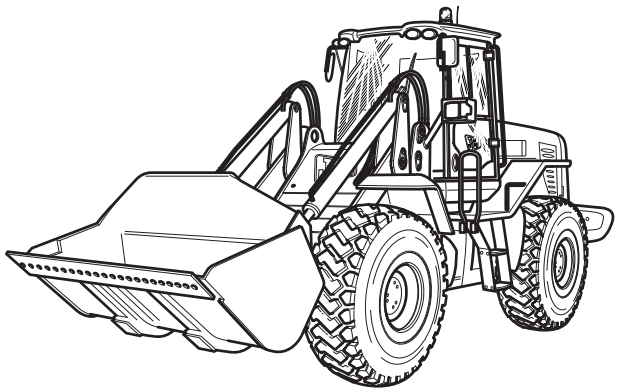
Brakes

Service Manual - Wheeled Loading Shovel - 412S, 416S, 416S



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Contents **Page No.**

Technical Data

412S, 414S

Service Brakes		
Type	Oil-Immersed Multi-Plate Disc Actuation	
Actuation	Hydraulic	
Location	Front and Rear Axle (2 Brake Packs each axle)	
Brake Valve		
Type	Ultra Hydraulics Modulating Valve	
Piston Diameter (each)	25.4 mm	(1 in)
Piston Area (each)	507 mm^2	(0.79 in^2)
Controlled Pressure to Brake Piston	50 bar	(725 lbf/in^2)
Charge Valve		
Type	Ultra Hydraulics Accumulator Charge Valve	
Cut-in Pressure	90 bar	(1305 lbf/in^2)
Cut-out Pressure	110 bar	(1595 lbf/in^2)
Accumulators		
Capacity (each)	0.5 litre	(1.06 pint)
Number Fitted	4	
Gas Charge Pressure	Pre-set, non-rechargeable	
Park Brake		
Type	Manually Adjusted Disc, cable operated	
Location	Front face of transmission	

416S

Service Brakes

Type	Oil-Immersed Multi-Plate Disc Actuation
Actuation	Dual Circuit, Full Hydraulic with compact valve and pressure accumulators
Location	Front and Rear Axle (2 Brake Packs each axle)

Brake Valve

Type	Rexroth Compact Type LT13

Pressure Regulator Setting

To Serial Number 543171		
Cut-In	164 bar	(2378 lbf/in^2)
Cut-out	200 bar	(2900 lbf/in^2)
Maximum Pressure Differential	36 bar	(522 lbf/in^2)
From Serial Number 543172		
Cut-In	80 bar	(1160 lbf/in^2)
Cut-out	100 bar	(1450 lbf/in^2)
Maximum Pressure Differential	18 bar	(261 lbf/in^2)

Service Brake Operating Pressure

To Serial Number 543171	60 bar	(870 lbf/in^2)
From Serial Number 543172	40 bar	(580 lbf/in^2)

Pressure Switch Operating Pressure

To Serial Number 543171	132 bar	(1914 lbf/in^2)
From Serial Number 543172	70 bar	(1015 lbf/in^2)

Accumulators

Capacity (each)	0.75 litre	(1.3 pint)
Number Fitted	2	
Gas	Nitrogen	
Gas Charge Pressure	57 bar	(826 lbf/in^2)

Park Brake

Type	Manually Adjusted Disc, cable operated
Location	Front face of transmission

Brake Circuits, Valves and Pedals

Brake Circuit Description 412S, 414S

A power brake system is fitted to 412S and 414S machines.

Hydraulic fluid from No. 1 pump **8** is supplied via the charge valve **7** to the brake valve **2**. When the brake valve is operated (by the brake pedal), fluid is directed to the front and rear brakes. Accumulators in the system maintain pressure which provides fluid to operate the brakes when the engine is not running (up to a minimum of 10 operations).

When the brake pedal is released, brake valve **2** connects brake pressure to tank **D**, allowing the brakes to be released.

Note: *The brakes themselves are dealt with as part of the K Brakes - Dismantling (T F-206) to K Brakes - Assembly (T F-207).*

Key to ⇨ *Fig 1. (🗋 G-4)*

1 Accumulators
2 Brake Valve
3 Front Brakes
4 Rear Brakes
5 Pressure Reducing Valve
6 Servo Filter
7 Charge Valve

A From Valve Block
B To Valve Block
C To Valve Block
D To Tank
E To Cooler/Tank
F From Tank
G To Tank
H To Servo Control via. Isolator Valve

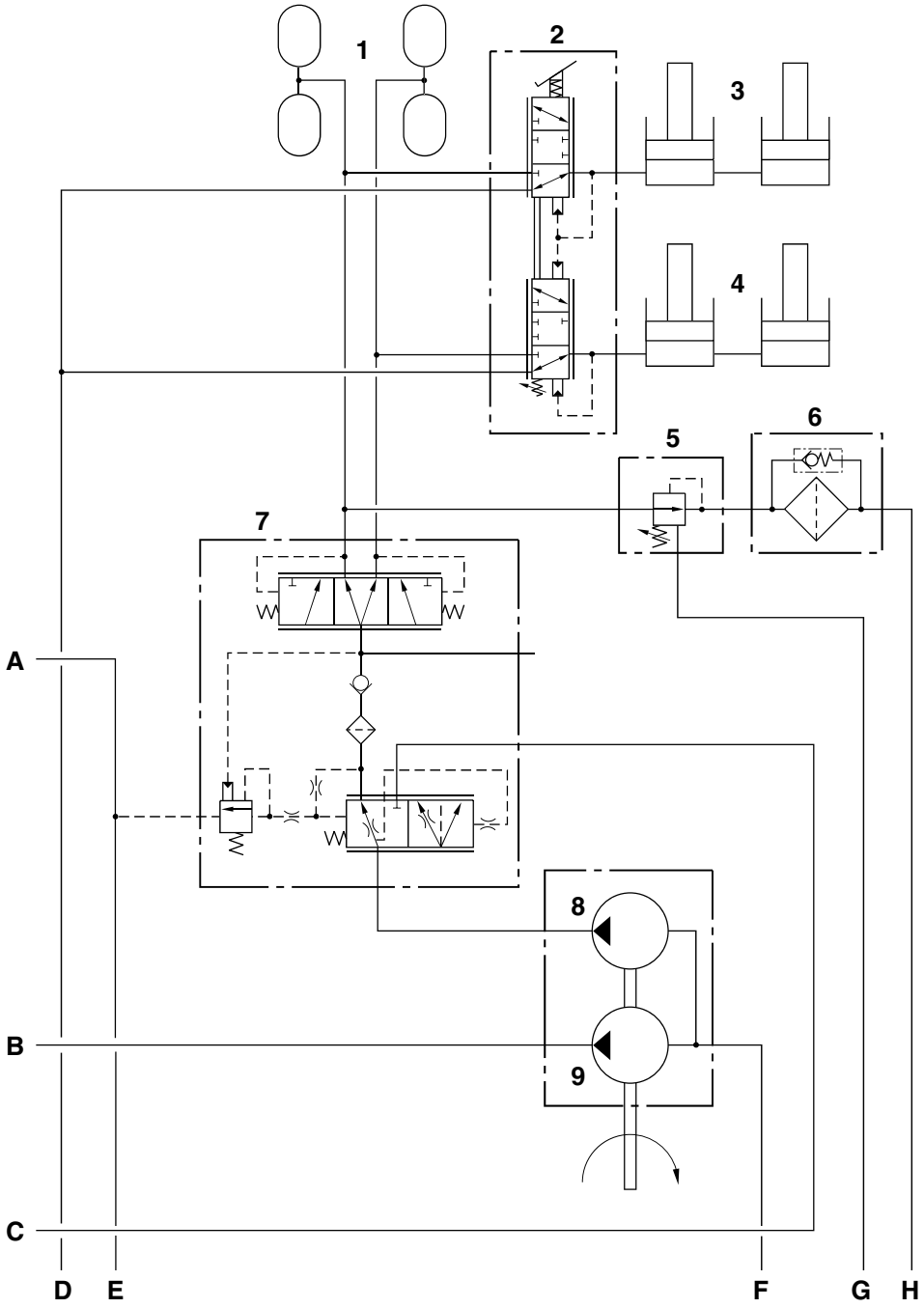

Fig 1.

Brake Valves 412S, 414S

Removal and Replacement

The brake valve is mounted beneath the cab floor, just to the rear of the brake pedal.

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

Removal

1 Park the machine on firm, level ground, engage the park brake and set the transmission to neutral. Lower the loader to the ground and stop the engine.

⚠ WARNING

A minimum of 10 applications of the service brake is possible from the stored accumulator pressure. Before removing an accumulator or disconnecting any part of the brake hydraulic system, make sure that engine is switched off and hydraulic pressure is fully discharged.

BRAK-2-2

2 Operate the foot brake pedal several times to vent residual hydraulic pressure.

3 Disconnect all hydraulic hoses from the brake valve and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct re-fitting.

4 Loosen and remove the two valve retaining bolts/ nuts.

5 Remove clip **1** and disconnect the valve rod from the brake pedal lever.

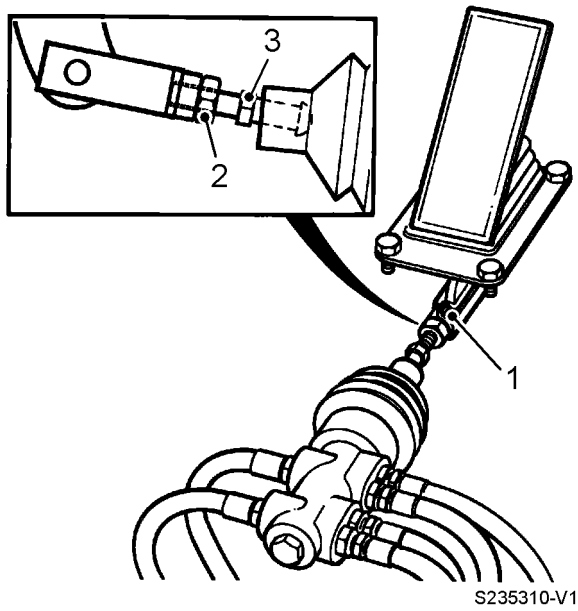

Fig 2.

Replacement

Replacement is the 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

Make sure that the hoses are correctly installed.

Brake Valve Setting

1 Fit the machine articulation lock.

2 Slacken locknut **1**, adjust push rod **2** to achieve no end float and no pre-load.

3 Lift apron mat to gain access to front axle. Remove brake bleed screw, coat threads with grease and refit.

4 Fit bleed tube to bleed screw, arrange tube over the loader tower and secure other end of bleed tube into a clear empty container placed on the cab floor. Open bleed screw.

Note: *Secure tube into top of container so that flow can be seen.*

5 Start the engine and run for 2 minutes to charge the system. Depress brake pedal **VERY** slowly (See note) until air free fluid flows into container. Release brake pedal.

Note: *Fluid will flow at a very high rate if the brake pedal is not treated with care while carrying out this procedure.*

6 With engine running, lengthen push rod **2** until fluid starts a very light uninterupted flow (not drip), shorten pushrod very slowly until fluid flow stops.

7 Shorten push rod **2** a further 4 flats.

8 Lock push rod by holding push rod **2** with a 13 mm AF spanner and tightening locknut **1** using a 17 mm AF spanner.

9 Press brake pedal until fluid flows, release pedal, check that fluid flow stops.

10 Close bleed screw and remove bleed tube, close apron mat, tighten hydraulic filler cap and remove the articulation lock.

11 Test the brakes.

Dismantling and Assembly

The valve may only be dismantled to renew seals (those detailed) and to examine other parts for damage. If any part fails, is damaged or excessively worn then the complete valve must be renewed.

Remove only sufficient parts to gain access to the seals. DO NOT dismantle further.

Parts included in the seal kit are:

Item No.	Description	Quantity
1	Boot	1
2	'O' Ring Seal	1
3	Seal Polypak	1
4	'O' Ring Seal	1

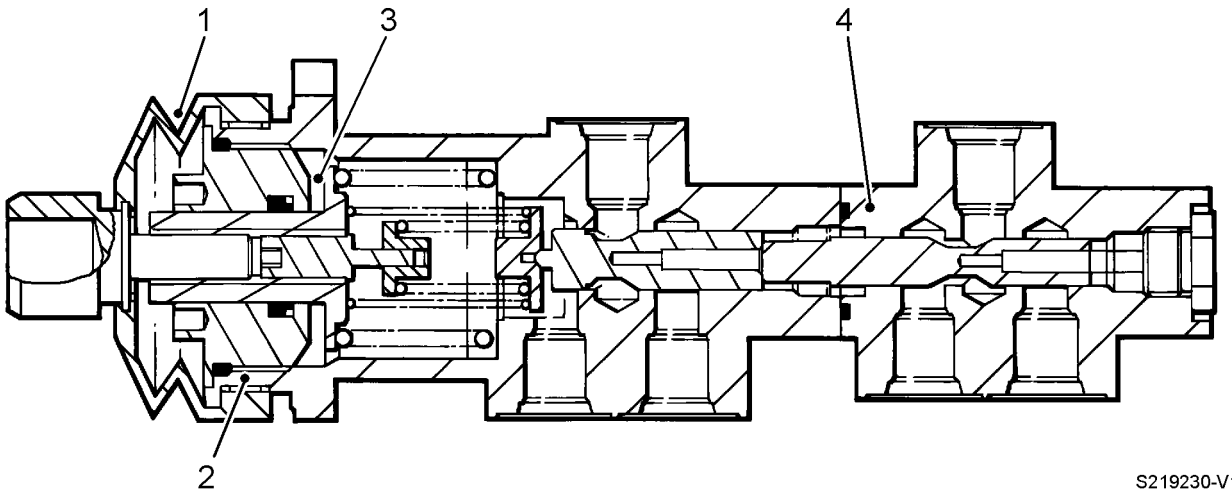

Fig 3.

Brake System Testing

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

1 Charge Valve Operation

a Park the machine on firm level ground and lower the attachments to the ground.

b Fit the pressure gauge at point **B** using a tee adaptor.

c Apply the park brake and stop the engine. Operate brake pedal to exhaust accumulator pressure (e.g. the gauge shows no pressure rise when the pedal is depressed).

d Connect a 0-400 bar (0-6000 lbf/in^2) pressure gauge at point **A** on the brake valve.

e Start the engine. Monitor the pressure - it should rise to 110 bar (1595 lbf/in^2). Engine speed should increase slightly as the charge valve cuts out.

f Repeatedly apply the footbrake, check that the charge valve cuts in at 90 bar (1305 lbf/in^2).

g Stop the engine and exhaust the system before removing the gauge.

h Bleed the brakes, refer to ⇒ ***Removal and Replacement (G-5)*** and ⇒ ***Bleeding the System (G-15)***.

If pressures are incorrect, renew the charge valve, as no adjustment is possible.

2 Brake Valve and Accumulator Pressure

⚠ WARNING

A minimum of 10 applications of the service brake is possible from the stored accumulator pressure. Before removing an accumulator or disconnecting any part of the brake hydraulic system, make sure that engine is switched off and hydraulic pressure is fully discharged.

BRAK-2-2

a Fit the pressure gauge at point **B**.

b Start the engine. Run the engine for 2 minutes, the brake low pressure warning light should extinguish.

c Press the brake pedal, the pressure should rise to 50 bar (725 lbf/in^2) and hold. If pressure is less than 50 bar (725 lbf/in^2), check brake valve set up, see ⇒ ***Brake Valve Setting (G-5)***. If pressure is more than 55 bar (797.5 lbf/in^2), replace the brake valve.

d Stop the engine. Operate the brake pedal 9 times, the pressure should remain at 50 bar (725 lbf/in^2).

If after 2 applications of the brake pedal, pressure decays below 45 bar (652 lbf/in^2), accumulator or non-return valve in charge valve is faulty.

See ⇒ ***Fig 5. (G-11)*** and ⇒ ***Fig 6. (G-12)***, remove and inspect items **25** and **28**. If satisfactory, replace accumulator **B1**.

e Repeat steps b to d. If fault is still apparent, replace accumulator **B2**.

f Remove gauge from point **B**. Fit gauge at point **C**.

g Repeat steps a to d as necessary. (For accumulators **B1** and **B2**, read **C1** and **C2**).

h Bleed the brakes, refer to ⇒ ***Bleeding the System (G-15)***.

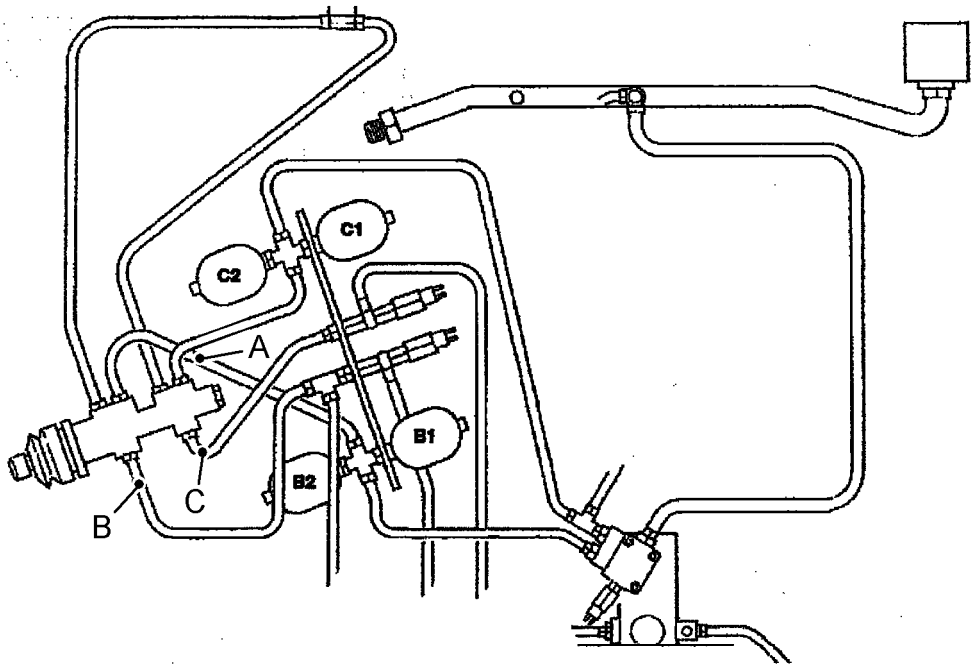

Fig 4.

Charge Valve 412S, 414S

Removal and Replacement

The charge valve is mounted beneath the cab floor, just to the rear of the brake valve.

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

Removal

1 Park the machine on firm, level ground, engage the park brake and set the transmission to neutral. Lower the loader to the ground and stop the engine.

⚠ WARNING

A minimum of 10 applications of the service brake is possible from the stored accumulator pressure. Before removing an accumulator or disconnecting any part of the brake hydraulic system, make sure that engine is switched off and hydraulic pressure is fully discharged.

BRAK-2-2

2 Operate the foot brake pedal several times to vent residual hydraulic pressure.

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 re-fitting.

4 Remove the two screws which secure it to its bracket, then remove the valve.

Replacement

Replacement is the reverse of the removal procedure. Test the system as described on ⇨ *Brake System Testing (G-7)*.

Dismantling and Assembly

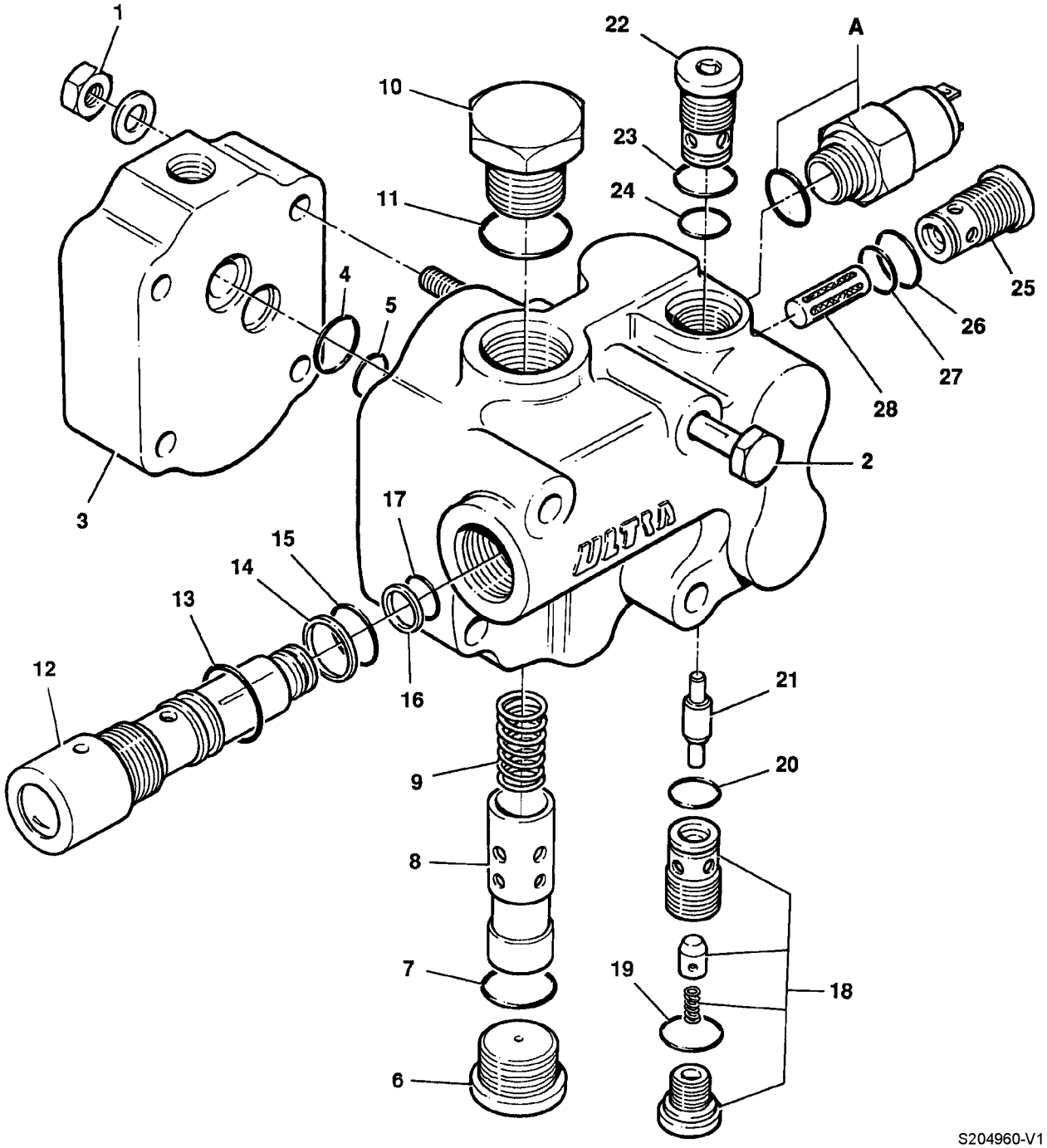

Fig 5.

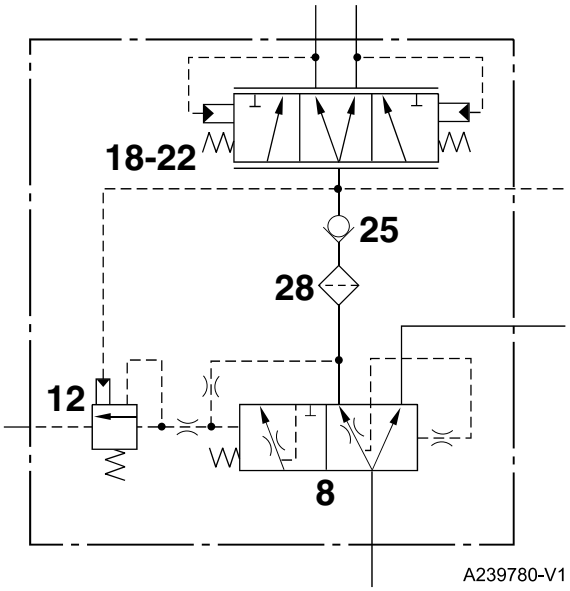

Fig 6.

Dismantling

1 Remove nuts **1** and bolts **2**.

2 Remove cover plate **3** along with 'O' rings **4** and **5**. Remove and discard the 'O' rings.

3 Remove plug **6** along with 'O' ring **7**. Remove and discard the 'O' ring.

4 Carefully withdraw spool/damping orifice assembly **8** and spring **9** from the valve body.

5 Remove spring seat **10** along with 'O' ring **11**. Remove and discard the 'O' ring.

6 Remove the complete relief valve assembly **12** using a 'C' spanner. Remove and discard 'O' rings **13**, **14**, and **17** and backing rings **14** and **16**.

7 Remove check valve assembly **18** from valve body. Remove 'O' rings **19** and **20** and discard.

8 Carefully withdraw pushrod **21** from its bore.

9 Remove check valve assemblies **22** and **25** from valve body. Remove all 'O' rings and discard.

10 Remove and discard filter **28**.

Note: *A new filter is supplied as part of the seal kit.*

Inspection

1 Thoroughly wash all components. Apply hydraulic oil immediately to prevent moisture collecting.

2 Inspect all bores and 'O' ring grooves and make sure that they are free from burrs.

Assembly

1 Make sure all components are thoroughly clean prior to assembly. Renew all 'O' rings and coat with JCB HP Grease on assembly.

2 Fit 'O' rings **26** and **27** to check valve assembly **25** making sure that 'O' rings fit correctly in grooves. Insert filter **28** into recess of check valve. Locate assembly into valve body making sure the filter locates in its seat in the body without undue force. Tighten to the correct torque.

3 Fit new 'O' rings **23** and **24** to check valve assembly **22**. Locate assembly and torque tighten.

4 Locate pushrod **21** in its bore. Fit new 'O' rings **19** and **20**, to check valve **18**. Locate assembly and torque tighten.

5 Fit 'O' rings **13**, **15** and **17** and backing rings **14** and **16** to the relief valve assembly **12**, fit item **12**.

6 Insert spool/damping orifice assembly **8** into valve body.

7 Fit plug **6** and new 'O' ring **7** and torque tighten.

8 Insert spring **9** into spool bore.

9 Locate spring seat **10** and new 'O' ring **11** over spring and torque tighten.

10 Fit new 'O' rings **4** and **5**, to cover plate **3**. Fit cover plate to valve body using nuts **1** and bolts **2**. Tighten to the correct torque.

Table 1. Torque Settings

Item	Nm	kgf m	lbf ft
1	39	3.98	29
6	75-81	7.65-8.26	55-60
10	100-105	10.20-10.70	74-77
18	38-42	3.87-4.28	28-31
22	38-42	3.87-4.28	28-31
25	40-44	4.08-4.48	30-32

Note: *If pressure switch **A** has been removed, when refitting, torque tighten the switch to 60 Nm (44 lbf ft; 6.1 kgf m).*

Brake Pedal 412S, 414S

Removal and Replacement

Removal

Disconnect the push rod assembly (see ⇨ ***Removal and Replacement (G-5)***). Then proceed to remove the pedal.

Note: *The numerical sequence is a guide to removal. Replacement is a reversal of the removal procedure.*

The pedal **10**, anti-slip pad **11** and boot **12** can be removed and replaced if worn or damaged.

The base plate **13** can be removed if necessary by removing nuts **14** and washers **15**. The gaiter **3** will come clear at the same time. Check the gaiter for wear or perishing, replace as necessary.

Note: *The adjustment cap screw **16** and its locking nut **17** (if fitted) should not be removed from the base plate.*

For setting up and connecting the push rod assembly see ⇨ ***Brake Valve Setting (G-5)***.

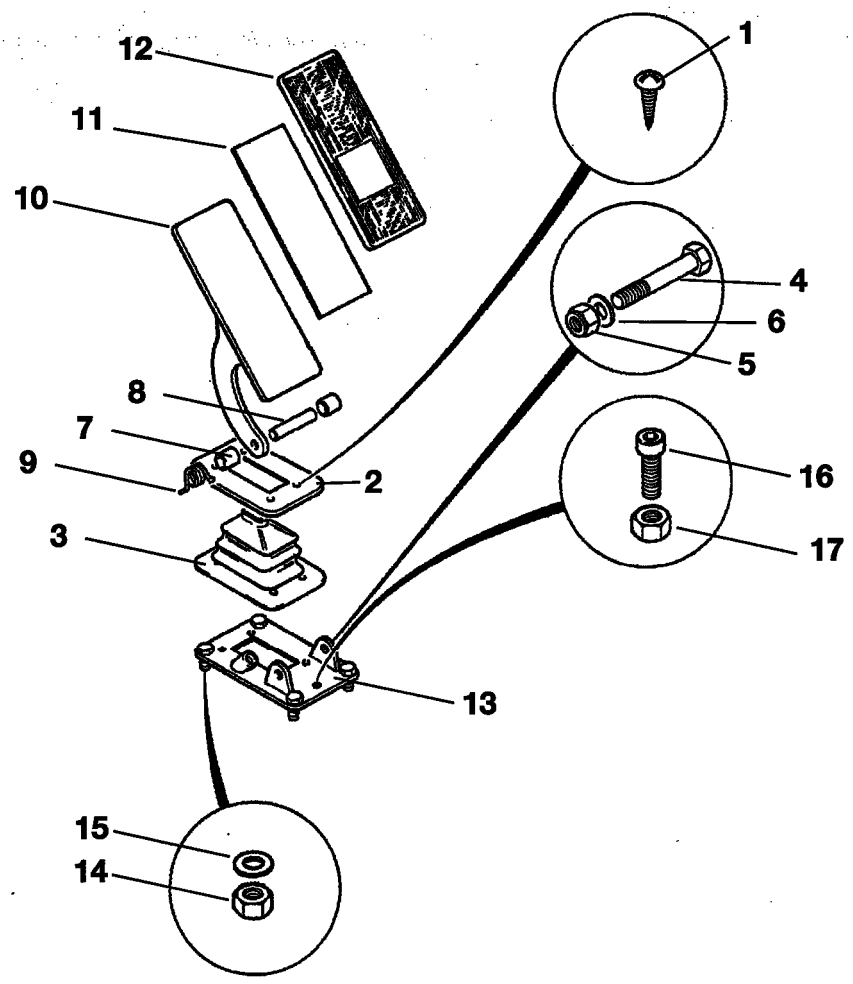

Fig 7.

Bleeding the System

⚠ WARNING

Before proceeding with the bleeding procedure it is important to ensure that the park brake is engaged and that one pair of wheels is blocked on both sides.

BRAK-1-2

Note: *The braking systems are fed from the main hydraulic system and incorporate brake accumulators. These allow approximately nine applications of the brakes with the engine stopped.*

Bleed each axle separately as follows:

Attach a tube to the brake bleed screw, located near the axle centre. Ensure that the free end of the tube is immersed in fluid contained in a suitable container.

Open the brake bleed screw and fully depress the brake pedal. Hold the pedal fully depressed until air free fluid flows from the bleed screw.

Close the brake bleed screw with the pedal fully depressed.

Repeat the procedure for the rear axle.

Check the hydraulic fluid level.

Brake Circuit Description 416S

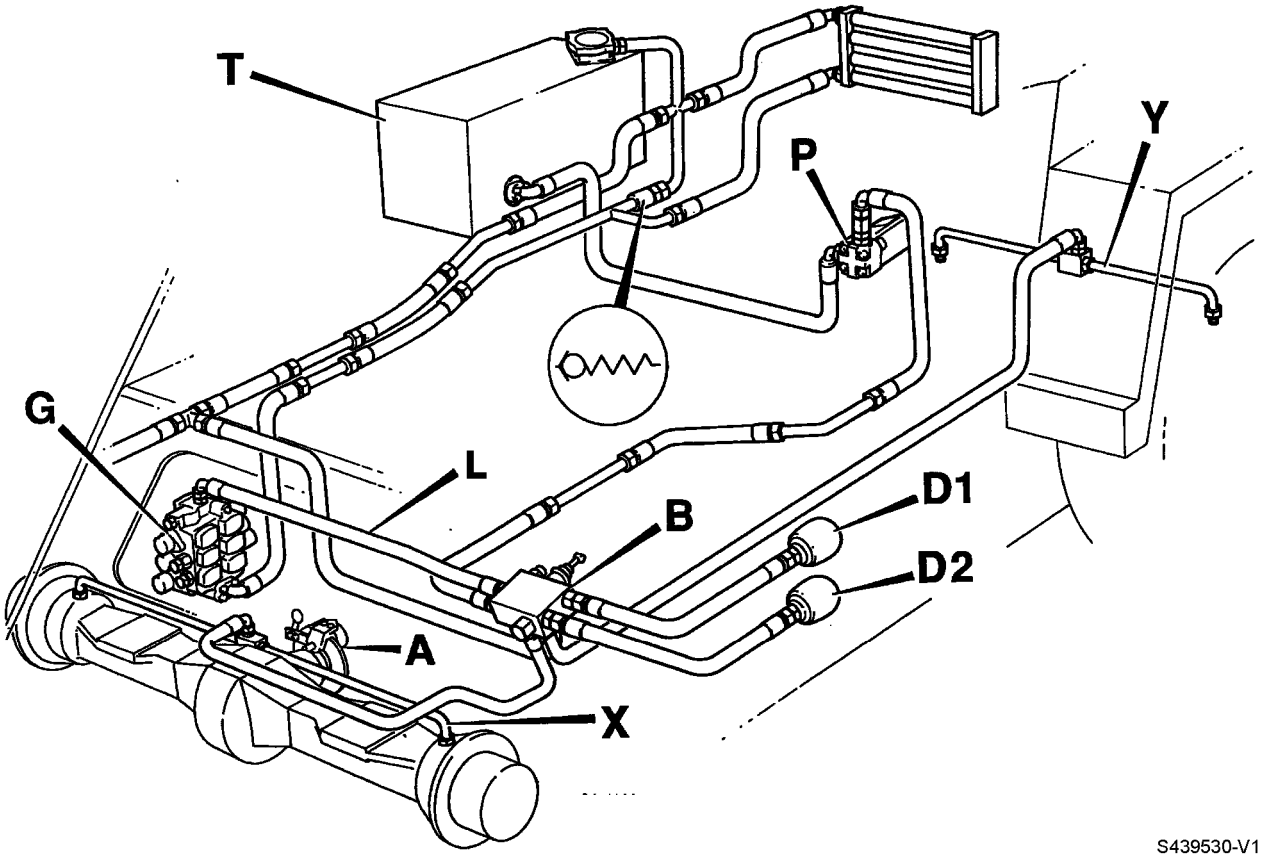

Fig 8.

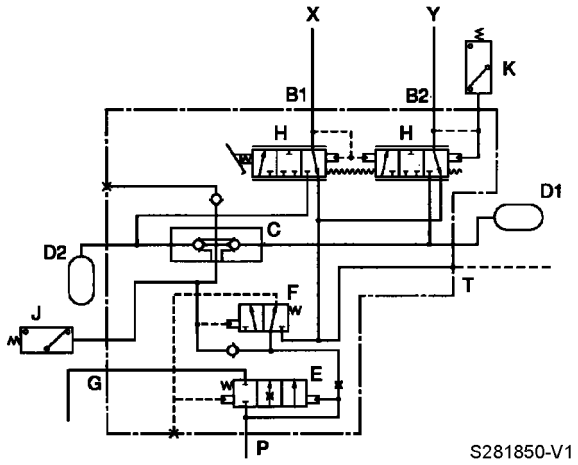

Fig 9.

Note: *On later machines hose **L** between loader valve **G** and brake valve **B** is no longer fitted. Where this hose has been deleted, port **G** on the brake valve will be connected to the tank return.*

The system is a full power hydraulic type in which hydraulic pressure is stored in accumulators and fed, on demand, to the four, fully enclosed, oil immersed brake units mounted on the axles. The transmission park brake **A** is cable operated. Oil is drawn from the hydraulic tank **T** by the engine driven pump **P** and passes to the brake valve **B**.

Initially the pump flow is directed via non-return valves **C** to charge up the accumulators $\mathbf{D_1}$ and $\mathbf{D_2}$. While charging is taking place, the pressure connections to spool **C** are self balancing so that spring pressure holds the spool in the position shown and the connection to spool **F** is at a low pressure so that the spool is held by spring pressure in the position shown. As the accumulators charge up, the pressure of the connection to **F** gradually increases until it is sufficient to overcome the spring pressure, at which point the spool moves against the spring. This connects the pressure line to spool **E** back to tank. At the same time the pressure building up in the accumulators moves spool **E**. This movement against the spring is progressive as the pressure builds to a maximum, so that the output from the valve is progressively connected to the loader valve **G**. As long as the brake is not used the circuit will remain in this condition.

Each accumulator consists of two chambers separated by a flexible membrane. The lower chamber is filled with hydraulic oil and is connected to the brakes via the brake valve. The upper chamber is filled with pressurised nitrogen gas which provides the energy to operate the brakes and ensures several applications even after the engine has stopped.

⚠ WARNING

The accumulators do not discharge when the pilot circuit is vented.

HYD-6-7

When the brake pedal is pressed, spools **H** connect accumulators $\mathbf{D_1}$ and $\mathbf{D_2}$ to the brake pistons front and rear. This causes the accumulator pressure to fall. When braking is discontinued the circuit behaves as previously described i.e. the accumulators charge up etc. Brake pressure switch **J** contacts open under pressure. If the pressure falls below a predetermined level the contacts close to illuminate a warning lamp. When the brake pedal is pressed, brake light switch **K** contacts close under the circuit pressure to illuminate the brake warning light.

Note: *The brakes themselves are dealt with as part of the wheel hubs in section F.*

Brake Valve 416S

Removal and Replacement

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

Removal

1 Park the machine on firm, level ground. Apply the park brake and stop the engine. Securely chock all four wheels. Repeatedly apply and release the service brakes and park brake until all the pressure in the accumulators is exhausted.

⚠ WARNING

Before disconnecting any part of the brake hydraulic system, make sure that engine is switched off and hydraulic pressure is fully discharged.

BRAK-3-1

⚠ WARNING

A minimum of 10 applications of the service brake is possible from the stored accumulator pressure. Disconnect service brake accumulator hoses with extreme caution.

BRAK-3-2

2 Disconnect and blank all hydraulic hoses having first identified them to ensure correct replacement.

3 Identify then unplug the electrical connections from the three pressure switches.

4 Remove the clip **1** from the foot brake push rod assembly. (After removing the heat shrink sleeving.)

5 Remove cap screws **2** and remove the valve from the bracket.

Replacement

1 Refit the valve by reversing the removal sequence.

2 When connecting the foot pedal linkage, adjust clevis **3** to take up any slack in the valve push rod.

Note: *If there are two holes in the brake pedal lever, connect the valve push rod to the upper hole.*

3 After refitting the valve, start the engine and wait for a few minutes until the accumulators are charged. Bleed the service brakes as described in ⇨ ***Bleeding the System 416S (G-27)***.

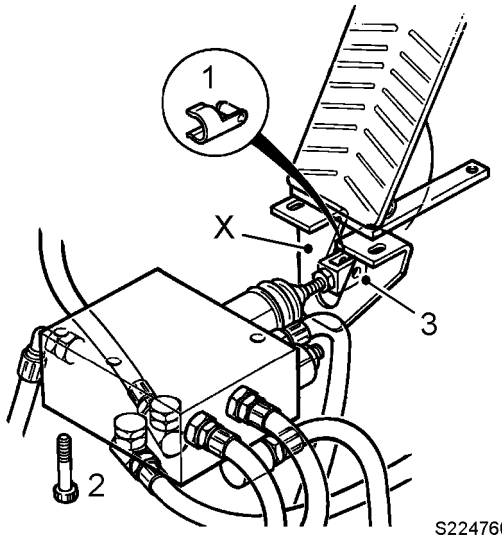

Fig 10.

Dismantling and Assembly

The valve may only be dismantled to renew seals. If any other part fails the complete valve must be renewed.

Remove only sufficient components to gain access to the seals. DO NOT dismantle further.

Two repair kits are available: one consists of all the seals and the other is a repair kit for the brake linkages and includes the necessary rubber gaiters.

Key to ⇨ *Fig 11. (G-20)*

1 Brake valve
2 Foot brake push rod assembly
3 Brake light switch
4 Transmission dump switch
5 Accumulator inlet adaptors (2 off)
6 Low pressure warning switch
7 Pilot valve adjuster
8 90° Adaptor (return to tank)
9 Tee adaptors (brake supply)
10 Adaptor (Pressure from pump)
11 Adaptor (Return to tank via loader valve)
12 Straight adaptors (2 off)
13 Dowty seal (4 off)
14 Dowty seal (M18)
15 Seal washer (5 off)
16 Adaptor (Return to tank)

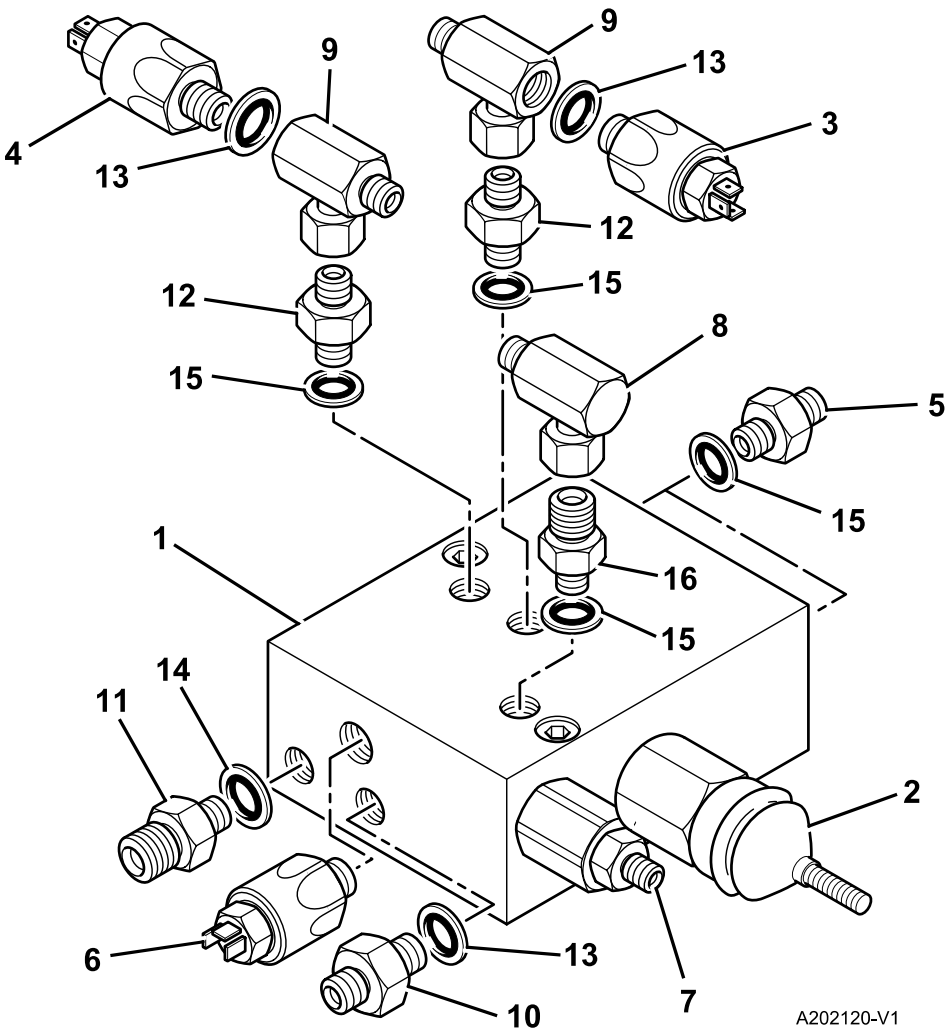

Fig 11.

Brake Pressure Setting

Note: *Use the following procedure to test and set the brake pressure if the heat shrink sleeving **A**, **B** has been removed.*

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

⚠ WARNING

Before disconnecting any part of the brake hydraulic system, make sure that engine is switched off and hydraulic pressure is fully discharged.

BRAK-3-1

⚠ WARNING

A minimum of 10 applications of the service brake is possible from the stored accumulator pressure. Disconnect service brake accumulator hoses with extreme caution.

BRAK-3-2

1 With the brake pedal fully up, check that there is a little free play between the brake push rod and the pedal assembly.

2 With the engine stopped and brake pressure released, connect a "T" adaptor at point **C** then connect a suitable pressure gauge (capable of reading 300 bar).

3 With the brake system operational, depress the brake pedal until the gauge shows the correct Operating Pressure. (See ⇨ ***Technical Data (🗋 G-1)***) With the pedal held in this position, adjust pedal stop **D** to contact the pedal. Release and re-operate the pedal a few times. checking each time that the gauge reading does not exceed the stated operating pressure. Tighten the stop locking nut.

4 Apply heat shrink sleeving as shown at **A**.

5 Without changing the adjustment, disconnect the push rod from the pedal. Apply heat shrink sleeving as shown at **B**.

6 Re-check the pressure. Remove the test point and gauge.

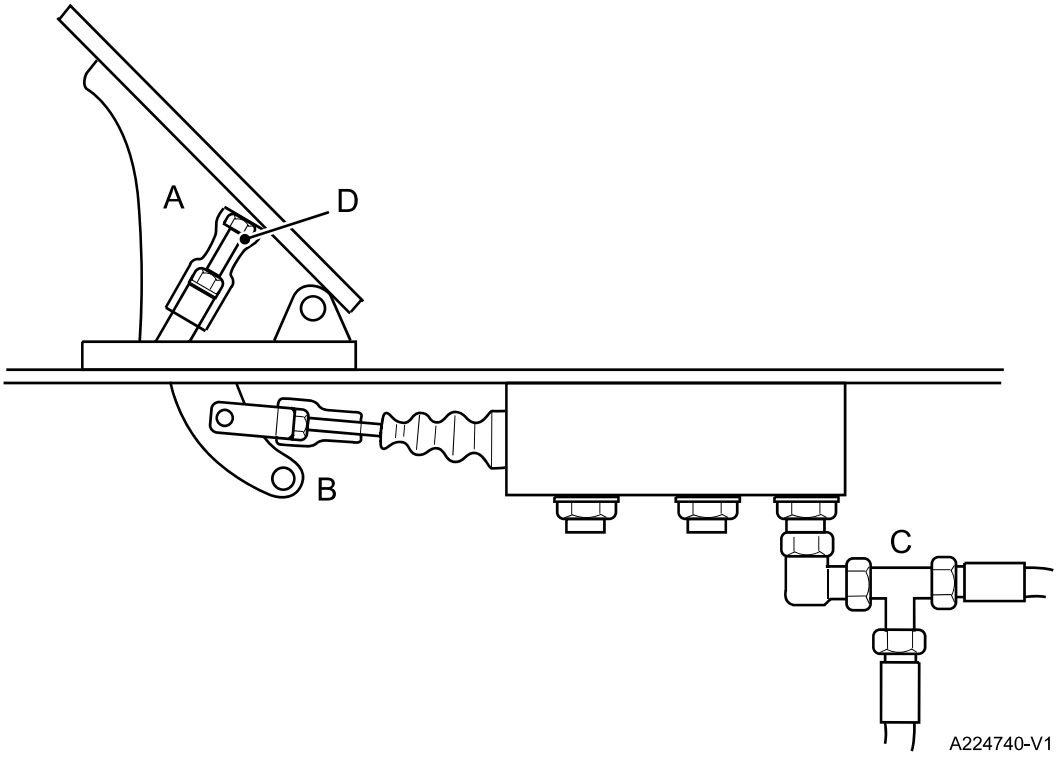

Fig 12.

System Testing 416S

⚠ WARNING

Before working on the brake system make sure the machine is on level ground and chock all four wheels.

BRAK-1-4

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

⚠ WARNING

Before disconnecting any part of the brake hydraulic system, make sure that engine is switched off and hydraulic pressure is fully discharged.

BRAK-3-1

Note: *The pedal arrangement shown is for machines prior to M529032. Later machines have a pedal stop screw rather than the stop plate* ***Y*** *shown. Both are factory set and non-adjustable.*

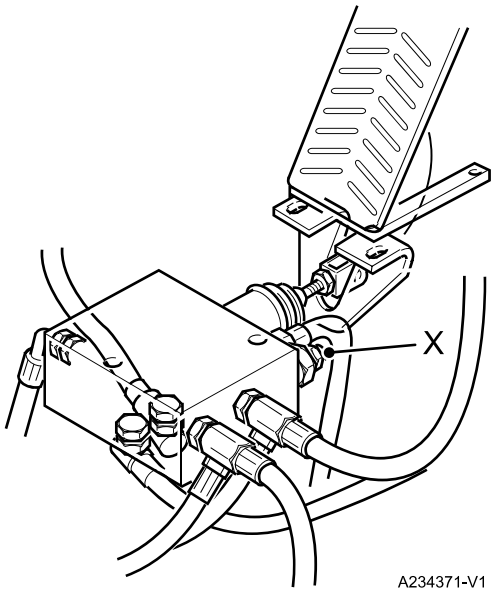

Fig 13.

Testing the System Pressure (Stored Accumulator Pressure)

1 Switch off the engine and operate the brake pedal repeatedly to make sure that all hydraulic pressure stored in the accumulators is discharged.

2 Disconnect one of the service brake accumulator hoses from the brake valve. Make up an adaptor to connect Pressure Test Gauge Kit 892/00253 between the valve and the accumulator hose.

3 Switch on the engine and check the gauge reading which should rise to the Pressure Regulator Cut-out pressure.(See ⇨ ***Technical Data (G-1)***). Operate the service brake pedal repeatedly with the engine running and check that the gauge reading does not fall below the Pressure Regulator Cut-in pressure. (See ⇨ ***Technical Data (G-1)***.)

4 Provided that the Maximum Pressure Differential is not exceeded, (see ⇨ ***Technical Data (G-1)***), the Pressure Regulator in the brake valve may be adjusted at **X** to bring the pressures within the required parameters. If, however, the pressure differential is greater than specified, the pressure

regulator is faulty and the brake valve should be renewed.

Note: *The pressure differential cannot be adjusted.*

Stop the engine and operate the service brake pedal a few times. The accumulator pressure should fall only slightly with each brake application. If the pressure falls drastically, it is likely that the accumulators need recharging with nitrogen gas. Repeat this test for the other brake circuit.

Testing the System Pressure (Brake Pump Test Point)

1 Switch off the engine and operate the brake pedal repeatedly to make sure that all hydraulic pressure stored in the accumulators is discharged.

2 Connect Pressure Test Gauge Kit 892/00253 to the test point on the brake pump beneath the engine cover.

3 Switch on the engine and check the gauge reading which should rise to the Pressure Regulator Cut-out pressure. (See ⇨ ***Technical Data (G-1)***) As soon as this pressure is reached, the gauge reading will fall to zero. Record the maximum pressure obtained.

Note: *Provided there are no leaks on the system and the brake pedal is not applied the gauge reading will remain at zero. Once the system's maximum pressure has been obtained the pressure regulator valve will discharge the pump pressure back to the tank.* ***The charged lines between the brake valve and the accumulators will still be at full charge pressure****. Before attempting to disconnect any part of the brake system, make sure the engine is switched off and all the hydraulic pressure is discharged by repeatedly operating the brake pedal.*

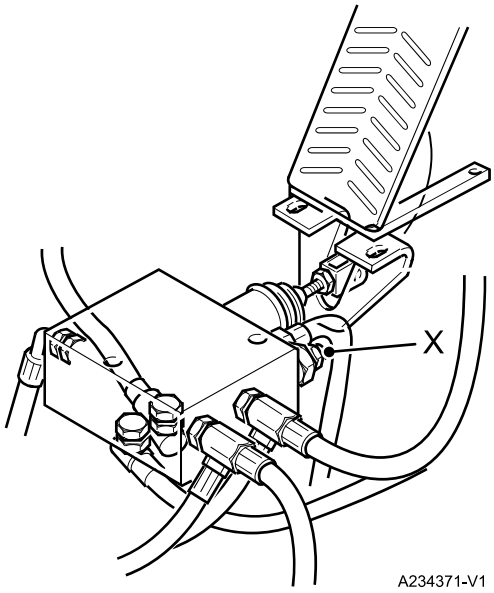

Fig 14.

Brake Pedal 416S

Removal and Replacement

Removal

Disconnect the push rod assembly (see ⇨ ***Removal and Replacement (G-18)***). Then proceed to remove the pedal.

Note: *The numerical sequence is a guide to removal. Replacement is a reversal of the removal procedure.*

The pedal **10**, anti-slip pad **11** and boot **12** can be removed and replaced if worn or damaged.

The base plate **13** can be removed if necessary by removing nuts **14** and washers **15**. The gaiter **3** will come clear at the same time. Check the gaiter for wear or perishing, replace as necessary.

Note: *The adjustment cap screw **16** and its locking nut **17** (if fitted) should not be removed from the base plate.*

For setting up and connecting the push rod assembly see ⇨ ***Removal and Replacement (G-18)***

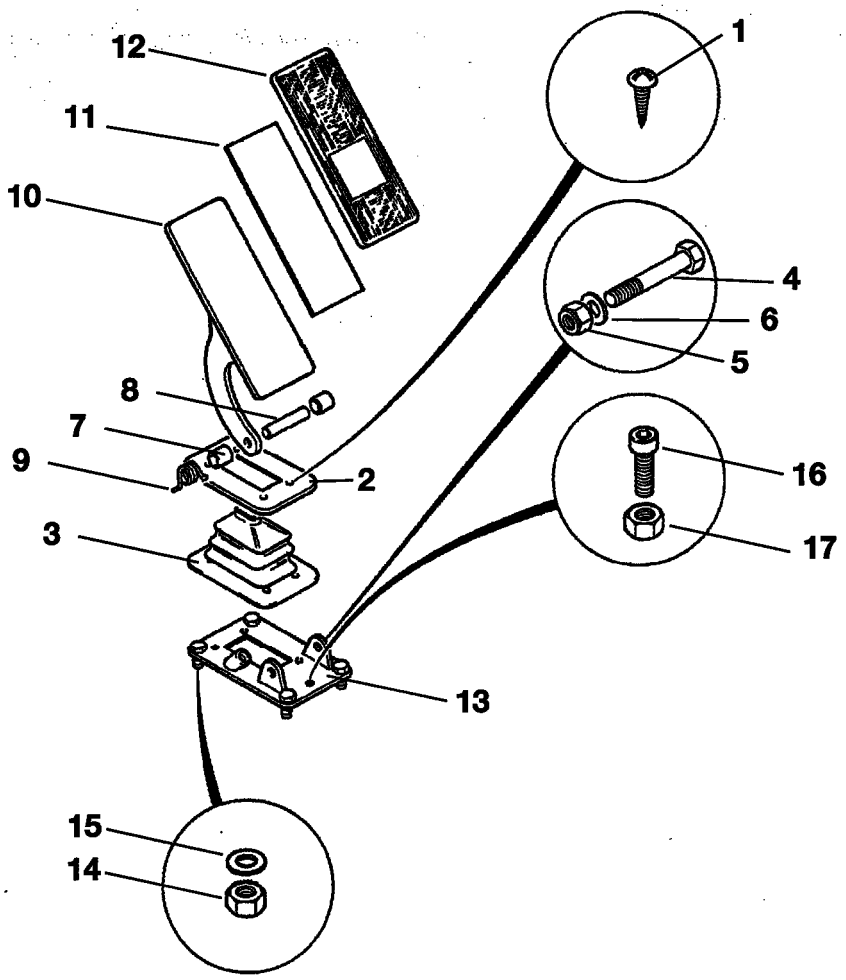

Fig 15.

Bleeding the System 416S

⚠ WARNING

Before proceeding with the bleeding procedure it is important to ensure that the park brake is engaged and that one pair of wheels is blocked on both sides.

BRAK-1-2

Note: *The braking systems are fed from the main hydraulic system and incorporate brake accumulators. These allow approximately nine applications of the brakes with the engine stopped.*

Bleed each axle separately as follows:

Attach a tube to the brake bleed screw, located near the axle centre. Ensure that the free end of the tube is immersed in fluid contained in a suitable container.

Open the brake bleed screw and fully depress the brake pedal. Hold the pedal fully depressed until air free fluid flows from the bleed screw.

Close the brake bleed screw with the pedal fully depressed.

Repeat the procedure for the rear axle.

Check the hydraulic fluid level.

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Park Brake

(Type 1)

Adjusting the Park Brake

1 Disengage the park brake (lever horizontal).

2 Turn adjuster **A** clockwise, half a turn.

3 Test the park brake. See ⇨ *Testing the Park Brake (G-39)*.

4 If the brake fails the test, repeat steps 1 to 3.

Note: *If after completing the above steps, the park brake does not pass the testing procedure. See* ⇨ *Adjusting the Brake Pads (G-30)*.

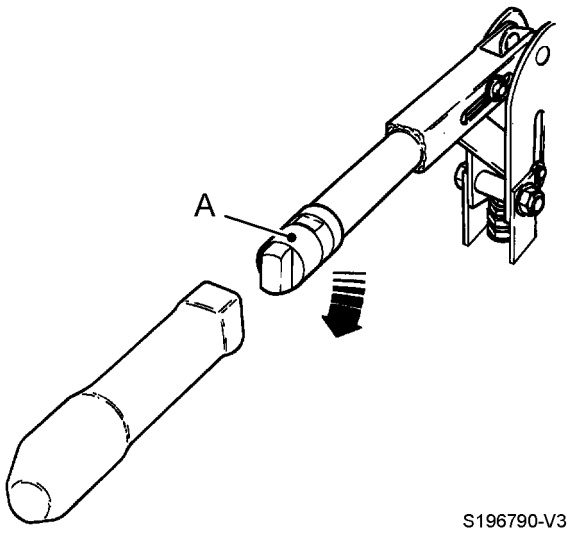

Fig 1.

Adjusting the Brake Pads

1 Turn adjuster **A** to return pin **B** to the bottom of the slot.

2 Check the pads just touch the disc when the park brake is disengaged (lever horizontal).

3 If necessary, adjust the pad position by turning nut **C** until the disc is clamped then back off nut **C** until the pads have a clearance of 0.5 mm (0.020 in) between the disc and one pad.

4 Engage the park brake 3 times and repeat step 2.

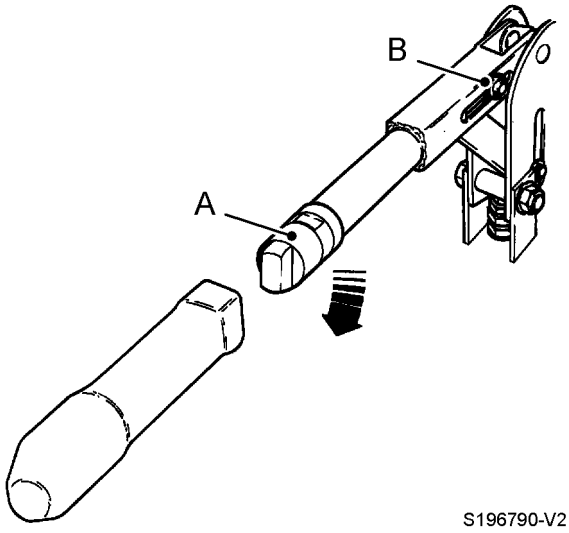

Fig 2.

Adjusting the Cable Slack

1 Loosen locknut **E** and remove pin **G** (at either end of the cable).

2 Screw in the clevis **F** only enough to remove the cable slack.

3 Refit pin **G** and tighten locknut **E** to 27 Nm (19.9 lbf ft).

4 Test the park brake, see ⇨ ***Testing the Park Brake (G-39)***.

5 If the brake fails the test, repeat steps 1 to 4.

Note: *The cable end must not contact lever **H**.*

Note: *If the brake cannot be adjusted by adjusting the pads and the cable slack, the cable must be replaced.*

Note: *When fitting park brake pads, never insert a screwdriver into the park brake slot since this could damage the pad material.*

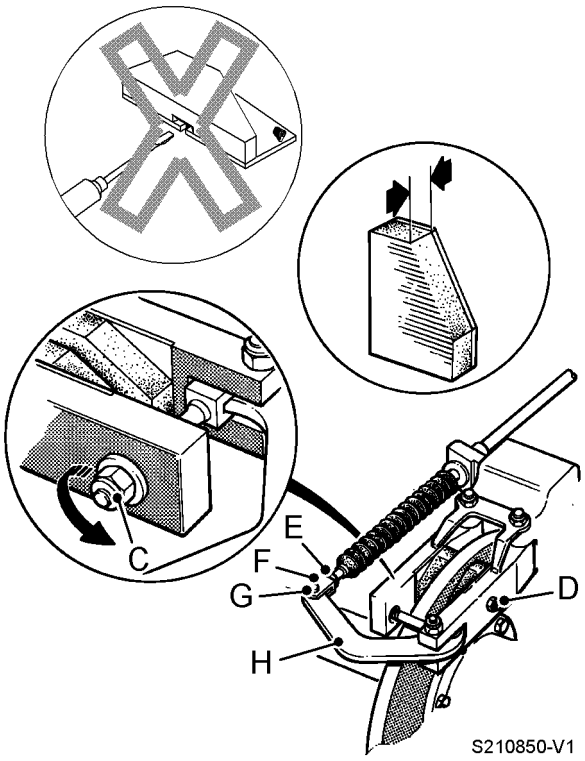

Fig 3.

Renewing the Brake Pads

Renew pads when thickness of friction material is 3mm (0.125 in).

⚠ WARNING

Before adjusting the park brake, make sure that the machine is on level ground. Put blocks each side of all four wheels. Disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

2-3-2-4

1 Disengage the park brake lever (lever horizontal). Turn handle grip to bring pin to the bottom of its slot.

2 Release the park brake cable.

3 Remove the caliper adjuster.

4 Release nuts/bolts sufficiently to disengage spring from callipers.

5 Undo and discard brake pad retaining nuts.

6 Remove both brake pads.

7 Pull brake callipers apart.

8 Remove and discard brake retaining bolts, fit new bolts.

9 Fit new brake pads.

10 Fit and tighten brake pad retaining nuts to 6Nm (4.4lbf ft).

11 Engage spring in brake callipers and tighten bolts so that the callipers move freely (14Nm, 10.32lbf ft).

12 Reconnect brake cable.

13 Fit adjuster and tighten until the pads just touch the brake disc with the park brake lever disengaged (lever horizontal). See ⇨ *Adjusting the Brake Pads (G-30)*.

14 Test the park brake, see ⇨ *Testing the Park Brake (G-39)*.

(Type 1)

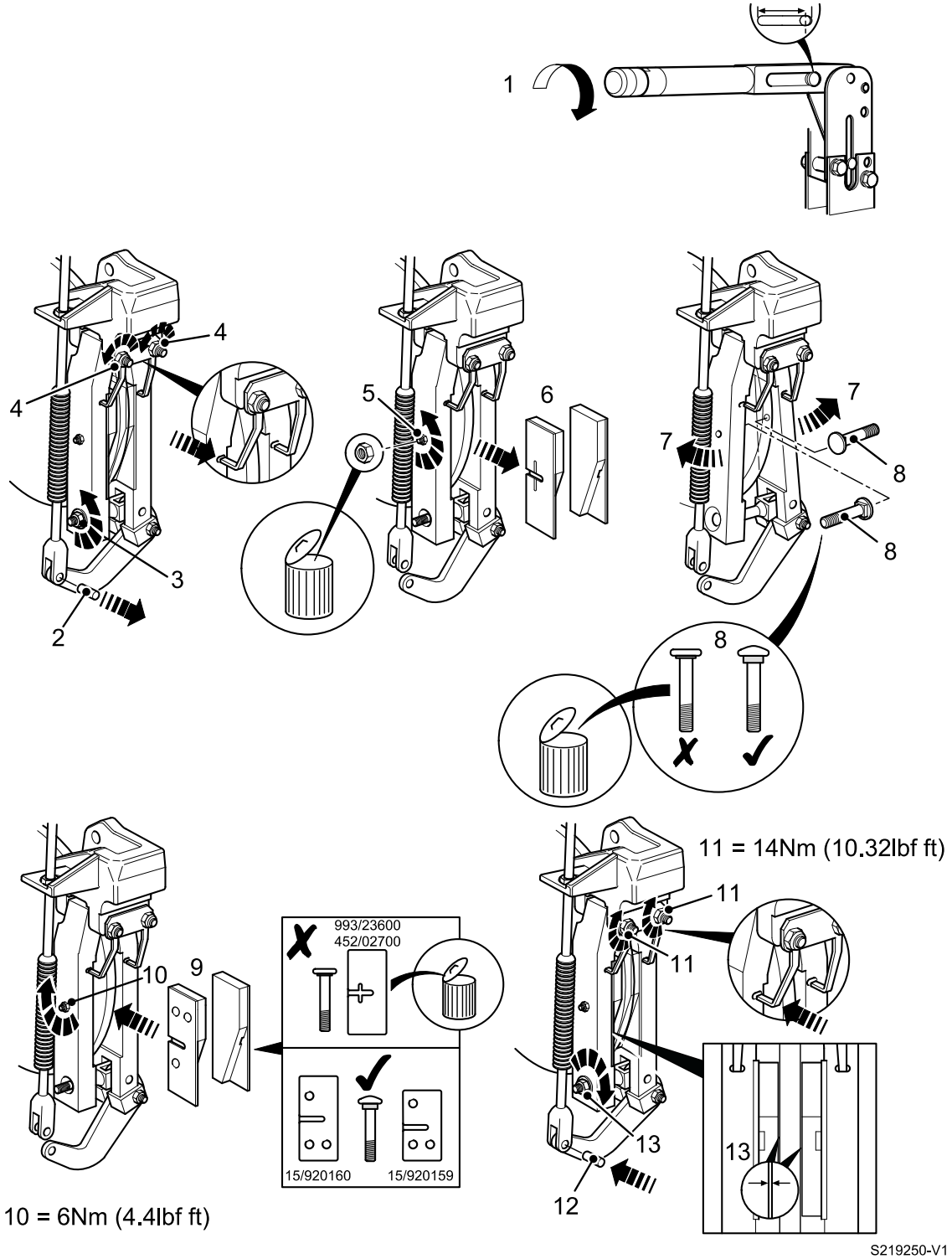
1
4
4
5
6
7
7
8
8
8
3
2
10
9
993/23600
452/02700
15/920160
15/920159
10 = 6Nm (4.4lbf ft)
11 = 14Nm (10.32lbf ft)
11
11
13
13
12
S219250-V1

Fig 4.

Dismantling and Assembly

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

For assembly the sequence should be reversed.

When Assembling

Lightly grease all pivots and working surfaces, taking care to avoid grease contacting the brake pads.

Fit shims **2** to align the park brake caliper centreline to within 0.5 mm (0.020 in) of the brake disc centreline.

Tighten nut **6** sufficiently to allow lever **8** to move freely with minimum side clearance.

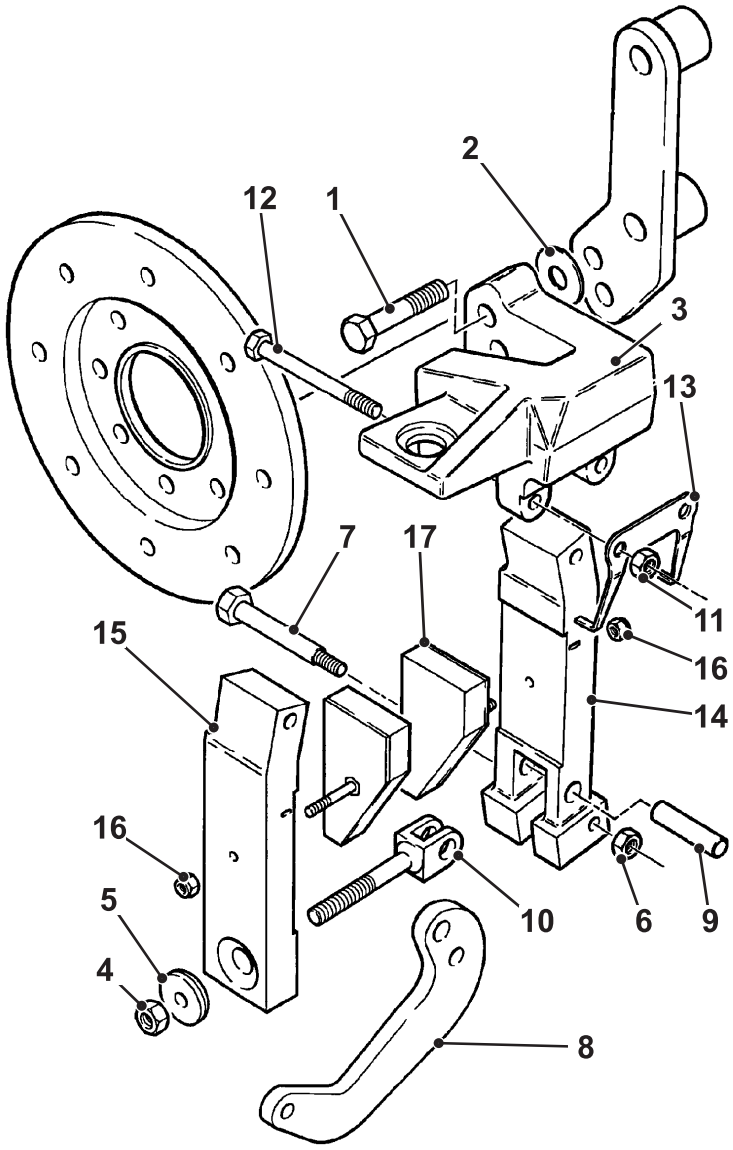

Fig 5.

(Type 2)

Adjusting the Park Brake

1 Disengage the park brake (lever horizontal).

2 Turn adjuster **A** clockwise, half a turn.

3 Test the park brake. See ⇨ ***Testing the Park Brake (G-39)***.

4 If the brake fails the test, repeat steps 1 to 3.

Note: *If after completing the above steps, the park brake does not pass the testing procedure. See* ⇨ ***Adjusting the Cable Slack (G-34)***.

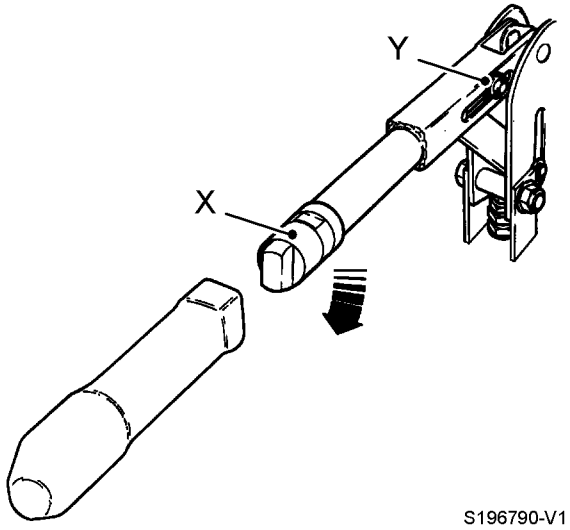

Fig 6.

Adjusting the Cable Slack

1 Turn adjuster **X** to return pin **Y** to the bottom of the slot.

2 Loosen locknut **A** and remove pin **B** (at either end of the cable).

3 Screw in the clevis **C** only enough to remove the cable slack.

4 Refit pin **B** and tighten locknut **A** to 27 Nm [19.9 lbf ft].Test the park brake, see ⇨ ***Testing the Park Brake (G-39)***.

5 If the brake fails the test, repeat steps 1 to 4.

Note: *If the brake cannot be adjusted by adjusting the cable slack, replace the brake pads and/or the brake cable.*

Note: *Operaing arm **D** has three machined holed to accommodate pin **B**. It is **MOST IMPORTANT** that pin **B** is fitted **ONLY** to the **CENTRE HOLE**.*

Note: *If the operating arm securing bolt **E** has to be removed it is **MOST IMPORTANT** that prior to removing the operating arm **D** its position on its splined shaft is carefully marked. The arm **MUST** be refitted in its **ORIGINAL POSITION**. Under **NO CIRCUMSTANCES** must the arm's position in relation to its shaft be altered in an attempt to gain additional movement, as this could cause damage to or failure of the park brake.*

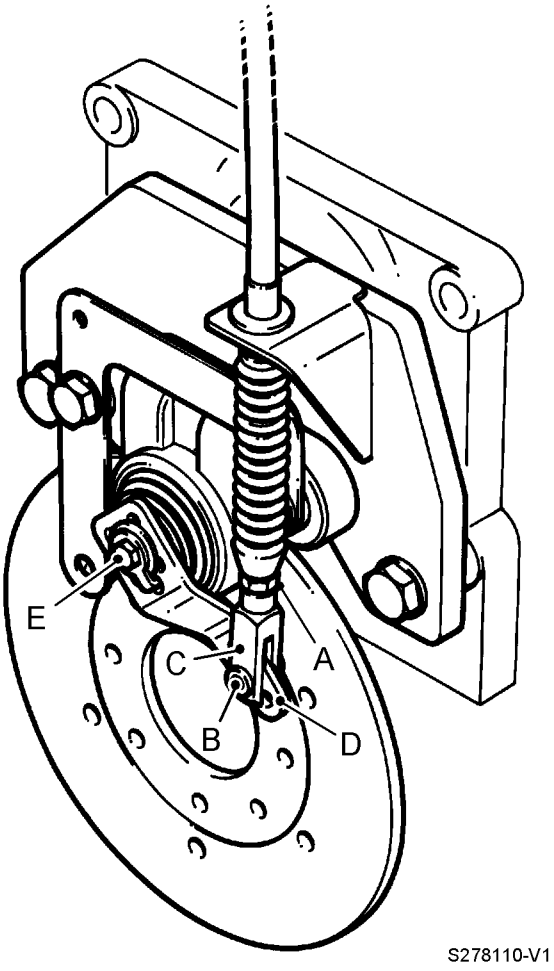

Fig 7.

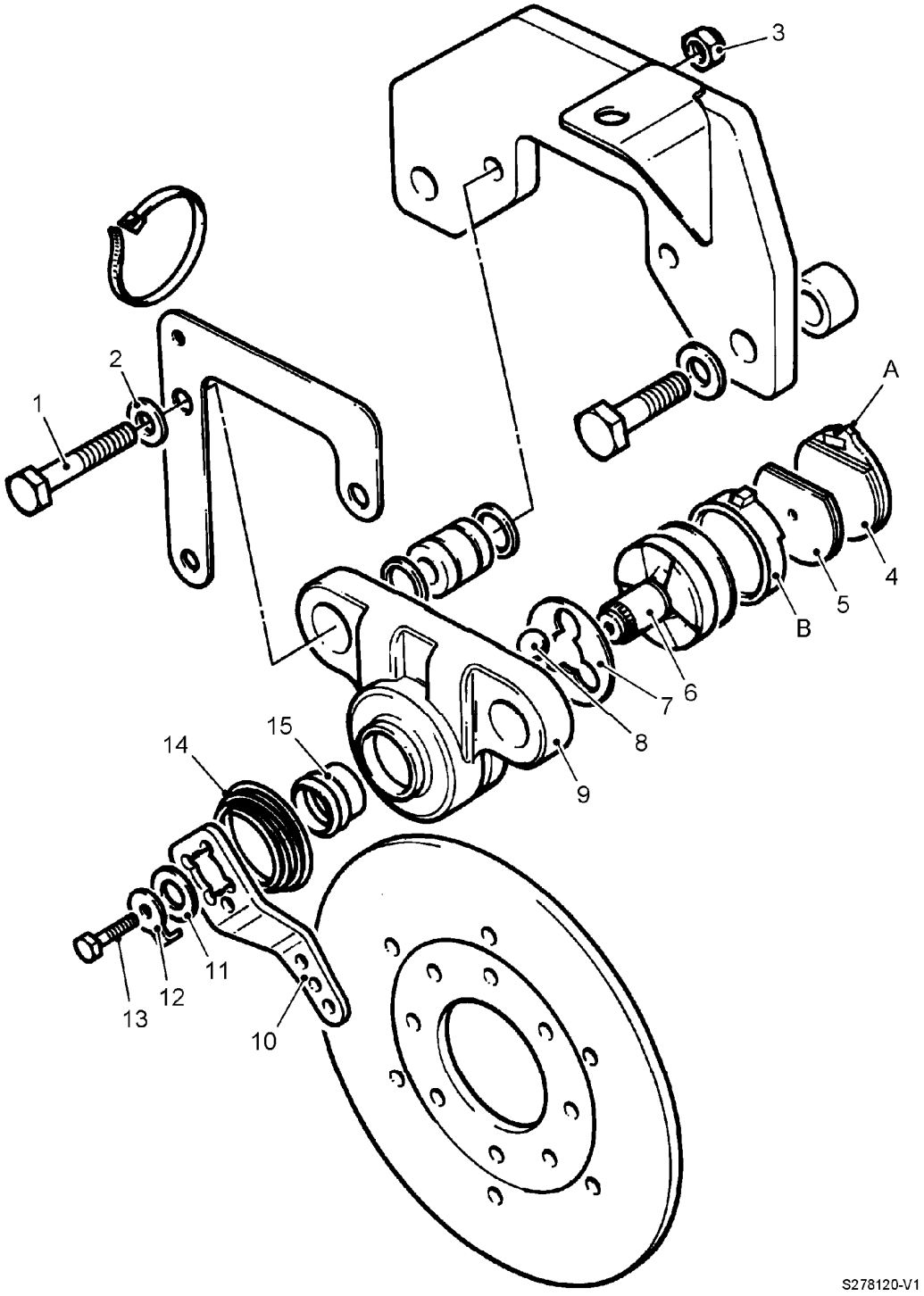

Fig 8.

Renewing the Brake Pads

Renew pads when thickness of friction material is 1mm (0.039 in).

1 Release brake and disconnect actuator from brake lever.

2 Slacken one and remove the other brake mounting bolt **1**, washer **2** and nut **3** position brake to expose brake pads.

3 Use flat bladed screw driver to remove pads **4** and **5**.

Note: *Take care when removing pad from the plastic actuator cover.*

4 Place pads in position.

Note: *Centre hole in lever side pad snaps over tabs on actuator cover. Align pad with flat on rotor cover **B**. If tabs are broken dab pad adhesive on the back edge of the pad and press firmly into correct position.*

5 Remove pad adhesive from pad compartment in pad carrier plate **A**.

6 Apply adhesive along back edge of pad carrier plate and press into place.

7 Push lever side pad as far as possible into the brake.

8 Position brake over disc, fit mounting bolt **1**, washer **2** and nut **3** and torque both bolts to 119 Nm [140 lb ft].

9 Attach cable to lever.

10 Adjust pad gap.

Dismantling

1 Disconnect actuator cable and remove brake.

2 Remove friction pads **4** and **5**.

Note: *Before dismantling, mark the relative position of the lever **10** to the shaft. The lever MUST be refitted in the same position.*

3 Unbend anti-rotation clip **12**, remove screw **13**, clip **12**, washer **11**, lever **10** and spring **14**.

4 Push out rotor assembly **6** from casting **9**.

5 Remove 3 ball bearings **8**.

6 Only if shaft seal **15** requires replacement. Press out plastic shaft seal from casting using steel spacer block 27.38mm [1.078in] diameter by 63.5mm [2.5in] long and an arbor press.

7 Remove any plastic left in casting.

Note: *Before assembly insure all parts are clean and serviceable.*

Assembly

1 Insert seal **15** into casting with extended smooth surface first. Using an arbor press with protective spacer block, gently press seal until it snaps into groove.

2 Grease ball pockets in casting **9**, shaft and ball pockets of the rotor assembly **6**.

3 Insert 3 ball bearings **8** and ball spacer **7** into the pockets in the casting **9**.

4 From the inside of the casting **9**, slide the shaft of the rotor assembly **6** through the shaft seal **15** and seat ball pockets against the ball bearings **8**.

5 Place the spring **14** over the large diameter pilot on the outside of the casting **9**.

6 Install lever **10** making sure the small diameter of the spring **14** is piloted on the outside of the four pins in the lever.

7 Set the lever **10** in the 4 o'clock position.

8 Install washer **11** and anti rotation clip **12**, with its tab inserted into the lower hole in the lever.

9 Insert screw **13** into rotor assembly shaft **6** and tighten to 12.4-15.8 Nm [110-140 in.lbs.], while guiding lever **10** over rotor assembly spine.

10 Bend up tab on the anti-rotation clip **12**.

11 Install the friction pads **4** and **5**.

12 Stroke lever **10** in the correct direction. The lever must rotate through 60 degrees of rotation. Return lever to 4 o'clock position and make sure the lever side friction pad **5**, is fully returned.

Park Brake (Pre-Smoothshift Transmission)

Note: *Pre-Smoothshift machine serial numbers as follows: 412S to Serial No. 435499, 414S to Serial No. 537299, 416S to Serial No. 543099*

Testing the Park Brake

⚠ WARNING

Before testing the park brake make sure the area around the machine is clear of people.

2-2-4-5

Test the brake on a level, dry surface. Make sure your seat belt is securely fastened.

1 The attachment should be in the travelling position.

2 Make sure the park brake is fully engaged.

3 Switch off transmission disconnect switch. (On the facia panel.)

a Select **4** on gear selector.

b Push down hard on the brake pedal and select forward drive.

Note: *An audible alarm will sound and a warning light will show when the park brake is engaged with the machine in forward (**F**) drive. The alarm will stop when neutral (**N**) drive is selected.*

c Keep the brake pedal pushed down.

4 Move the park brake lever fractionally forward until the park brake warning light is just extinguished.

⚠ WARNING

If the machine starts to move during the following test, immediately apply the foot brake and reduce the engine speed.

2-2-5-1

a Release the brake pedal.

b If the machine has not moved, use the accelerator pedal to gradually increase the engine speed to 1500rpm. The machine should not move.

c Reduce the engine speed to idle and set the forward/reverse lever (or switch) to neutral.

Do not do this test for longer than 20 seconds.

5 Return the park brake lever to the fully on position from its partially applied position.

6 Lower attachment and stop the engine.

Note: *If the machine moved during the test, see* ⇨ ***Adjusting the Park Brake (G-34)****. Do not use the machine with faulty brakes.*

⚠ WARNING

Do not use a machine with a faulty park brake.

3-2-3-10_2

⚠ WARNING

Non approved modifications to drive ratios, machine weight or wheel and tyre sizes may adversely affect the performance of the parking brake.

3-2-3-11

Park Brake Transmission Disconnect

When fully engaged, the park brake electrically disconnects the transmission drive; this prevents the machine from being driven with the park brake on. With 4 selected, the transmission disconnect is inhibited.

Park Brake (Smoothshift Transmission)

Note: *Smoothshift machine serial numbers as follows:412S from Serial No. 435500, 414S from Serial No. 537300, 416S from Serial No. 543100*

Testing the Park Brake

⚠ WARNING

Before testing the park brake make sure the area around the machine is clear of people.

2-2-4-5

Test the brake on a level, dry surface. Make sure your seat belt is securely fastened.

1 The attachment should be in the travelling position.

2 Make sure the park brake is fully engaged

3 Switch off transmission disconnect switch. (On the facia panel.)

4 Switch off Auto/Manual switch.

5 On the EMS press the two arrow keys and the SETUP key at the same time, to select the AEB setup menu

- **a** Use the UP or DOWN arrows to select the park brake test menu.
- **b** Press SETUP key to select **park brake test on**.

6 Select third gear/range (**3**).

- **a** Push down hard on the brake pedal and select forward drive.

Note: *An audible alarm will sound and a warning light will show when the park brake is engaged with the machine in forward (**F**) drive. The alarm will stop when neutral (**N**) drive is selected.*

⚠ WARNING

If the machine starts to move during the following test, immediately apply the foot brake and reduce the engine speed.

2-2-5-1

7 Release the brake pedal.

- **a** If the machine has not moved, use the accelerator pedal to gradually increase the engine speed to 1500rpm. The machine should not move.
- **b** Reduce the engine speed to idle and set the forward/reverse lever (or switch) to neutral.

  Do not do this test for longer than 20 seconds.

8 Press SETUP key again to select **park brake test off**.

9 Lower attachment and stop the engine.

Note: *If the machine moved during the test, see ⇨ Adjusting the Park Brake (G-34). Do not use the machine with faulty brakes.*

⚠ WARNING

Do not use a machine with a faulty park brake.

3-2-3-10_2

⚠ WARNING

Non approved modifications to drive ratios, machine weight or wheel and tyre sizes may adversely affect the performance of the parking brake.

3-2-3-11

Park Brake Transmission Disconnect

When fully engaged, the park brake electrically disconnects the transmission drive; this prevents the machine from being driven with the park brake on.

Charging the Accumulators

System Operation

⚠ DANGER

Make sure the articulation safety lock is fitted before transporting the machine. The articulation safety lock must also be fitted if you are carrying out daily checks or doing any maintenance work in the articulation danger zone.

If the articulation lock is not fitted you could be crushed between the two parts of the chassis.

GEN-3-1_1

1 Park the machine on level ground, lower the loader arm, switch off the engine and chock all four wheels. Release all hydraulic pressure in the accumulators by repeatedly applying the footbrakes (engine stopped).

2 Connect charging tool A892/00239 (see K Service Tools (T 1-8)) to a bottle of compressed nitrogen gas using hand valve **B**.

Note: *If the machine is fitted with Piston Type Accumulators, service kit* ***892/00948*** *will be required to connect to the accumulator charge point.*

3 Using an Allen key, "crack" open the plug of the accumulator being charged to allow later removal.

Note: *DO NOT unscrew the accumulator plug at this stage as any gas within the accumulator will be released.*

4 Fit the charging tool to the accumulator and fully tighten the retaining nut.

5 Close vent valve **C** then press down and turn tee handle **D** anticlockwise to unscrew the accumulator plug.

6 Slowly release hand valve **B** on the nitrogen bottle until the pressure gauge reading rises to the required charge pressure, (see ⇨ *Technical Data (G-1)*) then close the hand valve.

7 Press down and turn tee handle **D** clockwise to tighten the accumulator plug.

8 Open vent valve **C** to release pressure in the hose, then remove the tool from the accumulator.

9 Fully tighten the accumulator plug.Repeat steps 2 - 9 for subsequent accumulators.

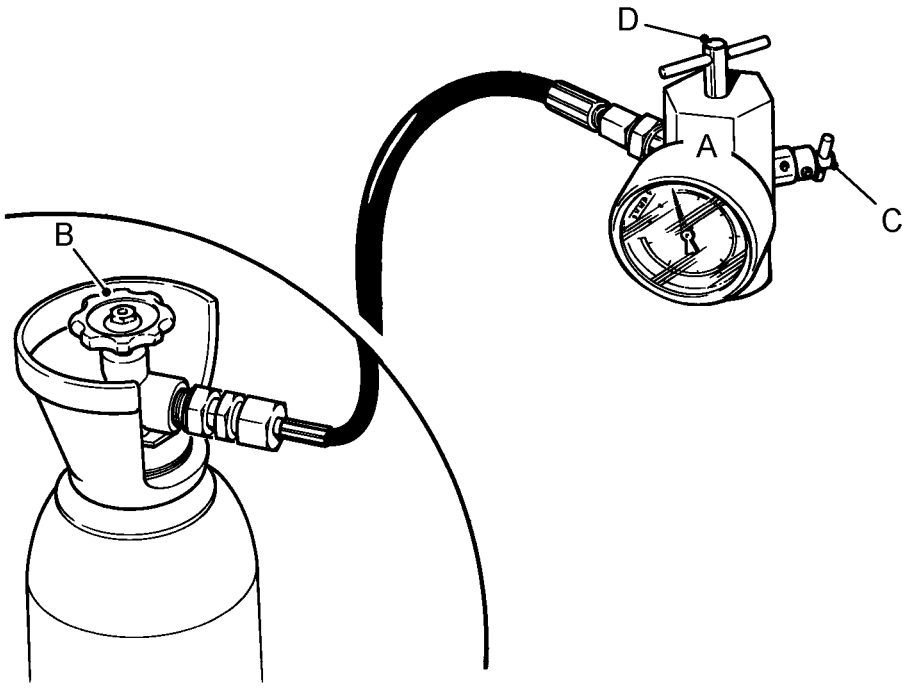

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Fig 9.