Brakes

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Technical Data

Machines with SD55, SD70 Axles

The following machines are fitted with SD55, SD70 Axles:

530-70
533-105
535-60
535-95
540-70

Machines fitted with AM and RJ engines

Service Brakes	
Type	Single Circuit, Oil-Immersed Multi-Plate Disc
Actuation	Hydraulic, servo assisted
Location	Front Axle Centre Mounted (2 Brake Packs)
Master Cylinder	
Type	Master cylinder with remote servo unit
Stroke	25 mm (1.0 in)
Servo Unit	
Type	Vacuum assisted hydraulic valve
Vacuum cylinder diameter	135mm (5.33 in)
Hydraulic cylinder diameter	19 mm (0.75 in)
Brake vacuum pressure	0.8 - 1 bar negative (vacuum)

All Other Engine Builds

Service Brakes

Type	Single Circuit, Oil-Immersed Multi-Plate Disc
Actuation	Hydraulic
Location	Front Axle Centre Mounted (2 Brake Packs)

Master Cylinder

Type	Master cylinder
Stroke	35 mm (1.38 in)

Machines with SD80 Axles

The following machines are fitted with SD80 Axles:

532-120
535-125
535-140
537-135 (550)
540-140
540-170 (5508)
550-170

Service Brakes

Type	Single Circuit, Oil-Immersed Multi-Plate Disc
Actuation	Hydraulic, servo assisted
Location	Front Axle Centre Mounted (2 Brake Packs)
	Rear Axle Hub Mounted (2 Brake Packs)

Master Cylinder

Type	Master cylinder with remote servo unit
Stroke	25 mm (1.0 in)

Servo Unit

Type	Vacuum assisted hydraulic valve
Vacuum cylinder diameter	201mm (7.9 in)
Hydraulic cylinder diameter	21.6 mm (0.85 in)
Brake vacuum pressure	0.8 - 1 bar negative (vacuum)

Pedal Effort versus Brake Pressure

Note: *The following information is intended for reference only.*

The relationship between Pedal Effort (Axis X), measure in Newtons, and Brake Pressure (Axis Y) measured in Bar is shown. ⇨ *Fig 1. (G-4)*

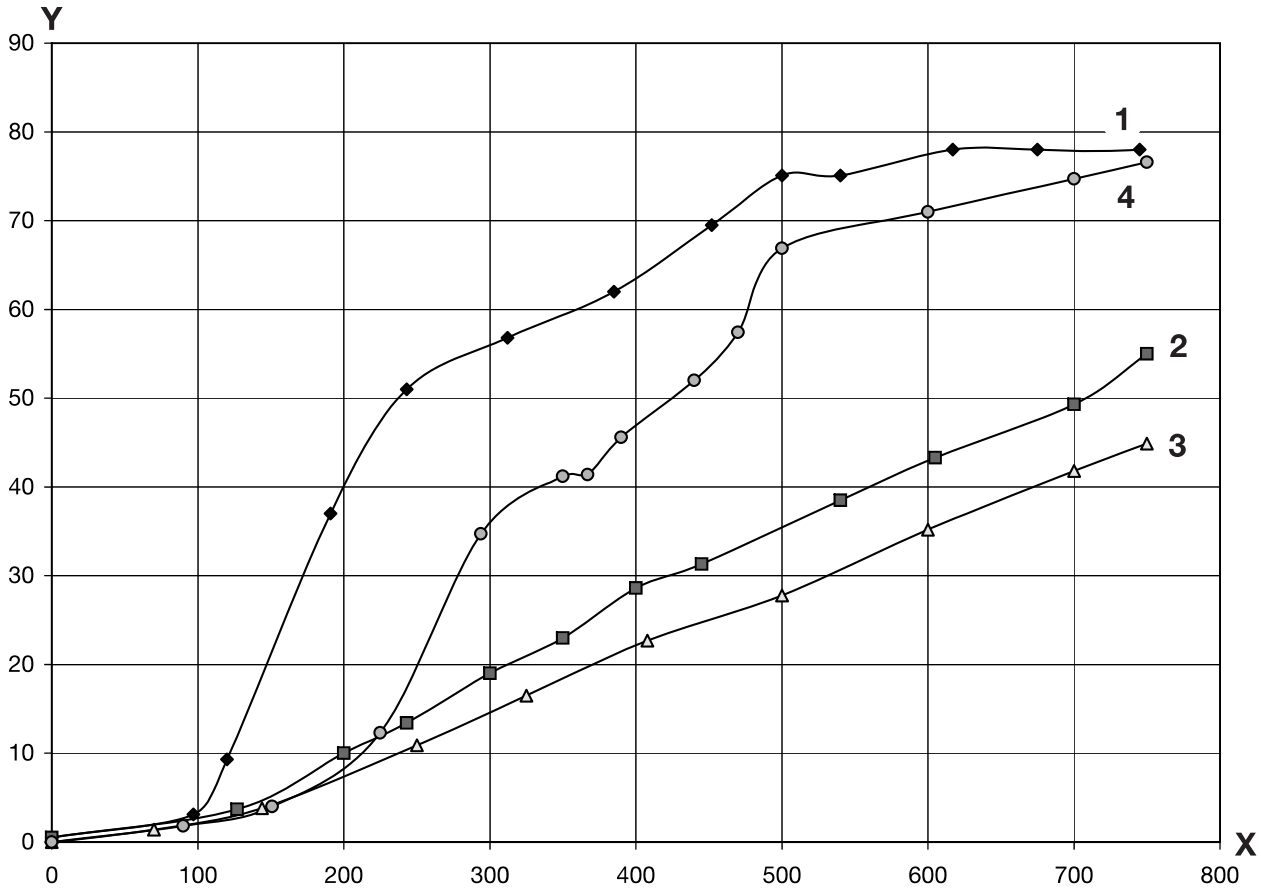

Fig 1. Pedal Effort versus Brake Pressure

1-**X**	Pedal Effort (N)
1-**Y**	Brake Pressure (Bar)
1-**1**	1 Dia M/C & modified Servo
1-**2**	1 Dia M/C No Servo
1-**3**	1 1/8 Dia M/C & current Servo
1-**4**	1 1/8 Dia M/C No servo

Basic Operation

General Description

The service brakes act on the front axle half shafts of all machines. The brakes are oil immersed, multi-disc types which are operated hydraulically by a single pedal and master cylinder arrangement. An exhauster (vacuum) unit is fitted on the engine to power the servo unit.

The brake cylinder reservoir is situated in front of the instrument panel in side the cab on Series I machines, and outside of the cab, below the front windscreen on Series II machines.

With 2-wheel drive selected, pressing the brake pedal will automatically select 4-wheel drive. This gives increased braking effect. The transmission will switch back to 2-wheel drive when the brake pedal is released.

The cable operated parking brake acts on a disc which is mounted on the gearbox output shaft to the front axle.

Fault Finding

Brake System

Note: *The brakes generate a high temperature when operating, this means that the casing will be hot to touch, this condition is normal.*

Fault(s)

Table 1. One or more brakes do not apply. (Brake travel not excessive, brakes not pulling to one side)

Possible Cause		Action
1	Master cylinder fault.	Check master cylinder to identify fault area, service as required.
2	Friction/counter plate distortion.	Renew friction/counter plates - Both sides of relevant axle.

Table 2. Pedal travel excessive (but not touching floor)

Possible Cause		Action
3	Air in hydraulic system.	Check fluid reservoir level. Check for fluid/air leaks, rectify as required. Bleed the brake system.
4	Leak in hydraulic system.	Check for fluid loss at master cylinder and brake piston, all pipes and fittings for loose connections. Rectify as required. Top up brake reservoir and bleed the brake system.
5	Friction/counter plate distortion.	See Item 2.

Table 3. Pedal hard to operate.

Possible Cause		Action
6	Tightness at pedal pivot.	Inspect pedal pivot. Free-off/lubricate.
7	Fluid contamination/seal damage.	Flush system and renew all hydraulic seals. Bleed the brake system.
8	Misaligned push rod/pedal.	Check and rectify as required.
9	Kinked or crushed brake pipes.	Check/renew brake pipework.
10	Vacuum failure due to low vacuum at source.(1)	Inspect/service engine mounted exhauster unit as required.
11	Blocked/leaking vacuum pipe.(1)	Check/renew vacuum pipe.
12	Servo defect.(1)	Renew servo unit.

(1) Machines fitted with servo assisted brakes only.

Table 4. Pedal touches floor under constant pressure - no fluid loss.

Possible Cause		Action
13	Master cylinder fault.	See Item 1.
14	Friction/counter plate distortion.	See Item 2.
15	Air in hydraulic system.	See Item 3.

Table 5. Pedal touches floor under constant pressure and fluid loss.

Possible Cause		Action
16	External fluid leaks.	Visually check brake circuit for fluid loss, service as required. Top up brake reservoir and bleed the brake system.
17	Internal fluid leaks.	⇨ *Brake Piston Seal Leakage (G-10)*.

Table 6. Poor braking (not pulling to one side).

Possible Cause		Action
18	Friction plates worn beyond limits or distorted.	Renew friction/counter plates - Both sides of relevant axle.
19	Master cylinder fault.	See Item 1.
20	Annular piston fault.	See Item 28.
21	Incorrect/low axle oil.	Fill axle with correct type of oil.
22	Vacuum failure.(1)	Inspect vacuum source/pipes, service as required.

(1) Machines fitted with servo assisted brakes.

Table 7. Brakes not releasing

Possible Cause	Action
23 Brake pedal spring fault.	Fit a new spring.
24 Master cylinder fault (plunger stuck in bore).	See Item 1.
25 Blocked hole in master cylinder reservoir cap.	Fit a new reservoir cap.
26 Brake pedal free travel incorrect.	Adjust pedal free travel.
27 Fluid contamination/seal damage.	Flush system and renew hydraulic seals. Refill with clean fluid and bleed the brake system.
28 Annular brake piston(s) binding in axle.	– Check that correct brake fluid has been used (incorrect fluid could swell the annular brake piston seals). – Check if annular brake piston seals in good condition. – Check that annular brake piston rotates freely in its housing with no seals fitted. – Check that the annular brake piston seal retracts the piston approximately 0.5 mm (0.020 in).
29 Kinked or crushed brake pipes.	Check and renew pipes as required.
30 Friction/counter plates not free on splines and/or dowels.	Check friction/counter plates for free movement, renew if required - Both sides of relevant axle.

Table 8. Poor braking when hot

Possible Cause	Action
31 Moisture in system vaporising when axle is hot.	Strip axle and clean annular piston to remove moisture. Remove master cylinder and check for corrosion, service as required. Flush system refill with clean fluid. Bleed the brake system.

Table 9. Excessive brake noise in operation

Possible Cause(1)	Action
32 Deterioration of axle oil or wrong type of axle oil.	Change axle oil.
33 Axle oil loss.	Refill axle with correct oil and check for leaks.
34 Friction plates worn beyond limits.	Renew friction/counter plates - Both sides of relevant axle.
35 Friction/counter plates in poor condition.	Check for distortion or surface pitting and/or roughness of friction/counter plates (annular grooving of counter plates is acceptable).

(1) Due to the metal to metal contact of oil immersed brakes, limited noise can be heard which is consistent with this type of design - this is normal.

Table 10. Fluid loss when machine standing for instance - overnight

Possible Cause[1]	Action
36 Severe damage or slight cut/nick in the brake piston seal.	Check as described. ⇨ ***Brake Piston Seal Leakage (G-10)***. If necessary, strip axle and renew seal(s).
37 External leakage through brake pipe connections, etc.	Check for and repair leaking connections.

(1) Confirm fault is as indicated by checking that the brake pedal does not touch the floor under constant pressure.

Service Procedures

Brake Piston Seal Leakage

The most common reason for internal piston seal leakage is a build-up of axle contamination as a result of excessive brake wear caused by extended service periods.

Note: *An overfull hub is an indication of a possible brake seal leak. If this is confirmed change the axle/hub oil after renewing the seal(s).*

Two types of internal leakage can occur within the axle or hub:

1 Low Pressure Leaks - Seal damage, or scoring to seal component surfaces, caused by a build-up of metal particles.

2 High Pressure Leaks - Mechanical leakage past a badly damaged or perished seal.

Note: *The low pressure leak test should be performed first. Low pressure leaks are difficult to find using a high pressure test - seals and other components can distort and form a seal under pressure.*

The following procedures explain how to check for low or high pressure leaks without the need to dismantle the axle first. The test must only be done when the axle is cold.

Front Axle

⚠ WARNING

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

BRAK-1-4

⚠ WARNING

Do not drive the machine with any part of its brake system disconnected. When the following test has been completed reconnect all brake pipes and bleed the brake system using the recommended procedure.

BRAK-2-1

Preparation

1 Disconnect and cap brake piston feed pipe **2-A** (non-sway machines) or feed hose **2-B** (sway machines).

2 Completely remove pipe **2-C** and plug port **2-D**.

3 Fill both brake piston housings with JCB Light Hydraulic Fluid via ports **2-E** and **2-F**.

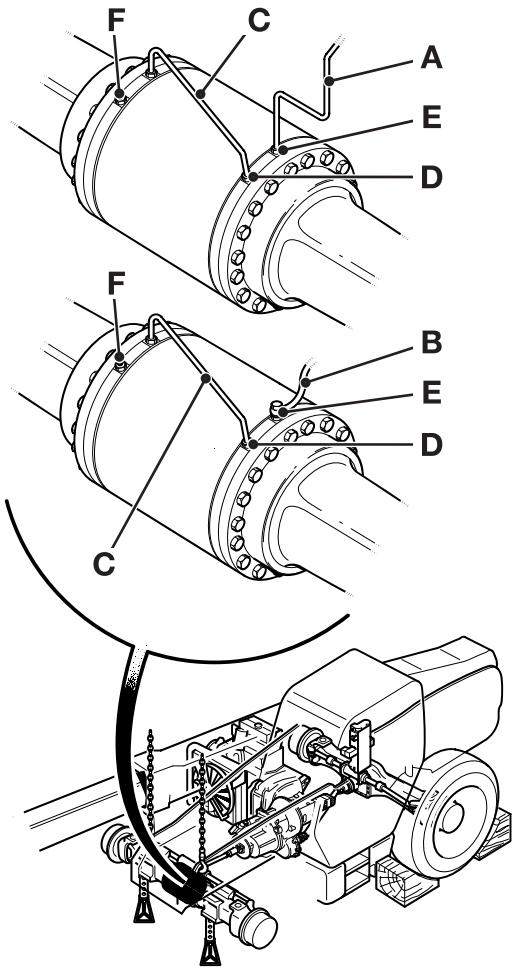

Fig 2.

4 Test for a Low Pressure Leak:

a Install an adapter fitted with a piece of clear tube to the brake piston port **3-A**.

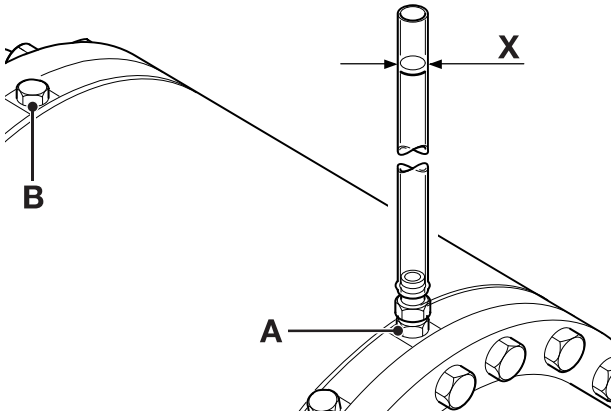

Fig 3.

Note: *The tube must be kept vertical during the test, use tape to attach the tube to the side of the machine.*

b Fill the tube until approximately three quarters full with JCB Light Hydraulic Fluid.

c Using a suitable pen, mark the level line of the brake fluid **3-X** on the tube.

d After approximately 1/2 hour, check if the level has dropped below the original marked line. If it has, check the brake piston seal for slight nicks, cuts or generally for wear.

e Repeat steps a to d at port **3-B**.

5 Test for a High Pressure Leak:

a Install a hand pump fitted with a 0 - 40 bar (0 - 600 lbf/in^2) pressure gauge to brake piston port **4-A**.

Note: *The hand pump must be filled with JCB Light Hydraulic Fluid. Do not exceed 69 bar (1000 lbf/in^2).*

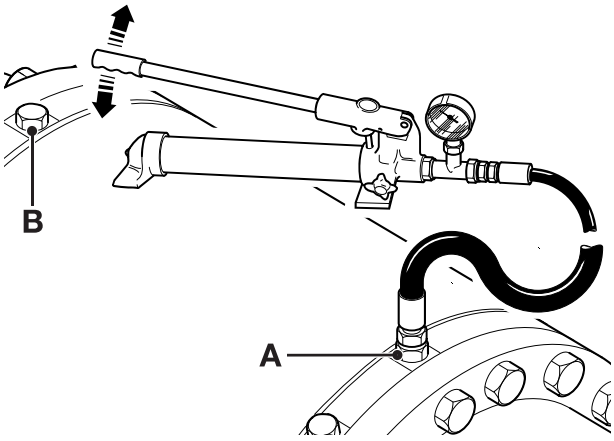

Fig 4.

b Use the hand pump to generate a pressure in the brake piston housing.

c If the pressure falls off rapidly, or if no pressure reading can be obtained, the seal is severely damaged and needs replacing with a new one.

d Repeat steps a to c at port **F**.

6 Re-instate the Brake System:

Reconnect all brake pipes and bleed the brake system. ⇒ ***Bleeding (G-18)***. Alternately, proceed to rear axle, if appropriate.

Rear Axle

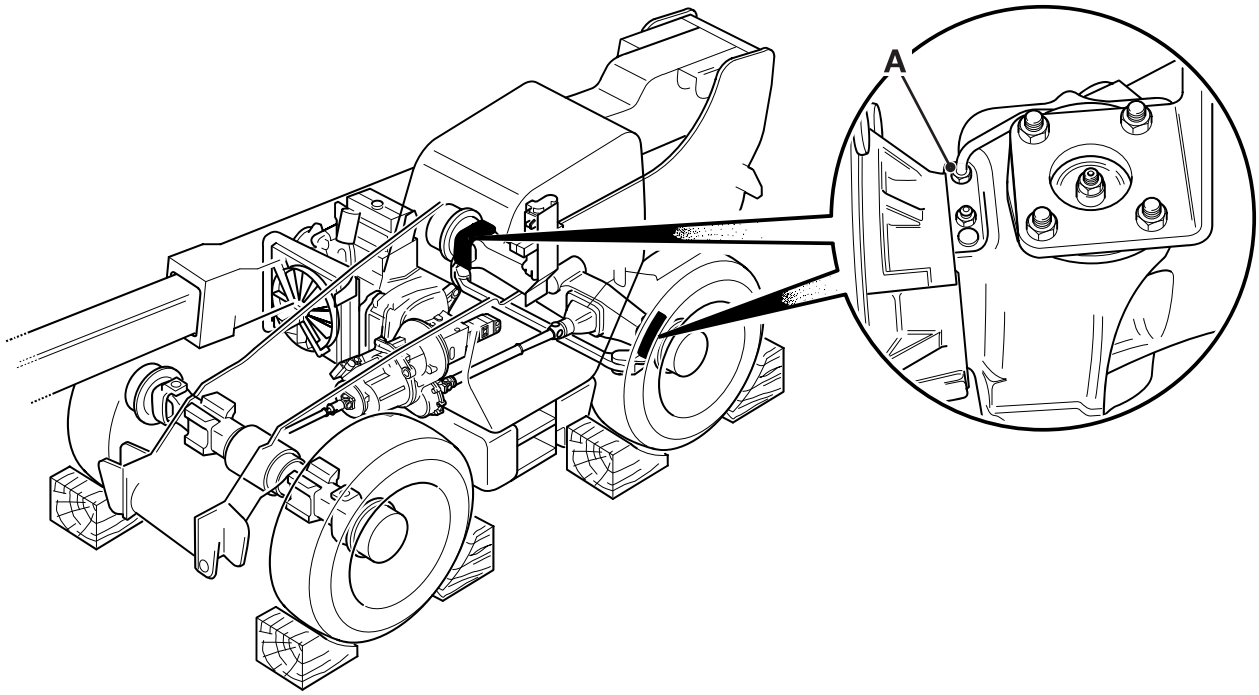

Fig 5.

1 Disconnect and cap brake piston feed pipe to port **5-H** on one hub.

2 Fill the brake piston housing with JCB Light Hydraulic Fluid via port **5-H**.

3 ⇨ *Front Axle (G-10)*. Carry out steps 4 (a to d) and 5 (a to c), this time attaching the hand pump or the clear plastic tube to port **5-H**.

4 Repeat steps 1 to 3 on the opposite hub.

5 Reconnect all brake pipes and bleed the brake system. ⇨ *Bleeding (G-18)*.

Parking Brake Switch

Adjustment

1 Select the starter switch to the ON position, do not start the engine.

2 Select either forward or reverse.

3 Raise the handbrake to the ON position.

4 Screw the parking brake switch **6-A** in a clockwise direction until the audible alarm sounds and the visual warning is illuminated.

5 Screw the switch a further half turn and lock switch **6-A** in position with lock nut **6-B**.

6 Release the parking brake and the audible alarm should cease and the visual alarm extinguish.

7 For adjustment of the Parking Brake, see ***Parking Brake***, Section G.

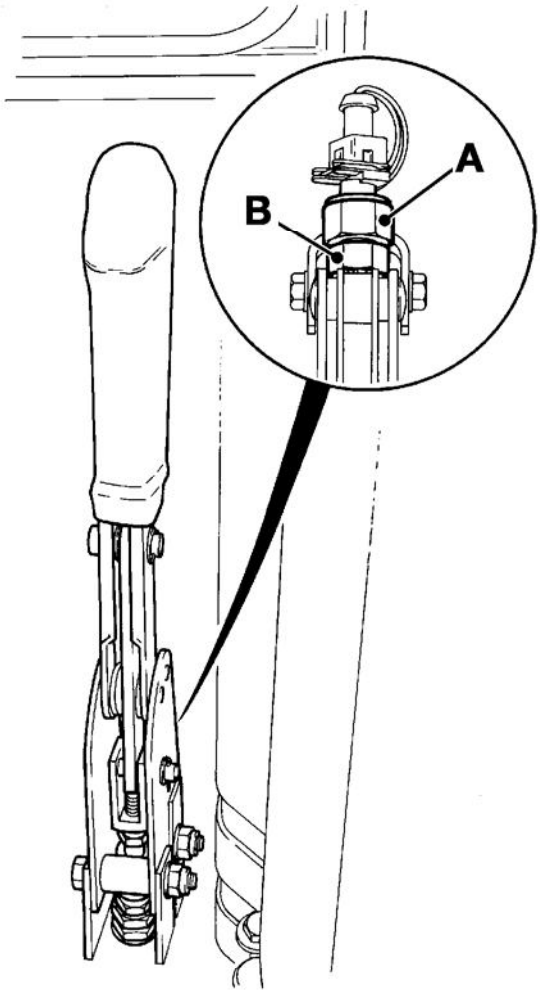

Fig 6.

Master Cylinder

Removal and Replacement

Removal

Note: *The master cylinder is not serviceable and must be renewed if faulty.*

1 Remove clevis pin **7-A** to disconnect the master cylinder operating rod from the brake pedal mechanism.

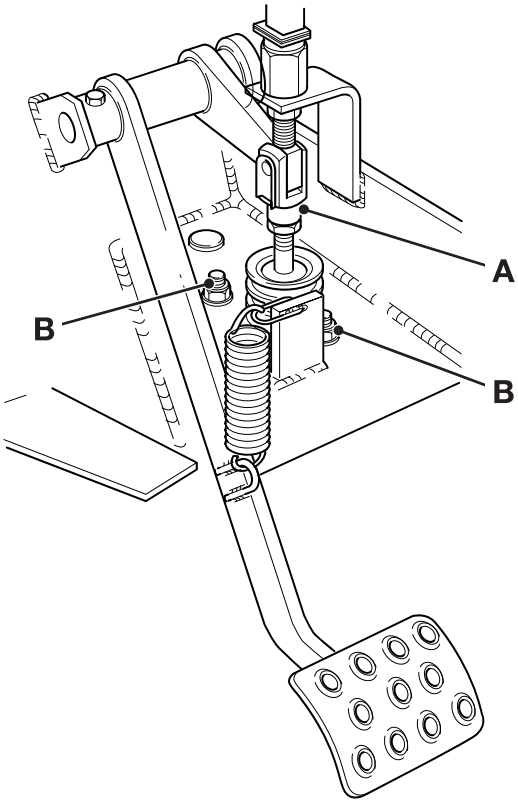

Fig 7.

2 Disconnect plastic feed pipe **8-A** from the brake fluid reservoir and either blank off the pipe or drain the reservoir.

3 Disconnect the master cylinder output hose **8-B**. Plug the cylinder port and blank off the hose (or pipe) to prevent ingress of dirt.

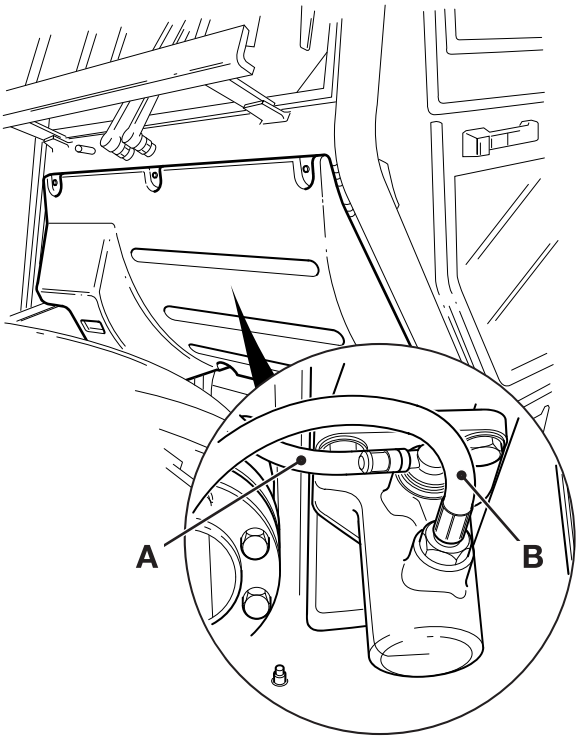

Fig 8.

4 Remove screws **7-B** and lift the master cylinder clear of the machine.

Replacement

Replacement is the reverse of removal.

Once the master cylinder is installed and the pipework connected check the brake fluid reservoir (see ***Checking the Brake Fluid Level***, Section 3) and then bleed the brake system. ⇨ ***Bleeding (G-18)***.

Servo Unit

Removal and Replacement

Machines with SD55, SD70 Axles

⇨ *Machines with SD55, SD70 Axles (G-1)*

Removal

1 Disconnect servo vacuum hose **9-A**.

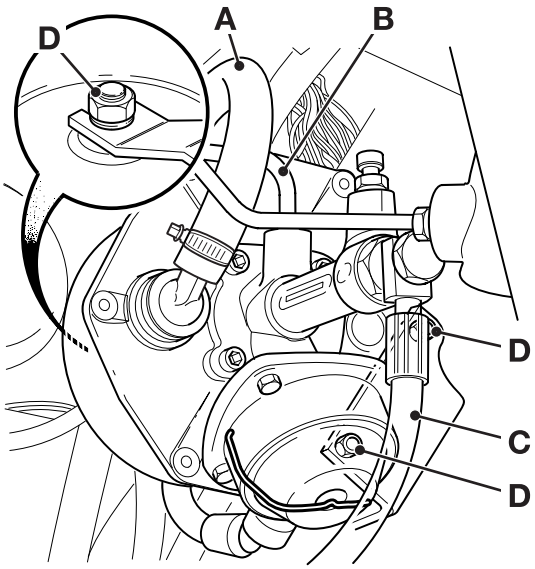

Fig 9.

2 Disconnect and blank off master cylinder output pipe **9-B**. Plug the cylinder port.

3 Disconnect cylinder output hose **9-C**. Blank off the hose and plug the cylinder port.

4 Loosen the three securing nuts **9-D** and slide the servo unit out of its mounting bracket.

Replacement

Replacement is the reverse of Removal.

Once the servo unit is installed and the pipework connected, check the brake fluid reservoir (see ***Checking the Brake Fluid Level***, Section 3) and then bleed the brake system. ⇨ *Bleeding (G-18)*.

Machines with SD80 Axles

⇨ *Machines with SD80 Axles (G-3)*

Removal

1 Disconnect servo vacuum hose **10-A**.

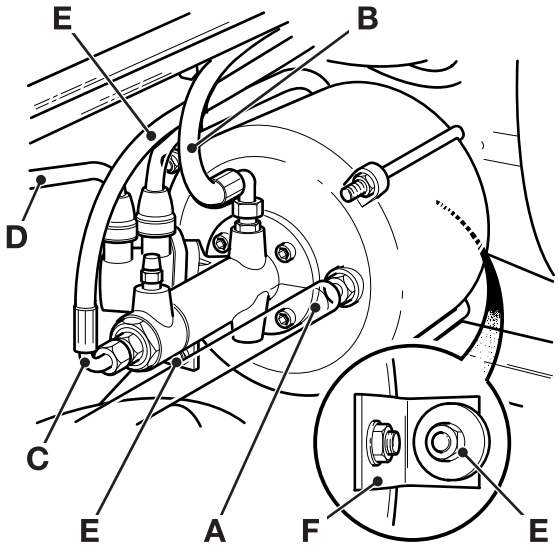

Fig 10.

2 Disconnect and blank off master cylinder hose **10-B**. Plug the cylinder port.

3 Disconnect cylinder output hose **10-C**. Blank off the hose and plug the cylinder port.

4 Disconnect servo breather hose **10-D**.

5 Remove the three securing nuts **10-E** and lift the servo unit complete with the rear mounting bracket **10-F**, from it's front mounting bracket.

Replacement

Replacement is the reverse of Removal..

Once the servo unit is installed and the pipework connected, check the brake fluid reservoir (see ***Checking the Brake Fluid Level***, Section 3) and then bleed the brake system. ⇨ *Bleeding (G-18)*.

Service Brakes

Dismantling and Assembly

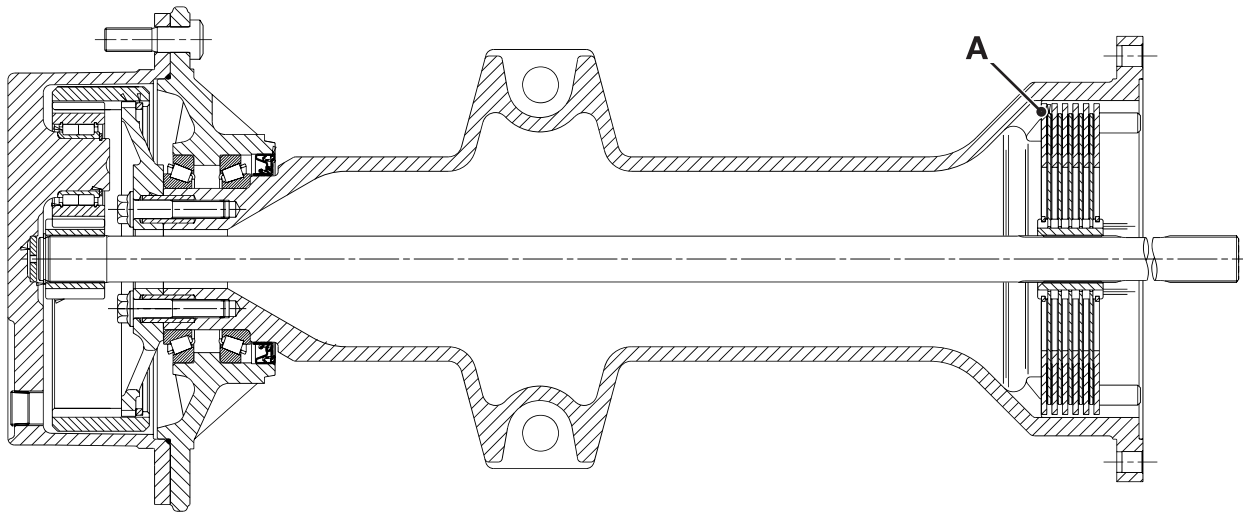

Fig 11.

The service brakes are located in the front axle, as shown at **11-A**. The procedures for dismantling and assembly are described in a separate publication, see ***Transmissions Service Manual*** (Publication No. 9803-8610) which includes procedures for the axle sub-assemblies.

Bleeding

Machines with SD55, SD70 Axles

⇨ *Machines with SD55, SD70 Axles (G-1)*.

⚠ 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

1 Fill the reservoir with correct fluid (see ***Lubricants and Capacities***, Section 3) and ensure that throughout the bleeding procedure the level is not allowed to fall below the MINIMUM mark.

⚠ WARNING

Use of incorrect fluid will cause serious damage to the seals which could in turn cause brake failure.

BRAK-1-1

2 Attach a tube to the appropriate bleed screw, ensuring that the free end of the tube is immersed in fluid in a suitable container.

3 Open the bleed screw and apply one rapid full stroke of the brake pedal followed by three rapid short strokes from the halfway pedal position. After the third short stroke, allow the pedal to return quickly to its stop.

4 Continue bleeding normally until all air is dispelled, closing the bleed screw with the pedal fully depressed.

5 Bleed the brake system, in the appropriate sequence, as follows:

- **a** Machines without servo brakes - Bleed at point **12-A** on the front axle.
- **b** Machines with servo brakes - Bleed in turn at point **13-A** on the servo unit and point **12-A** on the front axle.

6 Top up reservoir to the full mark.

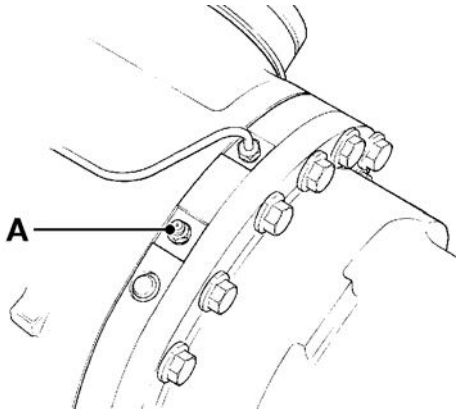

Fig 12. Front Axle

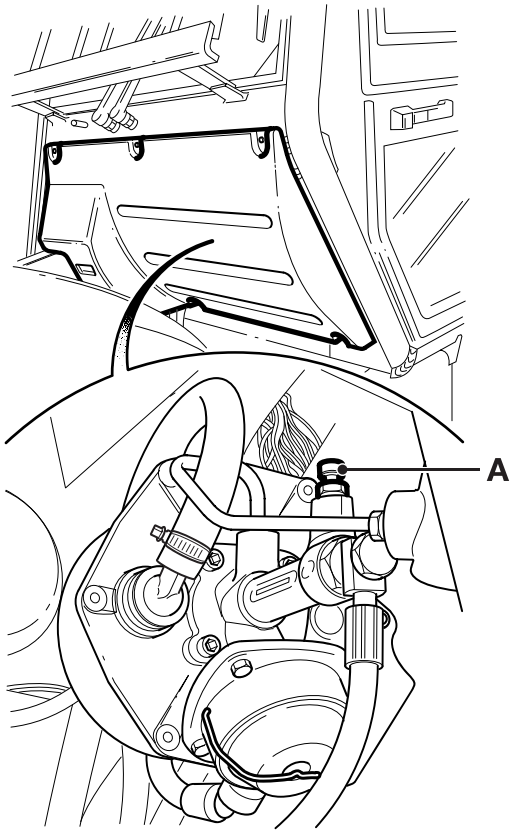

Fig 13.

Machines with SD80 Axles

⇨ *Machines with SD80 Axles (G-3)*

Machine up to S/N 771405

⚠ 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

Fill the reservoir with correct fluid (see ***Lubricants and Capacities***, Section 3) and ensure that throughout the bleeding procedure the level is not allowed to fall below the MINIMUM mark.

⚠ WARNING

Use of incorrect fluid will cause serious damage to the seals which could in turn cause brake failure.

BRAK-1-1

1 Position the machine on firm level ground. Apply the parking brake.

2 Fully retract the boom. Raise the boom and fit the safety strut. Switch off the engine and remove the key. Carefully remove the hydraulic tank filler cap and operate the controls to vent residual pressure.

3 Remove the plastic cover from the front of the cab.

4 Remove the bleed nipple and steel ball from the servo and fit a pressure test adaptor (45/914800), if not already fitted. Using hose **14-A** (611/23600), with pressure test probes (892/00706) fitted each end, connect the test adaptor on the remote servo to the test adaptor on the main hydraulic pump, as shown.

5 Remove the brake reservoir cap inside the cab.

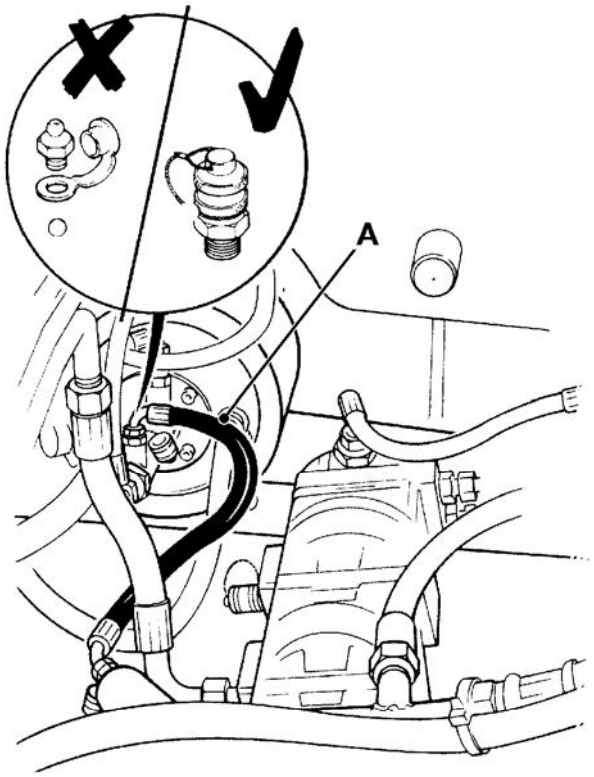

Fig 14.

6 If test adaptor **15-A** is fitted, a length of hose and a pressure test probe can be used to bleed the fluid from this point. If the adaptor is not fitted, unscrew union **15-B** on the master cylinder a maximum of two turns. Do not unscrew completely.

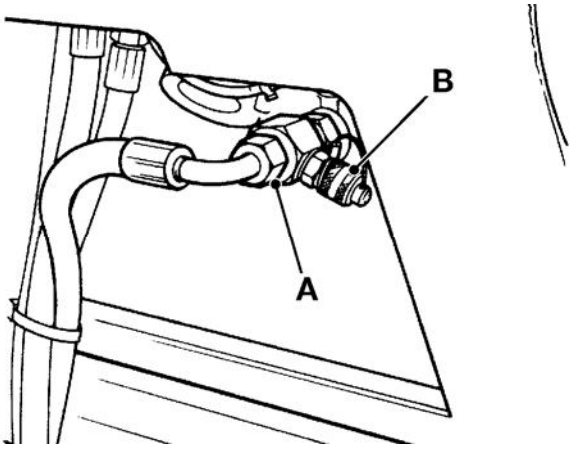

Fig 15.

7 Start the engine and operate at idle speed:

a Do not operate any hydraulic service

b Do not increase the engine speed

8 Using a suitable container, allow oil to escape from union **15-B** until all the air is removed. Re-tighten the union.

Oil will now fill the brake reservoir.

9 Depress the brake pedal when the fluid level reaches the MAX mark on the reservoir, and wedge the pedal in the down position using a suitable block.

10 Connect a clear plastic tube to bleed screw **16-A** on the front axle. Allow fluid to bleed into a suitable container until all the air is removed. Tighten the bleed screw.

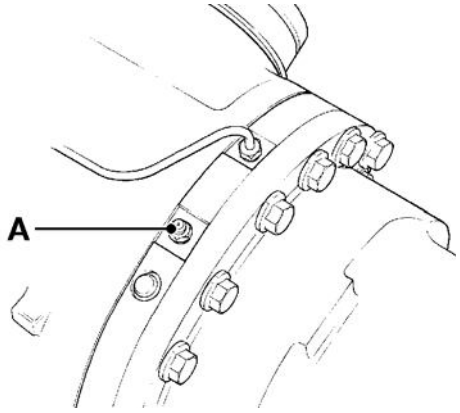

Fig 16. Front Axle

11 Connect a clear plastic tube to the left hand hub bleed screw **17-A** on the rear axle. Allow the fluid to bleed into a suitable container until all the air is removed. Tighten the bleed screw. Repeat the procedure for the right hand hub.

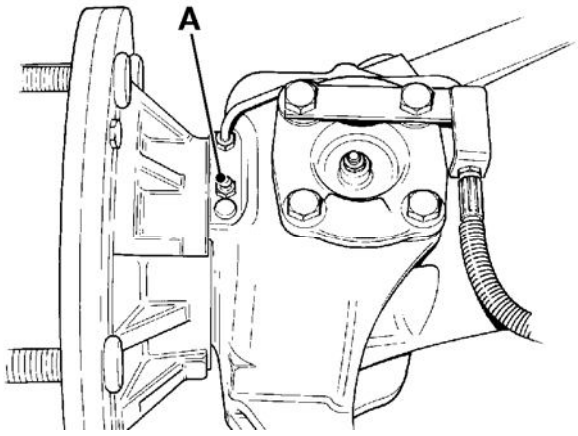

Fig 17. Rear Axle

12 Switch OFF the engine and remove the hose connecting the remote servo to the hydraulic pump and replace the test adaptor caps.

13 Remove the block from the brake pedal and refit the reservoir cap and cab front cover.

14 Check the oil level in the hydraulic tank and top up if required.

15 Check the brakes operate correctly before putting the machine back into service.

Machine from S/N 771406

⚠ 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

Fill the reservoir with correct fluid (see ***Lubricants and Capacities***, Section 3) and ensure that throughout the bleeding procedure the level is not allowed to fall below the MINIMUM mark.

⚠ WARNING

Use of incorrect fluid will cause serious damage to the seals which could in turn cause brake failure.

BRAK-1-1

1 Attach a tube to the appropriate bleed screw, ensuring that the free end of the tube is immersed in fluid in a suitable container.

2 Open the bleed screw and apply one rapid full stroke of the brake pedal followed by three rapid short strokes from the halfway pedal position. After the third short stroke, allow the pedal to return quickly to its stop.

3 Continue bleeding normally until all air is dispelled, closing the bleed screw with the pedal fully depressed.

4 Bleed the brake system, in the appropriate sequence, as follows:

Bleed in turn at point **18-A** on the servo unit, point **19-A** on the front axle and point **20-A** on the rear axle (first left side, then right side).

5 Top up reservoir to the full mark.

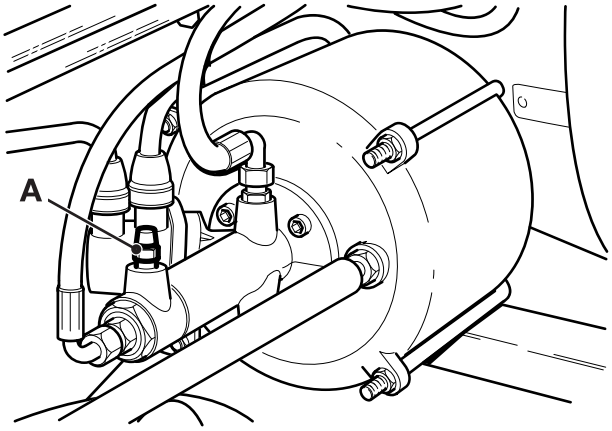

Fig 18. Servo Unit

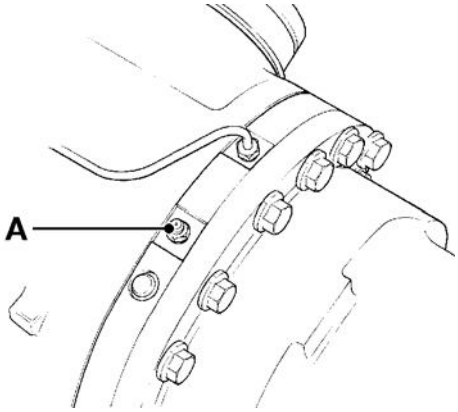

Fig 19. Front Axle

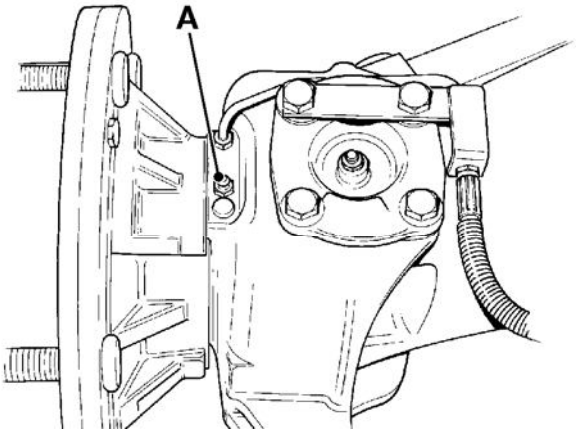

Fig 20. Rear Axle

Parking Brake

Applicability

Introduction

'Later' machines are fitted with a revised parking brake. Always confirm which parking brake is fitted to the machine before making any adjustments.

Early Machines

References made to 'Early' Machines, within this section refer to the following models:

- 530-70 upto Serial Number 772032
- 532-120 upto Serial Number 778686
- 537-135 upto Serial Number 778686
- 540-70 upto Serial Number 772032

Later Machines

References made to 'Later' Machines, within this section refer to the following models:

- 530-70 from Serial Number 772033
- 532-120 from Serial Number 778687
- 533-105
- 535-60
- 535-95
- 535-125
- 535-140
- 537-135 from Serial Number 778687
- 540-70 from Serial Number 772033
- 540-140
- 540-170

Early Machines

Renewing the Brake Pads

1 Make the machine safe

⚠ 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

2 Disengage the parking brake lever, (lever horizontal). Turn handle grip to bring pin central in its slot. ⇨ *Fig 21. (G-23)*.

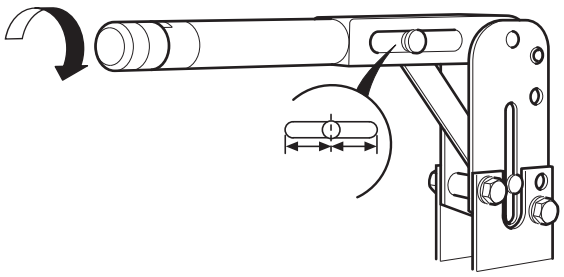

Fig 21.

3 Release the parking brake cable **22-A**.

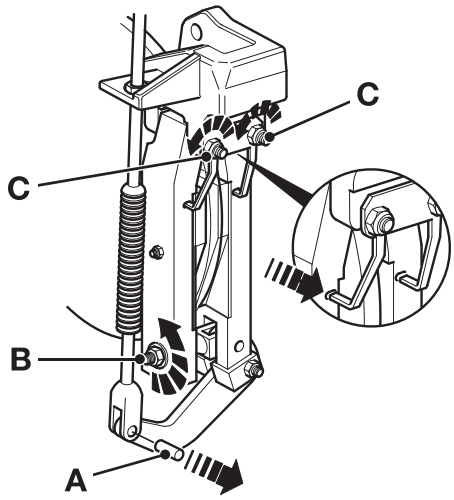

Fig 22.

4 Remove the caliper adjuster **22-B**.

5 Release nut/bolts **22-C** sufficiently to disengage spring from callipers.

6 Undo and discard brake pad retaining nuts **23-A**.

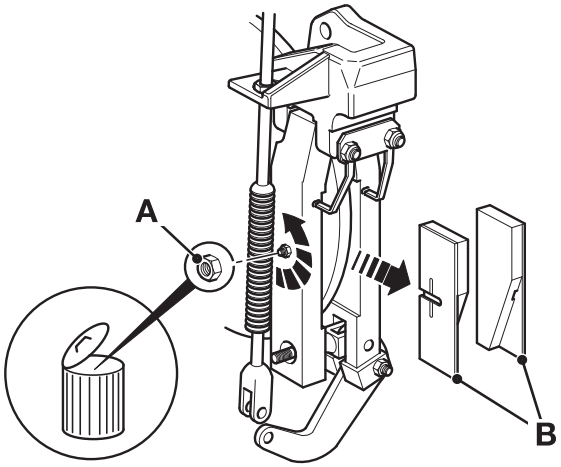

Fig 23.

7 Remove both brake pads **23-B**.

8 Pull brake calipers apart **24-A**.

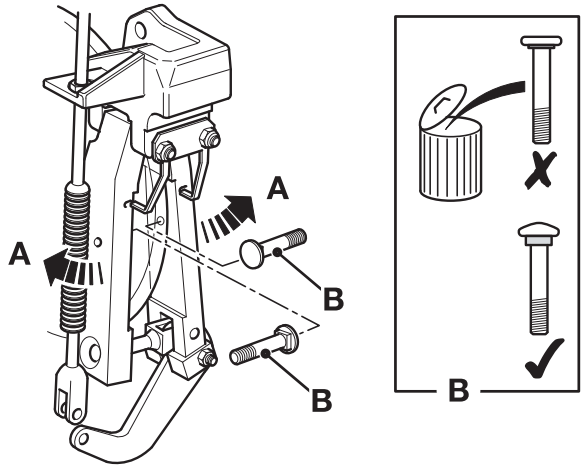

Fig 24.

9 Remove and discard brake retaining bolts **24-B**, fit new bolts.

10 Fit new brake pads **25-A**.

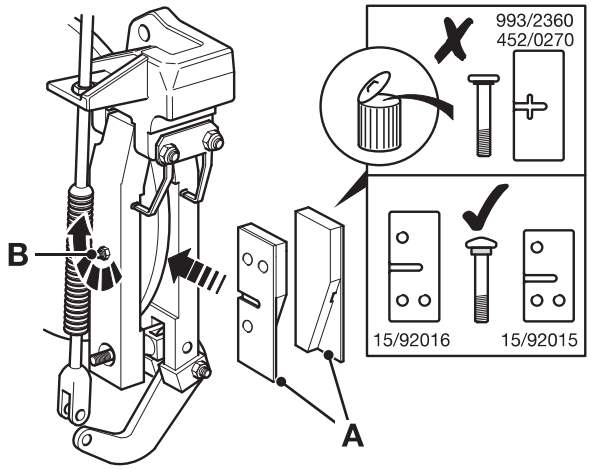

Fig 25.

11 Fit and tighten brake pad retaining nuts **25-B** to 6Nm (4.4 lbf ft).

12 Engage spring in brake calipers and tighten bolts **26-A** so that the calipers move freely (14Nm, 10.3lbf ft).

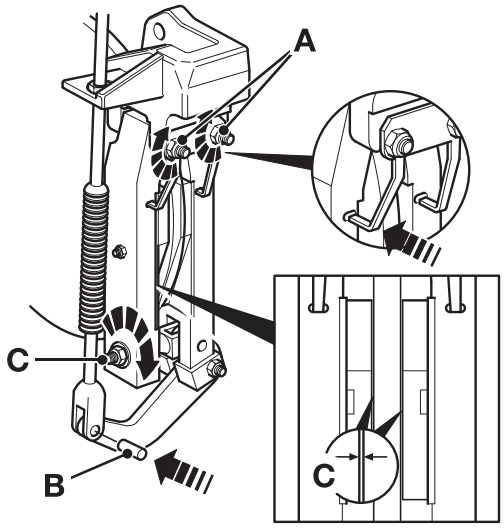

Fig 26.

13 Reconnect brake cable **26-A**.

14 Fit adjuster **26-C** and tighten until the pads just touch the brake disc with the parking brake lever disengaged (lever horizontal).

15 Test the parking brake. ⇨ *Testing (G-27)*.

Dismantling and Assembly

Dismantling

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

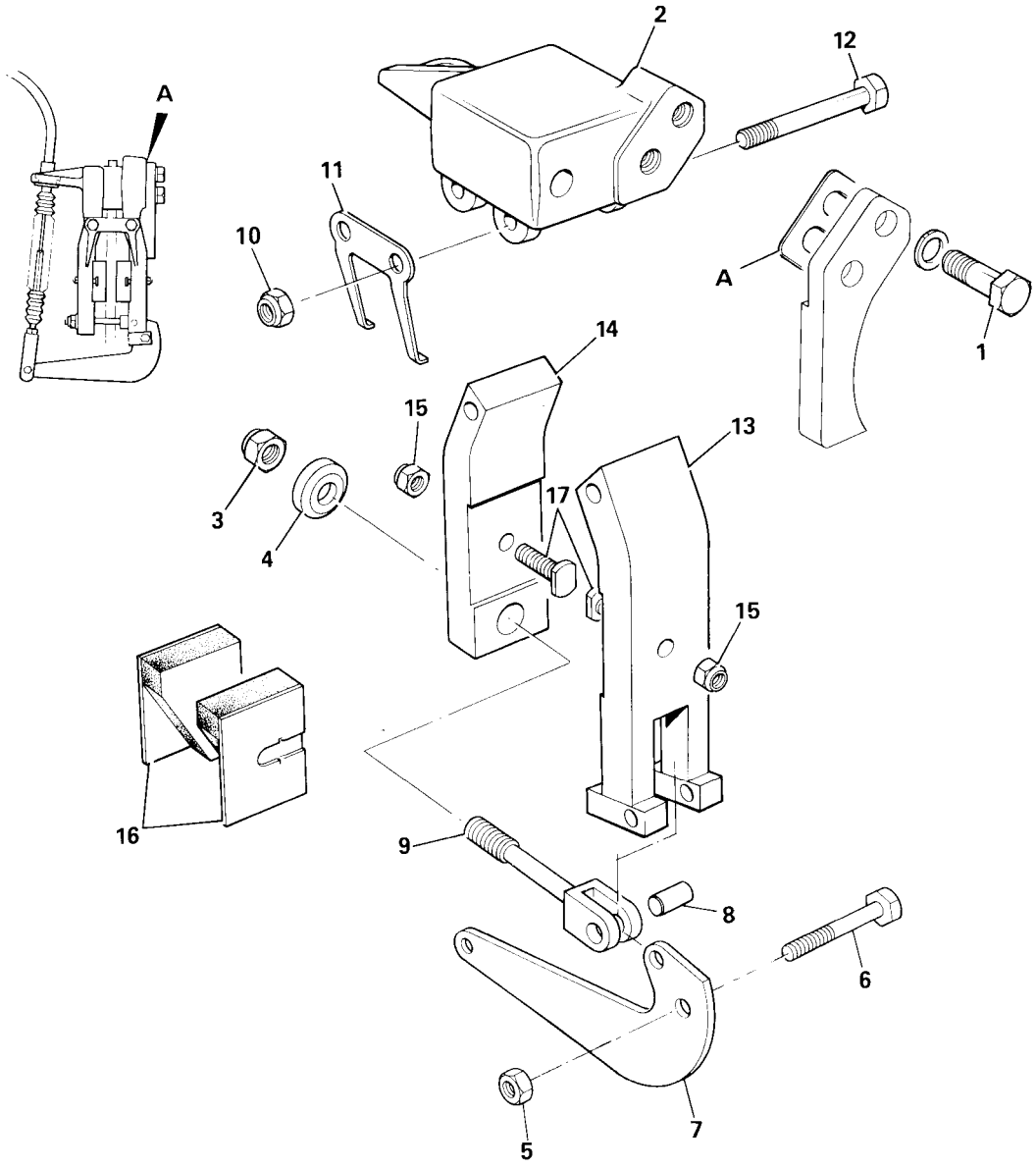

Fig 27.

Assembly

Assembly is the reverse of Dismantling. ⇨ *Dismantling (G-25)*.

Note: *Apply JCB Threadlocker and Sealer to mounting bolts* ***27-1*** *before fitting.*

Fit shims **27-A** as necessary to align the caliper **27-2** centreline to within +/- 0.5 mm (0.020 in) of the brake disc centreline.

Renew the pads if the thickness of the friction material is 3mm (0.125in) or less.

Lightly grease all pivots and working surfaces, taking care not to allow grease to contact the brake pads.

Tighten nut **27-5** sufficiently to allow lever **27-7** to move freely with minimum side clearance.

Table 11. Torque Settings

Item	Nm	kgf m	lbf ft
27-1	118	12.0	87
27-10	20	2.0	15
27-15	6	0.6	4.4

Testing and Adjustment

Testing

Important: *Ensure all routine health and safety precautions are observed before operating machines.*

⚠ WARNING

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

2-2-4-5

1 Enter the machine. Fasten your seat belt (if fitted) and park the machine on a level dry surface.

2 Fully apply parking brake **28-1**.

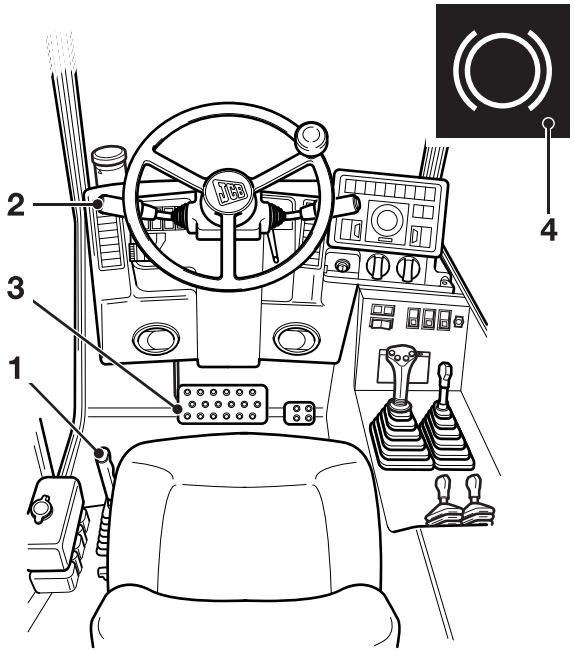

Fig 28.

3 Start the engine and raise the attachments to the appropriate travelling position.

4 Select fourth gear **28-2**.

5 Push down hard on foot brake pedal **28-3**.

6 Select forward drive **28-2**.

⚠ 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 Test the parking brake as follows:

a Move the parking brake lever fractionally forward until the warning light **28-4** is just extinguished.

b Slowly release the foot brake pedal **28-3**.

c If the machine has not moved, use the accelerator to gradually increase the engine speed to approximately 1500 RPM. The machine should not move.

d Do not do this test for longer than 20 seconds.

e Reduce engine speed to idle and select neutral **28-2**.

f Return park brake lever **28-1** to the fully on position from its partially applied position.

g Lower attachments and stop the engine.

h If the machine moved during the test, adjust the parking brake and repeat the test. Be sure to use the correct adjustment procedure for the applicable machine. ⇨ *Applicability (G-22)*.

⚠ 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

Adjustment

Important: *Later machines are fitted with a revised parking brake. Always confirm which parking brake is fitted to the machine before making any adjustment.* ⇨ *Applicability (G-22)*.

CAUTION

The parking brake must not be used to slow the machine from travelling speed, except in an emergency, otherwise the efficiency of the brake will be reduced. Whenever the parking brake has been used in an emergency, always renew both brake pads.

4-2-1-1_2

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

The parking brake should be fully engaged when the lever is vertical. The parking brake indicator light should light when the brake is engaged with the forward/reverse lever away from neutral (starter switch at IGN).

WARNING

Over adjustment of the park brake could result in the park brake not fully releasing.

0011

1 Check and Adjust the Pad Position

Measure the pad thickness. If the friction material **29-A** is 3 mm (0.125 in) or less, always fit a new set of pads. Check that the pads just touch the disc, shown at **29-B**, with the parking brake disengaged (lever horizontal).

If necessary, adjust the pad position by turning nut **29-C**. Turn the nut clockwise to close the pads onto the disc.

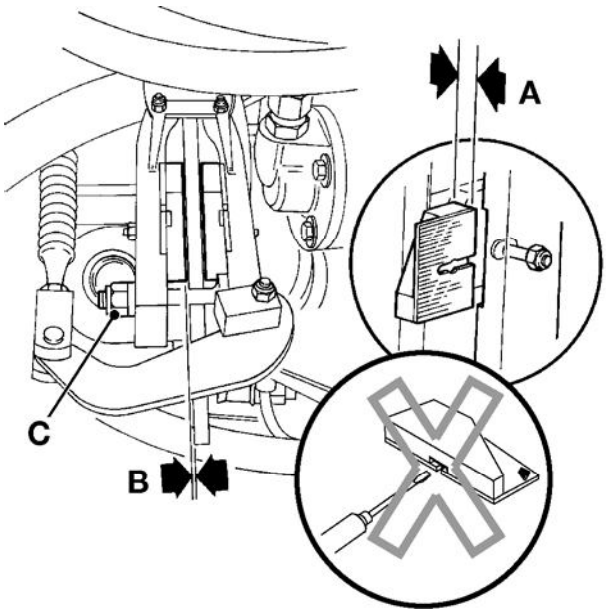

Fig 29.

2 Take Up the Cable Slack

a Disengage the parking brake (lever horizontal).

b Turn handle grip **29-A** clockwise, half a turn.

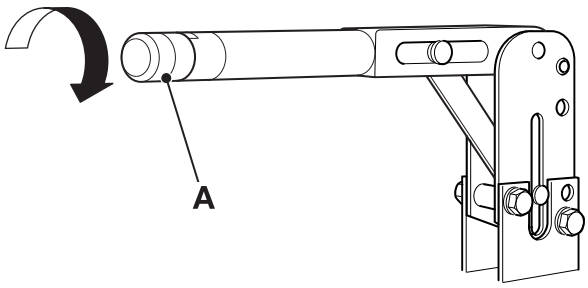

Fig 30.

c Test the parking brake. ⇨ *Testing (G-27)*.

d If the brake fails the test, repeat Step 2.

Later Machines

Brake Caliper

Removal and Replacement

⚠ WARNING

This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.

Installation and mounting of the park brake caliper requires tightening of the mounting bolts to a specific torque figure. Do not attempt to do this job unless you have the correct tools available.

0010

⚠ WARNING

Before working on the parking brake, park on level ground and put chocks on each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK-8-8

⚠ WARNING

Brake pads generate dust which if inhaled, may endanger health. Wash off the caliper assemblies before commencing work. Clean hands thoroughly after work.

13-3-1-3

Removal

1 Release the parking brake lever (lever horizontal).

2 Note which hole in the operating lever clevis **31-A** is attached to and disconnect the clevis.

3 Remove clip **31-B** and disconnect the cable from the bracket.

4 Support the caliper and remove the two mounting bolts and hardened washers **31-C**. Lift the caliper clear of the brake disc.

Note: *Do not remove transmission mounting bracket **31-D** unless it needs to be renewed.*

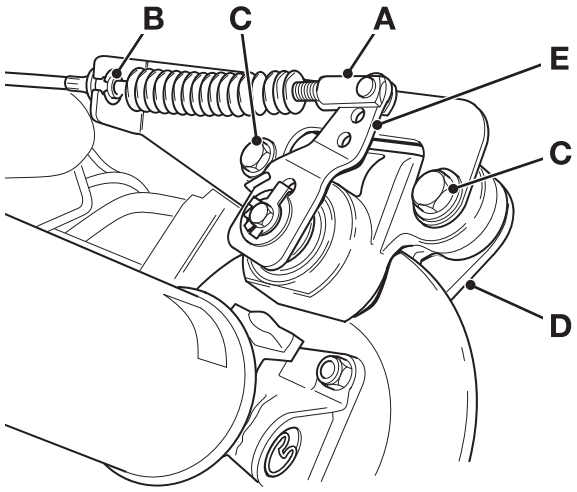

Fig 31.

Inspection

⚠ WARNING

Oil on the brake disc will reduce brake effectiveness. Keep oil away from the brake disc. Remove any oil from the disc with a suitable solvent. Read and understand the solvent manufacturer's safety instructions. If the pads are oily, new ones must be fitted.

2-3-2-3_3

1 Check the thickness of the friction material on the two brake pads. Renew both brake pads if the thickness of friction material is below 1mm (0.04 in) on either pad.

2 Check the condition of the disc surface. Renew the disc if badly warped, pitted or worn.

3 Renew the cable if worn or damaged.

Replacement

Replacement is the reverse of Removal.

⇨ *Component Identification (G-32)*.

1 If transmission mounting plate **31-D** has been removed, secure in place using three new verbus rip bolts. These bolts can only be used once. ⇨ *Torque Figures (G-31)*.

If the mounting plate has not been removed, check the retaining bolts are tightened as above before proceeding further.

Later machines are fitted with an improved transmission mounting plate which cannot be removed with the brake disc in place. ⇨ *Torque Figures (G-31)*.

2 Fit lever side pad **33-2**. Position the pad on the face of the rotor **33-9** and carefully press in place on the plastic clip in the centre of the rotor.

3 Fit carrier side pad **33-1**. Add a small amount of silicon sealant to the back outer edge of the backing plate to hold the pad in place within the housing.

4 Replace the caliper. Fit new mounting bolts **31-C** with hardened washers and tighten to 255 Nm (188 lbf ft).

5 Make sure floating parts move freely and that all other parts are mounted securely. Tighten all mounting bolts to the recommended torque figures. ⇨ *Torque Figures (G-31)*.

6 Attach the cable to the mounting bracket and secure in place with clip **31-B**.

7 Refit the clevis to the relevant hole in the operating lever as follows:

Top Hole - Attach the cable to the top hole of the operating lever only if the cable is fitted with adjusting nuts under the cab.

Middle Hole - Attach the cable to the middle hole of the operating lever if the cable is not fitted with adjusting nuts under the cab.

8 Make sure there is adequate freedom of movement of operating lever **31-E** to ensure a positive brake application, and that the lever returns to the rest position when the parking brake is released.

9 Adjust the parking brake. ⇨ *Adjustment (G-36)*. Never unscrew the clevis to adjust the cable.

Renewing the Brake Pads

⇨ *Component Identification (G-32)*.

1 Press carrier side pad **33-1** into housing **33-15** and remove. Ensure any residual silicone used for pad retention during assembly is removed.

2 Carefully lever side pad **33-2** from the rotor **33-9** using a flat blade screwdriver. Take care to prevent damage to the plastic clip in the centre of the rotor.

Torque Figures

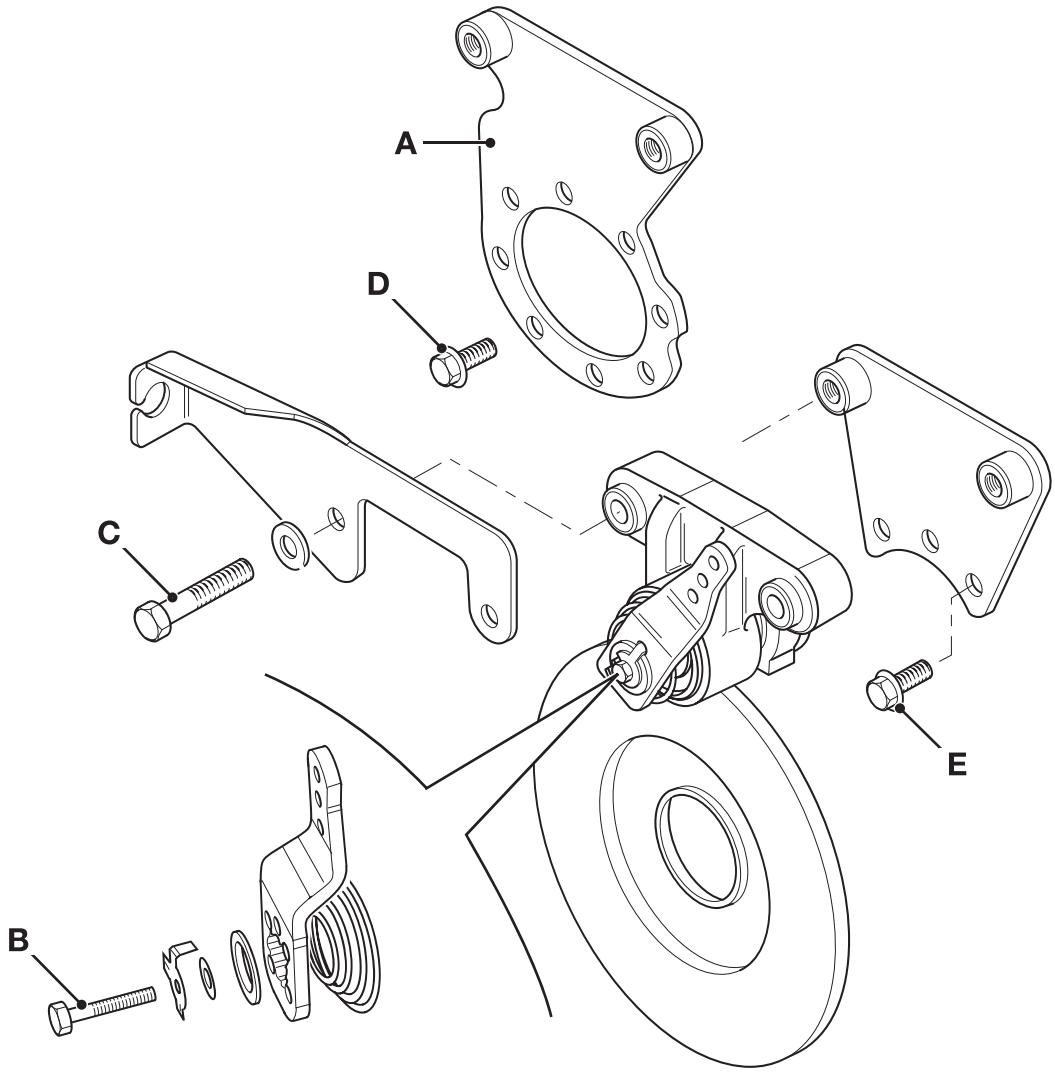

Fig 32. Typical Installation

Where appropriate, the grade of bolt (eg. 10.9) is indicated. ⇨ *Table 12. Torque Settings (G-31)*. Refer also to relevant dismantling and assembly procedures.

Note: *Later transmission casings are fitted with improved mounting bracket* ***32-A****. Make sure the bolts securing the bracket are tightened to the correct torque figure shown.*

Table 12. Torque Settings

Item	Grade	Nm	lbf ft
32-B		13-16	9-12
32-C	10.9	255	188
32-D(1)	12.9	166	122
32-E(1)		85	63

(1) Always use new bolts.

Dismantle, Inspection And Assemble

⚠ WARNING

This is a safety critical installation. Do not attempt to do this procedure unless you are skilled and competent to do so.

Installation and mounting of the park brake caliper requires tightening of the mounting bolts to a specific torque figure. Do not attempt to do this job unless you have the correct tools available.

0010

⚠ WARNING

Before working on the parking brake, park on level ground and put chocks on each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK-8-8

⚠ WARNING

Brake pads generate dust which if inhaled, may endanger health. Wash off the caliper assemblies before commencing work. Clean hands thoroughly after work.

13-3-1-3

The internal components of the brake caliper may differ. Where it is necessary to differentiate between the two designs, references will be made to ‘Type 1’ and ‘Type 2.’

Always confirm which parking brake is fitted to the machine before making any adjustments. ⇨ *Component Identification (G-32)*.

Component Identification

⇨ *Fig 33. (G-33)*.

33-1	Carrier Side Pad
33-2	Lever Side Pad
33-3	Screw (Type 2)
33-3A	Bolt (Type 1)
33-4	Washer
33-5	Washer
33-6	Lever
33-7	Spring
33-8	Rotor
33-9	Ball Spacer
33-10	Ball Bearings
33-11	Mounting Bushes (Type 2)
33-11A	Mounting Bushes (Type 1)
33-12	Dust seals (Type 2)
33-12A	O-ring (Type 1)
33-13	Rotor seal
33-14	Bearing ring
33-15	Housing
33-16	Shaft Seal
33-17	Anti-rotation clip (Type 1)

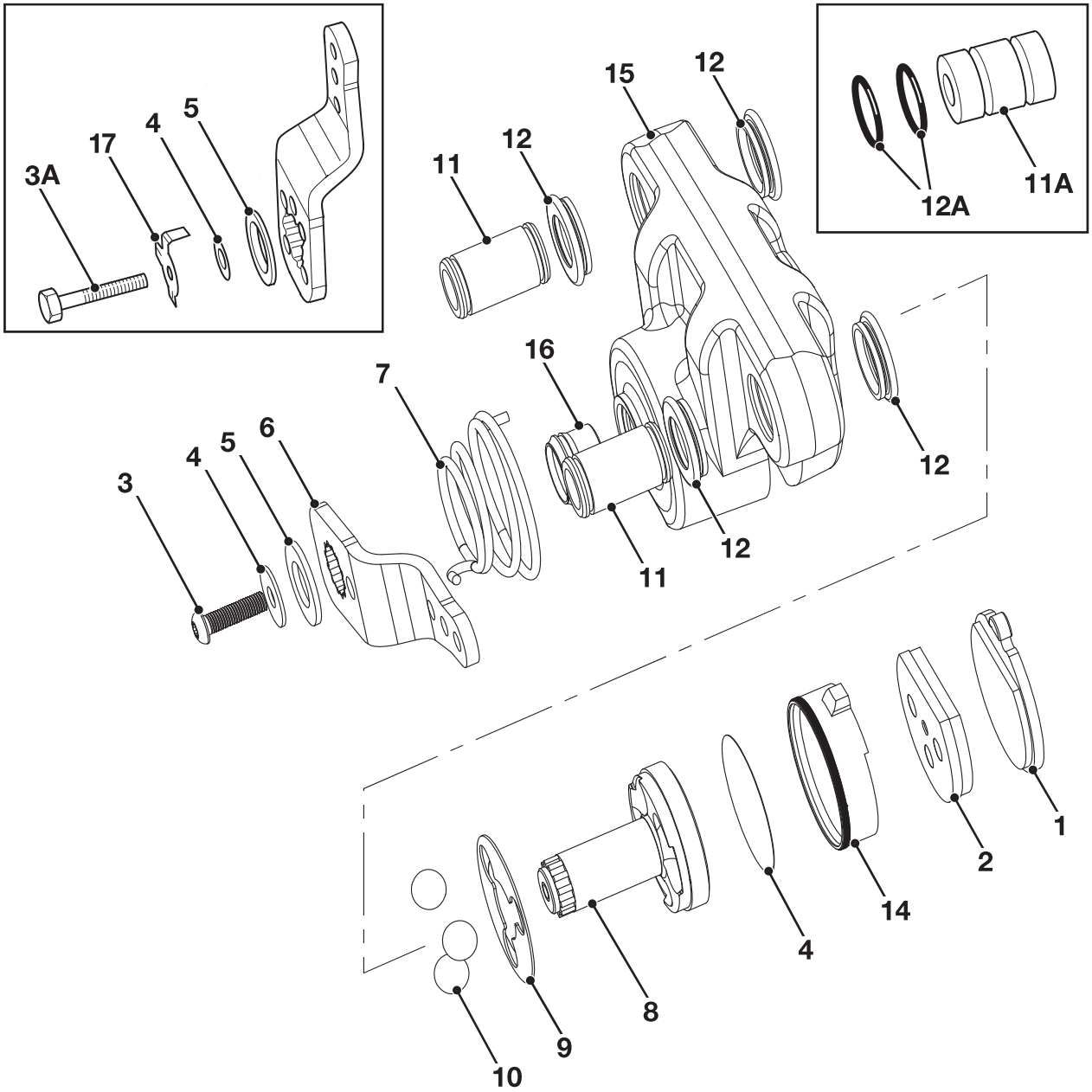

Fig 33. Park Brake Caliper

⇨ *Component Identification (G-32)*.

Dismantle

A numerical sequence, intended as a guide to dismantling, is provided. ⇨ *Fig 33. (G-33)*.

1 Remove the caliper and brake pads. See ⇨ *Removal (G-29)*.

2 Type 1 - Bend the tabs on anti-rotation clip **33-16**. Remove bolt **33-3A**, anti-rotation clip **33-16** and washers **33-5** and **33-6**. Hold lever **33-6** against the tension of the spring as the bolt is removed.

Type 2 - Remove the screw **33-3**, and washers **33-4** and **33-5**. Hold lever **33-6** against the tension of the spring as the screw is removed.

3 Note the position of lever **33-6** relative to the splines of the shaft **33-8**. Mark the end of the shaft and lever **33-6** to aid assembly. Remove lever **33-6** and spring **33-7**.

4 Push out rotor **33-8** and remove ball spacer **33-9** and ball bearings **33-10**. Take care not to lose the ball bearings.

5 Type 1 - Push out mounting bushes **33-11** and remove dust seals **33-12**.

Type 2 - Push out mounting bushes **33-11A** and remove O-rings **33-12A**.

6 Remove the rotor seal **33-13** followed by bearing ring **33-14**. Note that the rotor seal may be located on the rotor shaft or may have been left in the calliper housing **33-15**.

Note: *Shaft seal **33-16** will not need to be renewed unless excessively worn or damaged. If removal is necessary, press the seal out from inside the housing using a suitable spacer block and bench press. Clean out any remains of the seal after removal.*

Inspection

1 Clean and dry all parts. Check all parts are free from excessive wear, damage or corrosion. Light scores or stains should be removed. Renew corroded or deeply scored parts.

2 Check rotor **33-8** for damage or distortion and renew if necessary.

3 Always renew both brake pads if the parking brake has been used in an emergency.

4 Check the ball pockets in housing **33-15** for signs of scoring, pitting, damage or corrosion. Renew the housing if damaged.

5 Check spring **33-7** is not broken or distorted.

6 Check the condition of the disc surface. Renew the disc if badly warped, pitted or worn.

Assemble

A numerical sequence, intended as a guide to assembling, is provided. ⇨ *Fig 33. (G-33)*.

Before assembly make sure all parts are clean and serviceable.

1 Fit a new shaft seal **33-16** if removed. Install the seal as shown. Press the seal into the housing using a suitable spacer block and bench press.

2 Coat the shaft and ball pockets of rotor **33-8** and the ball pockets of housing **33-15** with silicone grease.

3 Insert the three ball bearings **33-10** into the pockets in the housing **33-15**. Insert ball spacer **33-9**.

4 Coat the bearing ring **33-14** with silicone grease and fit the ring to the inner diameter on rotor seal **33-13**. Assemble the rotor seal to the rotor **33-8**.

5 Slide rotor **33-8** through the housing and seat the ball pockets against the bearings.

6 Position spring **33-7** over the shaft of rotor **33-8**. Insert the large diameter end of the spring into hole **34-A** in the face of the housing.

7 Locate the small diameter end of spring **33-7** around the outside edge of lever **33-6** as shown at **34-B**.

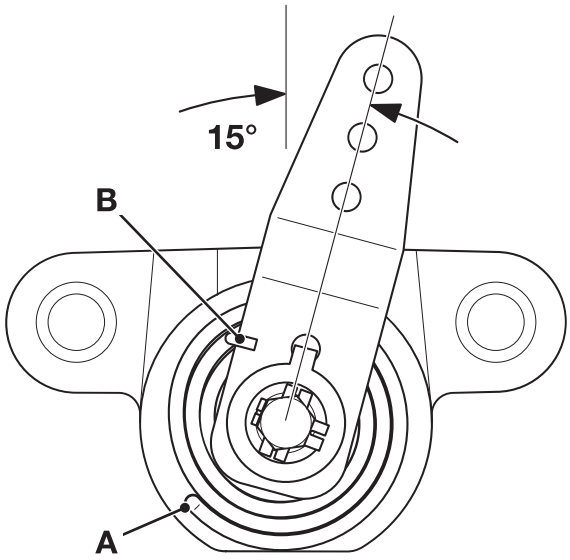

Fig 34.

8 Fit lever **33-6**. Align the lever to the mark made during dismantling. ⇨ *Fig 34. (G-35)*.

9 Type 1 - Hold the lever against the tension of the spring and fit washers **33-4** and **33-5**, and new anti-rotation clip **33-17**. Fit bolt **33-3A** and torque tighten.⇨ *Table 13. Torque Settings (G-35)*

Type 2 - Hold the lever against the tension of the spring and fit washers **33-4** and **33-5** Fit screw **33-3**and torque tighten. ⇨ *Table 13. Torque Settings (G-35)*.

10 Type 1 Only - Bend up a tab on the anti-rotation clip that aligns with one of the flats on the bolt.

11 Fit the new brake pads. ⇨ *Renewing the Brake Pads (G-30)*.

12 Type 1 - Lubricate the O-rings **33-12A** and bushes **33-11A** with silicone grease. Fit O-rings into the housing and insert mounting bushes. Wipe off any excess grease.

Type 2 - Lubricate the dust seals **33-12** and bushes **33-11** with silicone grease. Fit the dust seals to the housing and insert mounting bushes. Make sure that the dust seals locate in their location grooves on the bushes **33-11** and housing **33-15**. Wipe off any excess grease.

13 Before fitting the caliper, ensure the lever rotates smoothly and that the lever side pad **33-2** returns to the off position when the lever is released.

14 Refit the brake caliper. ⇨ *Replacement (G-30)*.

15 Adjust the parking brake. ⇨ *Adjustment (G-36)*.

Table 13. Torque Settings

Item	Nm	lbf ft
33-3 (Type 2)	13-16	9-12
33-3A (Type 1)	13-16	9-12

Testing and Adjustment

Testing

⇒ *Testing (G-27)*.

Adjustment

Lever Adjustment

The parking brake must be fully engaged when the lever is vertical. The parking brake indicator light must illuminate when the brake is engaged with the forward/reverse lever away from neutral (starter switch at IGN).

Later machines may be fitted with alternative parkbrake lever **35-A**. Squeeze the release lever under the hand grip and lower the parking brake forward to release.

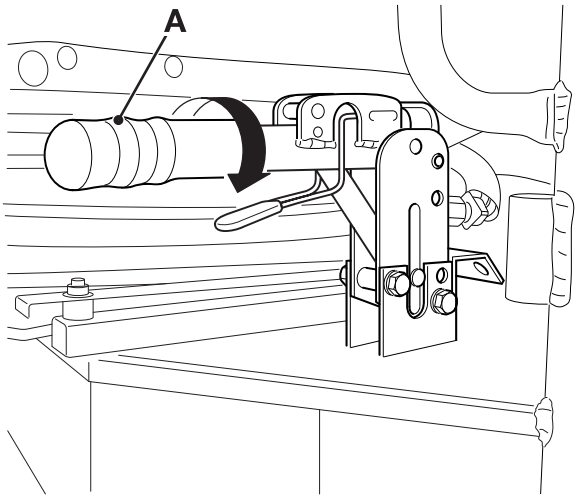

Fig 35.

1 Test the parking brake. ⇒ *Testing (G-27)*. Adjust the parking brake as described below if the machine moved during the test.

2 Release the parking brake (lever horizontal).

3 Turn hand grip **35-A** half a turn in the direction shown and re-test the brake.

4 If the brake fails the test, repeat Steps 2 and 3.

If there is insufficient adjustment using the parking brake lever. ⇒ *Cable Adjustment (G-36)*.

Cable Adjustment

WARNING

Before working on the parking brake, park on level ground and put chocks on each side of all four wheels. Stop the engine and disconnect the battery so that the engine cannot be started. If you do not take these precautions the machine could run over you.

BRAK-8-8

Renew the cable and check the pad thickness if adjusting nuts are not fitted. ⇒ *Brake Caliper (G-29)*.

Always renew a worn or damaged cable.

1 Disengage the parking brake (lever horizontal).

2 Set the handbrake lever mechanism to the centre of it's adjustment position:

a Early type park brake lever. ⇒ *Fig 36. (G-36)*.

Turn hand grip in direction shown to centre pin **36-A** in its slot.

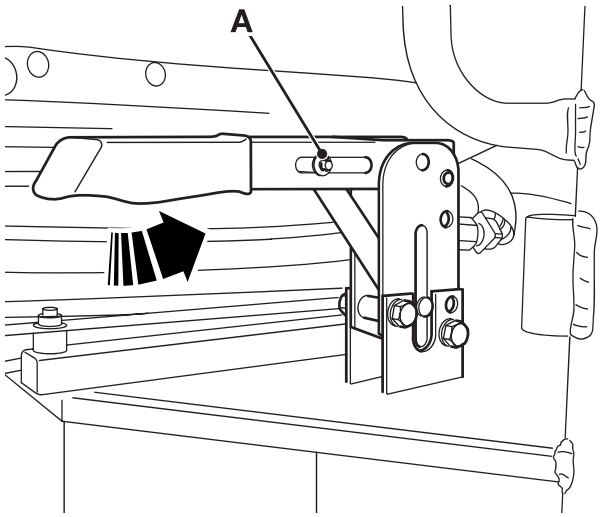

Fig 36. Early Type Park Brake Lever

b Later type park brake lever. ⇒ *Fig 37. (G-37)*:

i Release the parking brake.

ii Fully adjust the hand grip.

iii Turn the hand grip in the direction shown to position the mechanism at the centre of its adjustment (approximately 15 turns from the fully adjusted position).

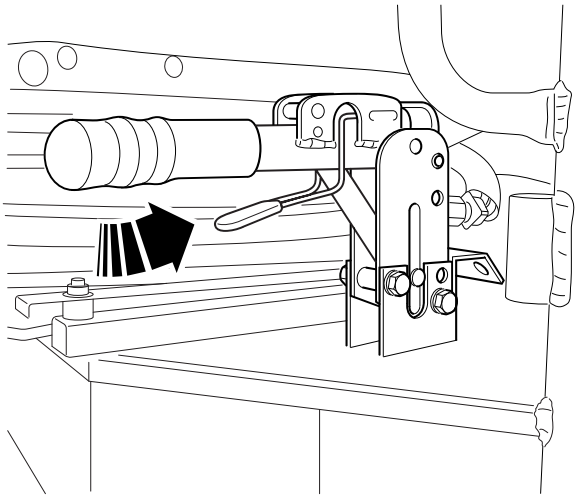

Fig 37. Later Type Park Brake Lever

3 Release the two locknuts at **38-A** and adjust the cable length as required. Renew both brake pads if there is insufficient adjustment at the cable. Renew the cable if there is still insufficient adjustment after new pads have been fitted.

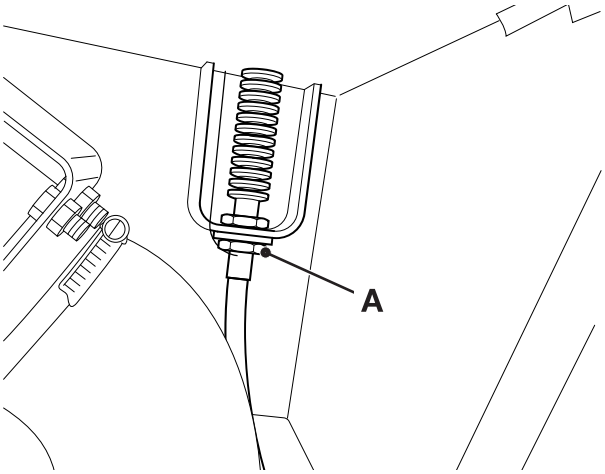

Fig 38.

4 Make sure there is adequate freedom of movement of operating lever **39-A** to ensure a positive brake application, and that the lever returns to the rest position when the parking brake is released.

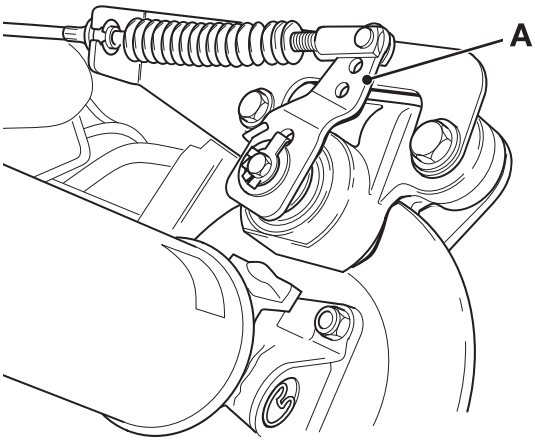

Fig 39.

Note: *If a new cable is fitted, position the threaded section of the cable with approximately four threads visible below the bottom adjusting nut.*

5 Test the parking brake. Make final adjustments at the park brake lever if the brake fails the test. ⇨ ***Lever Adjustment (*** ***G-36)*****.**

Axles

Axle Breather (Braked Axles)

Breathers are fitted to axles to relieve pressure build up, due to braking and prolonged roading.

If breathers are not kept clear, seal leakage and brake problems can result due to pressure build up. Most axles are fitted with long stem breather type **40-A**.

Ensure there is adequate clearance around the breather and if it should be dislodged or removed, ensure it is refitted with hole **40-C** pointing outwards towards the wheel.

The breather is always fitted on the opposite side to the crownwheel (in less turbulent oil) avoiding oil seepage.

Plug **40-B** is fitted in the crownwheel side.

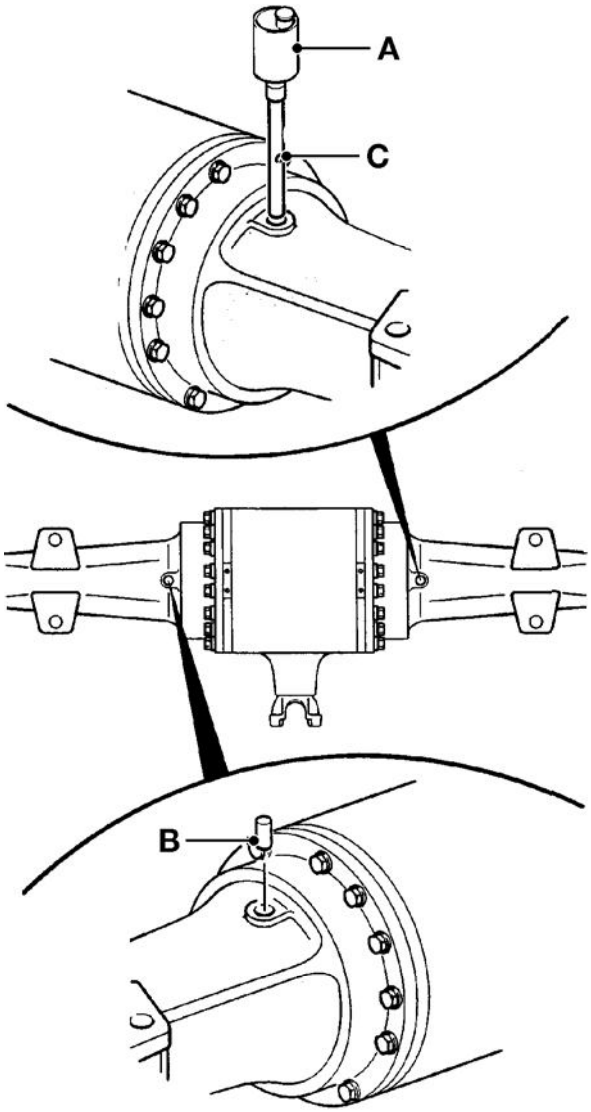

Fig 40.