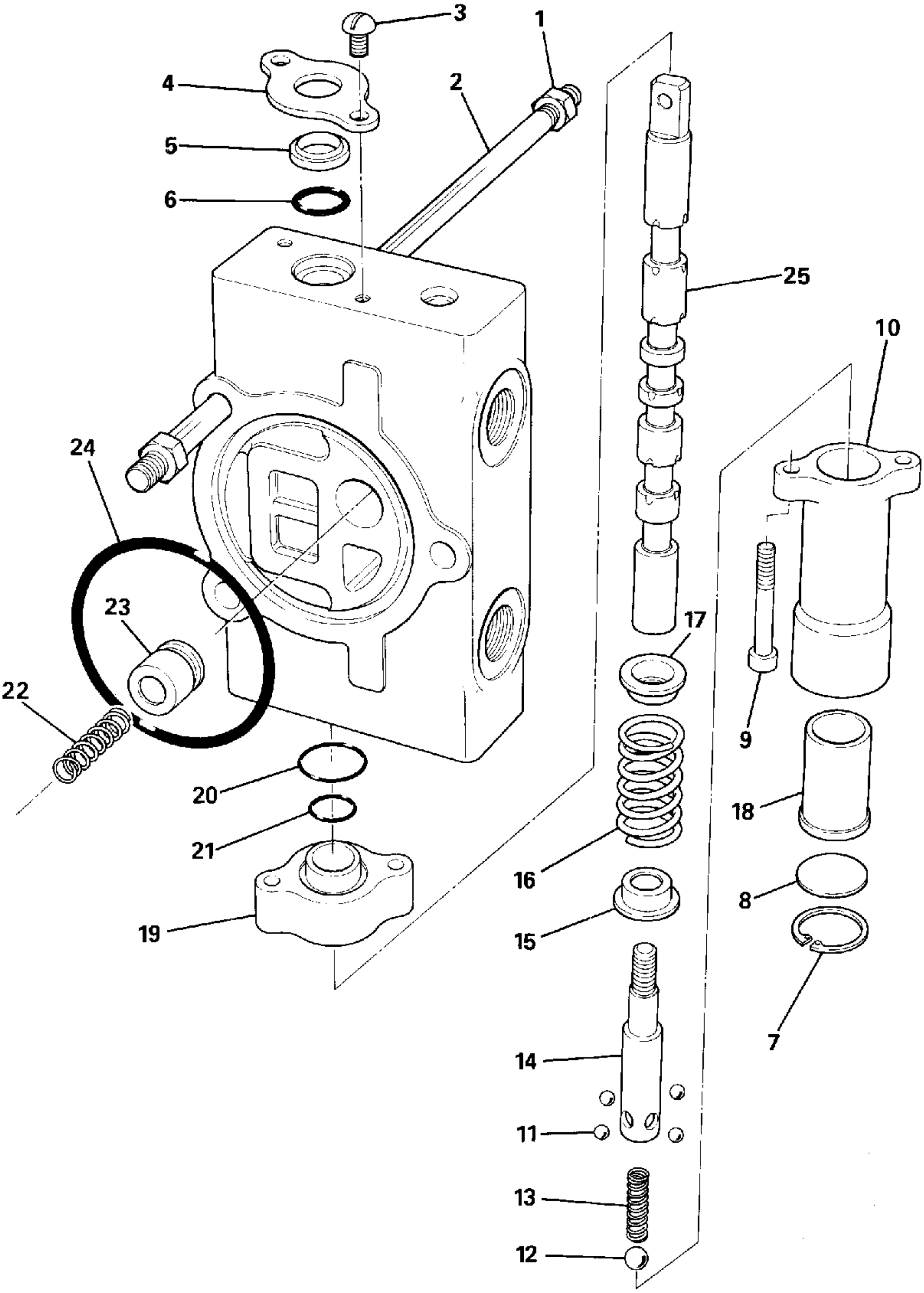


Fig 180. Float Spool

Electric Detent Spool

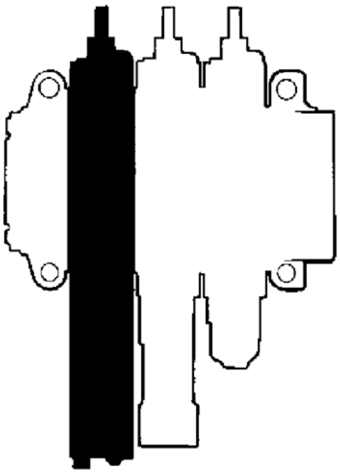


Fig 181.

The numerical sequence shown on the illustration is intended as a guide to dismantling. See ⇨ *Fig 182. (E-220)*.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to spool**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

Dismantle

Remove the lever linkage from the tang (lever) end of the spool.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the spool or seal grooves, for instance, item **3**, which is a wiper seal and is a press fit in the counterbore.

Care must be taken to ensure that the spool **16** is not damaged when removing it from the valve block.

Hold the spool in a suitable clamp, remove screw **9** and 'clapper' **10**. Unscrew spool end **12** and remove spring **14** with cups **13** and **15**.

Check for surface contamination on the under side of the seal plate **2** and spacer **17**. Clean if necessary. Check for the flatness of the seal plate. If found to be bent - replace with new (any work previously carried out on this valve may have resulted in the bending of the seal plate).

Assemble

Renew wiper **3** and 'O' rings **4**, **19** and **22**.

When fitting spool end **12**, clean the threads thoroughly using JCB Cleaner and Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

Check the operation of the solenoid **7** after assembly by connecting a 12V supply. The spool should be held when it is pushed into the detent position and returned when the supply is disconnected.

Re-connect the lever mechanism to the tang (lever) end of the spool.

Run the engine and inspect the valve for external leaks.

Table 40. Torque Settings

Item	Nm	kgf m	lbf ft
5	6.1 - 7.5	0.62 - 0.76	4.5 - 5.5
9	6.1 - 7.5	0.62 - 0.76	4.5 - 5.5
12	9.5 - 10.9	0.97 - 1.11	7 - 8

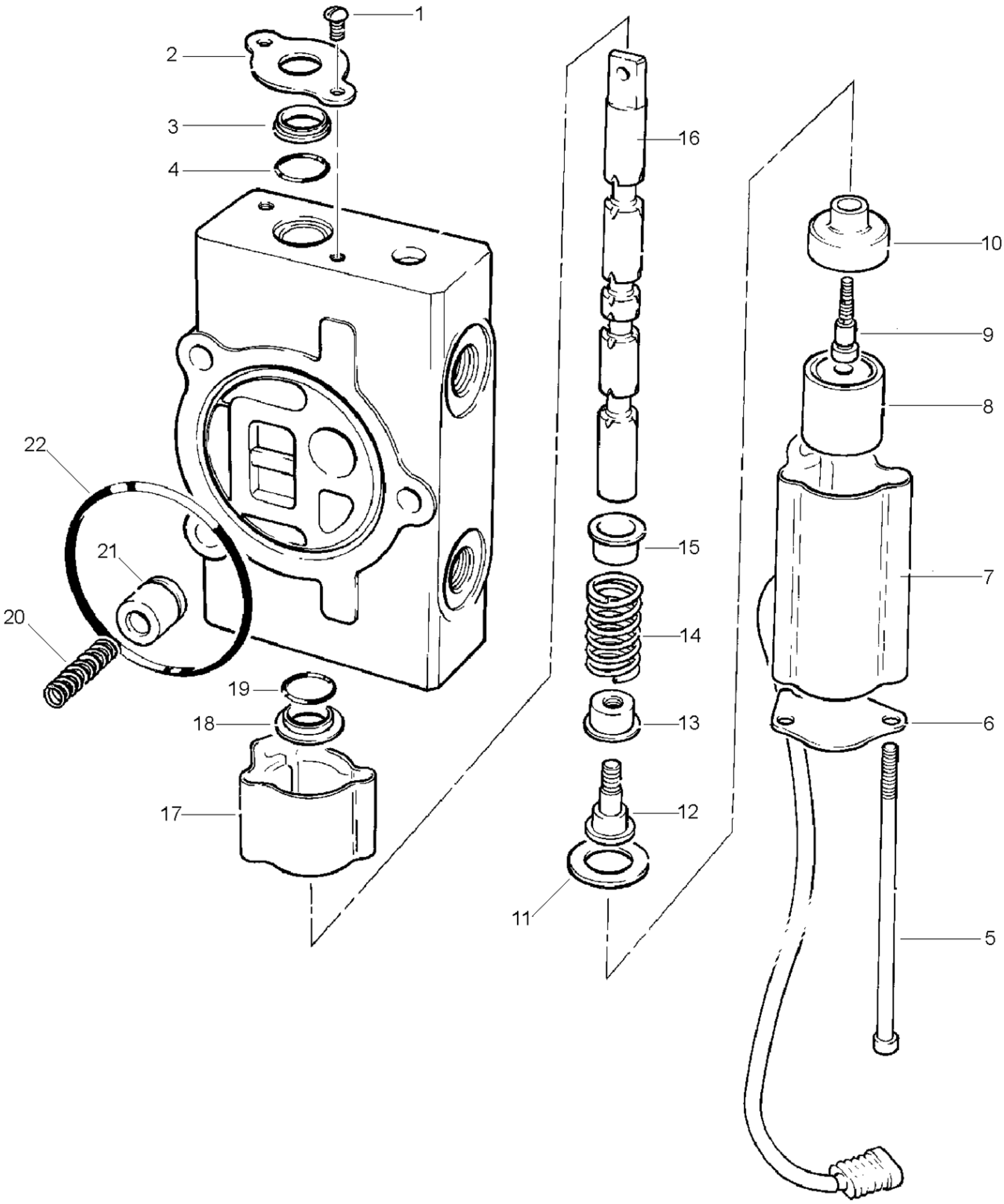


Fig 182. Electric Detent Spool

Excavator 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

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

1 Operate the valve block levers back and forth to vent residual pressure.

2 Remove the rear valance.

3 In order to gain access for valve removal the excavator control console **A** must be removed, see ***Section D, Controls.***

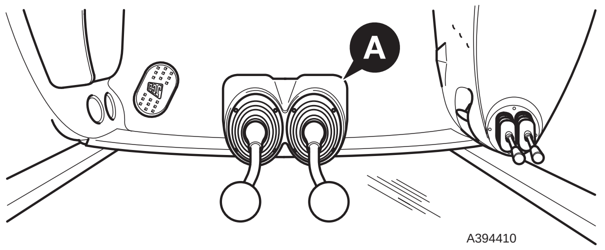


Fig 183.

4 Remove clevis pins **B** to disconnect the control levers from the valve block spools, see *⇒ Fig 184. (E-222)*.

5 Disconnect all hydraulic hoses from the valve block and plug all orifices to prevent ingress of dirt. Label each hose and note the phasing before disconnecting, this will ensure correct position when refitting.

6 Uncouple the electrical connection to the hydraclamp solenoid **F**.

7 Uncouple the electrical connection to the rear horn **G**.

8 Loosen nuts **H** - do not completely remove the retaining nuts.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

9 Open the rear window. Wrap a suitable sling around the valve, make sure that the weight of the valve is supported by the sling, *⇒ Fig 185. (E-222)*.

10 Remove nuts **H**. Remove the rear horn **G**. Lower the valve block to the ground.

Replacement

Replacement is a reversal of the removal sequence.

Hoses and pipes (when applicable) must be re-connected and phased in same position as removal. Refer to ***Dismantling and Assembly, Hoses and Pipes***.

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.*

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

Adjust the control levers to the correct positions, see ***Section D, Controls***.

After replacement check the auxiliary relief valve (ARV) pressure settings.

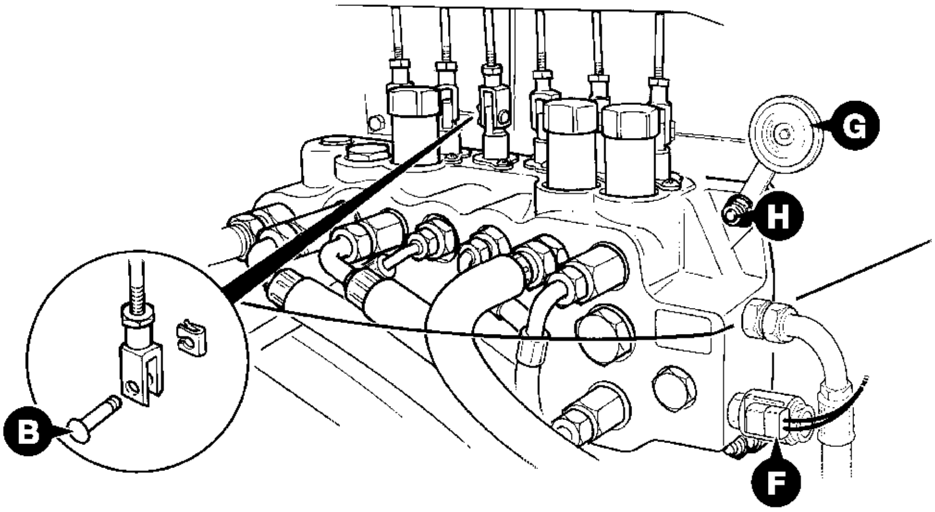


Fig 184.

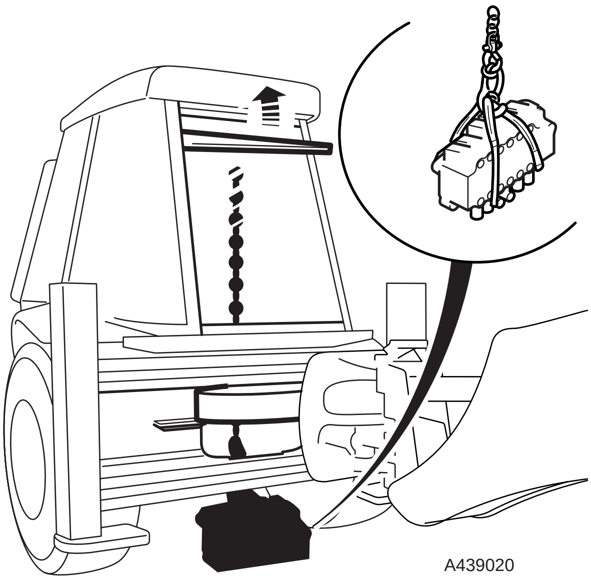


Fig 185.

Dismantle and Assemble

Valve Block

⇨ *Fig 186. (E-225)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Load Hold Check Valves

Each of the identical load hold check valves **4R** to **4W** can be removed as shown at **4W**. Make-up check valve **4X** is a smaller size but otherwise identical.

Ensure good condition of seating faces on poppets **4** and **8** and on the mating faces in the valve block.

Service Spools

Spools **4A**, **4B**, **4E** and **4F** are identical but must not be interchanged as they are matched to their bores. Stabiliser spools **4C** and **4D** are identical to each other but different from the excavator spools.

All spools have the same centring and sealing components items **9** to **21**.

To completely dismantle a spool, follow the sequence **9** to **21**. To prevent spool rotation when turning screw **15**, hold a rod through the eye end of the spool.

If only renewing the seals, dismantle as far as cap **14** then remove items **15** to **22** as an assembly.

Lubricate new seals with JCB Hydraulic Fluid and take care to prevent them from being damaged by the sharp edges of the spool.

Apply JCB Threadlocker and Sealer to threads of screw **15**.

Auxiliary Relief Valves

A.R.V's **4H** to **4P** appear identical but have various pressure settings, refer to ***Technical Data.*** Ensure that they are correctly adjusted and fitted in their specified positions.

Auxiliary relief valve dismantling and assembly procedures are detailed separately, ⇨ *Auxiliary Relief Valves (ARV's) (E-226)*.

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.*

Assemble

1 Fit the boot **10** to the seal plate **11**.

2 Fit a new lipseal **12A** into the valve block, ensure square. Fit wiper **12** on top of lipseal.

3 Fit the seal plate and boot assembly to valve block but do not torque tighten capscrews **9** at this stage. Ensure wiper locates into seal plate.

4 Use clean hydraulic oil as a lubricant. From the bottom, insert spool through the valve block, do not use excessive force when fitting, a turning motion should ease the spool through the valve block.

5 Check that the tang end of the spool passes through the boot without dislodging or damaging the boot. Ensure that the tang aligns with the control rod and that the boot is not distorted and is located in the spool land.

6 Torque tighten cap screws **9**, ⇨ *Table 41. Torque Settings (E-224)*.

7 When fitting bolt **15**, clean the threads thoroughly using JCB Cleaner and Degreaser, leave it for 10 minutes then apply a small quantity of JCB Threadlocker and Sealer to the threads of the spool.

8 Make sure that all the parts move freely, check that item **16** does not interfere with item **18**.

9 Renew 'O' ring **21** and seal **20**. Make sure the 'O' ring and wiper seal are not trapped or damaged.

10 Fit seal **20** and seal plate **19** to the valve block section. Torque tighten capscrew **13** on completion, ⇨ *Table 41. Torque Settings (E-224)*.

Re-connect the lever mechanism to the tang (lever) end of the spool. Run the engine and inspect the valve for external leaks.

Table 41. Torque Settings

Item	Nm	kgf m	lbf ft
1	122	12.4	90
5	80	8.3	60
9	9.5	0.96	7
13	7	0.7	5
15	11	1.1	8
23	95	10	70

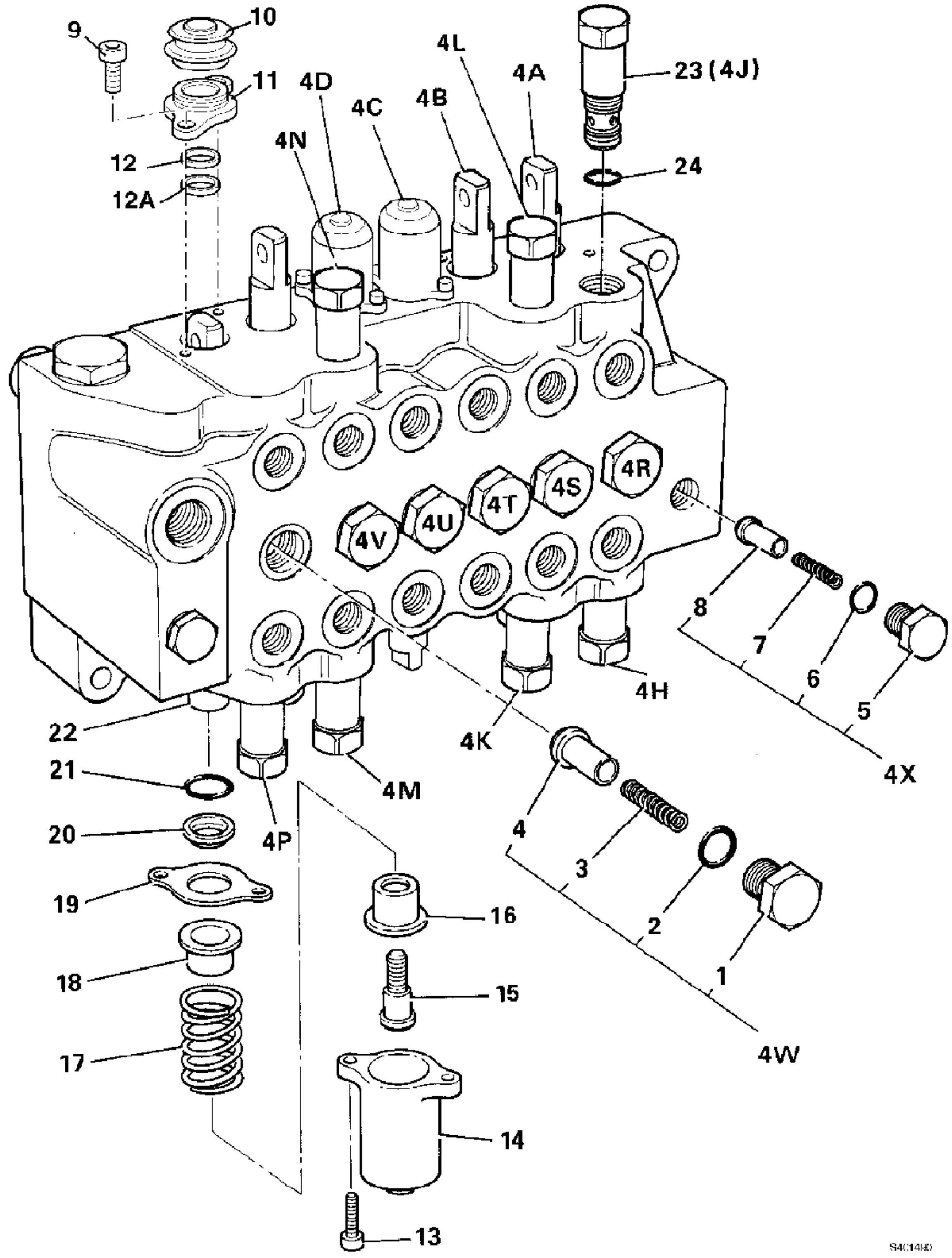


Fig 186. Excavator Valve

Auxiliary Relief Valves (ARV's)

⇨ *Fig 187. (E-226)*.

Eight A.R.V's are fitted at positions **4H** to **4Q**. These are identical in design but have various pressure settings, refer to ***Technical Data***.

Note: *The bucket rod side A.R.V.* ***4Q*** *is only fitted to machines equipped with a Rockbreaker.*

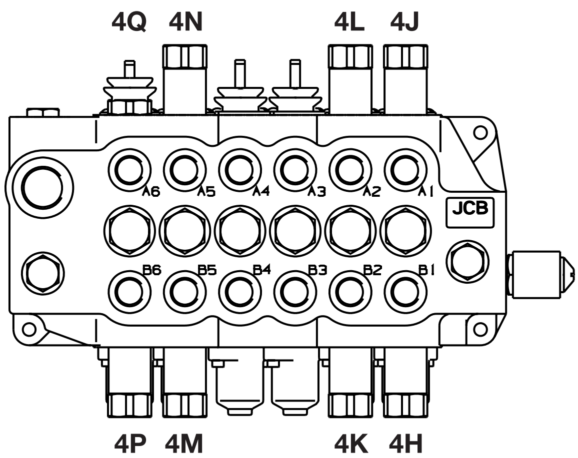


Fig 187.

A.R.V. Position Key:

	Control Layout			
	JCB	**ISO**	**Case**	**Ford**
Slew Right	4H	4H	4H	4H
Slew Left	4J	4J	4J	4J
Boom Rod	4K	4M	4M	4K
Boom Head	4L	4N	4N	4L
Dipper Rod	4N	4L	4K	4N
Dipper Head	4M	4K	4L	4M
Bucket Rod	4Q	4Q	4Q	4P
Bucket Head	4P	4P	4P	4Q

Dismantle

⇨ *Fig 188. (E-227)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Dismantle sub-assembly **14** from item **1** using a special tool (see ***Service Tools***). The special spanner locates in cross holes **B**.

Dismantle sub-assembly **14** into its component parts. Make sure that small drilling **A** is not blocked.

Discard old and worn O-rings and back-up rings.

Assemble

Renew all O-rings and back-up rings. Lubricate O-rings and back-up rings with JCB Hydraulic Fluid.

Fit back-up ring **13** on the upper side of 'O' ring **12** as shown in the inset.

Fit flat face of sleeve **9** against shoulder of poppet **10**.

Torque tighten item **14** using the special tool (see **Service Tools**), until its shoulder seats firmly against item **1**.

Pressure test the relief valves, refer to ***Service Procedures, Excavator Valve - Pressure Testing***.

Table 42. Torque Settings

Item	Nm	kgf m	lbf ft
1	65	6.6	48
3	24	2.5	18

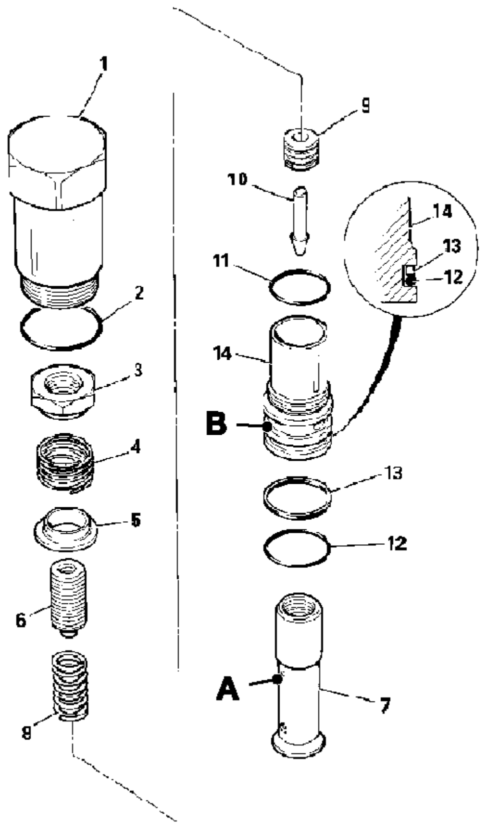


Fig 188. Auxiliary Relief Valve

Hydraclamp Valve (Sideshift Machines)

⇨ *Fig 189. (E-229)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

The following points MUST be avoided when dismantling and assembling the valve:

- **Contamination**
- **Damage to poppet and seat**
- **Damage to seal grooves**

All or any of the above points may result in possible problems with the valve.

When removing 'O' rings and seals, use an appropriately rounded tool that WILL NOT cause any damage to the seal grooves. Discard ALL 'O' rings DO NOT use worn or damaged items.

Note that the hydraclamp comprises two separate valve assemblies; 1) the check valve assembly (items **1** to **8**); 2) the solenoid assembly (items **11** to **14**).

Dismantle

Loosen nut **1** (turn anti-clockwise) and then remove the check valve assembly from the valve block. If required, the check valve assembly can be dismantled into its component parts (items **1** to **8**).

Inspect the valve components for scratches, nicks or any other type of damage, particularly on the poppet and seat faces. Replace with new if required.

Assemble

Renew all 'O' rings. The parts microfiche will identify the correct seal kit part numbers for items **2**, **2A**, **4**, **6**, **10** and **14**.

Fit seal **2A** with the recess towards `O' ring **2**, as shown at **A**.

Lubricate parts with JCB Hydraulic Fluid before assembling. Make sure that all the parts move freely.

Ensure that the small drilling through the centre of item **3**, is clear.

Do not over-tighten the solenoid assembly, it may affect the operation of the solenoid, use the spanner flats and torque tighten to figure indicated in the table below (items **11** and **13**).

Check the operation of the electric hydraclamp, refer to ***Circuit Descriptions, Excavator Valve - Manual Control - Hydraclamp Valve Operation***.

Table 43. Torque Settings

Item	Nm	kgf m	lbf ft
1	13.5	1.4	10
3	24.5	2.5	18
5	13.5	1.4	10
11	5.5	0.5	4
13	24.5	2.5	18

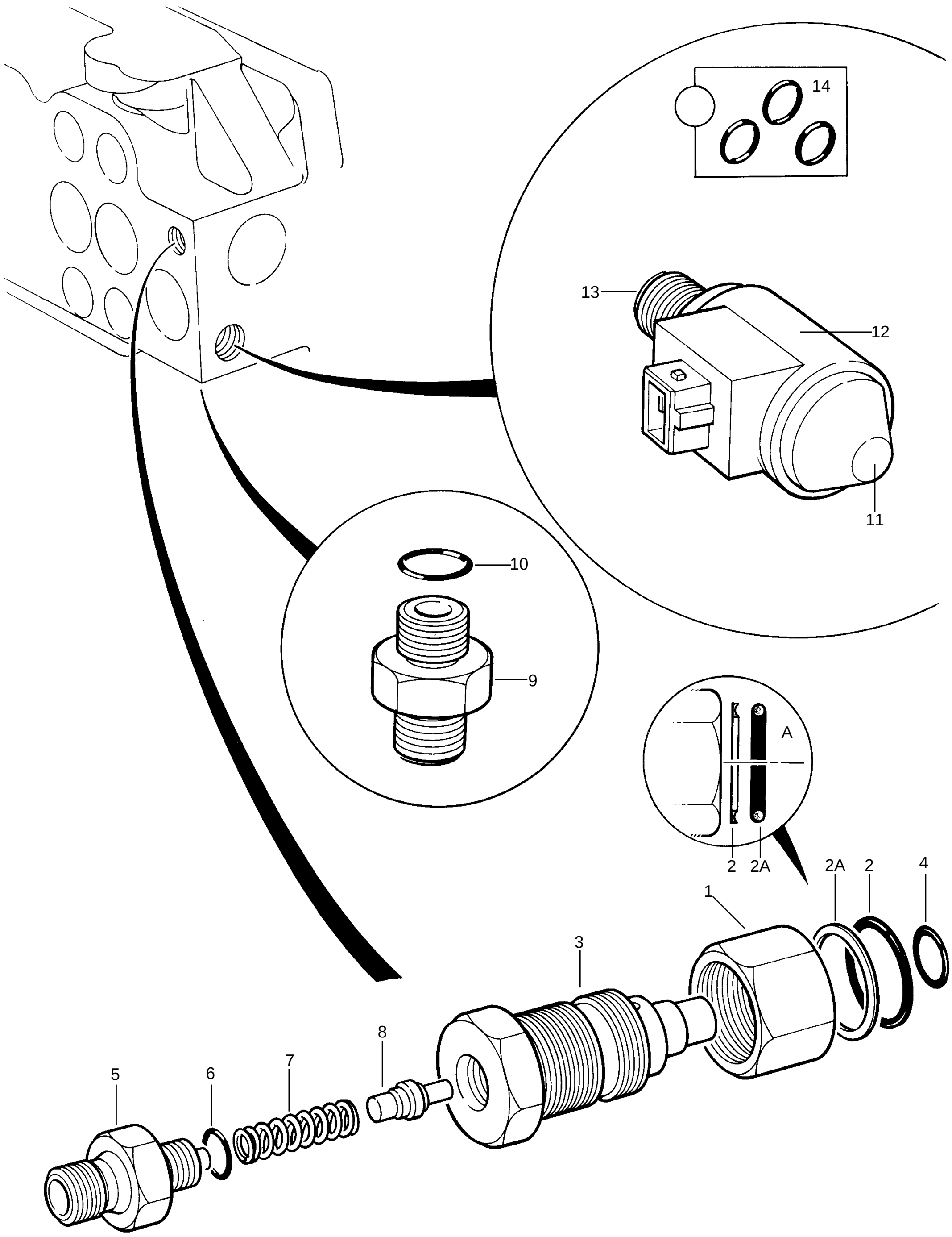


Fig 189. Hydraclamp Valve (Sideshift Machines)

Hoses and Pipes (Sideshift Valve)

Refer to ⇨ *Removal and Replacement (E-221)* for valve block removal and replacement procedure. Hoses and pipes (when applicable) must be re-connected and phased in same position as removal.

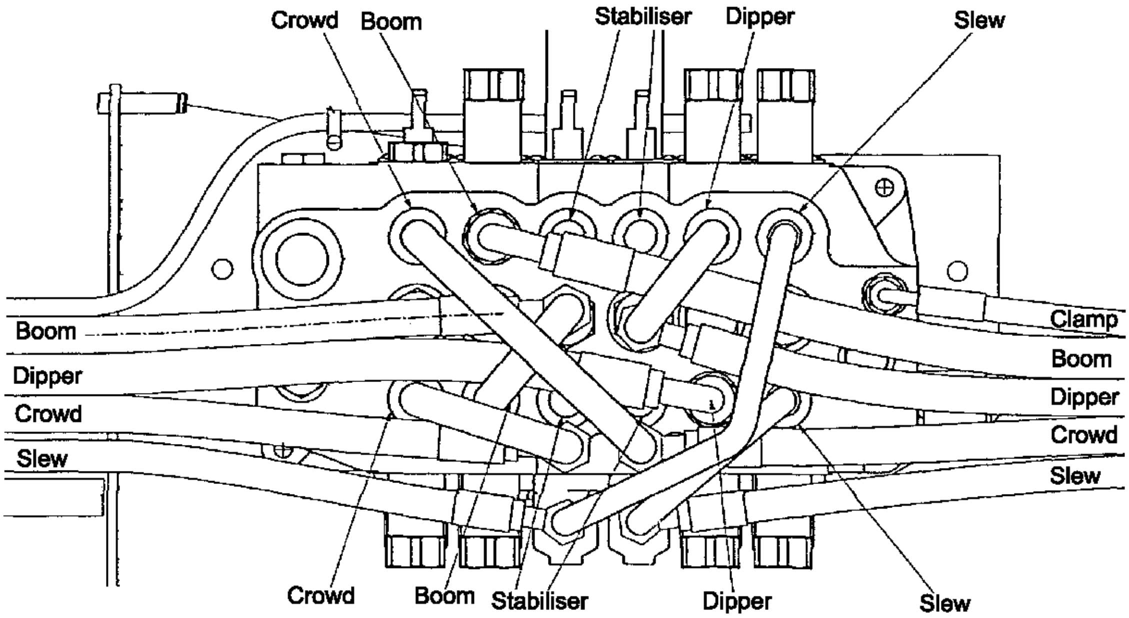


Fig 190. ISO Excavator Valve

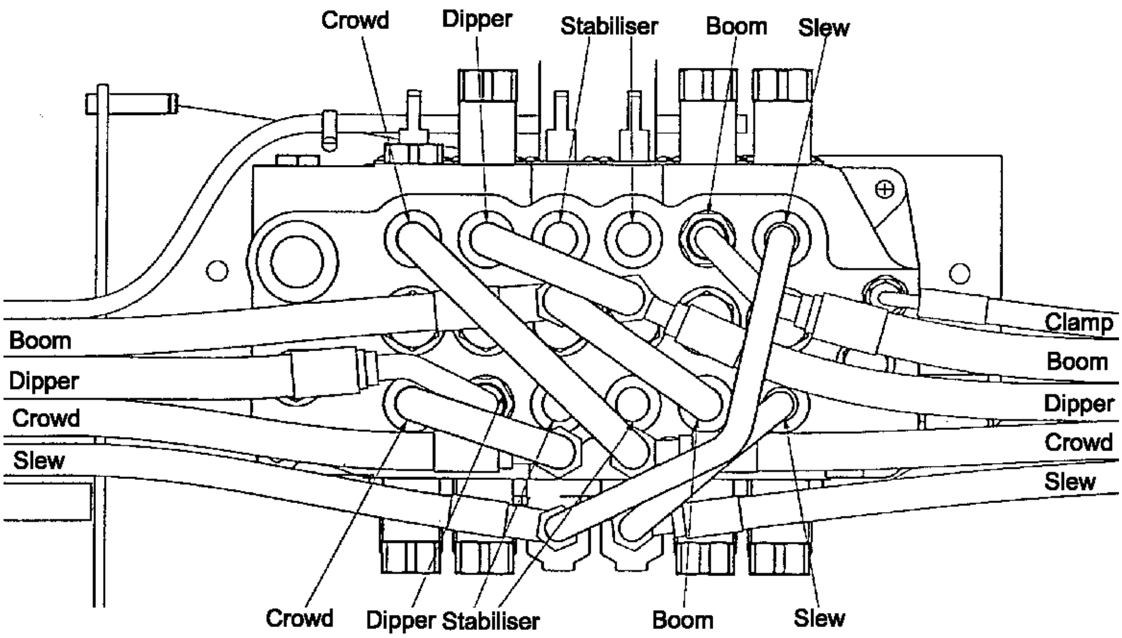


Fig 191. JCB Excavator Valve

Hoses and Pipes (Centremount Valve)

Refer to ⇨ *Removal and Replacement (E-221)* for valve block removal and replacement procedure. Hoses and pipes (when applicable) must be re-connected and phased in same position as removal.

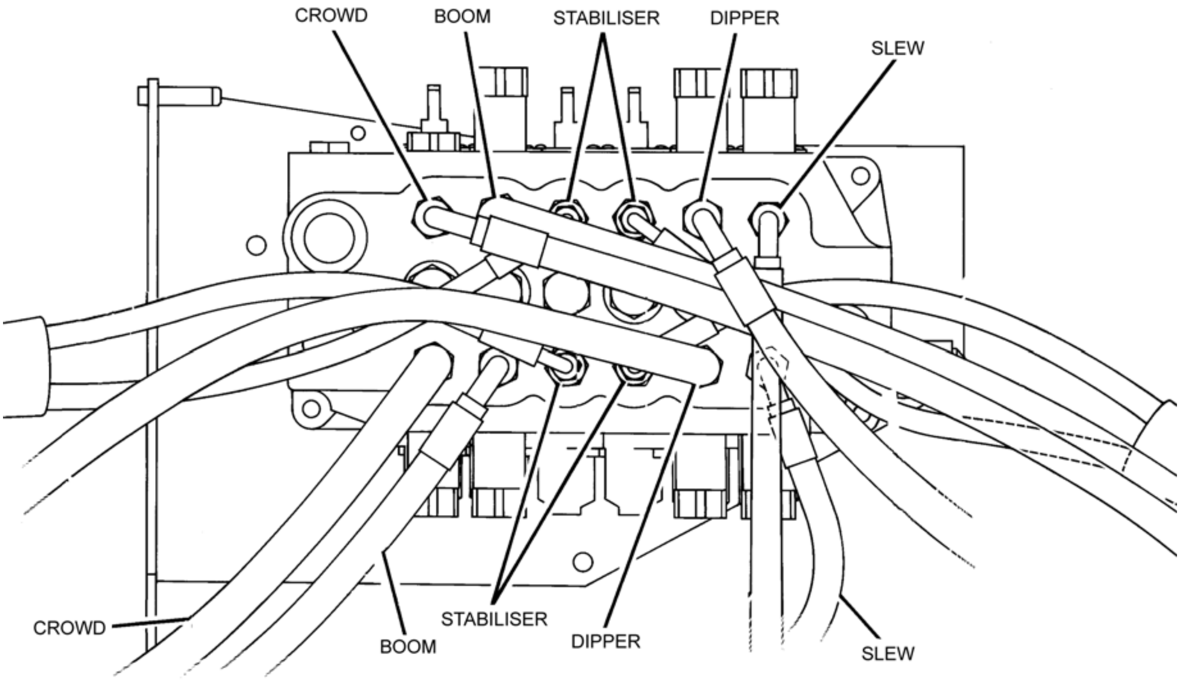


Fig 192. ISO Excavator Valve

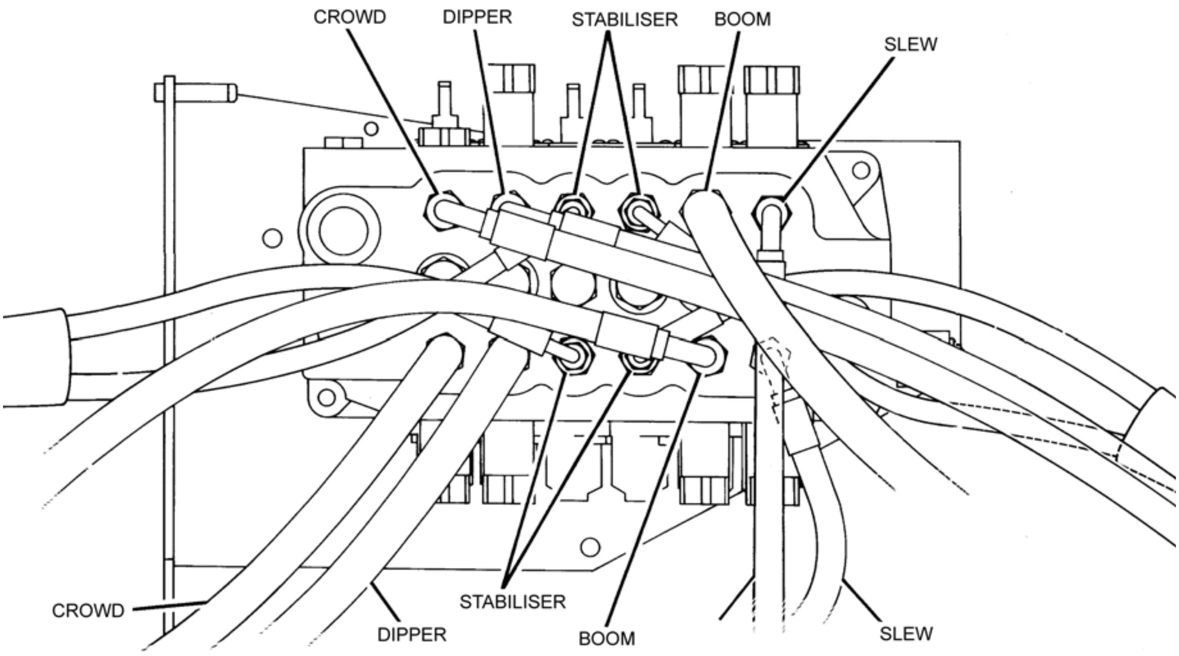


Fig 193. JCB Excavator Valve

Excavator Valve - Variable Flow

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

⇨ *Fig 194. (E-233)*.

Removal

1. Sideshift the carriage to one side as shown (sideshift machines only). Lower the backhoe and loader end to the ground and stop the engine.
2. Operate the valve block levers back and forth to vent residual pressure.
3. Remove the hose guide **A** (this makes access to the valve block easier).
4. Remove clevis pins **B** to disconnect the control levers from the valve block spools.
5. Disconnect all hydraulic hoses from the valve block and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.

⚠ WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

6. Insert two M10 bolts through the eye end spools (three spools each end) as shown. Make sure the bolt has a retaining nut on each end. When the bolts are in place thread suitable slings around the bolts as shown.
7. Remove nuts **C** and lower the valve block to the ground.

Inspection

Inspect the resilient mounts for damage, cracking etc. If the mounts are suspect, then replace them with new ones.

Replacement

Replacement is a reversal of the removal sequence.

Hoses and pipes (when applicable) must be re-connected and phased in same position as removal. Refer to ***Excavator Valve, Dismantle and Assemble - Hoses and Pipes.***

⚠ 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

After replacement check the auxiliary relief valve (A.R.V.) pressure settings.

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.*

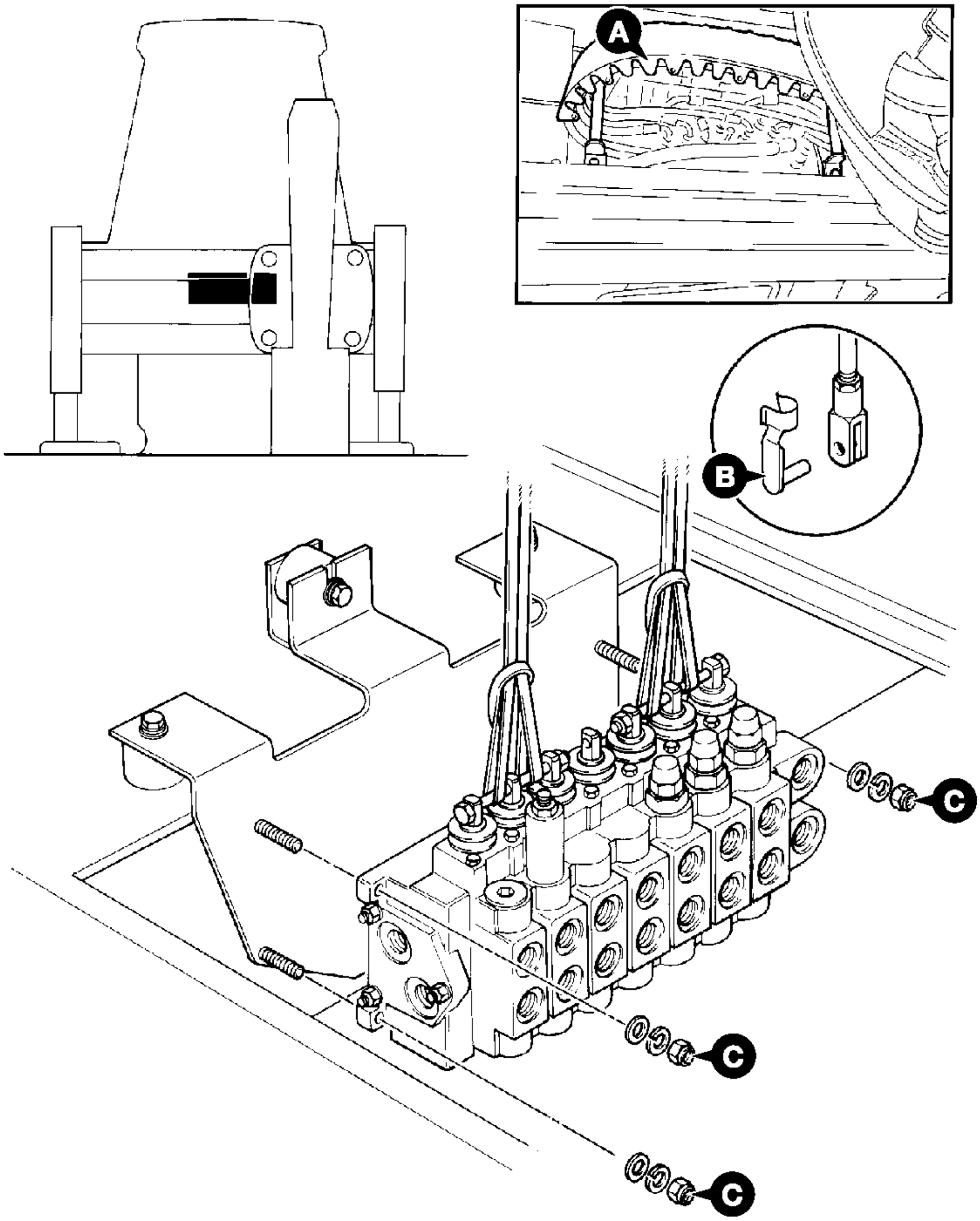


Fig 194. Excavator Valve - Variable Flow

Excavator Valve - 3C Machines (Sideshift)

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

1 Operate the valve block levers back and forth to vent residual pressure.

2 ⇨ *Fig 195. (E-235)*. Remove the clevis pin **C** and disconnect the hydraclamp control rod.

3 Remove clevis pins **A** to disconnect the control levers from the valve block spools.

4 Disconnect all the hydraulic hoses to the valve block and plug all orifices to prevent the ingress of dirt. Label each hose and note the hose phasing before disconnecting, this will ensure correct positioning when refitting.

5 Loosen bolts **B** - DO NOT completely remove the retaining bolts.

⚠ WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

6 Make sure that the valve assembly is safely supported and then remove the retaining bolts **B**.

7 Lift the valve assembly away from the chassis mounting lugs **D** and then lower it to the ground.

Replacement

Repacement is the reversal of the removal sequence.

Hoses and pipes (where applicable) must be re-connected and phased in their original positions.

⚠ 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

Adjust the control levers to the correct positions, refer to ***Section D, Controls.***

After replacement check the auxiliary relief valve (A.R.V.) pressure settings.

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

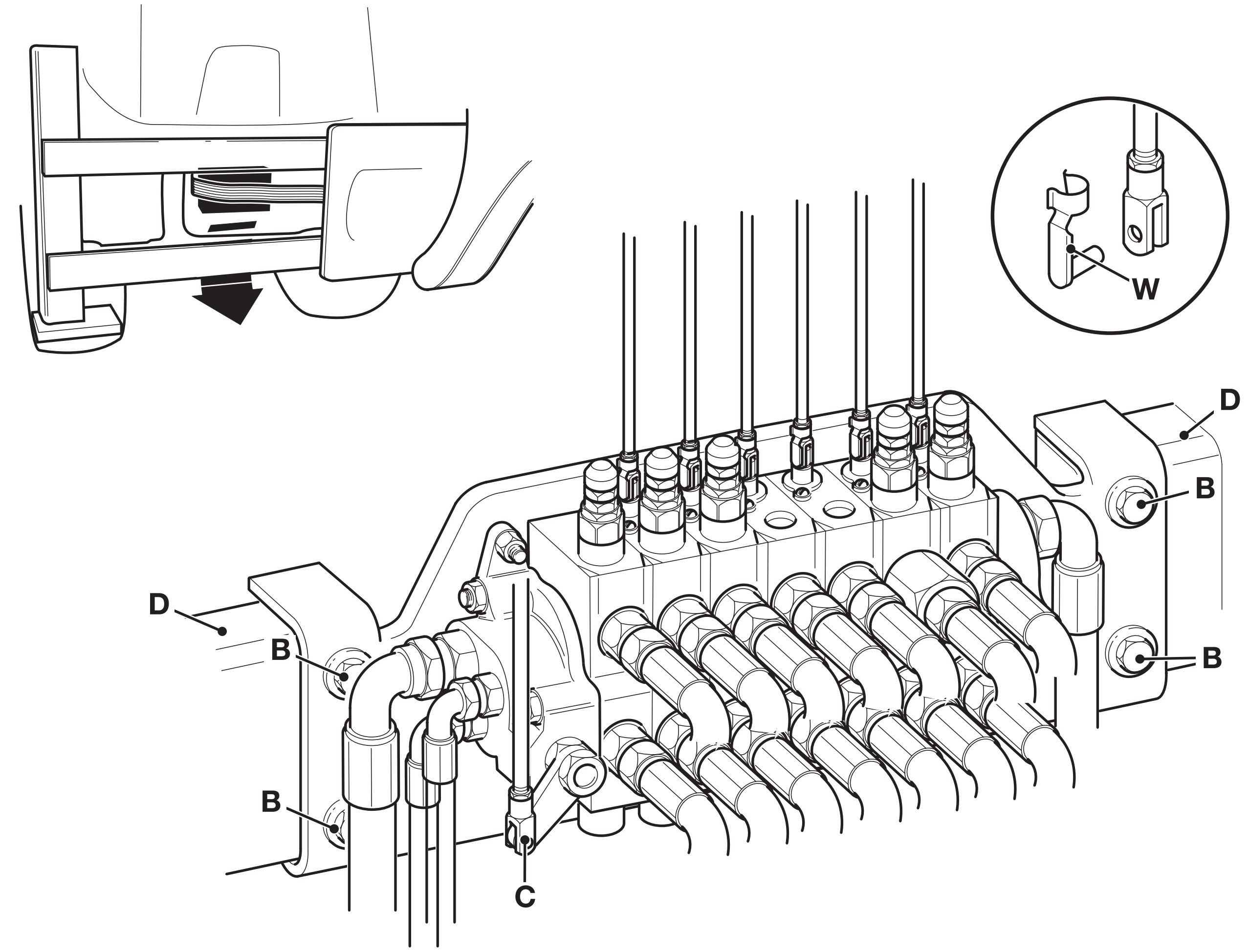


Fig 195.

Dismantle and Assemble

Valve Block

⇨ *Fig 196. (E-237)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Great care should be taken when dismantling and assembling to avoid the following:

- Contamination
- Damage to the spools
- Damage to the seal grooves

Any of the above may result in possible problems with the operation of the valve.

Dismantle

When removing `O' rings and seals, use an appropriately rounded to that WILL NOT cause any damage to the seal grooves.

Discard ALL `O' rings. DO NOT use worn or damaged items.

Inspect the valve components for scratches, nicks and any other type of damage, replace suspect components with new.

Load Hold Check Valves

Each of the identical load hold check valves **4R** to **4W** can be removed as shown at **4W**.

Note: *Only load hold check valve **4W** shown on illustration.*

Ensure the seating face on the poppet valve **10** and the mating face in the valve block are in good condition.

Service Spools

Spools **4B**, **4C**, **4D**, **4E** and **4F** are identical but must not be interchanged as they are matched to their bores. Slew spool **4A** is different in design to the afore mentioned spools.

All spools have the same centring and sealing components, items **11** to **19** and **24** to **27**.

To completely dismantle a spool, follow the sequence **11** to **19** and **24** to **27**. To prevent spool rotation when turning screw **13**, hold a rod through the eye end of the spool.

Auxiliary Relief Valves

A.R.V's **4H** to **4P** appear identical but have various pressure settings, refer to ***Technical Data.*** Ensure that they are correctly adjusted and fitted in their specified positions.

Torque tighten ARV's **4H**, **4J**, **4K** and **4N** to 41 - 68 Nm (30 - 50 lbf ft; 4.15 - 6.9 kgf m).

Torque tighten ARV's **4L**, **4M** and **4P** to 41 - 68 Nm (30 - 50 lbf ft; 4.15 - 6.9 kgf m).

Auxiliary relief valve dismantling and assembly procedures are detailed separately. ⇨ ***Auxiliary Relief Valves (ARV's) (E-238)***.

Assemble

Renew all `O' rings.

Lubricate new seals with clean JCB Hydraulic Fluid and take care to prevent them from being damaged by the sharp edges of the spools.

Apply JCB Threadlocker and Sealer to threads of screw **13**.

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

Table 44. Torque Settings

Item	Nm	Kgf m	lbf ft
1A	17.6 - 20.4	1.76 - 2.01	13 - 15
1B	41 - 49	4.2 - 5	30 - 36
11	6.1 - 7.5	0.62 - 0.72	4.5 - 5.5
13	9.5 - 10.9	0.97 - 1.11	7 - 8
22	41 - 68	4.15 - 6.9	30 - 50

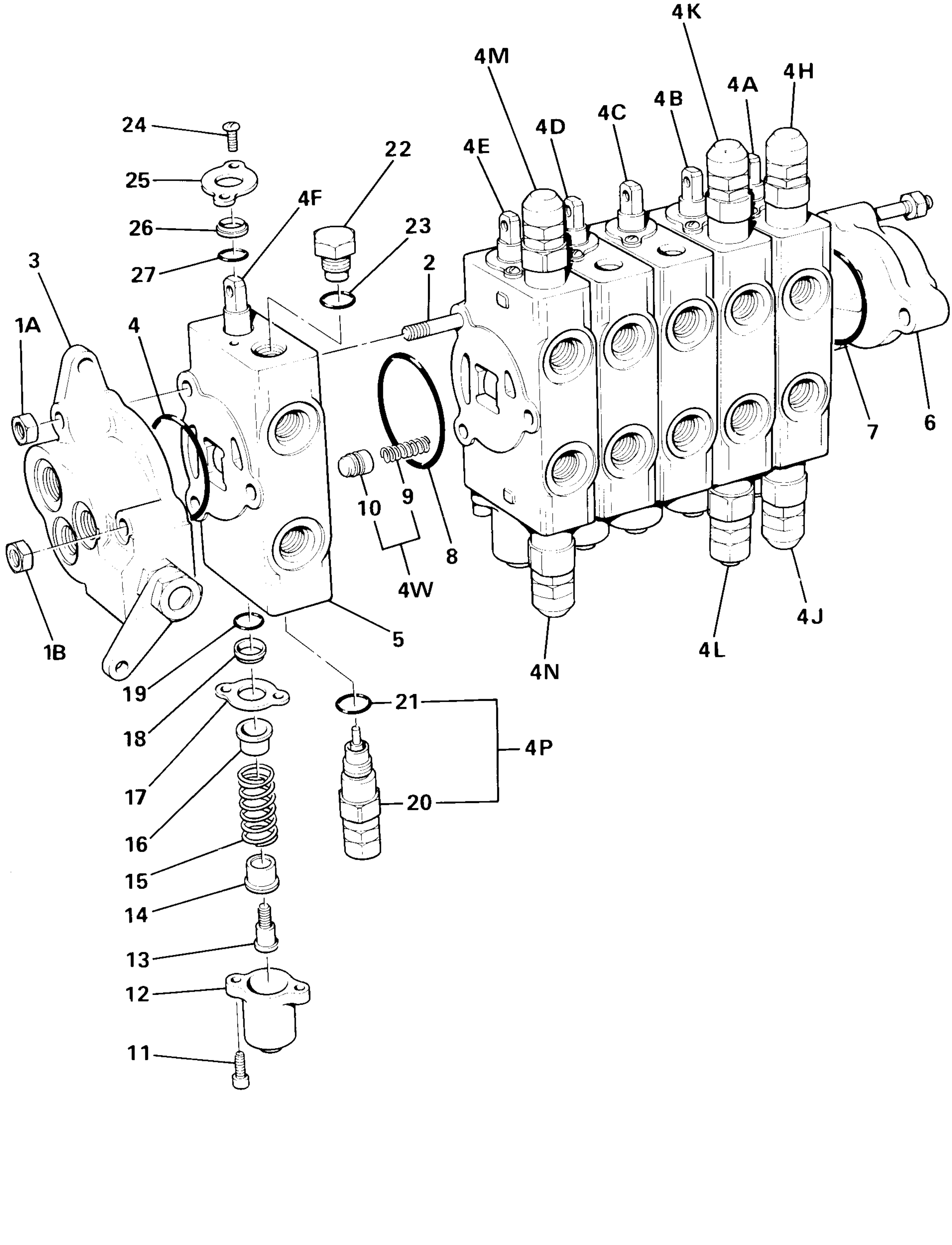


Fig 196. Excavator Valve Components

Auxiliary Relief Valves (ARV's)

Ten A.R.V's are fitted to the excavator valve block. The following procedure covers the dismantling and assembly of the A.R.V's

⇨ *Fig 197. (E-239)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequance should be reversed.

Great care should be taken when dismantling and assembling a valve to avoid the following:

– Contamination
– Damage to the spools
– Damage to the seal grooves

Any of the above may result in possible problems with the operation of the valve.

Dismantle

When removing `O' rings and seals, use an appropriately rounded to that WILL NOT cause any damage to the seal grooves.

Discard ALL `O' rings. DO NOT used worn or damaged items.

Retain shims **7** for re-assembly

Note: *The ARV's have various pressure settings dependant on their location, see* ***Technical Data****.*

Inspect the valve components for scratches, nicks and any other type of damage, replace suspect components with new.

Assemble

Renew all seals, using clean JCB Hydraulic Fluid as a lubricant.

Fit shims **7** to the same total thickness as those removed.

Note: *The shims are only intended to limit the maximum pressure to which it is possble to adjust the valve. The specified pressure setting of each valve is achieved by adjusting screw* ***5****. If the specified pressure cannot be achieved under test, it is permissible to add further shims as required.*

For detailed instruction on ARV pressure setting, see ***Service Procedures, 3C Machines.***

Table 45. Torque Settings

Item	Nm	kgf m	lbf ft
1	21.3 - 26.7	2.22 - 2.78	16 - 20
3	21.3 - 26.7	2.22 - 2.78	16 - 20
6	41 - 68	4.15 - 6.9	30 - 50

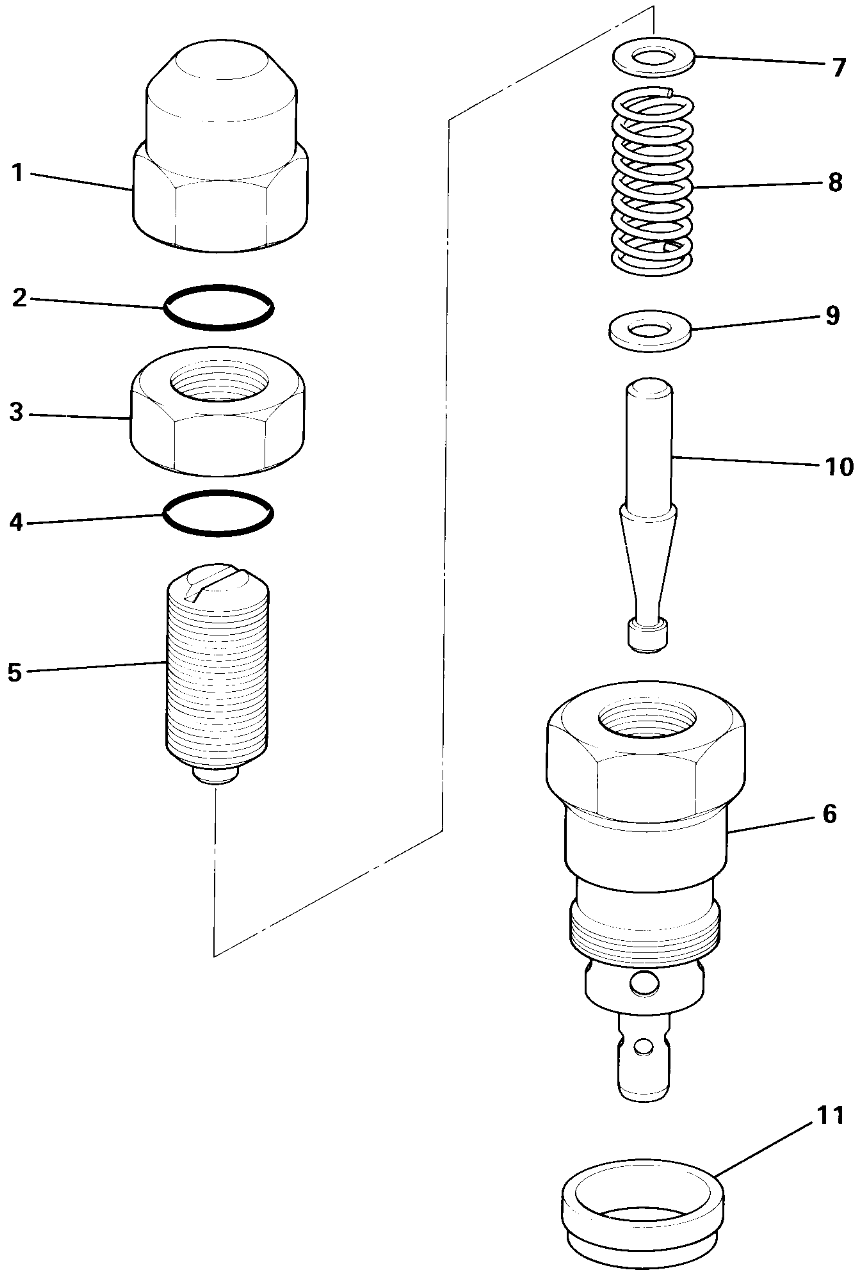


Fig 197. Auxiliary Relief Valve (ARV) Components

Hydraclamp Valve

⇒ *Fig 198. (E-241)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Great care should be taken when dismantling and assembling to avoid the following:

– Contamination
– Damage to the spools
– Damage to the seal grooves

Any of the above may result in possible problems with the operation of the valve.

Dismantle

When removing `O' rings and seals, use an appropriately rounded to that WILL NOT cause any damage to the seal grooves.

Discard ALL `O' rings. DO NOT used worn or damaged items.

Plug hose **1** to prevent the loss of oil and the ingress of dirt.

Inspect the valve components for scratches, nicks and any other type of damage, replace suspect components with new.

Assemble

Note: *View **A** shows the clamp in the OFF position.*

Ensure that orifice **X** is clear.

Lubricate the new seals with clean JCB Hydraulic Fluid before assembling.

Ensure plug **7** locates in groove **Y** of the rotary spool **9**.

Tighten nut **5** finger-tight before locking lever **4**.

Ensure that spool **9** rotates freely after tightening nuts **5** and **3**.

Table 46. Torque Settings

Item	Nm	kgf m	lbf ft
3	55 - 67	5.6 - 6.84	40.5 - 49.5
7	3.3 - 4.7	0.35 - 0.49	2.5 - 3.5
14	21.3 - 26.7	2.22 - 2.78	16 - 20

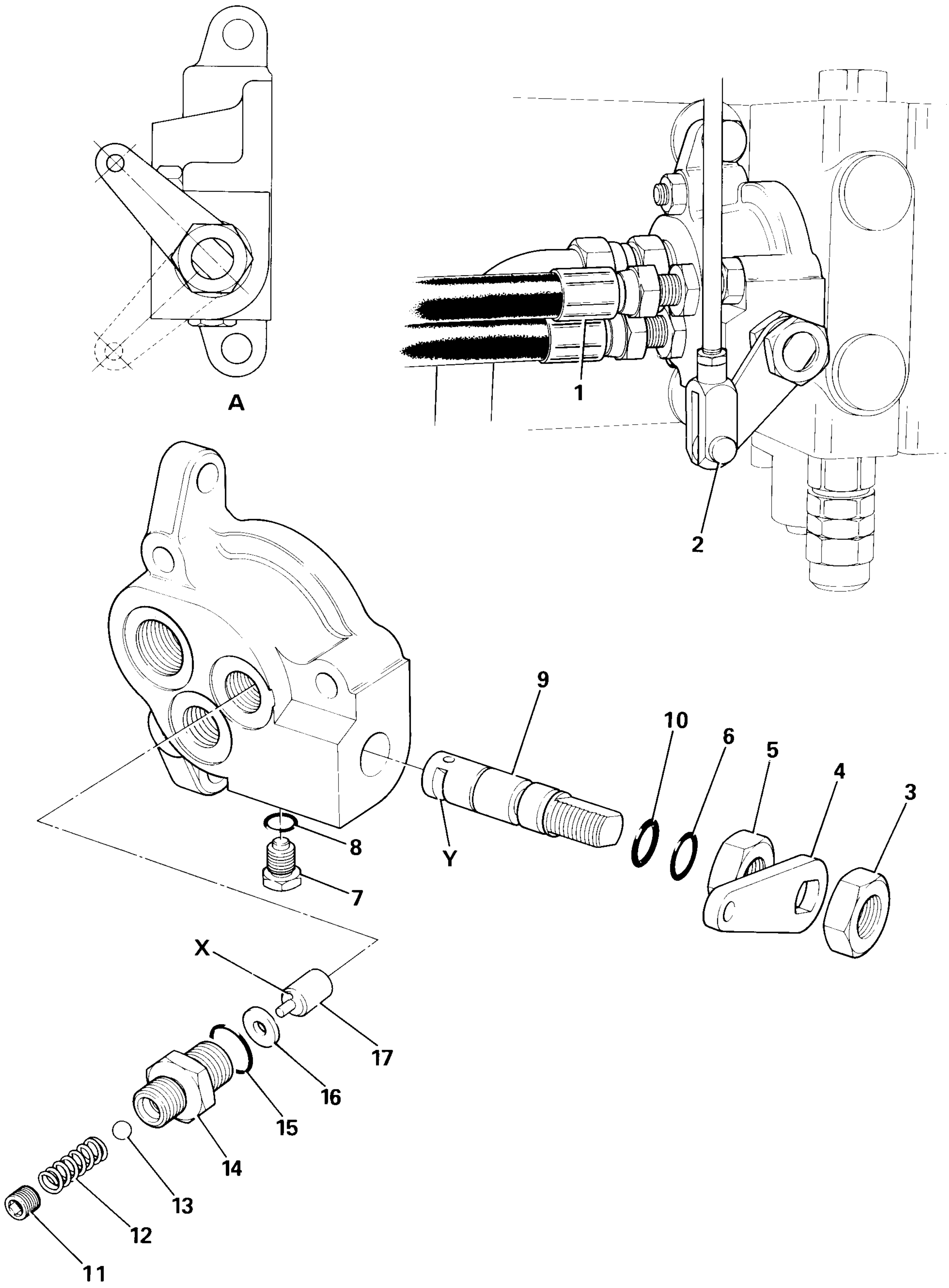


Fig 198. Hydraclamp Valve Components

Hose Burst Protection Valves - if fitted

Hydraulic Operation and Schematics - Loader HBPV

Note: *The small letters V2, C2, P, T and E correspond with the port markings on the valve.*

Machines with Smooth Ride System (SRS) have HBPV valves which incorporate an integral solenoid valve. ⇨ ***Smooth Ride System (SRS) - Option (E-244)***.

Load Raise

Oil from the loader lift spool is directed to port **V2** on the HBPV. The oil opens check valve assembly **A** and passes through an internal gallery to the head side of the ram via port **C2**.

Oil from the rod side of the ram returns to tank via the loader lift spool.

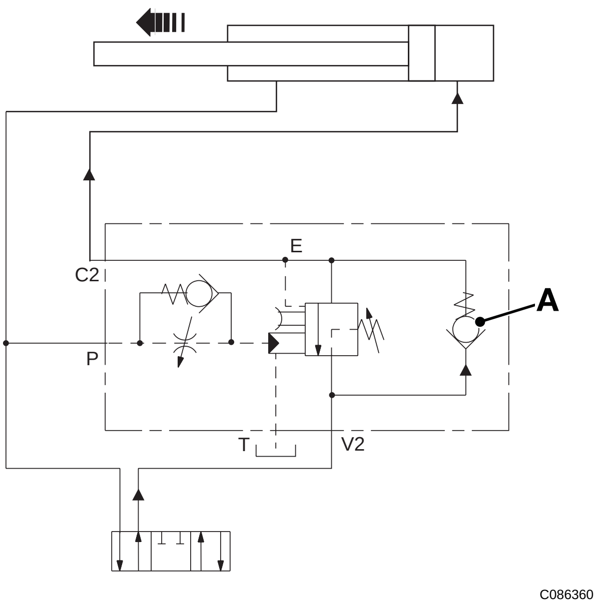


Fig 199.

Load Lower

Oil from the loader lift spool is fed directly to the rod side of the ram. An external pilot line **B** enables service line pilot pressure to act on the end of the relief valve piston **C**, which causes the piston to move off its seat against the force of the spring. Oil from the head side of the ram enters the HBPV at port **C2**, passes across the piston **C** and returns to tank via port **V2** and the loader lift spool.

The drilling and check valve assembly **D** act to 'dampen' any adverse effects of operating the control levers erratically.

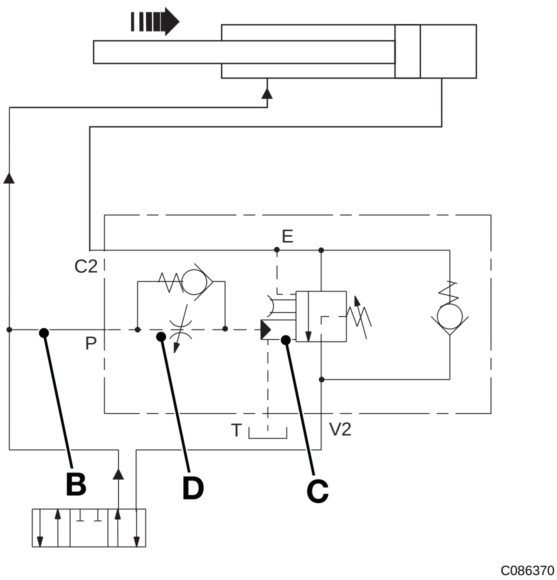


Fig 200.

Relief Valve

If during normal operation, the pressure in the head side of the ram increases (for example, by the operation of the shovel against an obstacle), the increasing pressure in the ram enters the HBPV at **C2** and acts on the pilot end of the relief valve piston **C**. When the pressure reaches the setting of the valve spring, the piston moves off its seat and creates a connection from the head side of the ram back to the loader lift spool.

Note: *Oil will not be exhausted from the ram until the auxiliary relief valve (ARV) in the loader valve block also operates.*

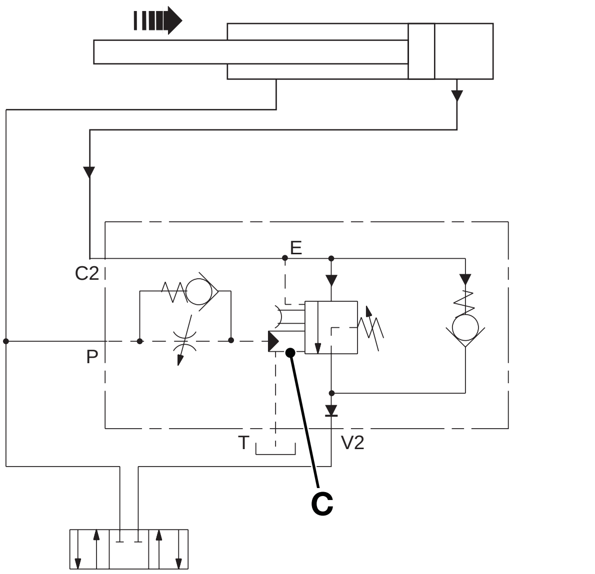


Fig 201.

Hose Burst

In the event of a hose burst, or leak in the pipework to the head side of the ram, the relief valve piston **C** will be held on its seat by the force of spring. The check valve **A** is kept firmly closed by hydraulic pressure due to the weight of the load in the shovel. Therefore oil is trapped in the head side of the ram and prevents the load from dropping.

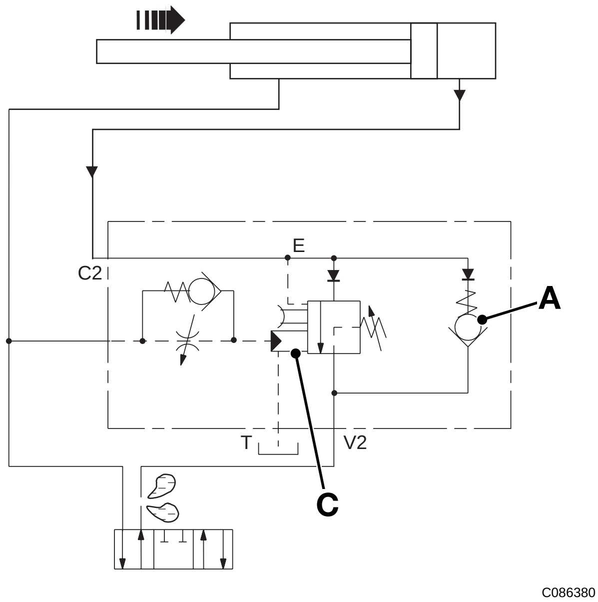


Fig 202.

Smooth Ride System (SRS) - Option

Machines with Smooth Ride System (SRS) have HBPV valves which incorporate an integral solenoid valve **X**.

When the SRS is selected ON, the solenoid on the HBPV valve is energised. This allows the hydraulic oil from the head side of the ram to pass through the valve via an internal gallery, by-passing the check valve assembly **A** and enter the SRS valve block **Y**. In this mode the HBPV valve is effectively by-passed and there will be no hose burst protection.

CAUTION

If both Smooth Ride System (SRS) and Hose Burst Check Valve (HBCV) options are fitted on your machine, when the SRS is selected ON there will be no HBCV protection. Do not switch the SRS ON when the front loader shovel is above 600mm (2ft).

0112

For a detailed description of smooth ride system (SRS) operation, see ***Circuit Descriptions***.

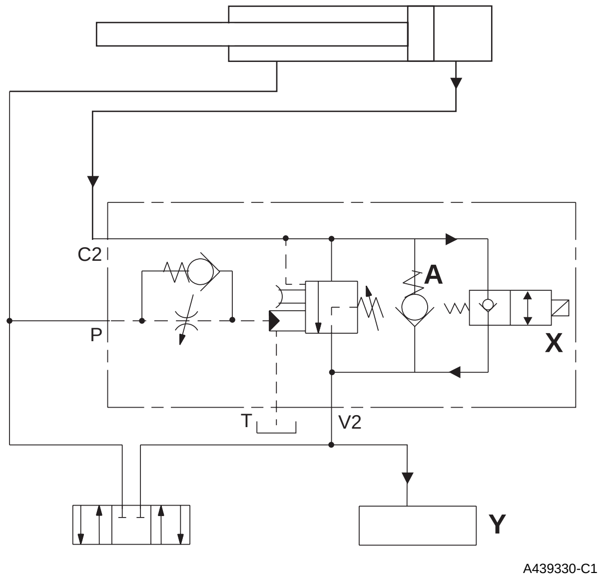


Fig 203.

Hydraulic Operation and Schematics - Boom HBPV

Note: *The small letters A, B, X, and Y correspond with the port markings on the valve.*

Load Raise

Oil from the excavator boom spool is directed to port **B** on the HBPV. The oil opens check valve assembly **A** and passes through an internal gallery to the rod side of the ram via port **Y**.

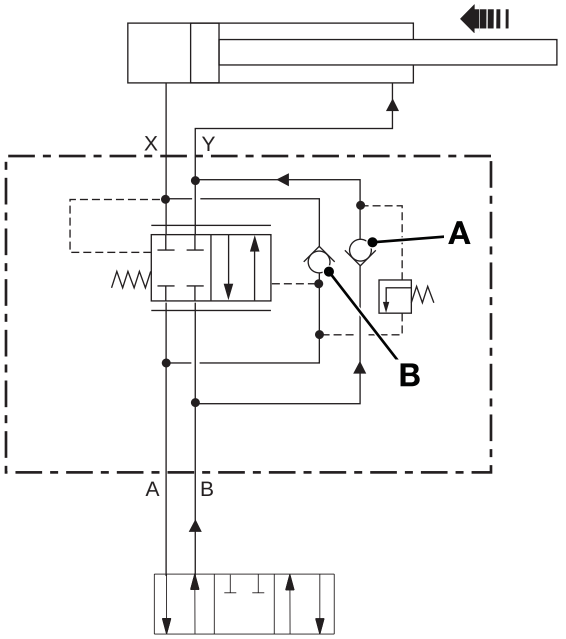
Oil from the head side of the ram enters at port **X**, opens check valve assembly **B** and returns to tank via port **A** and the excavator boom spool.

Load Lower

Oil from the excavator boom spool is directed to port **A**. The connection to the head side of the ram is blocked by the check valve assembly **B** and the position of the spool **C**.

Oil pressure in the pilot drilling **D** pushes spool **C** to the left against the force of the spring. The action of the spool allows oil to flow to the head side of the ram via port **X**.

Oil from the rod side of the ram enters at port **Y** and returns to tank via port **B** and the excavator boom spool.



C086410

Fig 204.

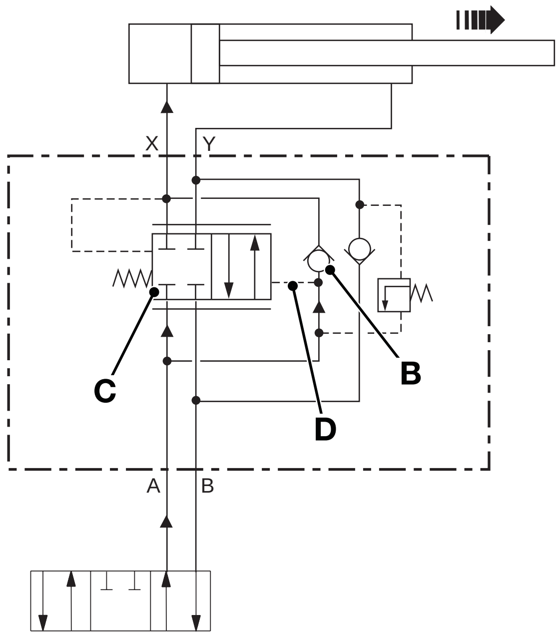


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Fig 205.

Relief Valve

If during normal operation, the pressure in the rod side of the ram increases (for example, by the operation of the bucket against an obstacle), the increasing pressure in the ram enters the HBPV at **Y** and acts on the relief valve piston **E**. When the pressure reaches the setting of the relief valve spring, the valve opens thus allowing oil to flow to port **A**.

The oil pressure moves spool **C** to the left against the force of the spring. The action of the spool allows oil to flow from the rod side of the ram to port **B**.

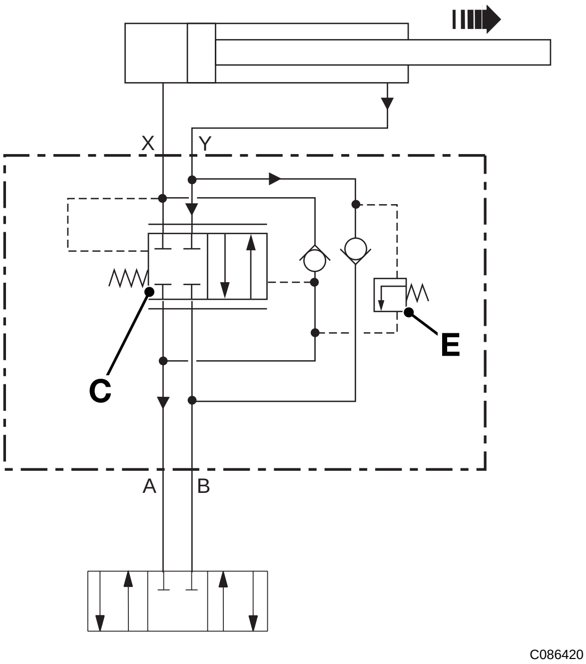

Fig 206.

Note: *Oil will not be exhausted from the ram via port* ***B*** *until the auxiliary relief valve (ARV) in the excavator valve block also operates.*

Hose Burst

In the event of a hose burst, or leak in the pipework to the rod side of the ram, the spool **C** will be held closed by the force of the spring. The check valve **A** is kept firmly closed by hydraulic pressure due to the weight of the load in the bucket. Therefore oil is trapped in the rod side of the ram and prevents the load from dropping.

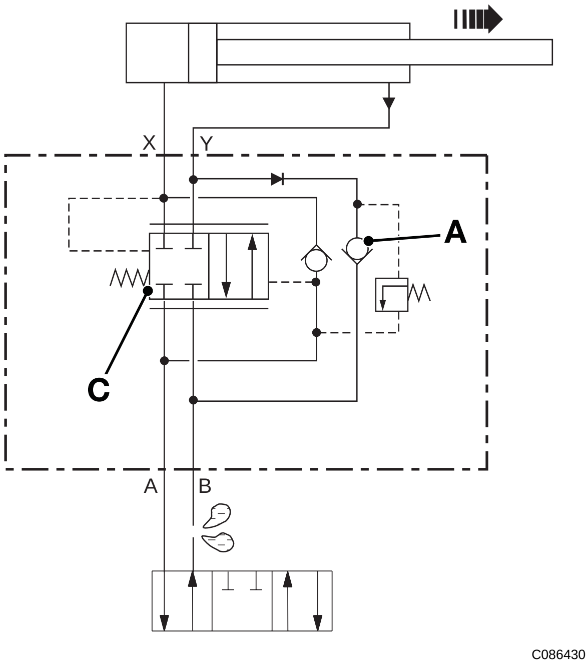

Fig 207.

Hydraulic Operation and Schematics - Stabiliser HBPV

Twin Check Valves

The machine has two stabilisers, each operated by its own control valve and ram. A check valve assembly provides protecton in the event of a hose burst in both the stabiliser raise and lower circuits. The operation for both stabilisers is identical. The following describes the operation of the check valve assembly for one stabiliser.

Stabiliser Lower

⇒ *Fig 208. (E-247)*. Oil from the control valve **C** flows to the check valve assembly **A**. Ball **D** is forced off its seat. Oil also flows across a pilot drilling and forces ball **E** off its seat. Oil now flows to the head side of the stabiliser ram **B**. Oil flows from the rod side past ball **E** and via control valve **C**.

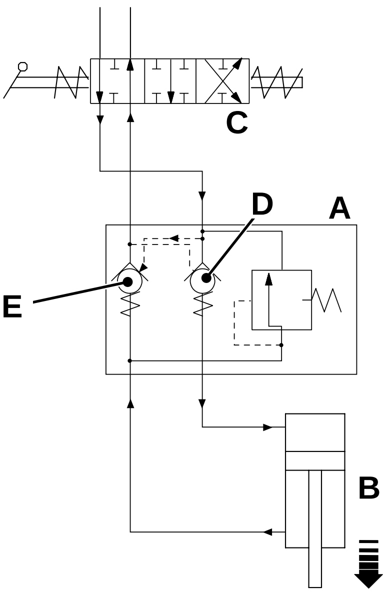

Fig 208.

Stabiliser Raise

⇒ *Fig 209. (E-247)*. Oil from the control valve **C** flows to the check valve assembly **A**. Ball **E** is forced off its seat. Oil also flows across a pilot drilling and forces ball **D** off its seat. Oil now flows to the rod side of the stabiliser ram **B**. Oil flows from the head side past ball **D** and via control valve **C**.

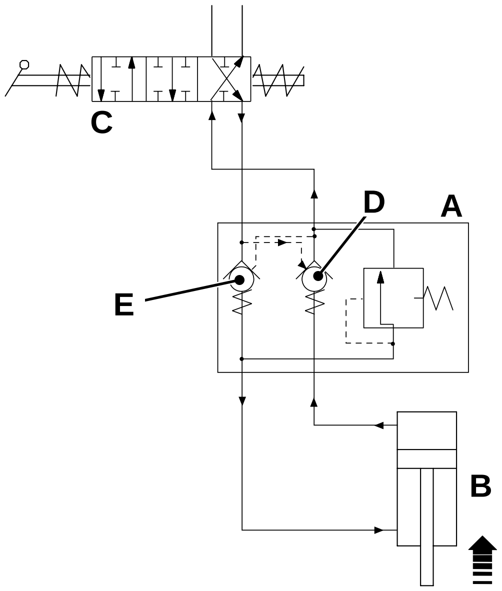

Fig 209.

Relief Valve (if fitted)

⇒ *Fig 210. (E-248)*. If during normal operation the pressure in the rod side of ram **A** increases when the stabilisers are being raised (for example when the ram reaches the end of its stroke), oil pressure in the relief valve pilot drilling overcomes the force of spring **F** and oil is diverted to tank via control valve **C**.

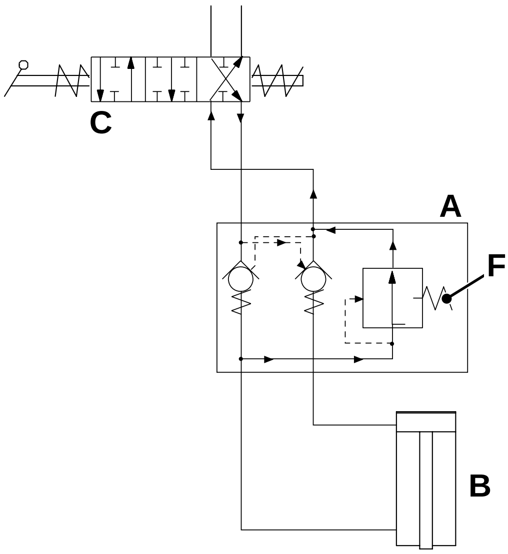

Fig 210.

Hose Burst

⇒ *Fig 211. (E-248)*. Since the check valve assembly **A** is connected directly to the steel pipes on the stabiliser ram **B** the check valves provide protection in the event of a hose burst. Pressure in the head or rod side of the stabiliser ram forces balls **E** or **D** onto their seats trapping oil in the ram and preventing it moving.

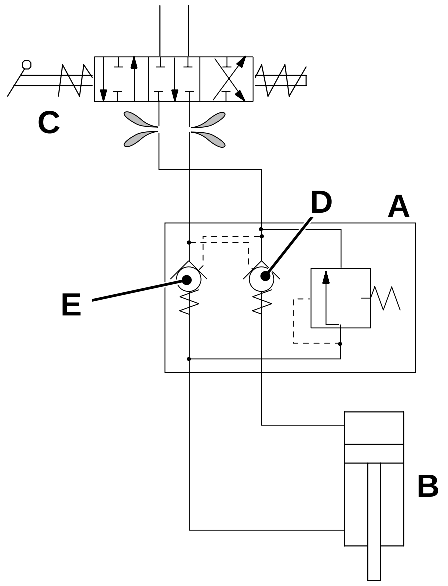

Fig 211.

Single Check Valve

The machine has two stabilisers, each operated by its own control valve and ram. A check valve assembly provides protecton in the event of a hose burst in the stabiliser raise circuit only. The operation for both stabilisers is identical. The following describes the operation of the check valve assembly for one stabiliser.

Stabiliser Lower

⇨ *Fig 212. (E-249)*. Oil from the control valve **C** flows to the check valve assembly **A**. Ball **D** is forced off its seat. Oil now flows to the head side of the stabiliser ram **B**. Oil flows from the rod side through a drilling in the check valve block and via control valve **C**.

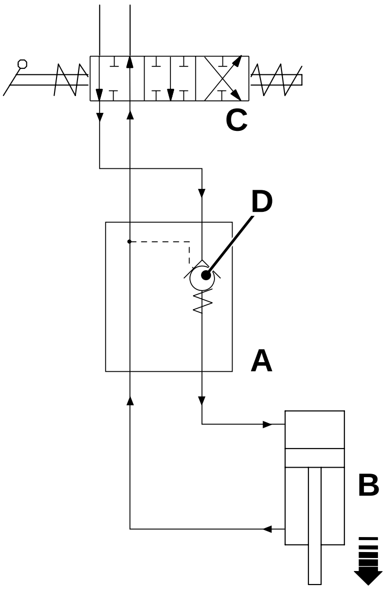

Fig 212.

Stabiliser Raise

⇨ *Fig 213. (E-249)*. Oil from the control valve **C** flows to the check valve assembly **A**. Oil flows across a pilot drilling and forces ball **D** off its seat. Oil now flows to the rod side of the stabiliser ram **B**. Oil flows from the head side past ball **D** and via control valve **C**.

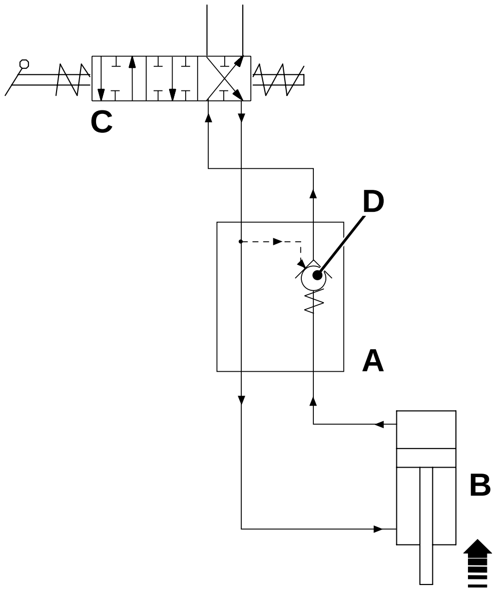

Fig 213.

Hose Burst

⇨ *Fig 214. (E-250)*. Since the check valve assembly **A** is connected directly to the steel pipes on the stabiliser ram **B** the check valve provides protection in the event of a hose burst on the head side of the ram. Pressure in the head side of the stabiliser ram forces ball **D** onto its seat trapping oil in the ram. In the event of a hose burst the machine will remain supported by the stabiliser.

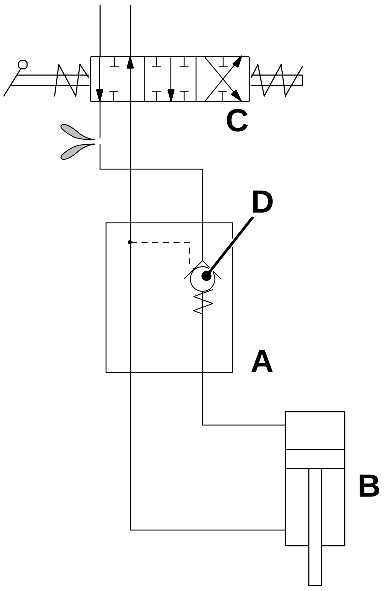

Fig 214.

Test Procedures

Checking Hose Burst Protection Valve

For the correct procedure, see ***Section 3, Maintenance***.

Lowering a Load

For the correct procedure, see ***Section 3, Maintenance***.

Pilot Valve Setting Procedure - Loader HBPV

The following text describes the pilot valve setting procedures and pressure testing sequences for ONE HBPV only, repeat the procedures for BOTH loader arm lift rams.

Preparation

Before starting the pressure testing procedure vent hydraulic system pressure as follows:

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral.

2 Lower the loader arms to the ground (not lifting the machine).

3 Select 'ARMS LOWER' to raise the front wheels approximately 25 - 50 mm (1 - 2 in) off the ground.

4 Switch off the engine.

5 Make sure all personnel are clear of the machine before completing step 6.

6 Select 'ARMS RAISE' - this will vent residual hydraulic pressure from the loader rams (head side).

7 Move all the backhoe control levers back and forth to vent any other residual hydraulic pressure from the backhoe service hoses.

Setting Procedure

⇨ ***Fig 215. (E-252)***. The pilot valve assembly, shown at **C**, must be set correctly before doing the relief valve pressure test. If the pilot valve is screwed too far into the HBPV it will create a flow path connection from port C2 to port V2 (see descriptions of operation).

To set the pilot valve assembly:

1 Remove pilot housing, item **D**, from the HBPV.

2 Check that the end face of the pilot valve assembly, item **C**, is flush (level) with the end face of its housing **D**, as shown at **E**.

3 If necessary, remove end cap **F** and, using a suitable Allen key, adjust the pilot valve as required.

4 Refit the end cap.

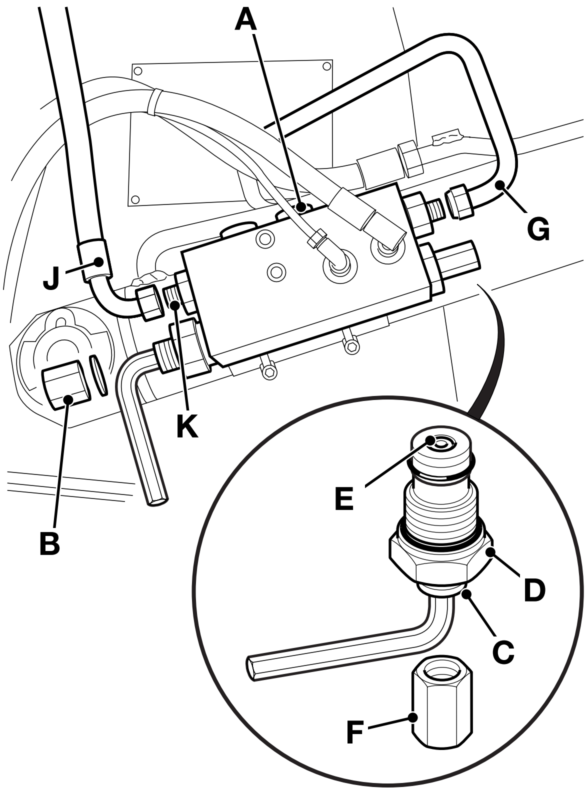

Fig 215.

Relief Valve Pressure Test

If the hose burst protection valve has been stripped and cleaned, then pre-set the valve as detailed in step 1. The pressure test procedure is described in steps 2 to 6.

1 Pre-set the relief valve:

a Remove cap **B** and its copper washer. Using an Allen key, turn the adjusting screw anti-clockwise to remove all tension.

b Using your fingers, turn the adjusting screw clockwise until a soft force (resistance) is felt.

c Using an Allen key, turn the adjusting screw a further 2 1/4 turns to pre-set the relief valve. Refit the cap and washer.

2 Remove hose **G** from port C2. Cap and plug the hose and valve port adapter (the valve port adapter MUST be plugged, otherwise the test procedure will not work).

3 Remove hose **J** from port V2. Plug the hose but DO NOT cap the valve port adapter.

4 Remove plug **A** and in its place fit a 0-400 bar (0-6000 lbf/in^2) pressure gauge connected to a hand pump.

5 Use the hand pump to increase the pressure. When the pressure reaches the setting of the relief valve, oil will escape from port V2, shown at **K**. Note the maximum gauge reading (the setting of the hose burst relief valve) which should be 250 bar (3625 lbf/in^2).

6 If necessary, adjust the pressure setting as follows:

a Remove cap **B** and its copper washer.

b Using an Allen key, turn the adjusting screw clockwise to increase the pressure or anti-clockwise to decrease the pressure. For information; one full turn of the relief valve adjusting screw is equivalent to approximately 110 bar (1595 lbf/in^2).

c Replace the cap and washer.

d Repeat pressure test, adjust as necessary.

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

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the backhoe and loader end to the ground and stop the engine.

Note: *For lowering a load with engine failure or a burst hose.* ***⇨ Lowering a Load (E-251)***.

2 Turn the manual over-ride screw fully clockwise.

3 Operate the main service control levers back and forth to vent residual pressure. For instance, if the HBPV is fitted on the boom or dipper then operate the backhoe control levers. If the HBPV is fitted on the loader arms then operate the loader control levers.

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

5 Undo the retaining clips and remove the HBPV.

Replacement

Replacement is a reversal of the removal sequence.

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

After refitting the valve to the machine, ensure that the valve operates correctly. ***⇨ Checking Hose Burst Protection Valve (E-251)***.

Dismantle and Assemble

Loader HBPV

Note: *This procedure applies to Hose Burst Protection Valves fitted to the loader arm rams ONLY.*

⇒ *Fig 217. (E-255)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Dismantle

If possible, avoid disturbing pressure settings, remove cartridges by unscrewing hexagons **1** and **13** and do not remove capnuts **3** and **16**.

Spool **2** and check valve **11** each have a Teflon ring fitted (items **A** and **B** respectively). These Teflon rings should only be removed and replaced with new ones if they are damaged.

Do not try to dismantle items **20**, **21** and **22** (these items are shown for pictorial reference only). To clean, use a non-metallic probe to move the ball **21** against spring **22** whilst assembly **17** is submersed in cleaning fluid.

Check condition of all visible seating faces. If any are damaged, renew complete cartridge or valve assembly.

Check valve bores and spools for nicks, scratches or scoring, if necessary, renew complete cartridge or valve assembly.

Assemble

DO NOT apply JCB Threadlocker and Sealer or any other type of locking fluid to the threads of item **17**. The threads form an integral part of the valve operating sequences - applying locking fluid to the threads will seriously effect the operation of the valve.

Ensure that the small drilled holes **C** and **D** in items **2** and **17** respectively are not blocked.

Renew all seals. If fitting new Teflon rings **A** and **B**, use a conical guide, item **E**, to expand the rings gradually, see ⇒ *Fig 216. (E-254)*. Complete the ring fitting procedure as quickly as possible, otherwise the ring will stretch.

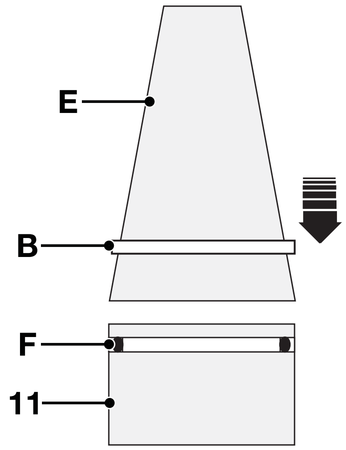

Fig 216.

Note: *There is an O-ring* ***F*** *fitted underneath each Teflon ring, if the Teflon rings are to be renewed, make sure that new O-rings are fitted first.*

During assembly, make sure that the valve parts move freely, if they don't, check that all the seals are correctly fitted.

After refitting the valve to the machine, check that the valve operates correctly. ⇒ ***Checking Hose Burst Protection Valve (E-251)***.

If the pressure settings were disturbed, then the valve must be re-set. ⇒ ***Pilot Valve Setting Procedure - Loader HBPV (E-251)***.

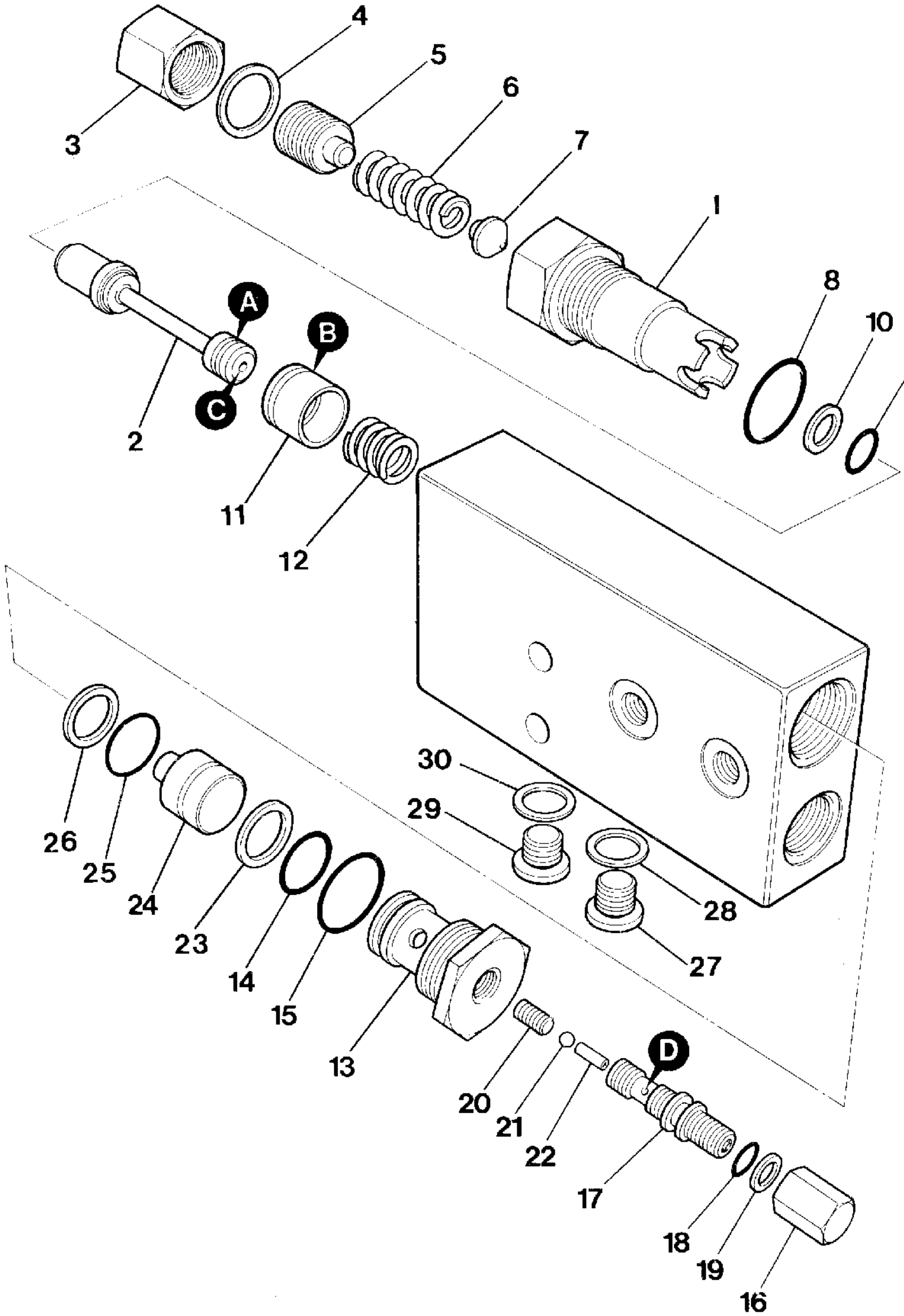

Fig 217. Loader HBPV

Boom HBPV

Note: *This procedure applies to Hose Burst Protection Valves fitted to the boom and dipper rams ONLY.*

There is no servicing permitted on this valve apart from the removing and fitting a new check valve assembly **A** when the seal **B** has been broken.

DO NOT use the machine with a broken seal.

If the assembly is fitted to the machine, before removing the check valve **A**, operate the main service control levers back and forth to vent residual pressure.

After fitting a new check valve ensure that the valve assembly operates correctly. ⇨ ***Checking Hose Burst Protection Valve (E-251)***.

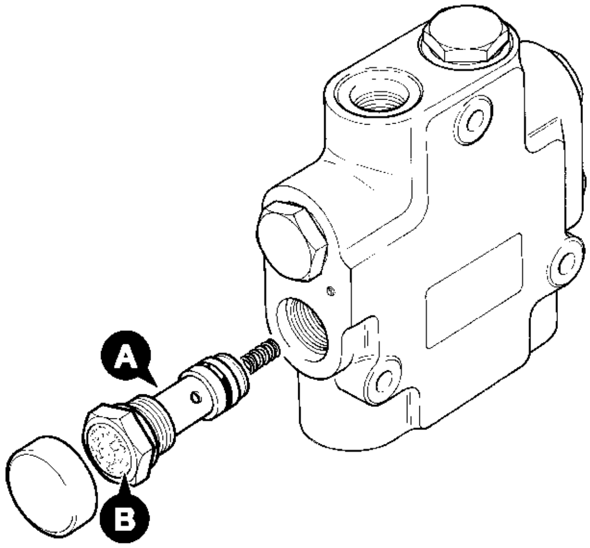

Fig 218.

Hydraulic Rams

Precautions During Use

TE-006

Installation

1 Precautions when installing the ram on the machine.

a When installing and removing from the machine, suspend the ram safely.

b Suspending the ram by the piping is not only dangerous, but can also cause damage to the cylinder.

c Secure the piston rod with a band. It is very dangerous if the rod extends unexpectedly. Also, the rod can be damaged and become unusable.

2 Welding after installing the ram may result in damage.

a If electric welding is done even at a point away from the ram, there may be sparking inside the ram and it will become necessary to replace the ram with a new one.

3 When painting the machine, mask the ram.

a If paint adheres to the rod surface or to the wiper ring and the ram is operated, the wiper ring will not function properly and foreign matter and paint can easily enter the ram. This will cause damage to the seals, drastically shortening the life of the ram.

4 Install the ram only when it is clean.

Caution During Use

1 Use only under designated conditions.

a If hydraulic oil other than the designated oil is used, the seals quickly degenerate and become damaged. If the relief valve is set at a value higher than specified, it may cause ram damage and is dangerous.

b In high temperature environments (approx. 90°C and above) or low temperature environments (below -20°C), seals quickly become damaged. Special seal materials are necessary so check to see if the ram that you are using is suitable or not.

c The number one cause of ram oil leakage is rod damage. Be careful not to damage the rod.

2 Warm up sufficiently before beginning work.

a In cold conditions the rod seals may be frozen, so if the ram is operated at maximum pressure and maximum speed, the seals will be damaged.

b There is a large amount of air in a new ram or one which has been left for a long time, so the ram will not operate smoothly. Also, if pressure is applied suddenly without bleeding the air, high temperatures will be generated due to adiabatic compression and the seals may burn.

c Before beginning work, always move the ram at full stroke with no load and expel air from the cylinder.

3 When stopping or storing, do it at a safe and fixed position.

a The installed ram cannot maintain the same position for a long period of time, because the oil inside the ram may leak and the hydraulic oil volume decreases as it cools. Stop or store the machine in a safe and fixed position.

Maintenance, Inspection Points

1 Carry out daily maintenance and inspection.

a The key point for correct long-term ram function is daily maintenance and inspection. Carry out maintenance and inspection so that the ram functions fully at all times. Always remove any mud, water, dust or oil film adhering to the rod and keep it in normal condition. However, when cleaning the wiper ring and seals, do not get them wet with water but wipe clean with a rag. To prevent rust forming during storage, the amount of exposed ram piston rod should be kept to a minimum. If leaving for more than one week, apply a light coating of suitable grease or petroleum jelly to the exposed part of the ram piston rod.

2 Use genuine JCB parts when replacing parts.

a If parts other than genuine JCB parts are used, the desired results may not be obtained. Use only genuine JCB parts.

3 Caution during dismantling and reassembly.

a Dismantling the ram while it is still installed on the machine can be dangerous as unexpected movements of the machine can occur. Remove the ram from the machine and then dismantle.

b If reassembled with dirty hands, foreign matter can enter the ram causing a shorter life span and also the other hydraulic equipment may be damaged. Reassemble in a clean state.

c Follow the instructions in the diagrams regarding torque tightening for screwed parts. If the torque is too high or too low, it can cause damage.

Removal and Replacement

Loader Shovel Ram

WARNING

The loader arm interlevers are potentially dangerous, when pivoting about their centre they form a 'scissor' point with the loader arm. Make sure the interlevers are securely blocked when working in the loader arm area.

BF-2-1

Removal

1. Park the machine on firm level ground. Engage the park brake and set the transmission to neutral.
2. ⇨ *Fig 219. (E-260)*. Rest the shovel flat on the ground as shown.
3. Stop the engine and remove the starter key.

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

4. Vent residual hydraulic pressure from the loader end by operating the loader controls back and forth several times.
5. Carefully disconnect the hydraulic hoses **A** at the shovel ram. Label each hose before disconnecting to ensure correct replacement. Plug the open ports and cap the hose ends to prevent loss of fluid and ingress of dirt.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

6. Wrap a suitable sling around the shovel ram, make sure that the weight of the ram is supported by the sling.
7. Remove the kliprings **B**, shims **C** and spacers **D**.
8. Remove pivot pins **E**.
9. Carefully lift the shovel ram clear of the machine.

Replacement

Replacement is the reverse of the removal sequence, but note the following:

Clean and lightly oil the pivot pins before fitting.

Make sure that each klipring is installed with a shim. All klipring installations to have a maximum end float of 2mm (0.080 in).

On completion, operate the loader shovel and make sure that the ram operates freely and does not foul.

Apply grease at each pivot pin grease nipple, see ***Section 3, Routine Maintenance***.

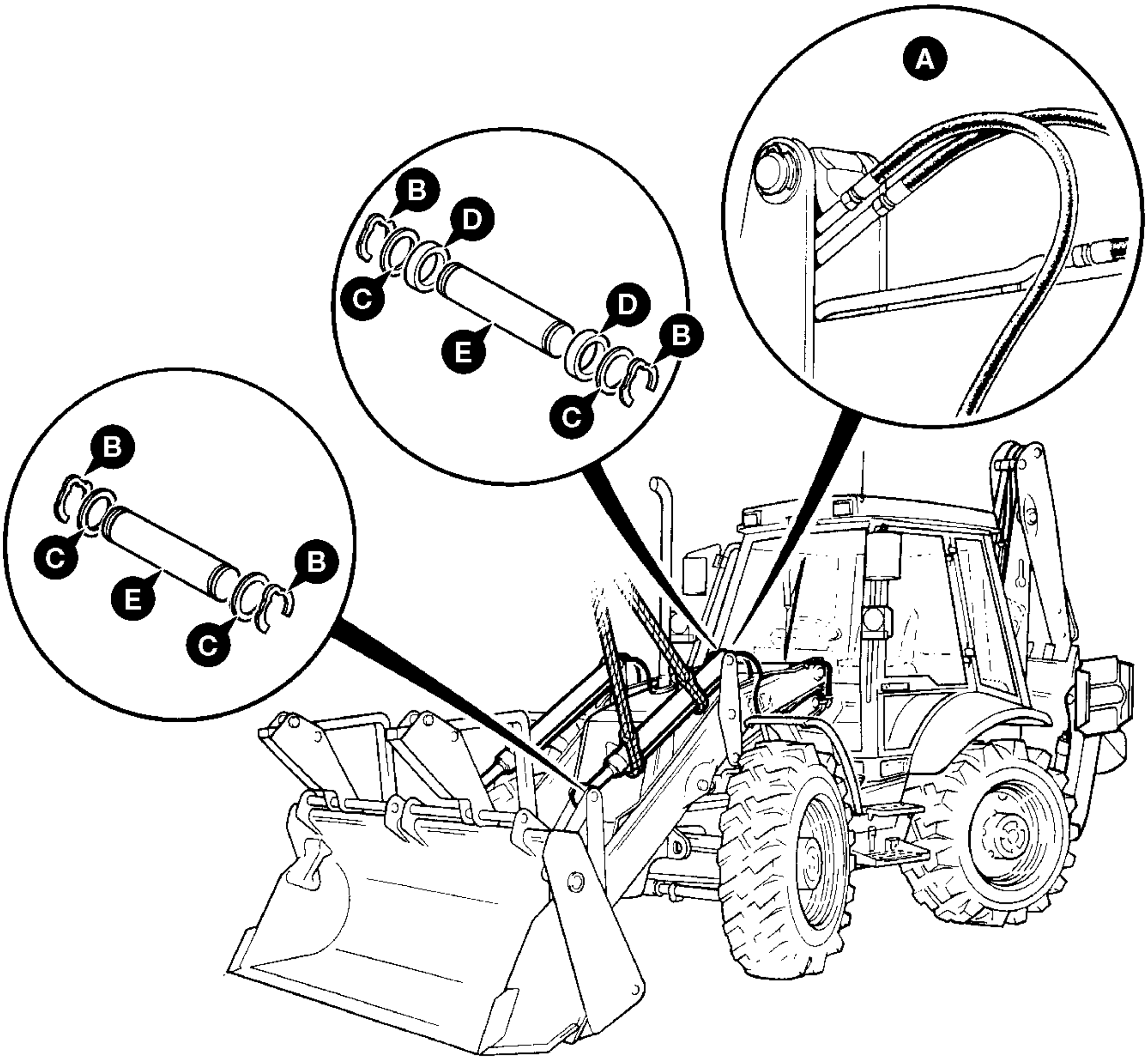

Fig 219. Loader Shovel Ram

Loader Lift Run

WARNING

The loader arm interlevers are potentially dangerous, when pivoting about their centre they form a 'scissor' point with the loader arm. Make sure the interlevers are securely blocked when working in the loader arm area.

BF-2-1

Removal

1. Park the machine on firm level ground. Engage the park brake and set the transmission to neutral.
2. ⇒ *Fig 220. (E-262)*. Raise the loader arms to give access to the lift ram pivot pin **D**. Put suitable supports **A** under the arms as shown.
3. Stop the engine and remove the starter key.

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

4. Vent residual hydraulic pressure from the loader end by operating the loader controls back and forth several times.

Important: *If a hose burst protection valve is fitted on the ram, the system will not vent. Extreme caution must be used when releasing hydraulic connections - release the connections one turn and allow the pressure to dissipate.*

5. Carefully disconnect the hydraulic hoses **B** at the lift ram. Label each hose before disconnecting to ensure correct replacement. Plug the open ports and cap the hose ends to prevent loss of fluid and ingress of dirt.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

6. Wrap a suitable sling around the lift ram, make sure that the weight of the ram is supported by the sling.
7. Remove the pivot pin retaining bolt **C** and then remove the rod end pivot pin **D**.
8. Remove the pivot pin retaining bolt **E** and then remove the pivot pin **F** (use the slide hammer kit, see ***Service Tools***).

   Take care to retrieve the spacer **G** and shims **H**. Record the locations of the spacer and shims so that they can be returned to their original positions.
9. Carefully lift the lift ram clear of the machine.

Replacement

Replacement is the reverse of the removal sequence, but note the following:

Clean and lightly oil the pivot pins before fitting.

Note: *Some machines may have a different shim arrangement to that shown. Make sure that all spacers and shims are returned to their original positions.*

Make sure that the head of bolt **E** is on the engine side.

On completion, operate the loader arms and make sure that the ram operates freely and does not foul.

Apply grease at each pivot pin grease nipple, see ***Section 3, Routine Maintenance***.

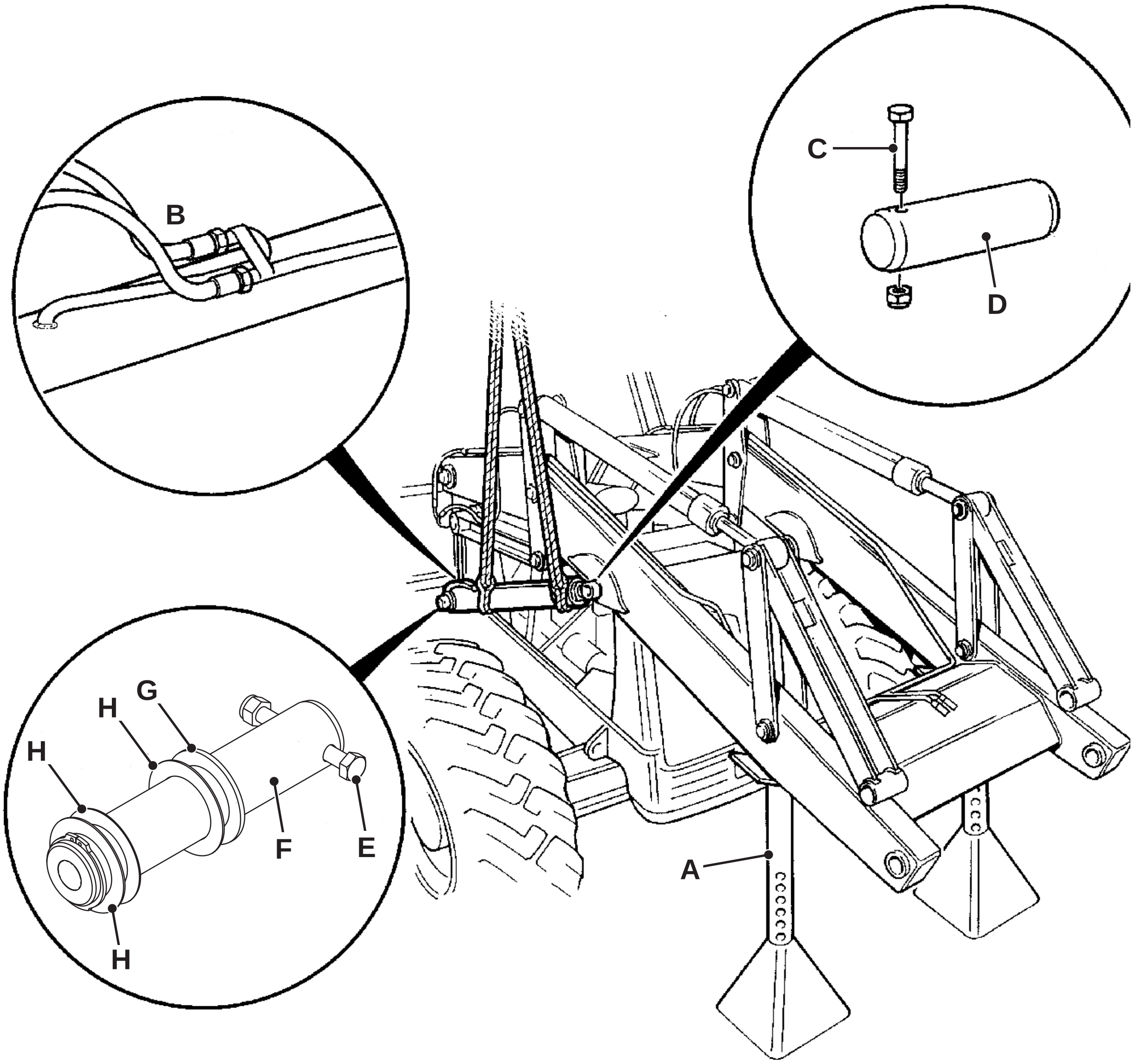

Fig 220. Loader Lift Ram

Slew Ram

Removal

Fig 221. (E-264).

1 Slew the backhoe to the left to remove the right hand slew ram and visa versa.

2 Lower the bucket to the ground and switch off the engine.

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

3 Vent any residual hydraulic pressure by operating the backhoe and slew control levers.

4 Disconnect the hydraulic hoses **1** to the slew rams - before disconnecting the hoses make sure that they are labelled (to assist with reassembly).

5 Plug and cap all open hydraulic connections to prevent ingress of dirt and loss of hydraulic fluid.

6 Loosen and remove trunnion bracket retaining nuts **2** and hardened washers **2A** (see note).

Note: *On assembly, the correct grade of nut (grade 12) and bolt (grade 10.9) must be used. Also, use hardened washers* ***2A*** *- NOT ordinary washers. Using incorrect specification items could result in a reduction of clamping efficiency.*

7 Remove the trunnion bracket **3**.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

8 Attach suitable lifting straps to the slew ram assembly. Note that the weight of the slew ram assembly is approximately 44 kg (97 lbs).

9 Remove thin nuts **4** (2 off per pivot pin) and remove the pivot pin retaining bolt **5**. Use a 25 - 30 mm diameter bar to knock the pin out vertically.

10 Remove the slew ram (eye end) pivot pin **6** and swing the ram to clear the kingpost casting.

11 Lift the slew ram assembly clear of the machine.

Inspection

Inspect the liner bearings **7** (located in the trunnion retaining bracket **3**) and liner bearing **8** for signs of damage, wear, scores or nicks etc. Replace as required.

To remove the liner bearing **8** use a jack located against blanking plate **9**. Shown in the inset at **Y**.

To remove the bearing liner **7** from the trunnion bracket use flat faced bearing pullers.

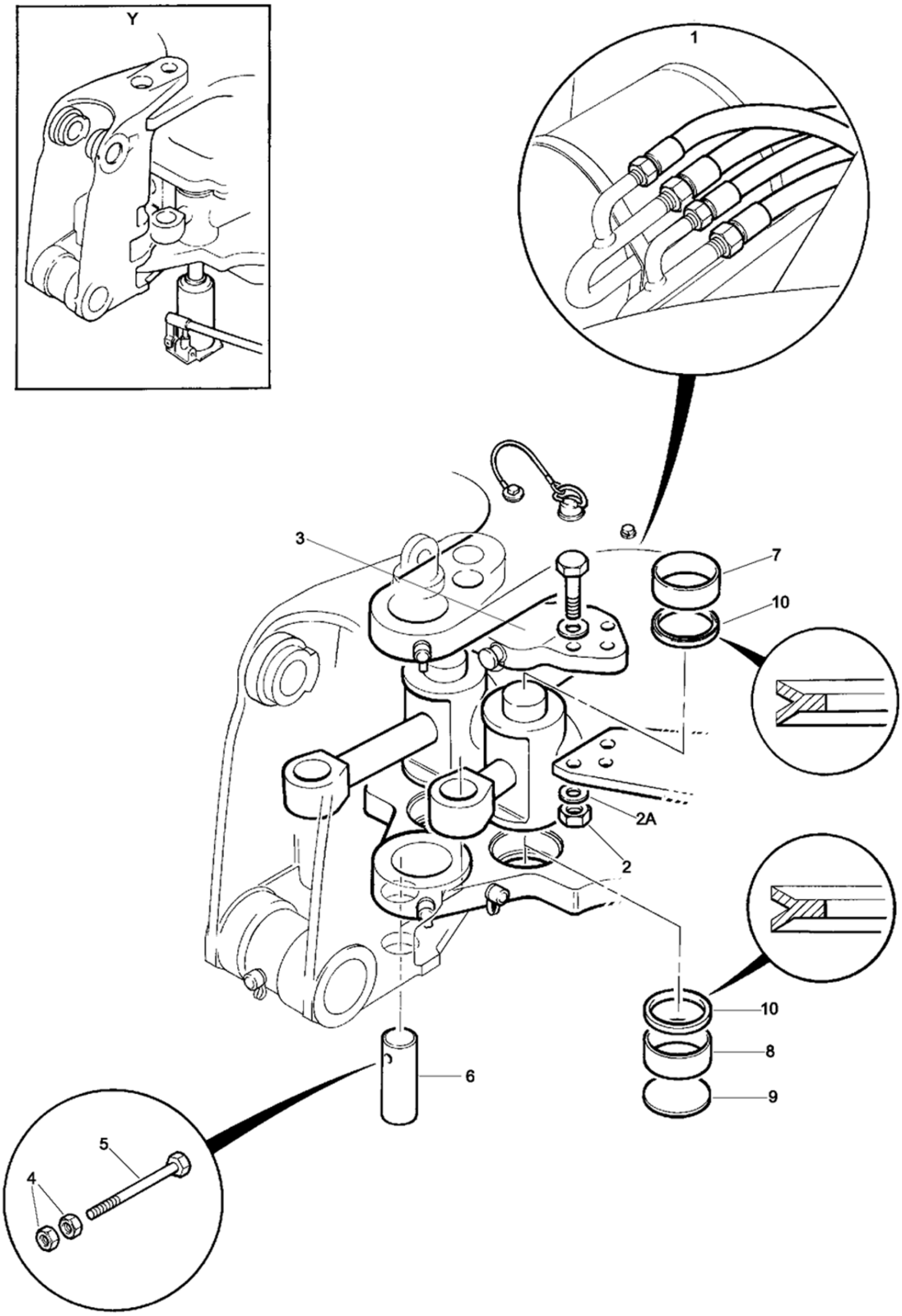

Fig 221. Slew Ram

Replacement

⚠ 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

Replacement is generally a reversal of the removal procedures, however note the following:

The liner bearings **7** and **8** have a `lead-in' diameter (noticeable with a slight step), always install the smaller diameter first into the pivot bore. The bearings must be installed so that they sit flush.

The eye end pivot pins **6** should be secured first - i.e. BEFORE the trunnion bracket retaining nuts **2**, this will help to maximise ram assembly alignment.

Make sure that the hydraulic hoses are correctly installed.

Make sure that any new or reused bearings are clean and smeared with grease prior to reassembly of pins and trunnion journals.When fully assembled, apply grease at each grease nipple BEFORE operating the machine.

Table 47. Torque Settings (Un-plated Fasteners)

Item	Nm	lbf ft	kgf m
2	565	417	57.5

Table 48. Torque Settings (Plated Fasteners)

Item	Nm	lbf ft	kgf m
2	510	376	52

Stabiliser Ram (Sideshift)

Removal

⇒ *Fig 222. (E-267)*.

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the backhoe and loader end to the ground.

2 Lower the stabiliser legs until the pads are approximately 4 in. (100 mm) off the ground and stop the engine.

3 Remove the bottom locking nut **A** and bolt **B**. Drive out the bottom pivot pin **C** and allow the stabiliser foot **D** to fall clear. Lift the inner leg and temporarily refit the pivot pin **C** through inner leg and ram.

4 Place a block of wood underneath the stabiliser leg.

5 Remove circlips **E** and drive out top pivot pin **F** with spacing collars **G**.

6 Start the engine and slowly extend the stabiliser ram so that the dump end of the ram protrudes from the top of the outer leg section.

7 Attach suitable lifting gear to the ram as shown at **H**. Make sure that the weight of the ram is supported by the sling and remove the bottom pivot pin **C**.

⚠ 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

8 Make sure the engine is switched off, vent residual hydraulic pressure by moving the backhoe and stabiliser control levers back and forth.

Note: *If a check valve is fitted on the ram, the system will not vent. Extreme caution must be used when releasing hydraulic connections - release the connections one turn and allow the pressure to dissipate.*

9 Loosen and remove the stabiliser hoses **L**, label the hoses before removing (as an aid to assembly). Plug all open orifices to prevent loss of fluid and ingress of dirt.

⚠ WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

10 Using suitable lifting equipment, lift the ram clear.

Replacement

Replacement is a reversal of the removal sequence.

⚠ 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

Use suitable lifting appliances to locate the stabiliser ram.

After replacing or fitting the ram, connect the hydraulic pipes, make sure that the ram and leg operate freely and do not foul.

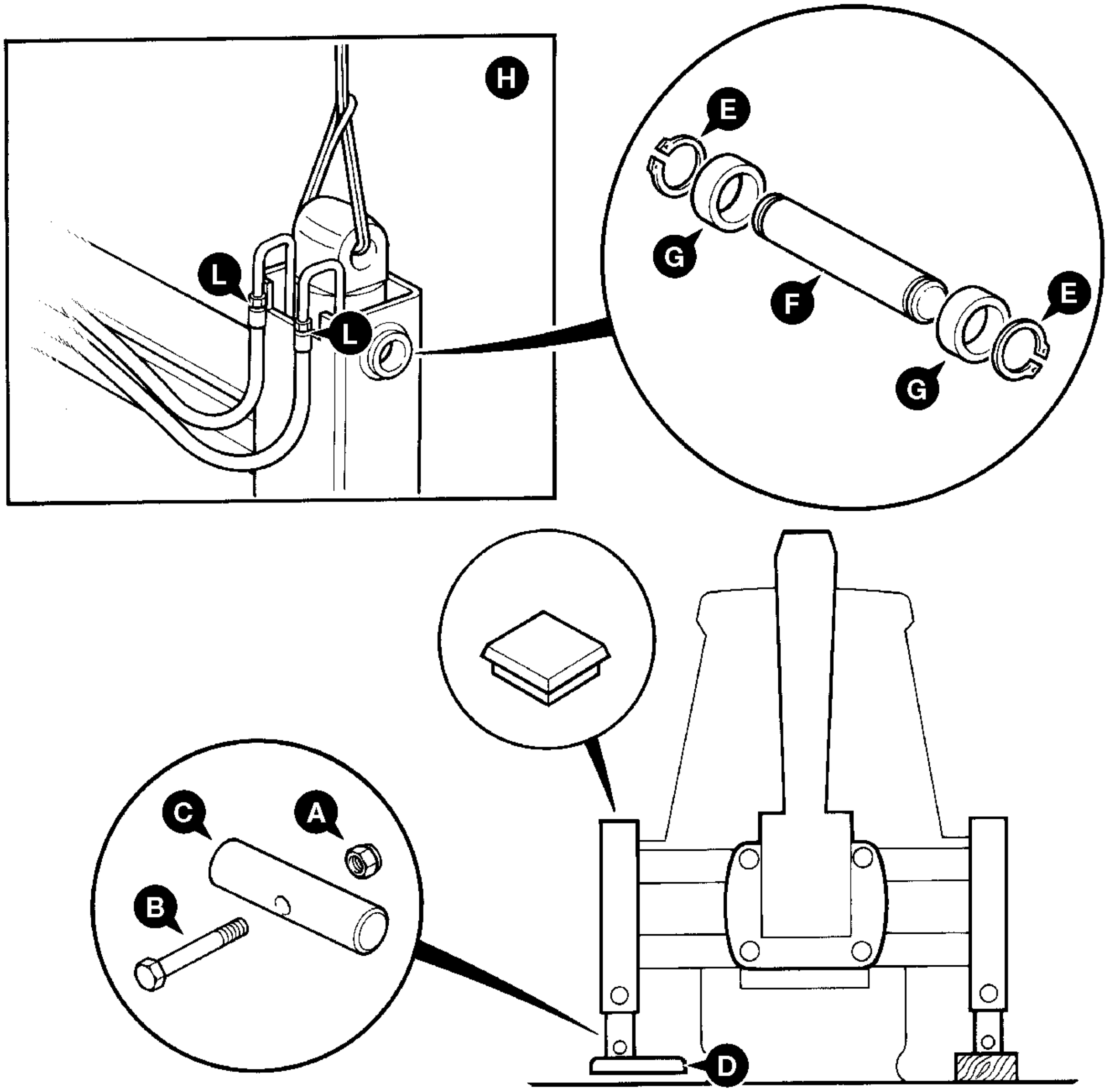

Fig 222. Stabiliser Ram (Sideshift)

Stabiliser Ram (Centremount)

Removal

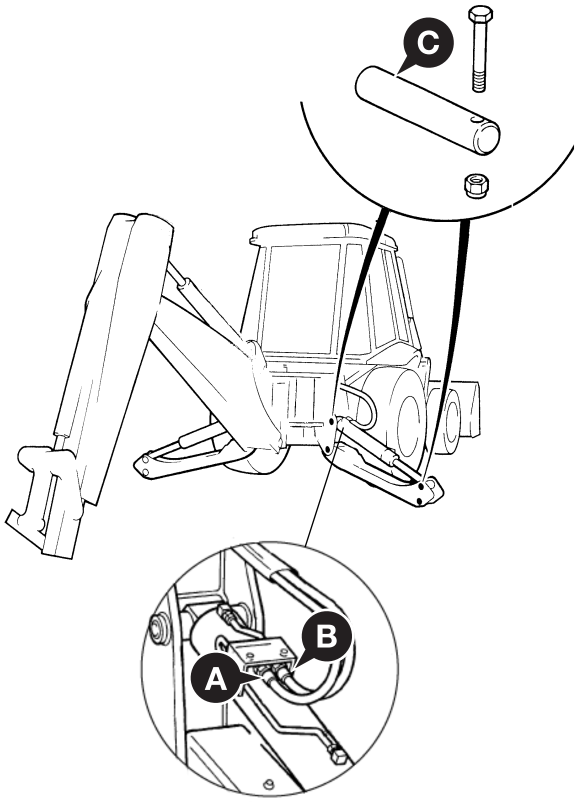

Fig 223.

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the stabiliser legs to the ground.

2 Lower the backhoe and loader end to the ground and stop the engine.

⚠ 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

3 Make sure the engine is switched off, vent residual hydraulic pressure by moving the backhoe and stabiliser control levers back and forth.

Note: *If a check valve is fitted on the ram, the system will not vent. Extreme caution must be used when releasing hydraulic connections - release the connections one turn and allow the pressure to dissipate.*

4 Carefully disconnect hydraulic hoses **A** and **B** from the stabiliser hydraulic ram, label the hoses before removing (as an aid to assembly). Release the connections slowly.

⚠ WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

5 Wrap a suitable sling around the stabiliser ram, make sure that the weight of the ram is supported by the sling.

6 Remove the ram pivot pin retaining nut and bolt, drive out the ram pivot pin as shown at **C**.

7 Remove the stabiliser ram.

Replacement

Replacement is a reversal of the removal sequence.

⚠ 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

Use suitable lifting appliances to locate the stabiliser ram.

After replacing or fitting the ram, connect the hydraulic pipes, make sure that the ram and leg operate freely and do not foul.

Bucket Crowd Ram

Removal

⇨ *Fig 224. (E-271)*.

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the backhoe and loader end to the ground and stop the engine.

⚠ 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

2 Vent residual hydraulic pressure from the backhoe hoses by operating the backhoe controls back and forth several times.

Note: *If a hose burst protection valve is fitted on the ram, the system will not vent. Extreme caution must be used when releasing hydraulic connections - release the connections one turn and allow the pressure to dissipate.*

3 Label and then remove the bucket crowd ram hoses **A**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

⚠ WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

4 Fasten lifting straps to the bucket crowd ram, make sure that the weight of the ram is supported by the sling.

5 Remove the pivot pin retaining nut **B** and bolt **C**, remove the pivot pin **D**.

6 Remove the bucket crowd ram.

Replacement

Replacement is a reversal of the removal sequence.

⚠ 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

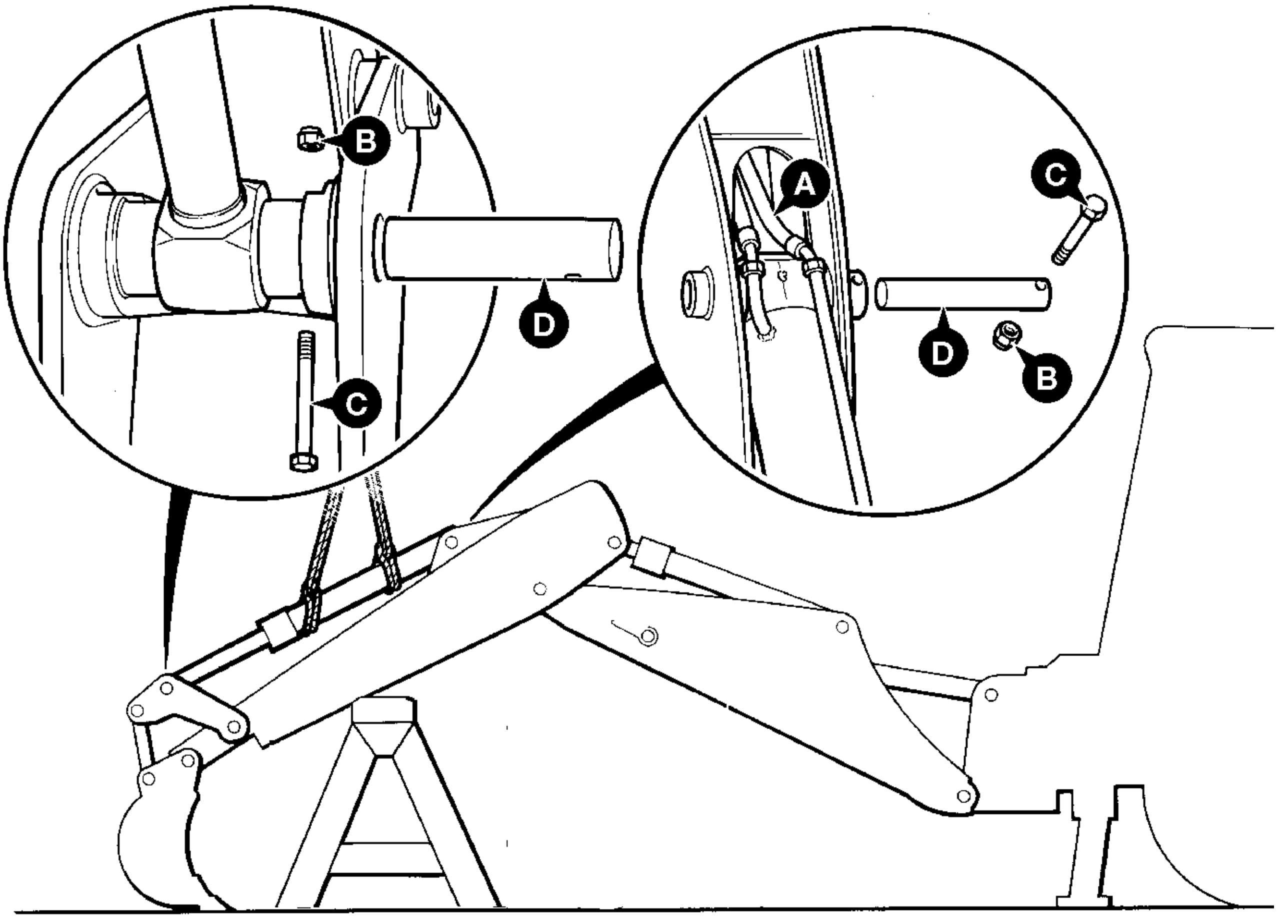

Fig 224. Bucket Crowd Ram

Dipper Ram

Removal

⇨ Fig 225. (E-273).

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the backhoe and loader end to the ground and stop the engine.

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

2 Vent residual hydraulic pressure from the backhoe hoses by operating the backhoe controls back and forth several times.

Note: *If a hose burst protection valve is fitted on the ram, the system will not vent. Extreme caution must be used when releasing hydraulic connections - release the connections one turn and allow the pressure to dissipate.*

3 Label and then remove the dipper ram hoses **A**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

4 Fasten lifting straps to the dipper ram, make sure that the weight of the ram is supported by the sling.

5 Remove the pivot pin retaining nut **B** and bolt **C**, remove the pivot pin **D**.

6 Remove dipper ram.

Replacement

Replacement is a reversal of the removal sequence.

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

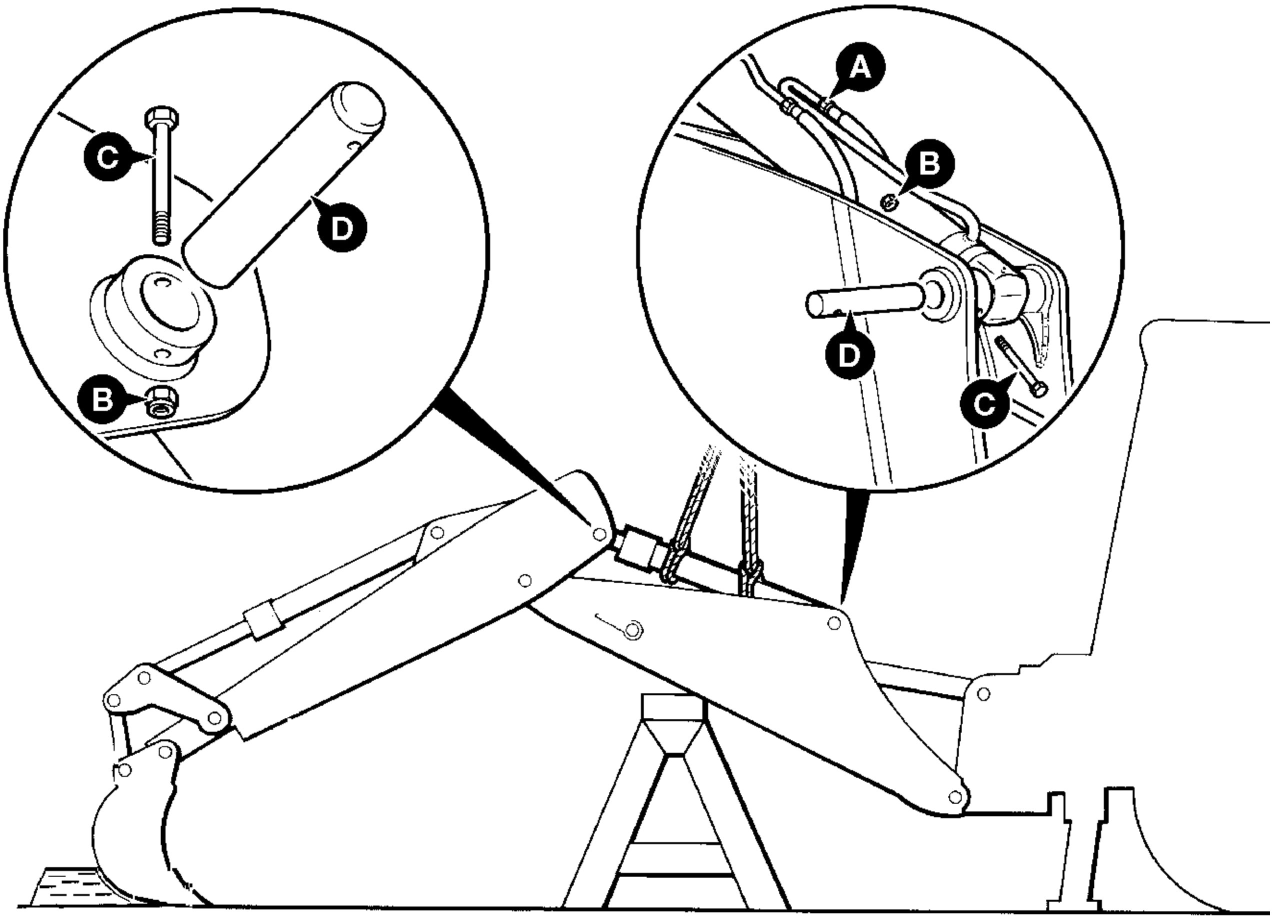

Fig 225. Dipper Ram

Boom Ram

Removal

⇨ *Fig 226. (E-275)*.

1. Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the backhoe and loader end to the ground and stop the engine.
2. Remove pivot pin retaining nut **A** and bolt **B**. Remove the pivot pin **C**.
3. Remove the grease nipple from the eye end of the ram (through access hole **D**).
4. Use the machine hydraulics to SLOWLY retract the ram.
5. Remove the hose clamp.

⚠ 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

6. Vent residual hydraulic pressure from the backhoe hoses by operating the backhoe controls back and forth several times.

Note: *If a hose burst protection valve is fitted on the ram, the system will not vent. Extreme caution must be used when releasing hydraulic connections - release the connections one turn and allow the pressure to dissipate.*

7. Label and then remove the boom ram hoses **E**. Plug and cap all open orifices to prevent loss of fluid and ingress of dirt.

⚠ WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

8. Fasten lifting straps to the boom ram, make sure that the weight of the ram is supported by the sling.
9. Remove the pivot pin retaining nut **F** and bolt **G** remove the kingpost pivot pin **H**.
10. Remove the boom ram.

Replacement

Replacement is a reversal of the removal sequence.

⚠ 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

It will be necessary to extend the ram to align and engage the boom pivot pin **C**. As the ram extends, the ram will tend to turn.

For this reason it is recommended that a smaller diameter steel bar is used to locate the boom ram at the kingpost casting. The steel bar can be more readily removed to allow for re-alignment of the boom pivot pin **C**.

When the boom pivot pin has been correctly aligned and fitted, then fit the correct pivot pin **H** at the kingpost.

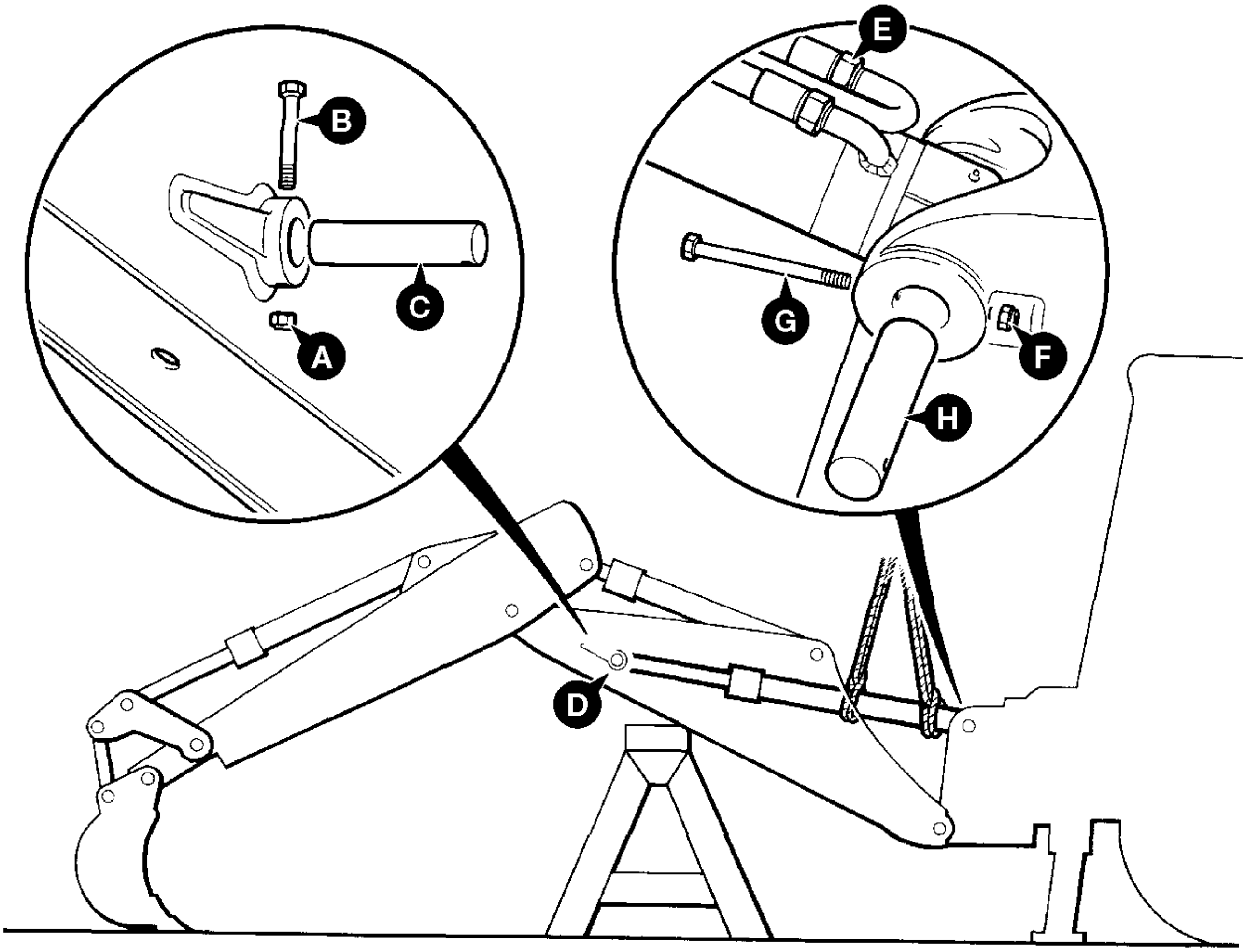

Fig 226. Boom Ram

Dismantle and Assemble

Typical Ram

The procedures described below are applicable for the following rams:

- **Loader Shovel Ram**
- **Loader Lift Ram**
- **Stabiliser Ram**
- **Bucket Crowd Ram**
- **Boom Ram**
- **Extending Dipper Ram** - if fitted

Dismantle

See ⇨ *Fig 229. (E-278)* and ⇨ *Fig 230. (E-278)*.

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

For assembly the sequence should be reversed.

Place ram assembly on a locally manufactured strip and rebuild bench as shown in ⇨ *Fig 227. (E-276)*.

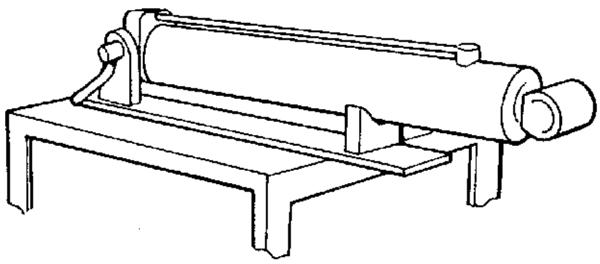

Fig 227.

Slacken end cap **1** using special spanner (see **Service Tools**), and remove the piston rod assembly **2** from the cylinder.

⚠ WARNING

If air or hydraulic pressure is used to force out the piston assembly, ensure that the end cap is securely fitted. Severe injury can be caused by a suddenly released piston rod.

HYD-1-2

Position piston rod assembly on bench in place of ram cylinder. Remove seal **4** and wear rings **3** and **5** from piston head.

Extract dowel **6** from the piston head using a metric screw (M3, M4, or M6 depending on ram size) threaded into the extractor hole.

Remove piston head from rod using special spanner (see ***Service Tools***).

Remove gland bearing and end cap **1** from piston rod and remove the `O' ring **9**, wiper seal **10** and rod seal **11**. Check the end cap bearing for damage, scores or nicks. If damaged, the bearing must be replaced as part of the end cap assembly.

Ensure that metal components are free from scoring, nicks and burrs. A damaged rod will impair the life of the seals.

Check the bore of the ram cylinder for damage.

Assemble

Clean threads of piston rod, piston head, end cap and cylinder using a wire brush. 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).

For the correct method of fitting seals to the end cap and piston head, ⇨ *JCB Ram Sealing Procedure (E-288)*.

Apply JCB Activator to threads of end cap 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.*

Fit locking dowel **6** to piston head and rod as follows:

1 Fit 'O' ring **8** into piston head **7**.

2 Fit piston head to piston rod and torque tighten, ⇨ *Table 49. Torque Settings (E-277)*.

3 New ram Shaft and piston head fitted. If both are required, the following procedure should be followed:

- **a** Drill through piston head into piston rod. Use an undersized diameter drill first as a guide and then drill with the correct size diameter drill to suit, see ⇨ *Fig 228. (E-277)* and ⇨ *Table 50. Drill Diameters and Depths (E-277)*.
- **b** Remove all swarf and contamination. Insert dowel **6** into drilled hole, make sure tapped extractor hole is to outside.

4 New piston head fitted on a **pre-drilled piston rod**. Re-drill and dowel **BOTH** the piston head and piston rod at 90° from the existing drilled dowel hole in the piston rod. Follow the procedures described in step 3.

5 New piston rod fitted to a **pre-drilled piston head**. Use the pre-drilled hole in the piston head. Care must be taken not to elongate the existing hole in the piston head.

- **a** Use a drill the same diameter as the pre-drilled hole in the piston head to make a 'centre mark' in the piston rod. DO NOT drill the piston rod at this stage.
- **b** Use an undersized diameter drill as a guide and drill into the piston rod to the required depth, ⇨ *Table 50. Drill Diameters and Depths (E-277)*. Make sure the drill has centred correctly on the 'centre mark' made at step 5a.
- **c** Use the correct size diameter drill to suit the dowel and drill to the required depth, ⇨ *Table 50. Drill Diameters and Depths (E-277)*.
- **d** Remove all swarf and contamination, insert the dowel.

Position cylinder on bench and install rod assembly into cylinder.

Apply JCB Threadlocker and Sealer (High Strength) to first three threads of cylinder, torque tighten the end cap, ⇨ *Table 49. Torque Settings (E-277)*.

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.*

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

Table 49. Torque Settings

Item	Nm	kgf m	lbf ft
1	678	69.2	500
7	405	41.3	300

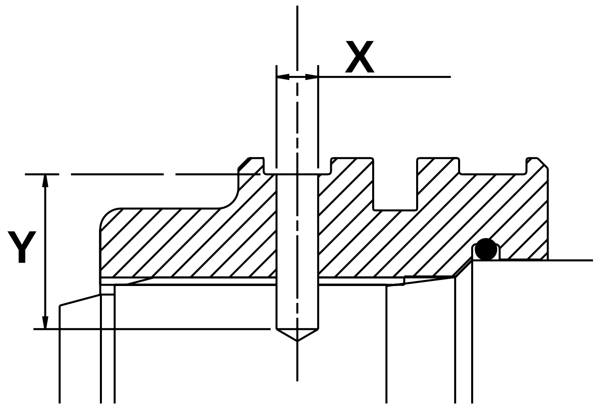

Fig 228.

Table 50. Drill Diameters and Depths

All Dimensions are in mm

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø **X**	Dowel Drill Depth **Y**
80 x 50	6Ø x 20	4	21	6.02-6.1	22-23
70 x 40					
90 x 50	8Ø x 25	5	24	8.02-8.1	27-28
100 x 60					
110 x 60	12Ø x 30	8	28	12.02-12.1	32-33
110 x 65					
120 x 65	12Ø x 35	8	33	12.02-12.1	37-38
130 x 75					

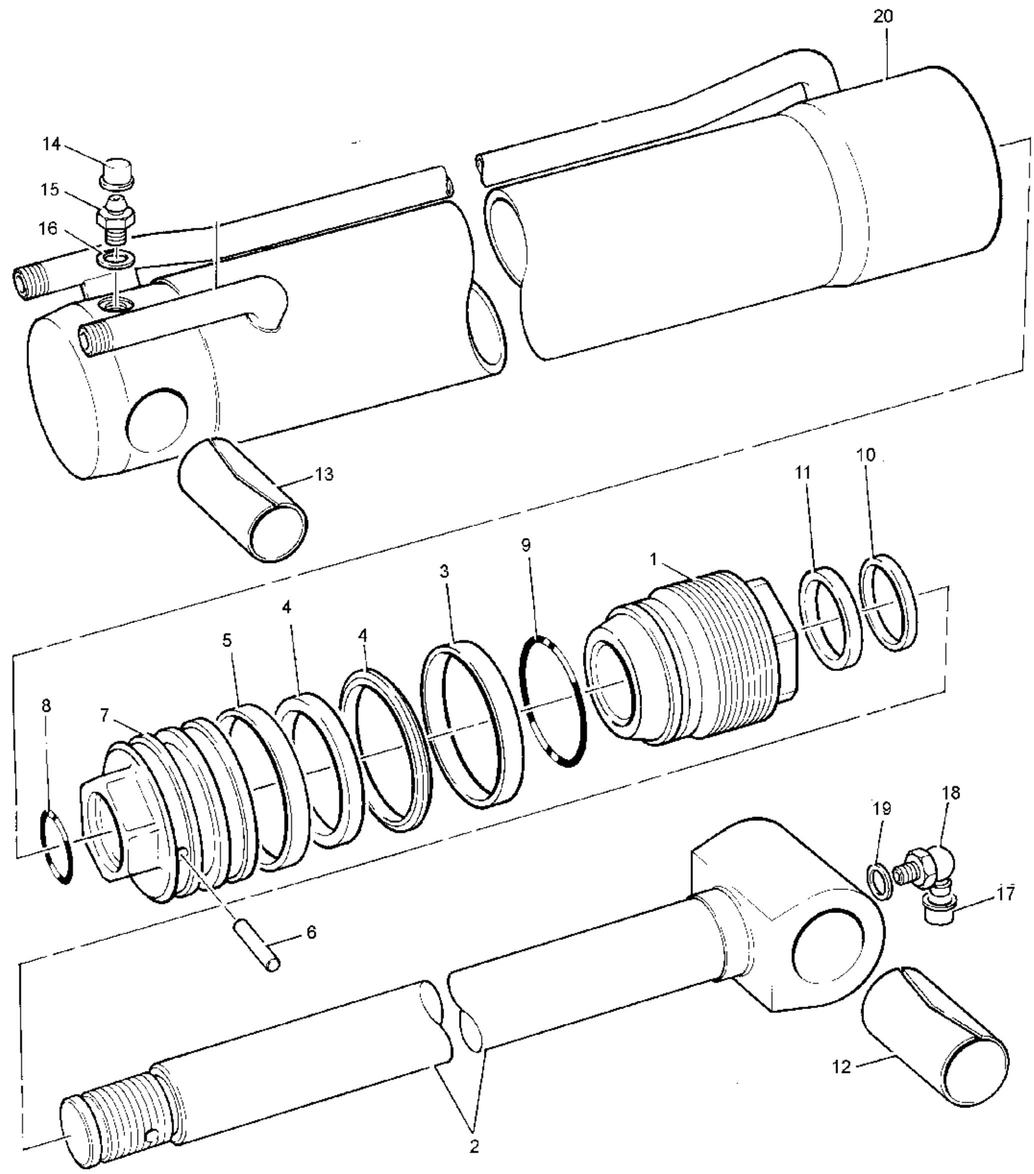

Fig 229.

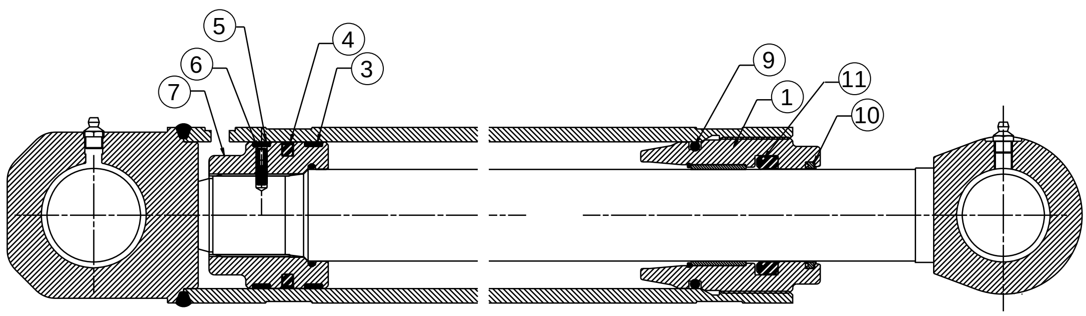

Fig 230. Typical Ram Assembly

Note that on boom and bucket rams, pivot pin grease seals are fitted.

Slew Ram

Dismantle

⇨ *Fig 233. (E-282)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Place ram assembly on a locally manufactured strip and rebuild bench as shown or alternatively, hold the ram in a suitable vice taking care not to damage machined faces.

Remove cylinder **6** using special spanner (see ***Service Tools***). Tap the cylinder off the piston head assembly using a suitable drift (e.g. nylon).

Position the piston rod assembly in a vice, use soft jaws and stand the assembly vertical whilst clamping on the eye end as shown in ⇨ *Fig 231. (E-279)*.

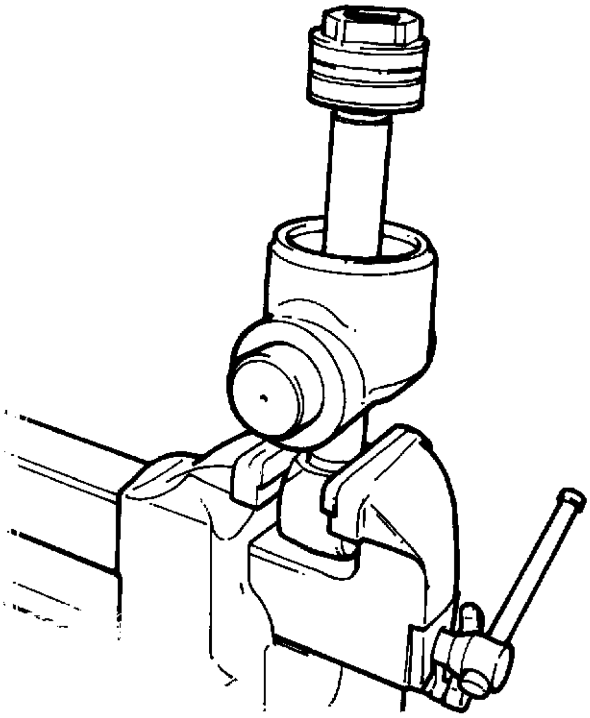

Fig 231.

Remove seal **8** and wear rings **7** and **9** from piston head. Extract dowel **10** from the piston head using a metric screw threaded into the extractor hole.

Remove piston head from rod using special spanner (see ***Service Tools***).

Remove `O' ring **12**.

Lift the end cap assembly **13** off the piston rod. Remove `O' ring **14**, rod wiper seal **15** and rod seal **16** from the end cap assembly. Check the end cap bearing **13A** for damage, scores or nicks.

Item **18** is the metering orifice plate and item **17** its retaining wire, do not remove these items unless problems with the metering are suspected.

Ensure that metal components are free from scoring, nicks and burrs. A damaged rod will impair the life of the seals.

Check the bore of the ram cylinder for damage.

Assemble

Clean threads of piston rod, piston head, end cap and cylinder using a wire brush. 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).

For the correct method of fitting seals to the end cap and piston head, ⇨ ***JCB Ram Sealing Procedure (E-288)***.

Apply JCB Activator to threads of end cap 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.*

Fit locking dowel **10** to piston head and rod as follows:

1 Fit 'O' ring **12** into piston head **11**.

2 Fit piston head to piston rod and torque tighten, ⇨ ***Table 51. Torque Settings (E-280)***.

3 New ram Shaft and piston head fitted. If both are required, the following procedure should be followed:

a Drill through piston head into piston rod. Use an undersized diameter drill first as a guide and then drill with the correct size diameter drill to suit, see ⇨ *Fig 232. (E-281)* and ⇨ *Table 52. Drill Diameters and Depths (E-281)*.

b Remove all swarf and contamination. Insert dowel **10** into drilled hole, make sure tapped extractor hole is to outside.

4 New piston head fitted on a **pre-drilled piston rod**. Re-drill and dowel **BOTH** the piston head and piston rod at 90° from the existing drilled dowel hole in the piston rod. Follow the procedures described in step 3.

5 New piston rod fitted to a **pre-drilled piston head**. Use the pre-drilled hole in the piston head. Care must be taken not to elongate the existing hole in the piston head.

a Use a drill the same diameter as the pre-drilled hole in the piston head to make a 'centre mark' in the piston rod. DO NOT drill the piston rod at this stage.

b Use an undersized diameter drill as a guide and drill into the piston rod to the required depth, ⇨ *Table 52. Drill Diameters and Depths (E-281)*. Make sure the drill has centred correctly on the 'centre mark' made at step 5a.

c Use the correct size diameter drill to suit the dowel and drill to the required depth, ⇨ *Table 52. Drill Diameters and Depths (E-281)*.

d Remove all swarf and contamination, insert the dowel.

Install cylinder onto the rod assembly, make sure that the cylinder is fitted square to the rod assembly. Firmly push the cylinder over the piston head seals.

Apply JCB Threadlocker and Sealer (High Strength) to first three threads of cylinder, torque tighten the cylinder, ⇨ *Table 51. Torque Settings (E-280)*.

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.*

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

Position pipe assembly in correct position and torque tighten probe assembly **2** to 75Nm (55 lbf ft; 7.6 kgf m). DO NOT over-tighten the probe.

Make sure seals **19** and **21** are fitted the correct way as shown.

Table 51. Torque Settings

Item	Nm	kgf m	lbf ft
6	678	69.2	500
11	405	41.3	300

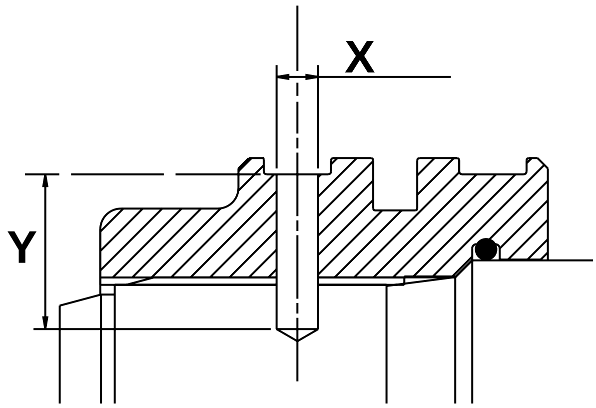

Fig 232.

Table 52. Drill Diameters and Depths

All Dimensions are in mm

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø **X**	Dowel Drill Depth **Y**
80 x 50 70 x 40	6Ø x 20	4	21	6.02-6.1	22-23
90 x 50 100 x 60	8Ø x 25	5	24	8.02-8.1	27-28
110 x 60 110 x 65	12Ø x 30	8	28	12.02-12.1	32-33
120 x 65 130 x 75	12Ø x 35	8	33	12.02-12.1	37-38

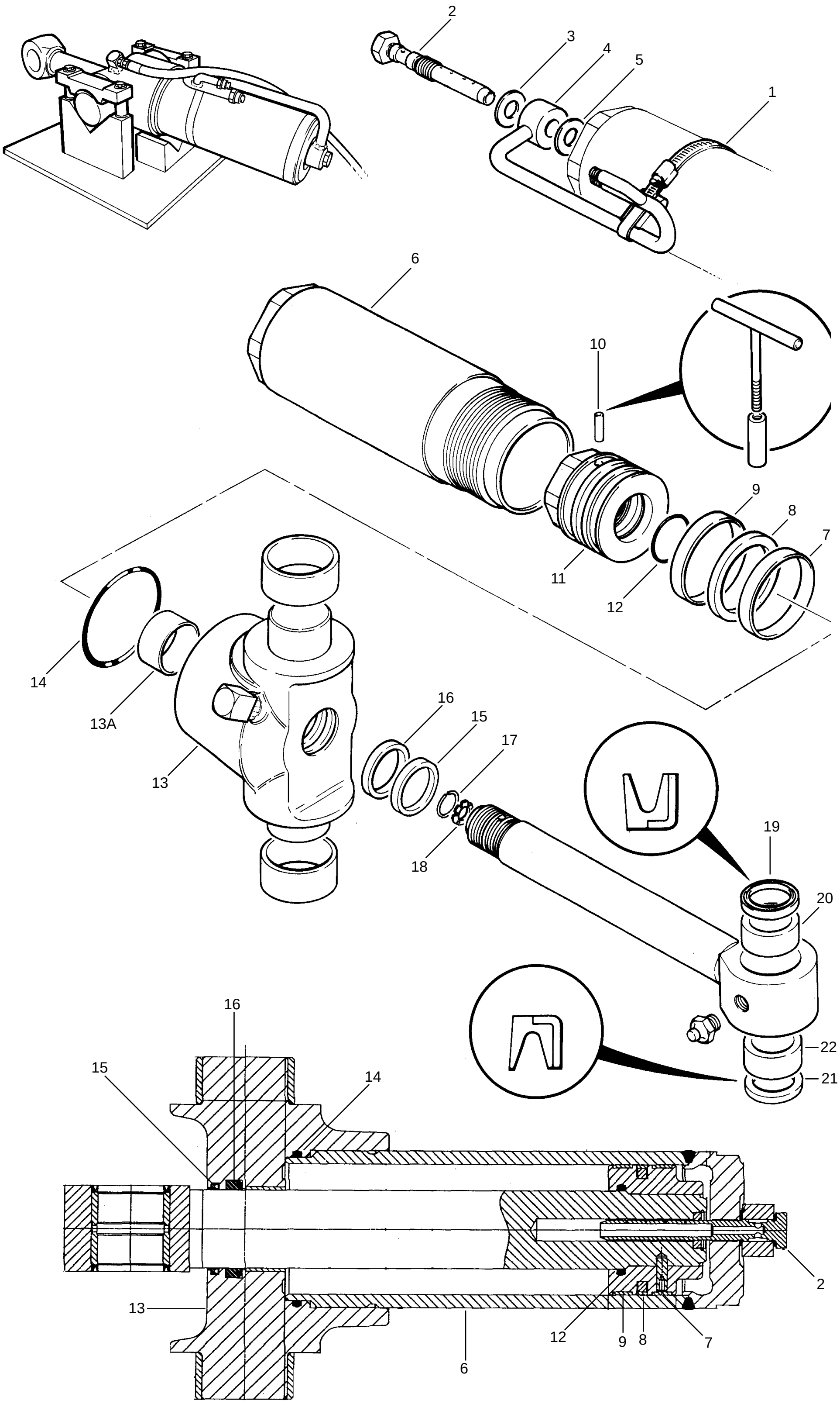

Fig 233. Slew Ram

Dipper Ram

Dismantle

⇨ *Fig 236. (E-285)*. The numerical sequence shown on the illustration is intended as a guide to dismantling.

For assembly the sequence should be reversed.

Place ram assembly on a locally manufactured strip and rebuild bench as shown in ⇨ *Fig 234. (E-283)*.

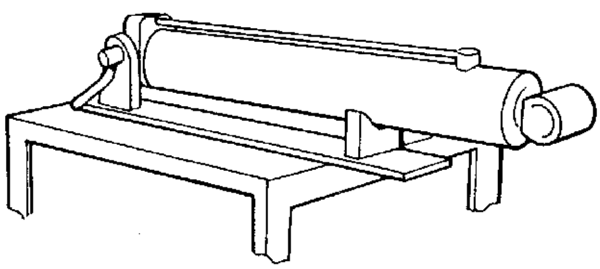

Fig 234.

Slacken end cap **1** using special spanner (see ***Service Tools***), and remove the piston rod assembly **2** from the cylinder.

⚠ WARNING

If air or hydraulic pressure is used to force out the piston assembly, ensure that the end cap is securely fitted. Severe injury can be caused by a suddenly released piston rod.

HYD-1-2

Position piston rod assembly on bench in place of ram cylinder. Remove seal **4** and wear rings **3** and **5** from piston head.

Extract dowel **6** from the piston head using a metric screw (M3, M4, or M6 depending on ram size) threaded into the extractor hole.

Remove piston head from rod using special spanner (see ***Service Tools***).

Remove gland bearing and end cap **1** from piston rod and remove the `O' rings **11** and **12**, wiper seal **13** and rod seal **14**. Check the end cap bearing for damage, scores or nicks. If damaged, the bearing must be replaced as part of the end cap assembly.

Ensure that metal components are free from scoring, nicks and burrs. A damaged rod will impair the life of the seals.

Check the bore of the ram cylinder for damage.

Assemble

Clean threads of piston rod, piston head, end cap and cylinder using a wire brush. 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).

For the correct method of fitting seals to the end cap and piston head, ⇨ ***JCB Ram Sealing Procedure (E-288)***.

Apply JCB Activator to threads of end cap 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.*

Ensure that end damping spring **9** is engaged with collar **10** and piston head **7**.

Fit locking dowel **6** to piston head and rod as follows:

1 Fit 'O' ring **8** into piston head **7**.

2 Fit piston head to piston rod and torque tighten, ⇨ ***Table 53. Torque Settings (E-284)***.

3 New ram shaft and piston head fitted. If both are required, the following procedure should be followed:

  a Drill through piston head into piston rod. Use an undersized diameter drill first as a guide and then drill with the correct size diameter drill to suit, see ⇨ ***Fig 235. (E-284)*** and ⇨ ***Table 54. Drill Diameters and Depths (E-284)***.

  b Remove all swarf and contamination. Insert dowel **6** into drilled hole, make sure tapped extractor hole is to outside.

4 New piston head fitted on a **pre-drilled piston rod**. Re-drill and dowel **BOTH** the piston head and piston rod at 90° from the existing drilled dowel hole in the piston rod. Follow the procedures described in step 3.

5 New piston rod fitted to a **pre-drilled piston head**. Use the pre-drilled hole in the piston head. Care must be taken not to elongate the existing hole in the piston head.

  a Use a drill the same diameter as the pre-drilled hole in the piston head to make a 'centre mark' in the piston rod. DO NOT drill the piston rod at this stage.

b Use an undersized diameter drill as a guide and drill into the piston rod to the required depth, *⇨ Table 54. Drill Diameters and Depths (E-284)*. Make sure the drill has centred correctly on the 'centre mark' made at step 5a.

c Use the correct size diameter drill to suit the dowel and drill to the required depth, *⇨ Table 54. Drill Diameters and Depths (E-284)*.

d Remove all swarf and contamination, insert the dowel.

Position cylinder on bench and install rod assembly into cylinder.

Apply JCB Threadlocker and Sealer (High Strength) to first three threads of cylinder, torque tighten the end cap, *⇨ Table 53. Torque Settings (E-284)*.

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.*

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

Table 53. Torque Settings

Item	Nm	kgf m	lbf ft
1	678	69.2	500
7	405	41.3	300

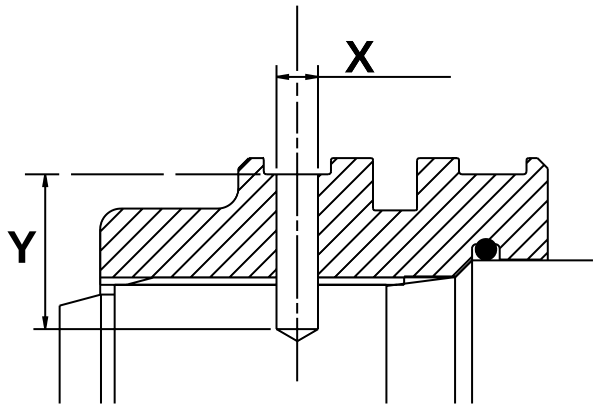

Fig 235.

Table 54. Drill Diameters and Depths

All Dimensions are in mm

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø **X**	Dowel Drill Depth **Y**
80 x 50 70 x 40	6Ø x 20	4	21	6.02-6.1	22-23
90 x 50 100 x 60	8Ø x 25	5	24	8.02-8.1	27-28
110 x 60 110 x 65	12Ø x 30	8	28	12.02-12.1	32-33
120 x 65 130 x 75	12Ø x 35	8	33	12.02-12.1	37-38

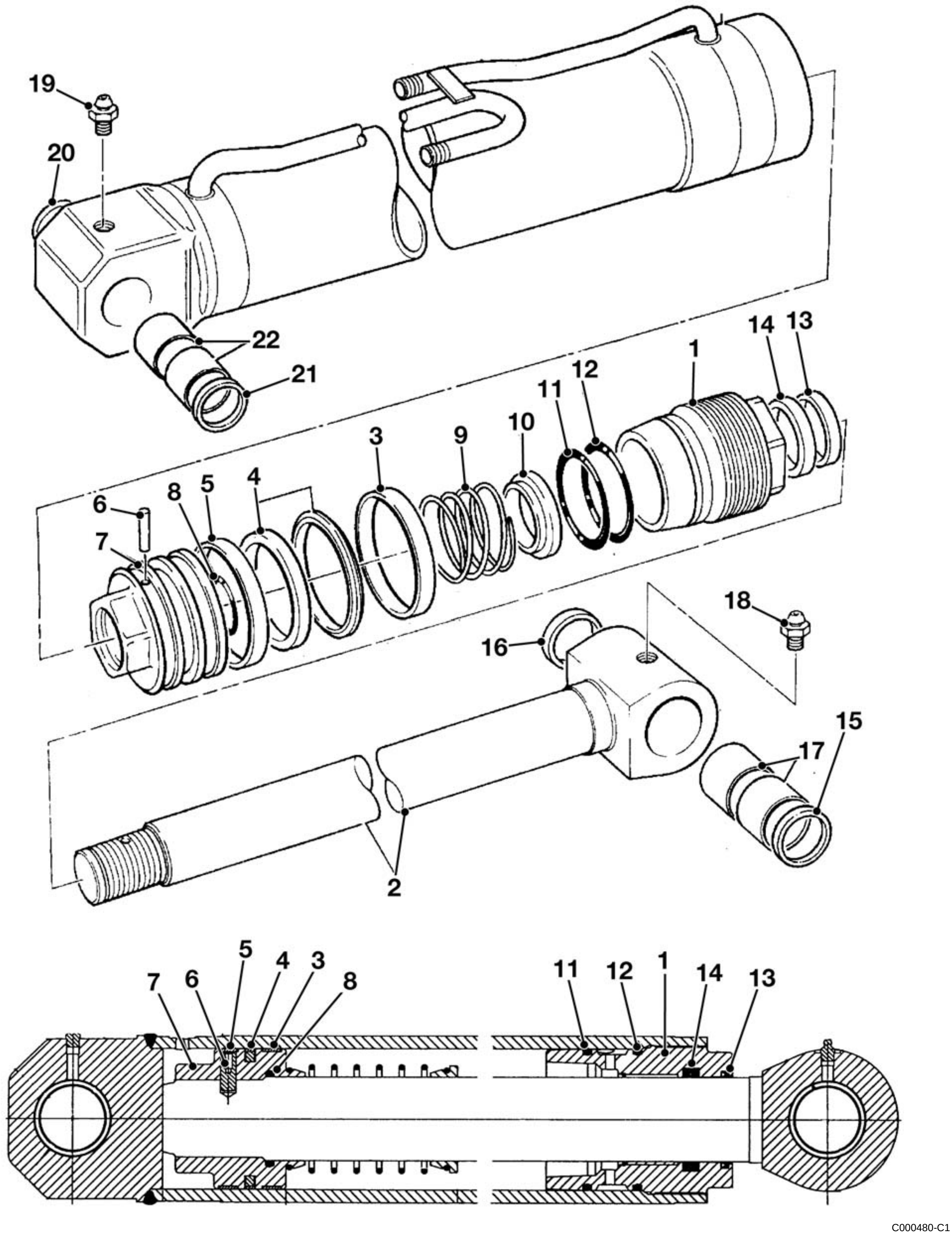

Fig 236. Dipper Ram

Power Sideshift Ram

⇨ *Fig 237. (E-287)*. 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**, (46mm AF). 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 on a bench in place of the ram cylinder. Remove the wear rings **2** and seal **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.*

5 Remove the end cap seal **4**, wiper seal **5** and `O' ring **6**, both end caps are the same.

6 Remove spacers **7** and `O' rings **8**.

Assemble

1 Clean the threads of the end caps 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 For the correct method of fitting seals to the end cap and piston head, ⇨ *JCB Ram Sealing Procedure (E-288)*.

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 Fit new `O' rings **8** to spacers **7**, slide onto the piston head and rod assembly.

6 Apply JCB Activator to threads of the end caps 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.*

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

8 Ensure that there are no burrs at the ends of the piston rod.

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

9 Fit an end cap 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 55. Torque Settings (E-286)*.

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 55. Torque Settings

Item	Nm	kgf m	lbf ft
1	400	40.8	295

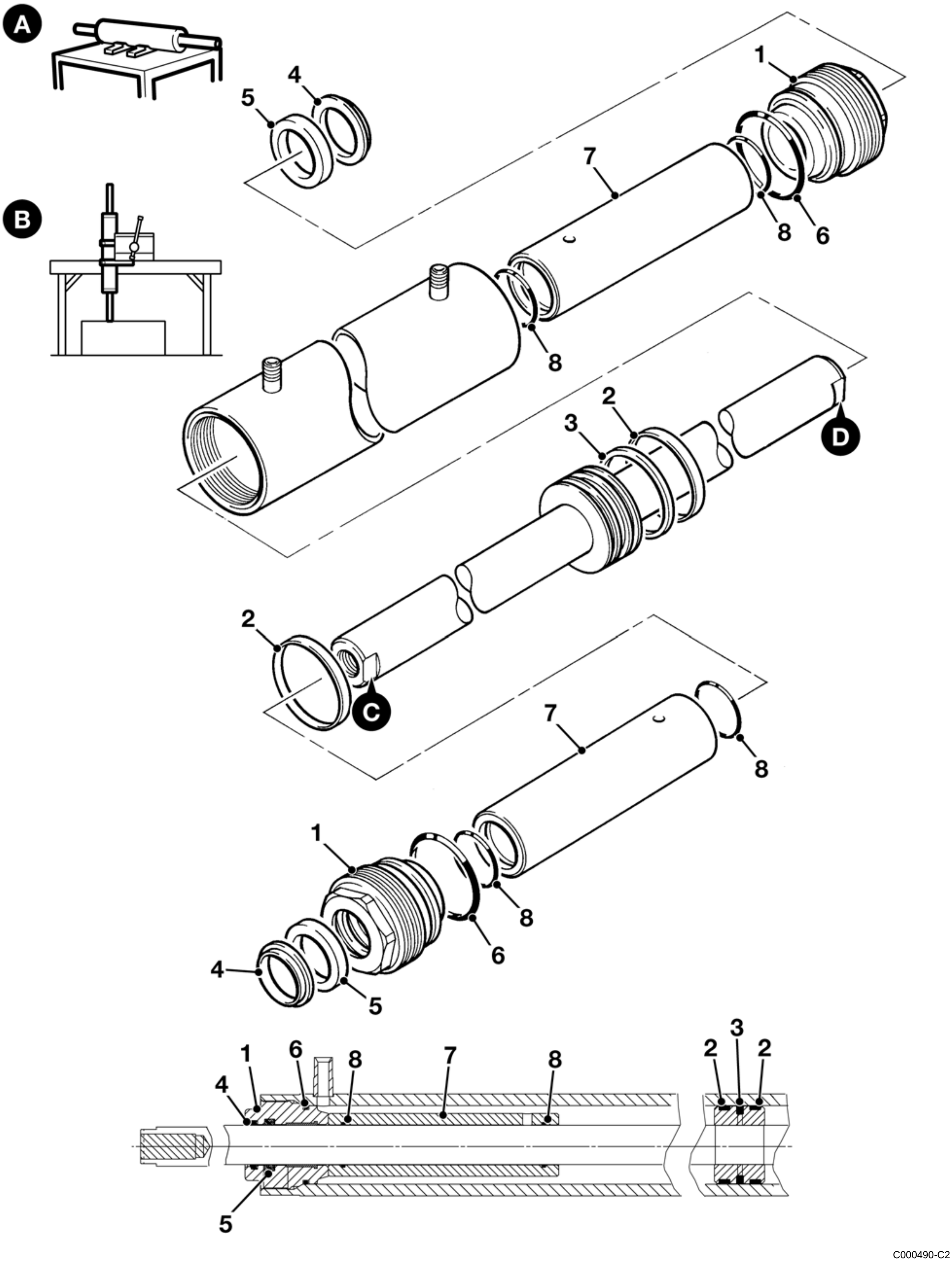

Fig 237. Power Sideshift Ram

JCB Ram Sealing Procedure

TE-005

1 Fit new rod seals.

Use seal fitting tool **238-A** to fit rod seals, the size (diameter) and position of pins **238-B** is determined by the diameter and radial width of the rod seal being fitted.

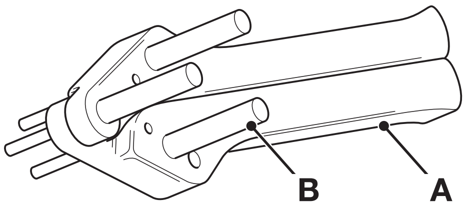

Fig 238. Seal Fitting Tool

The pins are screwed into threaded holes in the tool body, the spacing of the holes is designed to suit small or large diameter rod seals.

a Open the tool and insert the new rod seal **239-A**. The seal must be fitted behind the two front pins but in front of the rear pin as shown.

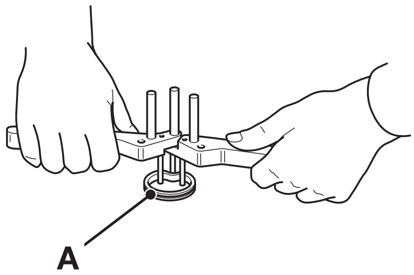

Fig 239.

Note: *Later ram end caps and piston heads are metric threads. The seals are also different, make sure the correct seals are fitted. On metric threaded rams make sure the seals are fitted the correct way round, as shown at **240-A** and **240-B**.*

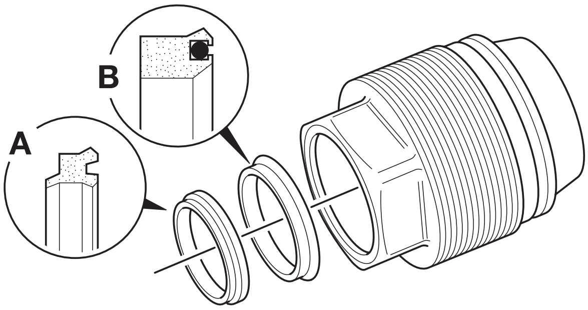

Fig 240.

b Close the tool. ⇨ *Fig 241. (E-288)*. The seal must form a reniform (kidney shape).

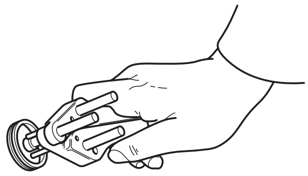

Fig 241.

c Before fitting the rod seals check the seal grooves are free of contamination and sharp edges.

d Locate the seal in the end cap groove. ⇨ *Fig 242. (E-288)*. When the seal is in position, open the tool to release the seal. Make sure the seal is correctly installed in its grooved and remove the tool.

Fig 242.

e Fit rod wiper seal **240-A** into seal groove. Make sure the seal is correctly installed as shown.

Note: *Some rod wipers, i.e. power track rod, may use a metal encased seal which is pressed into the housing.*

Care must be taken to ensure the seal is square before it is pressed in.

f Sleeve **243-A** must be used to protect the rod seals from damage when fitting end cap onto the piston rod. There are various sizes of sleeve, see ***Service Tools***, Section 1. Make sure the hexagon on the end cap is towards the eye end of the rod.

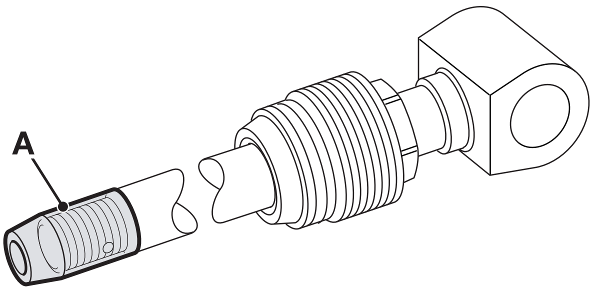

Fig 243.

2 Fit new head piston seals.

a Use a blunt instrument **244-A** (Part no. 892/01027) to lever the inner seal **244-B** into the piston head seal groove. Do not let the seal twist. There are identification marks on the outer diameter of the seal, make sure the marks are visible and the seal is free to rotate, if not remove the seal and refit.

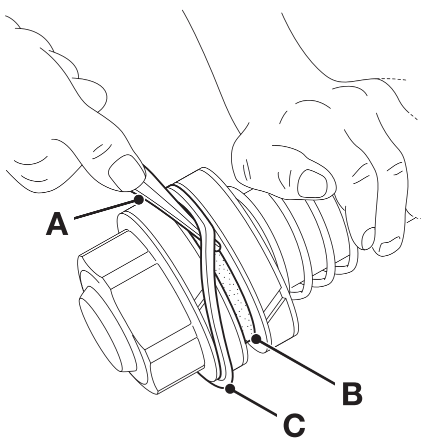

Fig 244.

b Fit outer seal **244-C** using the same procedure as stated for seal **244-B**. Check the external grooves are visible.

c Ensure the O-ring is fitted into the internal seal groove on the piston head. Screw the piston head onto the thread of the piston rod, refer to the relevant section for torque figure and completion of ram assembly.

d Fit the piston head retaining dowel, refer to the relevant section for torque figure and completion of ram assembly.

e Fit wear rings **245-A** and **245-B**. Rotate the wear rings so that the piston retention dowel is covered by the wear ring, Not as shown at **245-C**.

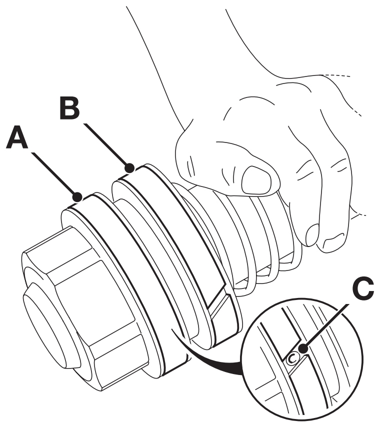

Fig 245.

3 Fit the piston rod and head assembly into the cylinder.

a Insert the piston/rod assembly into the cylinder. Align the rod and head assembly until parallel with the cylinder then push the assembly into the cylinder.

b Fit the end cap, refer to the relevant section for torque figure and completion of ram assembly.

Oil Cooler Matrix

Removal and Replacement

⇨ *Fig 246. (E-291)*. The hydraulic oil cooler **A** forms part of a combined cooling pack assembly, which also incorporates the transmission oil cooler **B**. To remove the unit therefore it is necessary to disconnect the associated hoses from the transmission system.

Removal

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

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 Vent any residual hydraulic pressure that may be in the system by operating the controls back and forth several times.

⚠ 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

3 Remove the front grille and raise the engine cover.

4 Disconnect and remove the battery.

5 Remove the front grille housing **C**, see ***Section B, Body and Framework***.

6 Disconnect the hydraulic hoses **F** and the transmission hoses **G**. Label the hoses before disconnecting to ensure correct replacement. Plug the hose ends to prevent ingress of dirt and loss of fluid.

Important: *If the machine is fitted with air conditioning, it will be necessary to remove the condenser from the front of the cooling pack. DO NOT disconnect the air conditioning hoses at the condenser. Refer to* ***Section B, Air Conditioning.***

7 Remove the cooler mounting bolts **H** (4-off each side), and carefully lift the cooler matrix from the machine.

Replacement

Replacement is the reverse of the removal procedure but note the following:

On completion, run the engine and check for leaks.

Check the transmission oil level and top up with specified transmission fluid. Refer to ***Section 3***, ***Routine Maintenance, Synchro Shuttle or Powershift Gearbox - Checking the Oil Level.***

Check the hydraulic oil level and top up the tank with specified hydraulic fluid. Refer to ***Section 3***, ***Routine Maintenance, Hydraulic System - Checking the Fluid Level.***

Removal and Replacement

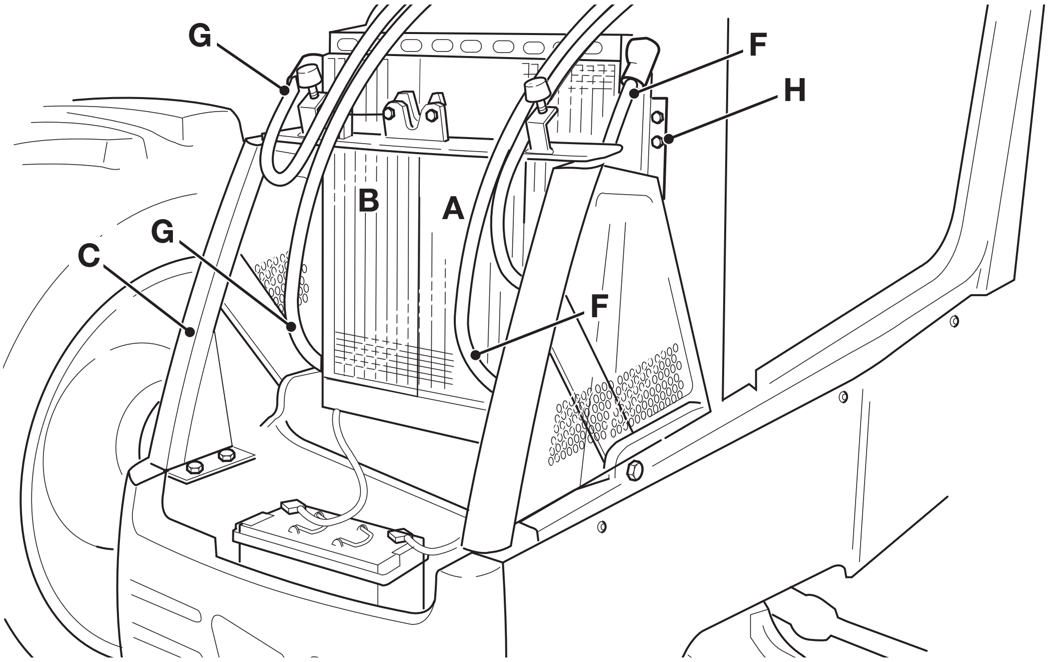

Fig 246.

Smooth Ride System (SRS) - if fitted

Accumulator

Removal and Replacement

⇨ *Fig 247. (E-293)*. The illustration shows the installation for gearpump machines. Some machine variants may have a different configuration to the one illustrated.

Removal

1 Park the machine on firm level ground, engage the park brake and set the transmission to neutral. Lower the loader arms to the ground, switch OFF the engine and chock all four wheels.

⚠ CAUTION

You must vent all the hydraulic pressure from the accumulators before disconnecting them from the hydraulic system.

0043

2 Release all hydraulic pressure in the accumulator by selecting the starter key to the ON position without the engine running, switch SRS ON and operate the loader arm hydraulic lever back and forth several times.

3 Loosen the `U' clamp **A**, then use a spanner on the adaptor **B** at the opposite end of the accumulator to carefully unscrew the accumulator from the solenoid valve block.

4 Lift the accumulator from the machine. Plug the open ports to prevent loss of fluid and ingress of dirt.

5 Discharge the accumulator nitrogen gas pressure, see ***Service Procedures, Smooth Ride System - Accumulator Charging and Discharging*** for the correct procedure.

Replacement

Replacement is the reverse of the removal sequence, but note the following:

1 Pre-charge the accumulator with nitrogen gas before fitting, see ***Service Procedures, Smooth Ride System - Accumulator Charging and Discharging*** for the correct procedure.

2 After fitting, operate the machines hydraulic system. Check for correct operation and leaks.

3 Replenish the hydraulic system with the recommended hydraulic fluid as required, see ***Section 3, Maintenance - Lubricants and Capacities***.

Important: *It is not possible to dismantle the accumulator. The extent of permissible servicing is limited to checking the nitrogen gas pre-charge pressure. If the accumulator is suspected as being faulty it must be renewed as a complete assembly.*

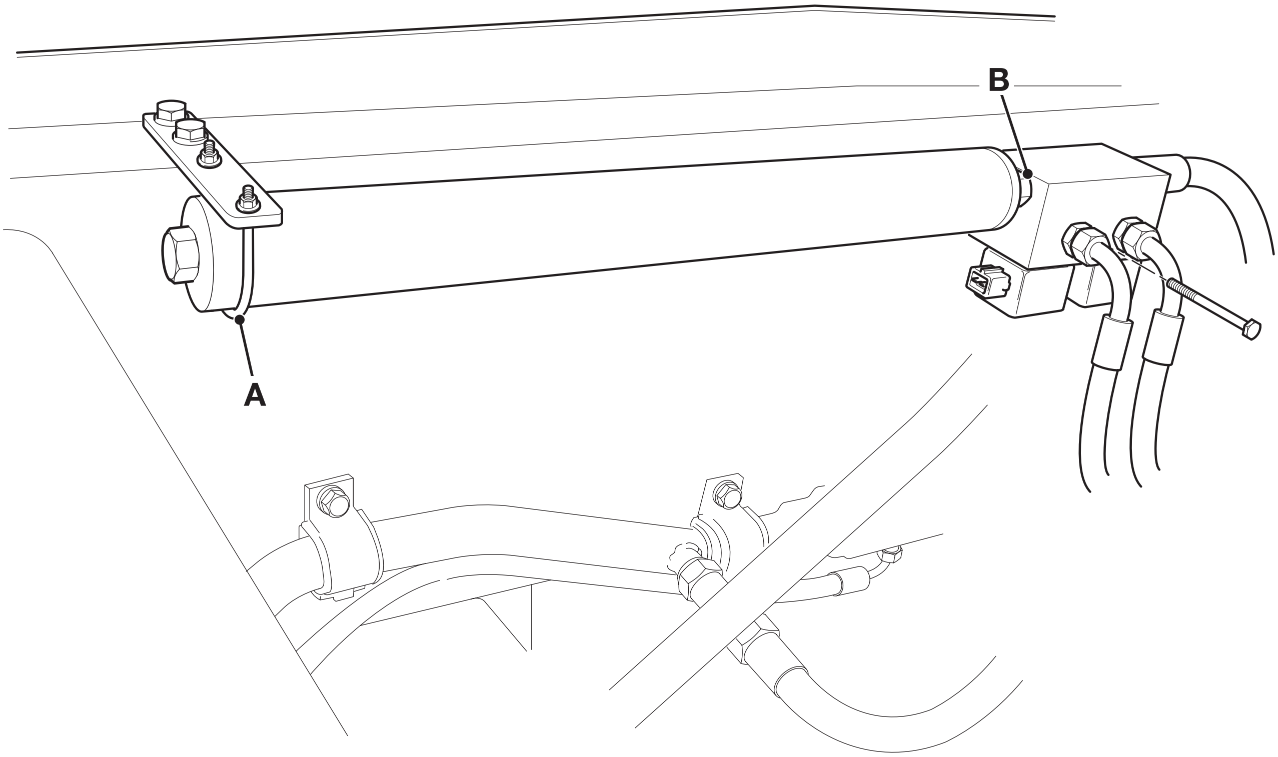

Fig 247. Removal and Replacement

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