BRITISH RAILWAYS - WESTERN REGION

INSTRUCTIONS AND INFORMATION FOR CARRIAGE AND WAGON EXAMINERS

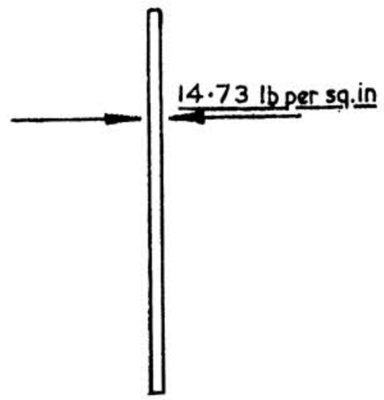
SECTION D

M. & E.E. Training School,
SWINDON

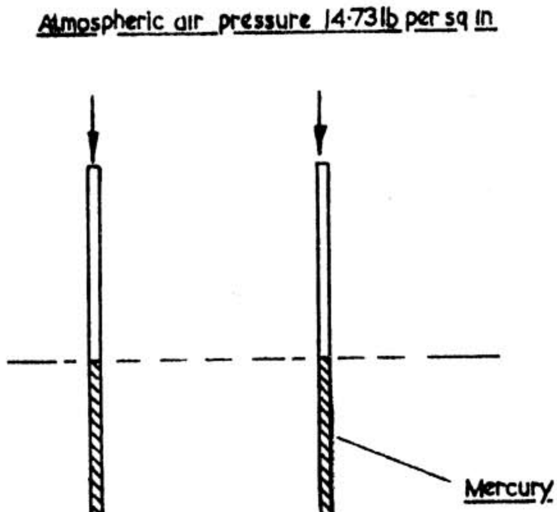
May 1979.
1st Edition.

The Automatic Vacuum Brake.

A vacuum is a space devoid of air pressure. Atmospheric air pressure is approximately 14.73 lbs per sq. in., but normally it is nullified as an effective pressure because it is in opposition to itself.



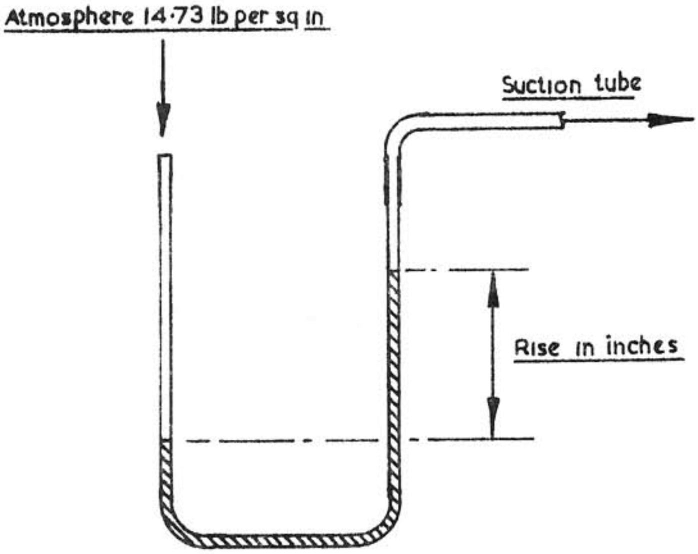
Under controlled conditions the atmospheric air pressure can become effective as a force. This can be demonstrated by a U-tube with mercury inside.



The mercury level is equal on both sides of the U-tube.

Attach a suction tube to one side of the U-tube and withdraw air (create a vacuum). The air pressure on the other side will exert pressure on the mercury and force it up the tube on the vacuum side, dependant upon the amount of air withdrawn.

When all the air is withdrawn from the tube, the rise in the mercury will be 30 inches.



In other words, the whole atmospheric air pressure of 14.73 lbs per square inch.

30 inches rise in the mercury = 15 lbs p.s.i. (to the nearest whole numbers).

therefore 1 inch rise in the mercury $= \frac{15}{30} = \frac{1}{2}$ lb. p.s.i. (approx.)

This rise in inches is quoted to denote the amount of vacuum created in a system.

The B.R. standard vacuum created is 21 inches ($10\frac{1}{2}$ lbs per square inch effective air pressure).

Air leaking into the vacuum side will nullify the effective air pressure (the vacuum is destroyed).

The principle of the creation of a vacuum and the resultant effective air pressure obtained is used to operate component parts in the automatic vacuum brake system.

When a vacuum is created above the valve (Fig. 1.) the air pressure below will lift it, allowing the air to be withdrawn from the other side (Fig.

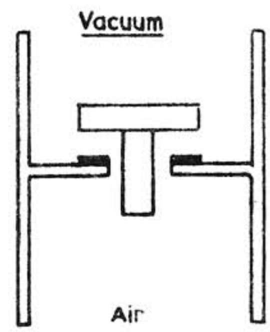


FIG. 1

If air is admitted into the vacuum above the valve the air pressure will seal the valve and retain the vacuum on the other side (Fig. 2.

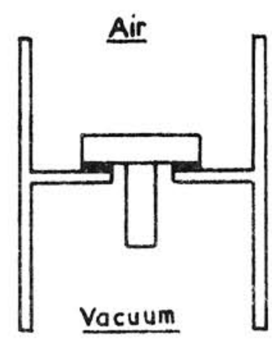


FIG. 2.

The Vacuum Cylinder.

Detailed descriptions of the types and operation of vacuum cylinders will be dealt with as a separate subject but basically the principle is as follows.

Inside the cylinder is a piston and piston rod. The end of the piston rod protruding out of the cylinder is attached to the brake shaft which operates the brakes.

When a vacuum is created in the bottom and top portion of the cylinder, the piston falls to the bottom of the cylinder by its own weight and the brakes are released (Fig. 3

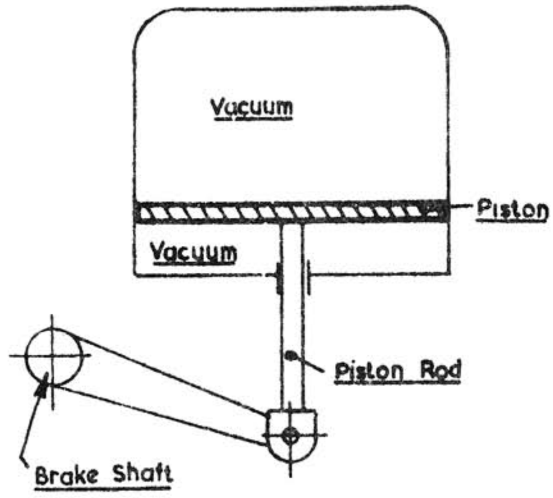


Fig. 3 Brakes 'OFF'

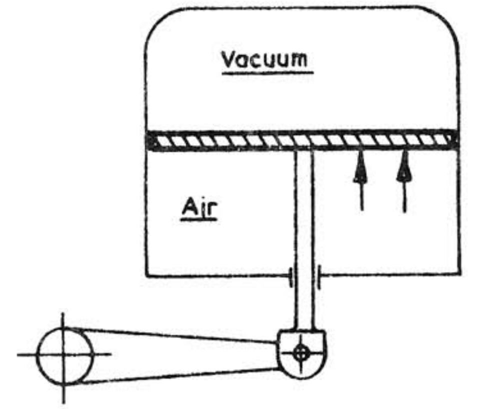
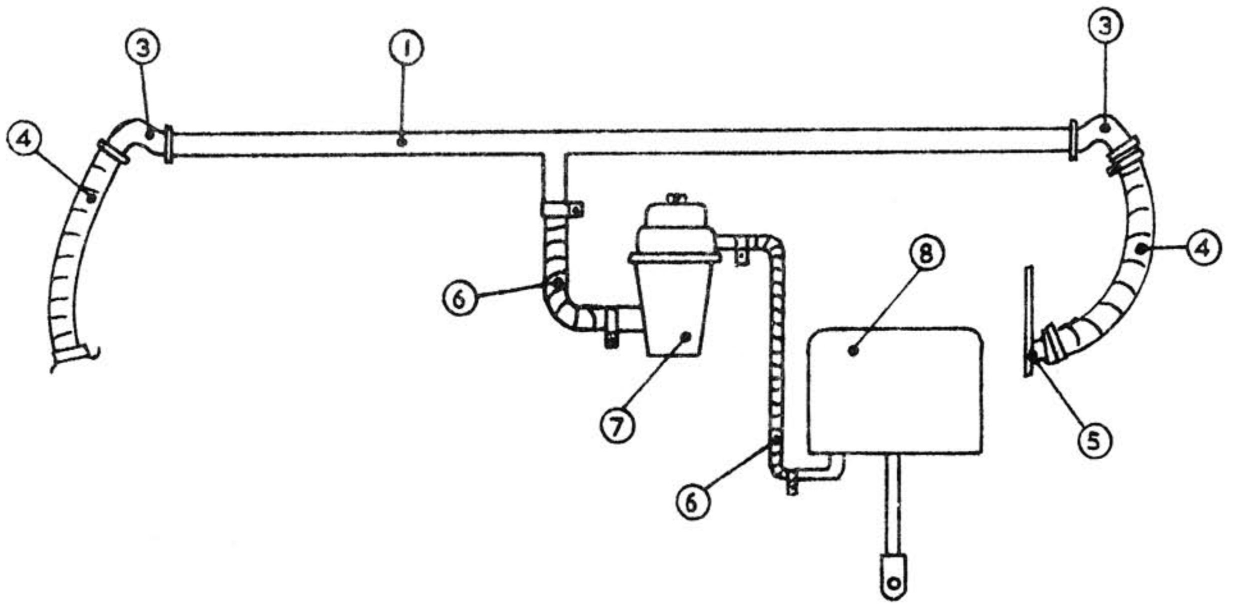


Fig. 4 Brakes 'ON'

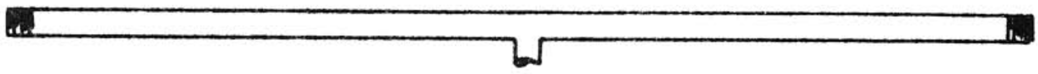
Air admitted to the bottom portion of the cylinder only will cause the piston to rise and the brakes will apply.

This method of operation is ess ential to ensure that if there is a break in the vacuum continuity (e.g. a train parting) the brakes will automatically apply on both halves of the train.

Component Parts of the Automatic Vacuum Brake.



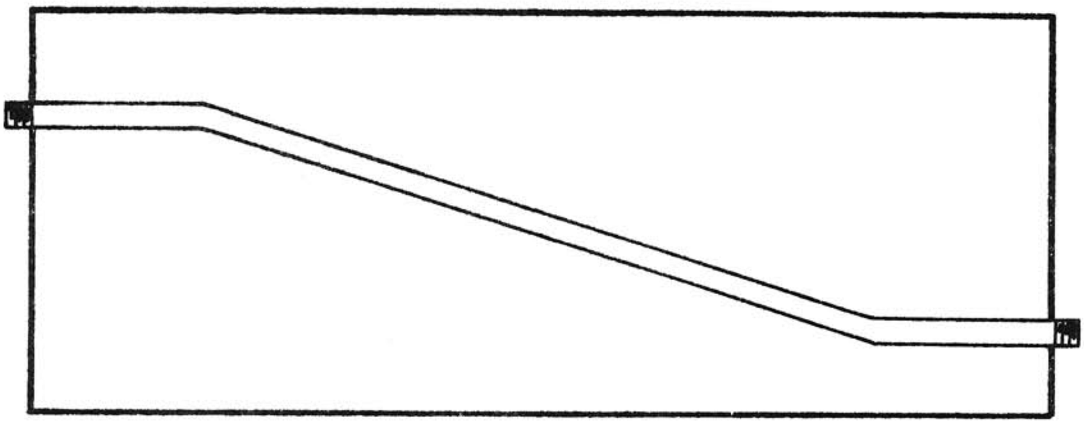
1. **Main Train Pipe.**



Purpose.

To enable a vacuum to be created in the vacuum brake system on the vehicle and also any other vacuum fitted vehicles when connected together.

The main train pipe runs the full length of the vehicle with screwed threads each end for fitting the connections to join the vehicles together. The main train pipe is cranked to permit connection to other vehicles when the vehicle has been turned around.



Identification.

The connections at each end of the vacuum main train pipe are painted freight stock red.

2. Through Pipe.

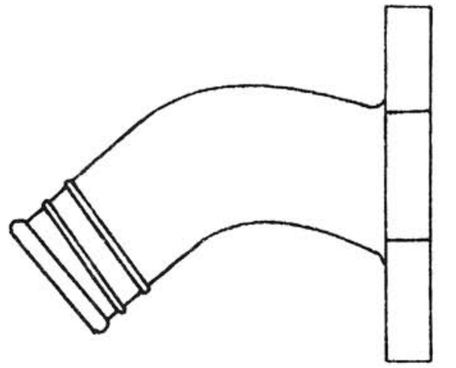
This pipe is the same as a main train pipe with connections at each end to join the vehicle to other vacuum fitted vehicles but there is no automatic vacuum brake fitted to the vehicle.

Identification.

Connections at each end are painted white .

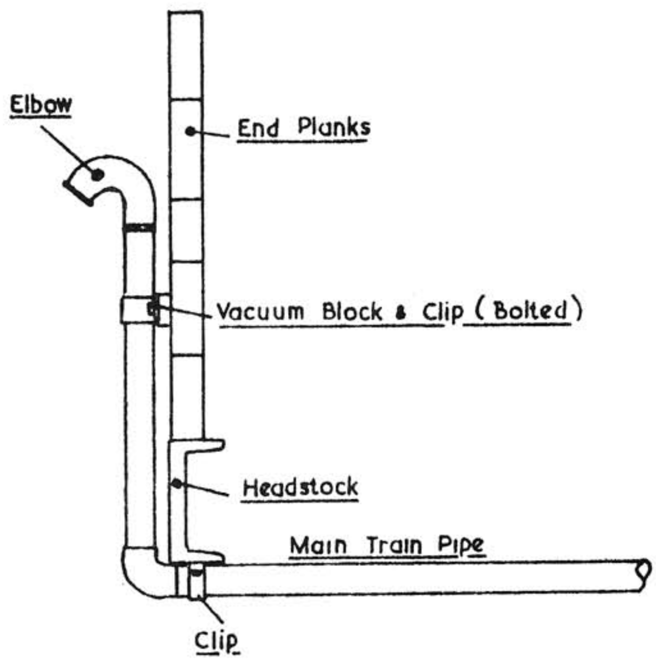
3 (a) Swan Neck.

To allow flexible hose pipes to be fitted at the correct angle on the vehicle.



(b) High Stand Pipe.

Fitted to older vehicles for the purpose of fitting flexible hose pipes to the vehicle.



4. Flexible Hose Pipe.

For connecting vacuum fitted vehicles together or a vacuum fitted vehicle to the locomotive.

The flexible hose pipe is strengthened by a steel spiral to prevent the pipe collapsing when a vacuum is created in the pipe.

A metal cross is fitted in the coupling head to prevent any waste etc. being drawn into the pipe which could cause a blockage.

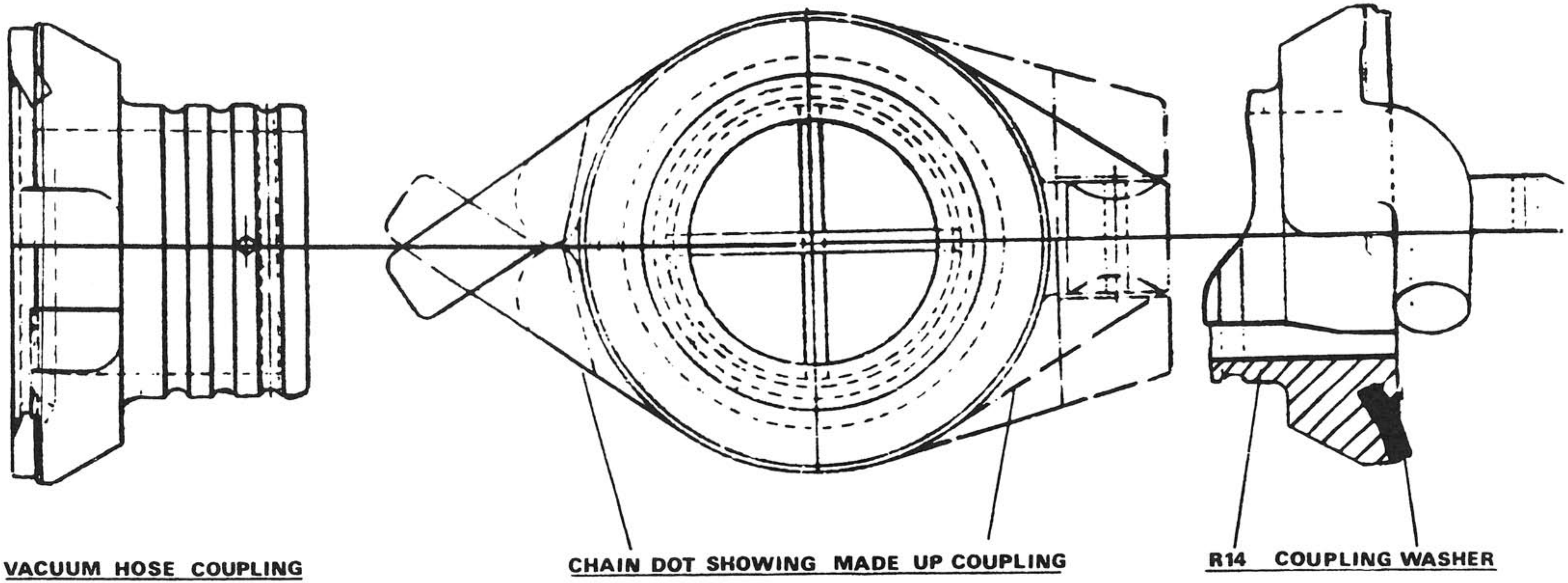


Fig 5 FLEXIBLE HOSE PIPE COUPLING HEAD

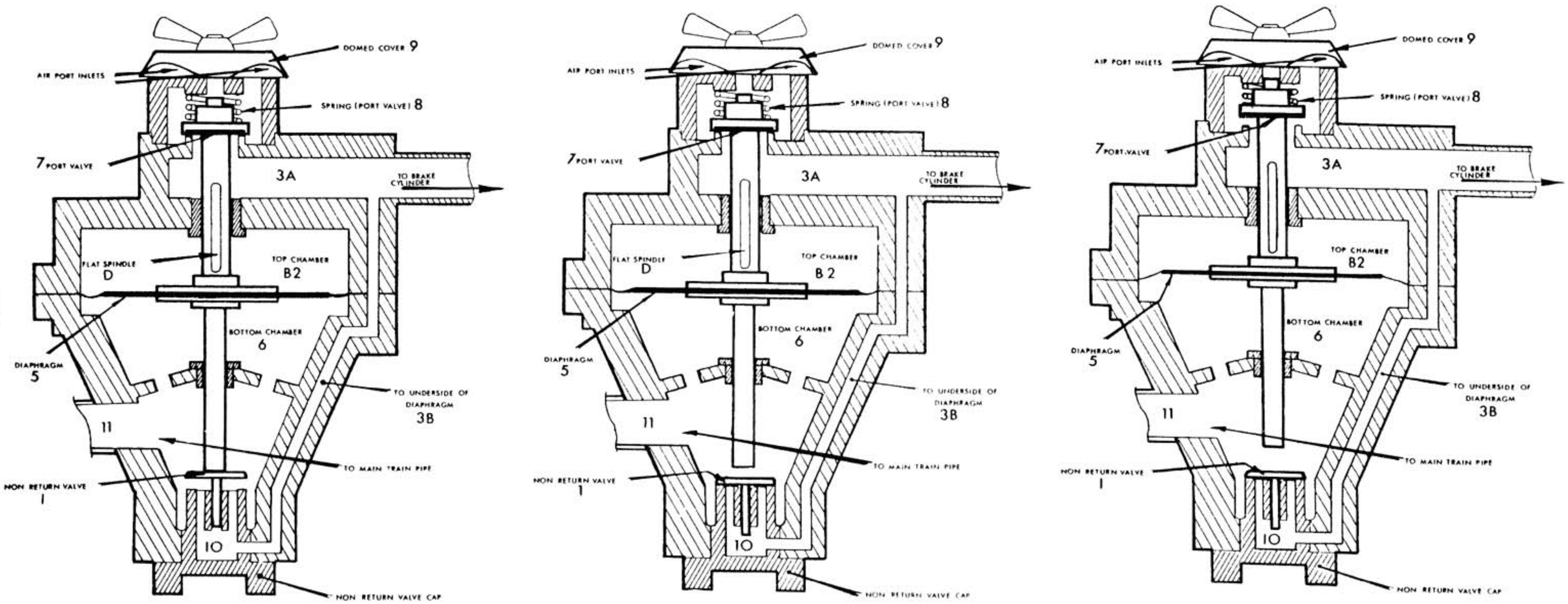


Fig. 6. Direct Admission Valve

A pin and chain are required to secure connected coupling heads on all coaches and on freight vehicles fitted with a high stand pipe.

Freight vehicles fitted with a swan neck do not require a pin and chain.

A brass clip and bolt secures the flexible hose pipe to the swan neck or high stand pipe.

5. Dummy Stop.

The last flexible hose pipe at the end of the vacuum system must be sealed.

Each end of the vehicle has a bracket fitted with the dummy stop bolted on to act as a seal when required.

The bracket is twisted to allow the dummy stop to be at the right angle for easy connection of the flexible hose pipe.

6. Branch Pipe.

Used to connect the main train pipe to the brake cylinder or to the direct admission valve, and the direct admission valve to the cylinder.

Coaches have a steel pipe from the main train pipe to the direct admission valve.

The branch pipe is strengthened to prevent collapse and is secured by brass clips and bolts.

7. Direct Admission Valve.(Fig. 6.

The direct admission valve admits air direct from atmosphere to the brake cylinder in proportion to the drop in vacuum in the main train pipe when a brake application is required.

Creation of Vacuum in the Direct Admission Valve (Brakes "OFF").

Air is withdrawn from the bottom portion of the direct admission valve (6).

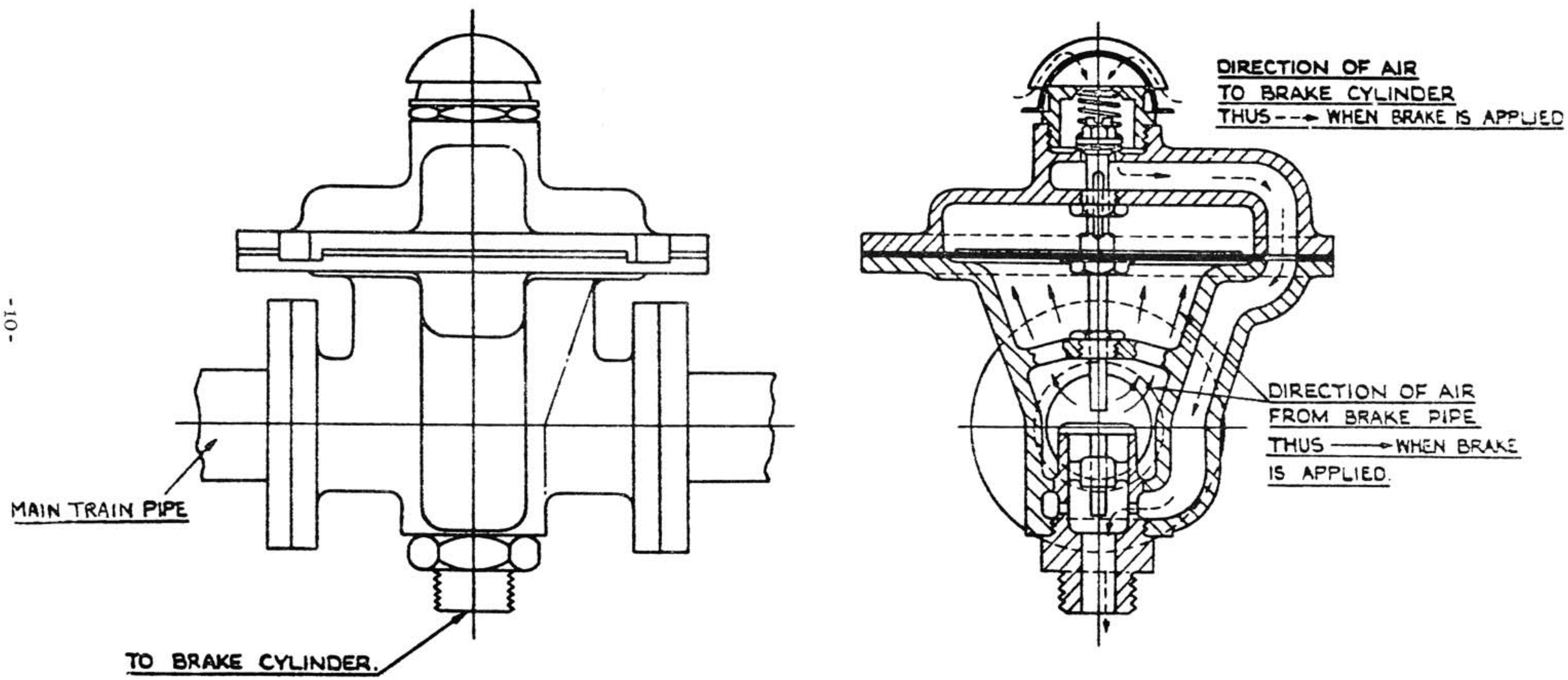
The non-return valve (1) lifts allowing air to be withdrawn from the top portion of the direct admission valve (2) past the 'D' flat on the spindle (4), down the side channel (3B) through the holes in the non-return valve cage (10), past the open non-return valve (1) into the bottom portion (6) of the direct admission valve and back to the main train pipe (11).

Destruction of Vacuum in the Direct Admission Valve (Brakes "ON").

Air is admitted into the bottom portion of the direct admission valve (6) sealing the non-return valve (1).

The air pressure in the bottom portion (6) lifts the diaphragm (5) taking with it the 'D' flat spindle (4). The 'D' flat spindle compresses the port valve spring (8) and opens the port valve (7).

Atmospheric air enters through the open port valve (7) via top channel (3A) to the brake cylinder thus applying the brakes.



Direct Admission Valve Ex GWR Type

At the same time air is entering the top portion (2) via the 'D' flat on the spindle (4).

When the air pressure in the bottom portion of the cylinder, the top portion (2) of the direct admission valve and the main train pipe are equal. The air pressures above and below the diaphragm now being equal, the 'D' flat spindle (4) falls aided by the port valve spring (8). The port valve (7) closes, therefore no more air is admitted to the cylinder.

This means that the brake cylinder pressure is determined by the amount of air admitted into the main train pipe and bottom portion (6) of the direct admission valve.

Defects.

(a) Port valve sticking in the open position.

Air allowed continuously into the brake cylinder and into the main train pipe (dragging brakes).

(b) Port valve sticking in the closed position.

No air allowed into the brake cylinder (brake off).

(c) Bolts loose on body.

(d) Cracked body.

(e) Split diaphragm.

Faulty direct admission valves must be blanked out providing the brake cylinder is not defective.

Method of Blanking Out.

(a) Pressed Sheet Metal Domed Cover.

Remove split pin, winged nut, domed cover, brass coned washer, filter or choke.

Place a lightly oiled card over the port hole. Replace the brass coned washer (larger diameter downwards) over the oiled card.

Replace the domed cover and filter or choke upside down. Securely tighten down wing nut and refit split pin.

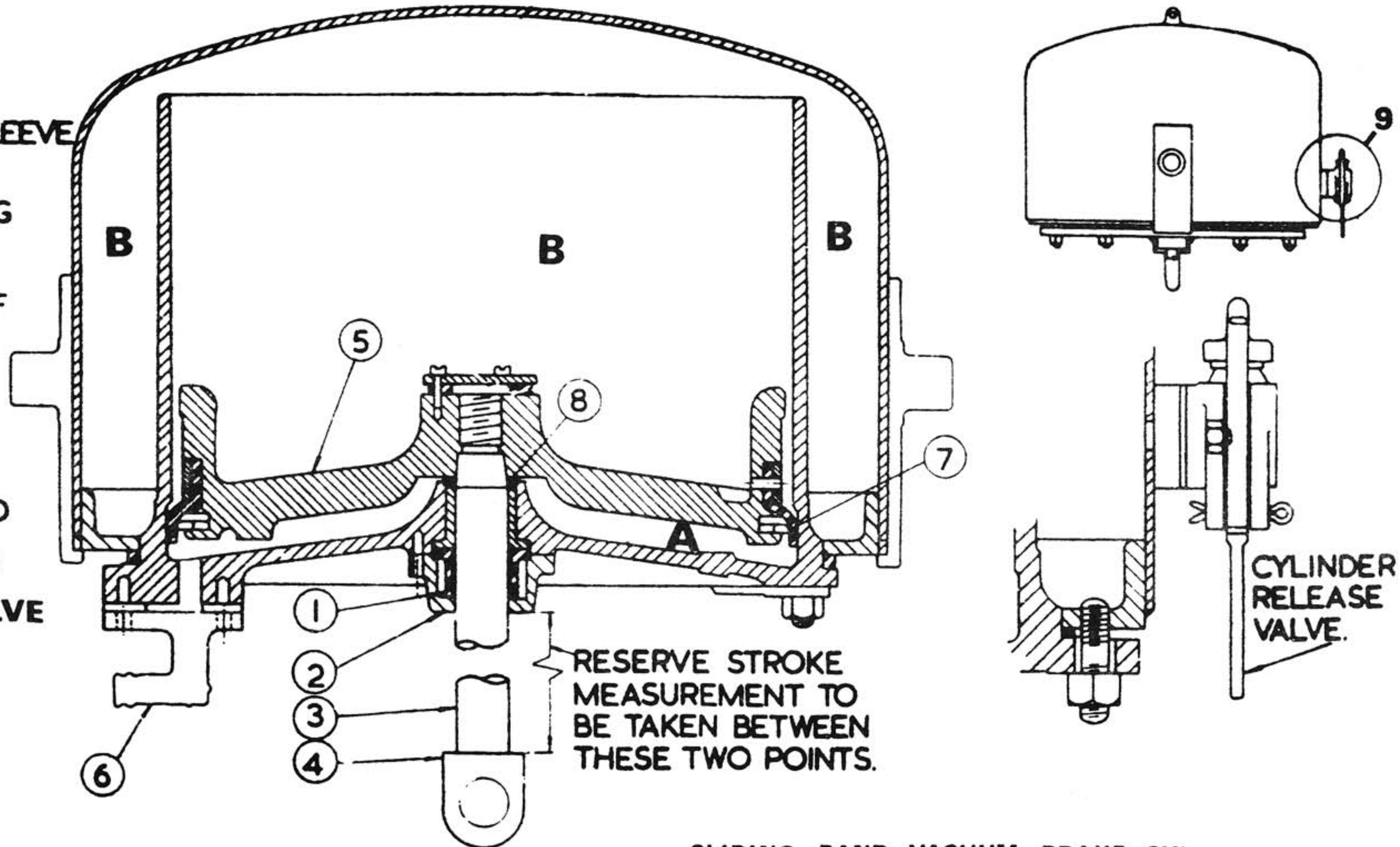
(b) Remove split pin, winged nut, cast domed cover, filter or choke.

Place a lightly oiled card over the port hole.

Replace the domed cover and filter or choke upside down. Securely tighten down the wing nut and refit split pin.

The top of the domed cover has a raised ring which presses down on the lightly oiled card to form a seal around the port hole.

1. PISTON ROD GLAND & NYLON SLEEVE
2. PISTON ROD GLAND CASING
3. PISTON ROD.
4. SHOULDER OF PISTON ROD.
5. PISTON.
6. MODERATING VALVE.
7. SLIDING BAND
8. BUFFING RING
9 RELEASE VALVE



SLIDING BAND VACUUM BRAKE CYL.

In each case, on completion of blanking out, ensure the brake cylinder is released by pulling the release cord and check that the brake blocks are free.

Affix labels B.R.21352/1 on both sides of the vehicle and inform the guard and driver.

W.R. Type.

The wire gauze filter should be removed and a $\frac{3}{4}$" cork fitted in the port hole. A penknife will remove the wire gauze cap.

Plastic Choke.

Fitted to direct admission valves on frieght vehicles only in place of the filter.

Reason.

To regulate the amount of atmospheric air admitted to the cylinder.

Method of Fitting the Plastic Choke.

See Page 14

Removal of the Non-return Valve.

In some cases the non-return valve was removed from the direct admission valve. In this case the brake operates as if the direct admission valve was not fitted to the vehicle.

Identification.

The domed cover is painted yellow.

8 Types of Vacuum Brake Cylinders.

(a) Sliding Band Cylinder.

Creation of Vacuum (Brakes 'OFF').

Air is withdrawn via the branch pipe and the moderating valve (6) from the bottom portion (A) below the piston (5). The piston (5) falls by its own weight and the brakes are 'OFF'.

The I.R. expansion band (7) will collapse, allowing air to be withdrawn from the top portion (B) above the piston (5) and between the inner and outer shells (B).

Destruction of Vacuum (Brakes 'ON').

Air is admitted into the bottom portion (A) below the piston (5) via the moderating valve (6). The I.R. expansion band seals tight against the inner shell, retaining the vacuum in the top portion (B). Higher air pressure in the bottom portion (A) forces up the piston (5) and the brakes are 'ON'.

NOTE:- A damaged I.R. expansion band will render the cylinder inoperative.

Instructions for fitting Choke Disc on B.R. Type Direct Admission Valve on Vacuum Braked Freight Rolling Stock.

No flexible hose type chokes must be fitted to freight vehicles having D.A. valves.

Before any attempt is made to fit the choke disc ensure that vehicle brakes are working correctly.

To fit the choke disc:-

1. Remove split pin in valve screwed spindle.
2. Unscrew and remove wing nut.
3. Remove filter cover.
4. Remove filter cover support washer, if separate item.
5. Remove air filter and dispose of as valuable scrap material.
6. Fit over screwed spindle the choke disc chamfered side uppermost.
7. Check that the choke disc protrusion locates freely between the webs of the air inlet nut.
8. Check seating of disc to nut to ensure that when valve is reassembled in working order no leakage occurs at this surface.
9. Refit in correct position the cover support washer (if separate item), domed cover, wing nut and new split pin ($\frac{1}{8}$" dia. x $1\frac{1}{2}$" long).

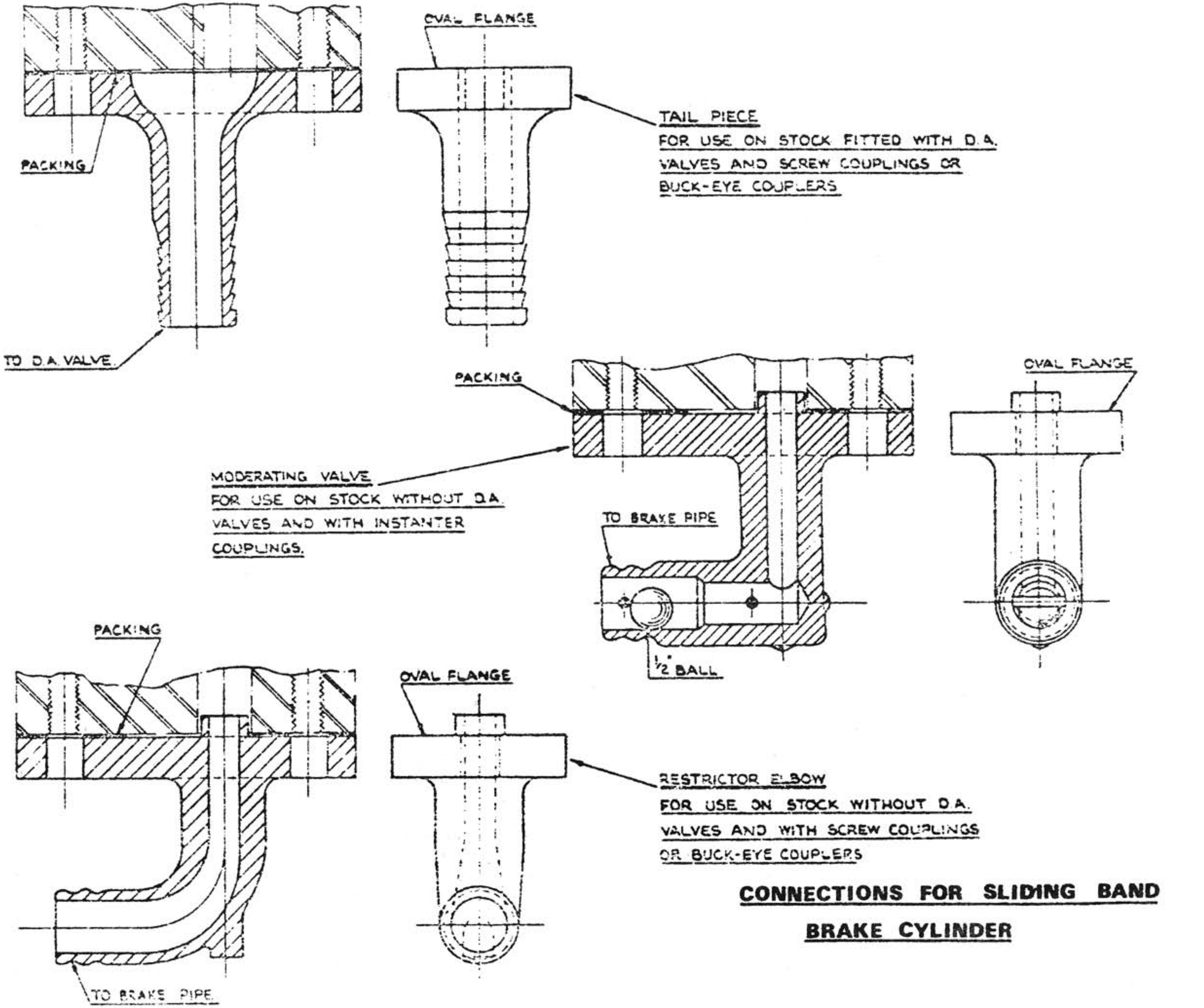
The action of the vacuum brake must now be tested to ensure that the brakes are working correctly. The filter cover must be thoroughly cleaned and a coat of B.R. Standard Coach Blue applied to it.

Moderating Valve (Brass Elbow).

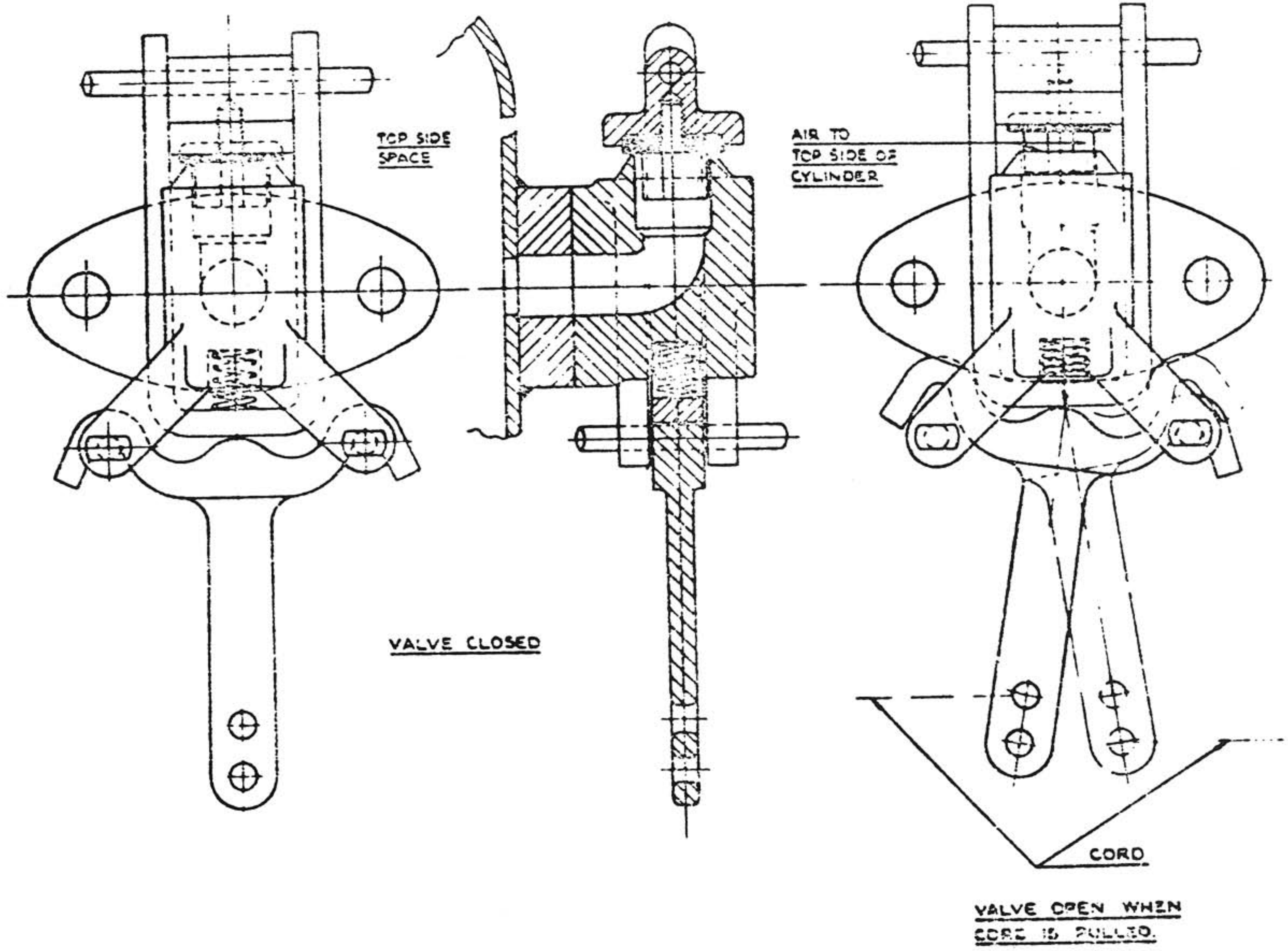
Acts as a connection for the branch pipe.

Permits easy withdrawal of air from the cylinder but regulates the entry of air into the cylinder.

NOTE:- The moderating valve flange has a raised rim around the hole and therefore care must be taken when fitting the rubber tongue and tightening up during blanking off procedure.



CONNECTIONS FOR SLIDING BAND BRAKE CYLINDER



RELEASE VALVE FOR SLIDING BAND BRAKE CYLINDER

Release Valve.

Situated on the side of the outer shell. There is no branch pipe fitted to it.

Operation.

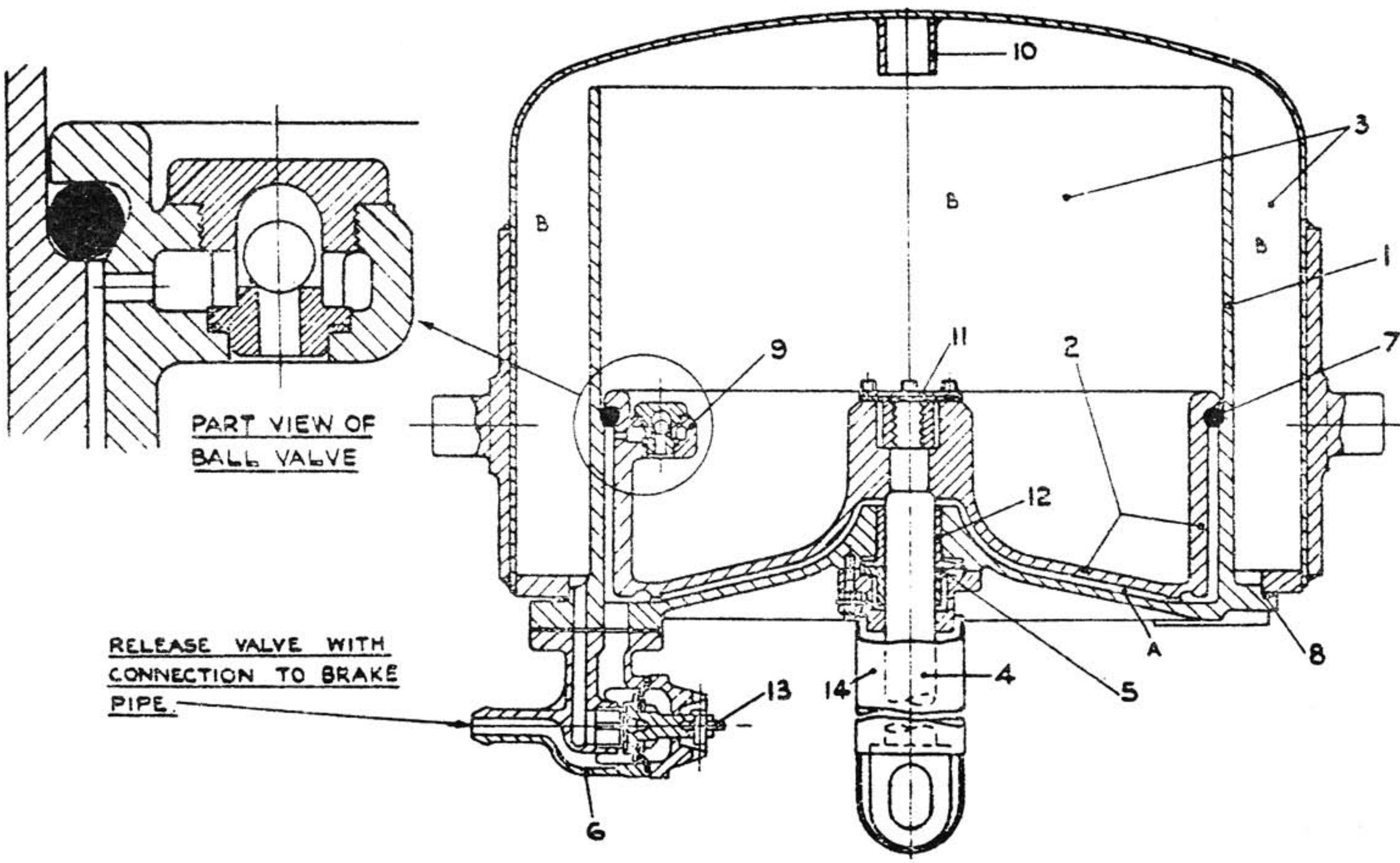
When the cord is pulled the release valve opens, allowing atmospheric air directly into the space between the inner and outer shell, and the top position (B) above the piston (5) thus destroying the vacuum.

This means that if the brakes are applied on a vehicle, they will be released when the cord is pulled.

Defects.

The release valve spring, if defective or the release valve is not seating properly, will admit air into the top position of the cylinder and render the brake inoperative.

The air will also pass the I.R. expansion band and leak back to the main train pipe thus causing dragging brakes on the train.



DESCRIPTION OF PARTS

1. VACUUM CYLINDER
2. PISTON HEAD
3. TOP SIDE SPACE
4. PISTON ROD
5. PISTON ROD GLAND & PACKING
6. RELEASE VALVE
7. ROLLING RING
8. SEALING RING
9. BALL VALVE
10. STOP FOR PISTON
11. PISTON ROD CAP
12. PISTON ROD GUIDE BUSH
13. RELEASE VALVE LEVER
14. PISTON ROD SLEEVE

Fig 7 Type E1 Brake Cylinder

B. E.1 CLASS ROLLING RING CYLINDER (FIG. 7)

Creation of Vacuum (Brakes 'OFF').

Air is withdrawn from the bottom portion (A) beneath the piston (2). The piston (2) will fall, by its own weight, to the bottom of the cylinder and release the brakes.

When the piston (2) drops down, the rolling ring (7) will roll upward past the three holes of the ball valve (9) in the side of piston (2).

Withdrawal of air from the top portion (B) and between the inner and outer shells (B) can now take place via ball valve (9).

Destruction of Vacuum (Brakes 'ON').

Air is admitted into the bottom portion (A) beneath piston (2) and also enters the ball valve (9) and seals the ball on its seat.

The air pressure in the bottom portion (A) will force up the piston (2), thus applying the brakes. The rolling ring (7) will roll downward past the three holes in the side of the piston (2).

The bottom portion (A) is now completely isolated from the top portion (B) and the vacuum is retained in the top portion (B).

Internal Leak.

A damaged rolling ring could allow air from the bottom portion (A) into the top portion (B).

When the vacuum is destroyed in the top portion (B) the piston (2) will fall to the bottom of the cylinder and the brakes will be released.

Brakes Dragging or Slow to Release.

A twisted or stretched rolling ring will either prevent the piston dropping smoothly or dropping at all thus causing a dragging brake.

Piston Rod.

The piston rod (4) is screwed into the piston (2). A seal for the piston rod in the base of the cylinder is accomplished by a rubber gland and a nylon insert (5) which is held in position by the gland casting.

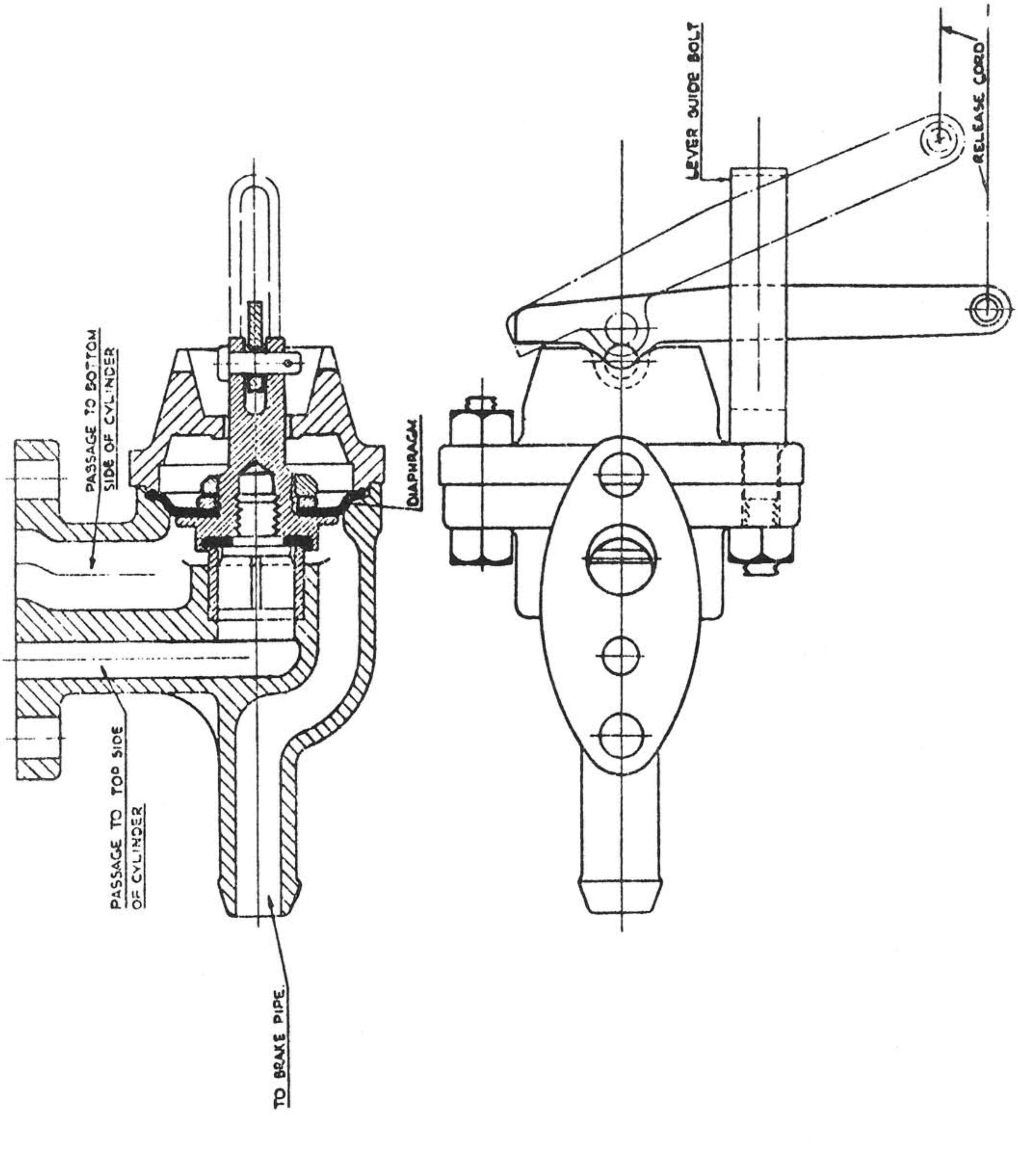
The piston rod has a canvas dust cover (14) for protection.

A defective seal can cause a brake application.

A bent piston rod will be forced up to apply the brakes but will not drop to release them.

A piston rod unscrewed will prevent the brakes being applied.

If the piston rod is scored or cut it will cause the brakes to apply.



RELEASE VALVE FOR TYPE 'E1' BRAKE CYLINDER

Reserve Piston Stroke.

When the brakes are applied there should be at least 4½" between the gland casting and the shoulder of the piston rod boss. A brake adjustment is required if the measurement is less than 4" or brake arm shaft is above horizontal.

If a piston rod will not come right down when releasing the cylinder:-

(a) Remove the piston rod pin.

(b) Blank off the cylinder.

(c) Secure the piston rod by tying through the pin hole to prevent the cylinder turning over.

(d) The brake shaft arm may also require tying up to prevent it from dropping foul.

RELEASE VALVE - E.1 TYPE CYLINDER.

Purpose - manual release of the brake.

The release valve is attached to the base of the cylinder (the letter E.1 is cast on the side of the valve body).

When the release cord is pulled, a flat valve is operated, allowing communication between the top and bottom portions of the cylinder.

When equalisation takes place the piston will fall by its own weight to the bottom of the cylinder, thus releasing the brake.

An E.1 cylinder may become inoperative if the wrong type of release valve is fitted.

Release Valve Cord.

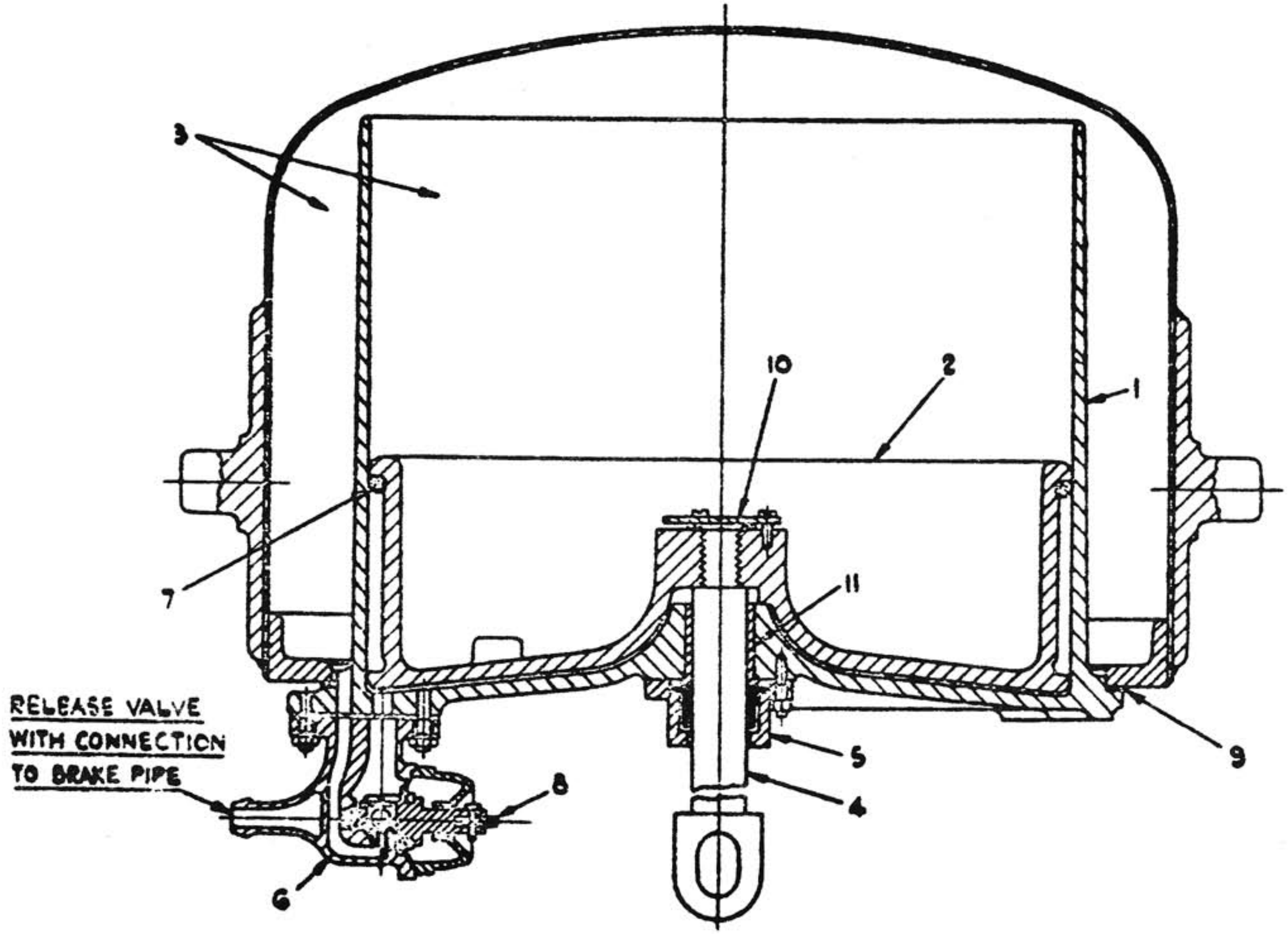
The release valve can be operated from either side of the vehicle by the cord which is attached to the release valve and the solebar.

The location of the release cord is denoted by a small white, or black, star on the side of the vehicle or on the solebar.

The cord must be slack enough to allow for the movement of the cylinder on its trunnions during a brake application. The cord must not be too slack in case of entanglement.

Cords made with natural fibre are subject to shrinkage when wet, but those made of synthetic material are not.

Examiners must ensure that these cords are in position and are in a good condition.



DESCRIPTION OF PARTS

1. VACUUM CYLINDER
2. PISTON HEAD
3. TOP SIDE SPACE
4. PISTON ROD
5. PISTON ROD GLAND & PACK'NG
6. COMBINED BALL & RELEASE VALVE
7. ROLLING RING
8. RELEASE VALVE LEVER
9. SEALING RING
10. PISTON ROD CAP
11. PISTON ROD GUIDE BUSH

Type 'C' Combined Brake Cylinder

Method of Blanking Out an E.1 Type Cylinder.

1. Pull the release valve cord.

   To ensure complete destruction of the vacuum, the flexible hose pipe should be left off the dummy stop until release is complete.

2. Undo release valve studs.

3. Insert a rubber tongue to cover both holes on the release valve.

   NOTE:- When this operation is carried out in a train with a locomotive attached, ensure that the driver has destroyed the vacuum first, otherwise the rubber tongue could be drawn into the hole and blanking out will not be successful.

4. Tighten up the release valve studs.

5. Check that the brake blocks are free of the wheels.

6. Card the vehicle with automatic brake defective pipe operative cards B.R.21352/1.

7. Inform driver and guard if in a train.

Alternative Methods of Blanking Out a Cylinder.

A. If fitted with a D.A. Valve.

   1. Remove the branch pipe from the D.A. valve to the cylinder at the D.A. valve end.

   2. Insert a wooden plug in the D.A. valve orifice.

   3. Fasten up the branch pipe.

   4. Pull the release cord to release the brakes.

B. If no D.A. valve fitted.

   1. Remove the branch pipe from the main train pipe.

   2. Insert a wooden plug in the main train pipe.

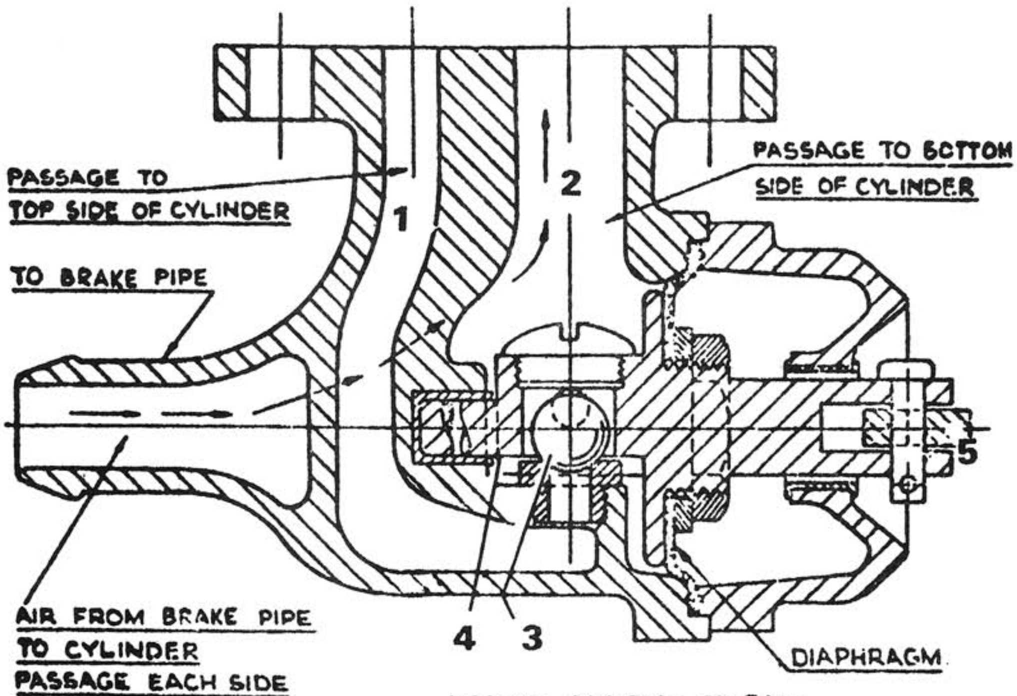
   3. Fasten up the branch pipe.

   4. Pull the release cord to release the brakes.

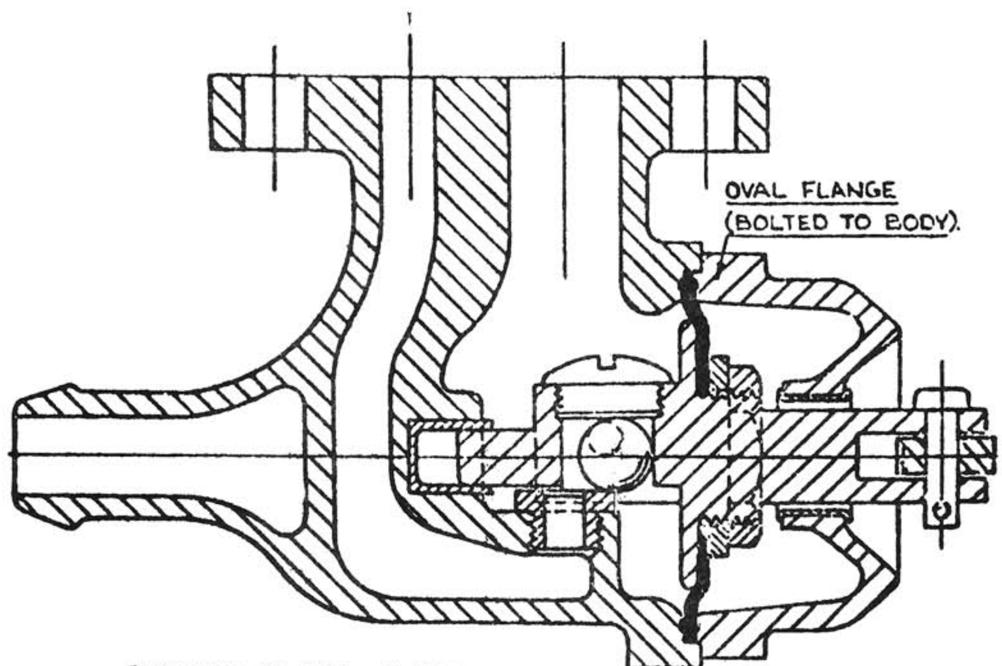
If there is difficulty in removing clips from the branch pipe etc., as a last resort the branch pipe can be cut off and the wooden plug inserted.

C. Class C. Vacuum Cylinder (Rolling Ring).

The class 'C' type rolling ring cylinder does not have a ball valve



NORMAL POSITION OF BALL.



POSITION OF BALL WHEN
CORD IS PULLED.

'C' Type Ball Release Valve

in the piston.

The ball valve is incorporated in the release valve which is attached to the base of the cylinder.

'C' Type Ball Release Valve.

No mark on the body to denote the type.

The passage (2) is connected to the bottom of the cylinder beneath the piston and is always in communication with the main train pipe.

Passage (1) is connected to the top portion of the cylinder and between the inner and outer shell.

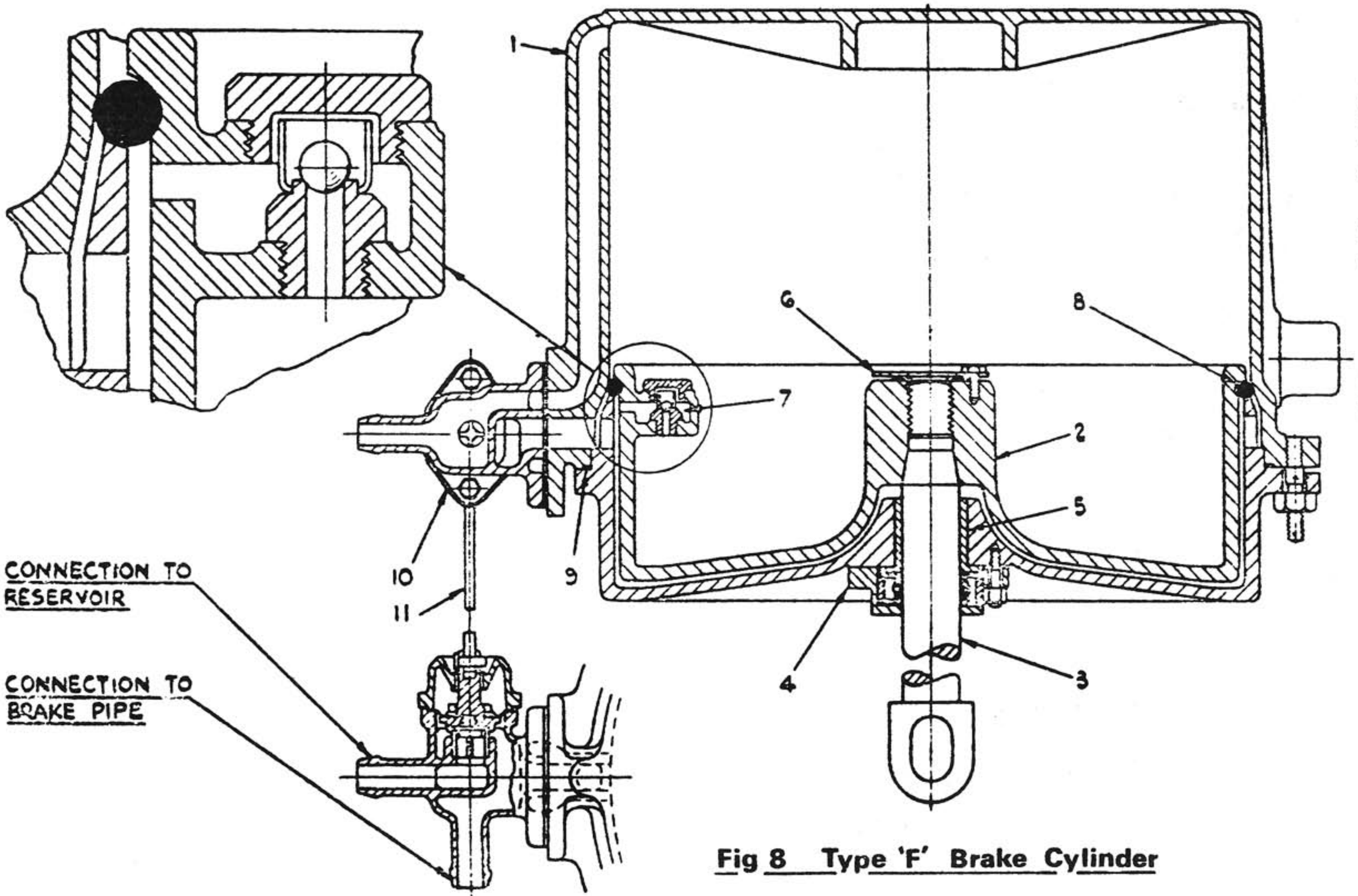
When a vacuum is created in passage (2) above the ball (3) the air in passage (1), underneath the ball (3), will lift the ball (3) off its seat, allowing the withdrawal of air from the top portion of the cylinder.

Any air admitted into passage (2) will reseat the ball (3) and retain the vacuum in the top portion.

Manual Release.

The ball (3) is in a sliding cage (4) which is embodied in the release valve casting.

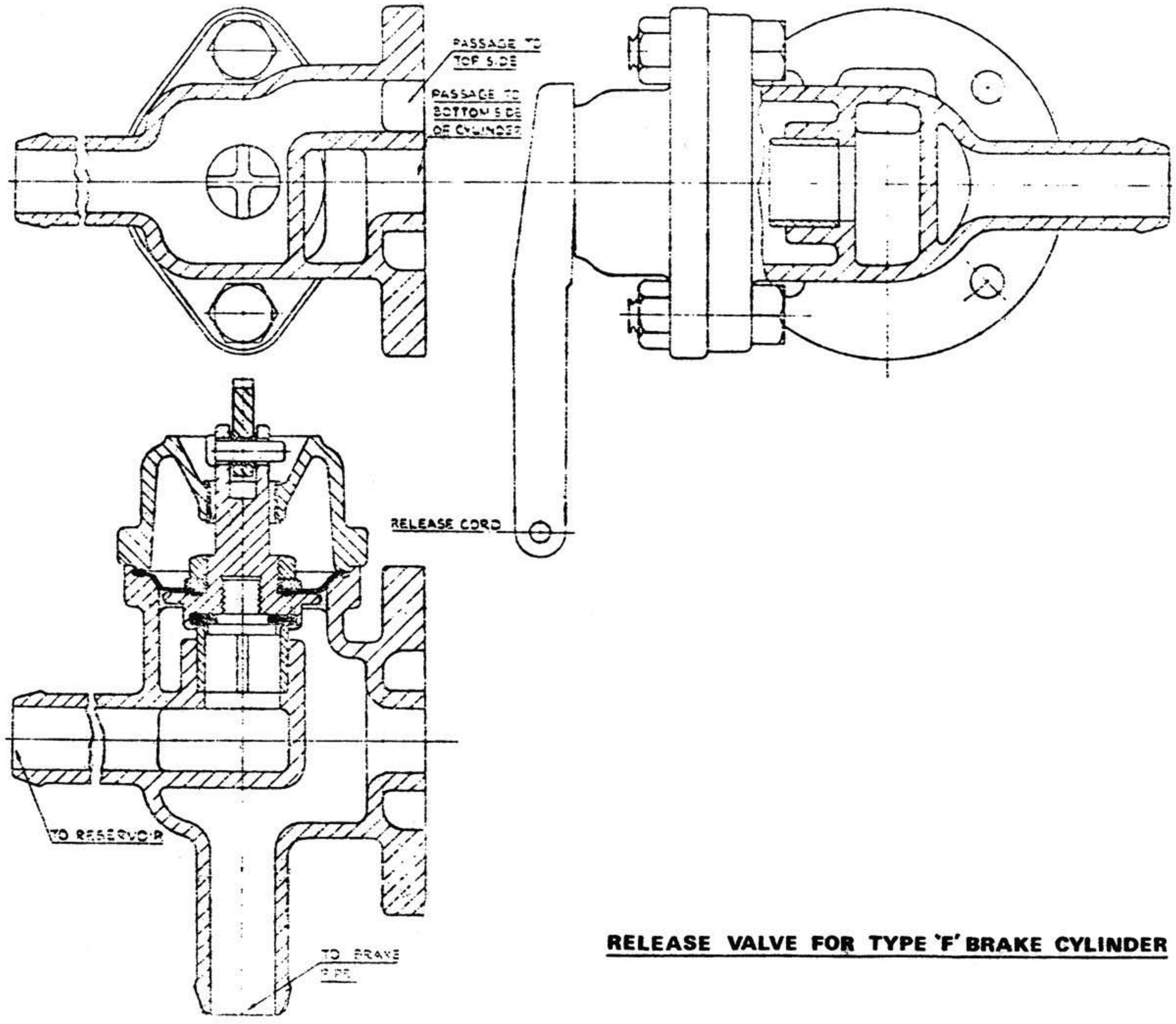
The outer end of the ball cage (4) is connected to a cross lever (5). When the lever is moved, it pulls the ball cage (4) and the ball (3) off its seat. This allows equalisation to take place between the vacuum in the top portion and air in the bottom portion of the cylinder which releases the brake.



DESCRIPTION OF PARTS

1. VACUUM CYLINDER
2. PISTON HEAD
3. PISTON ROD
4. PISTON ROD GLAND & PACKING
5. PISTON ROD GUIDE
6. PISTON ROD CAP
7. BALL VALVE
8. ROLLING RING
9. JOINT RING
10. RELEASE VALVE
11. RELEASE VALVE LEVER

Fig 8 Type 'F' Brake Cylinder



RELEASE VALVE FOR TYPE 'F' BRAKE CYLINDER

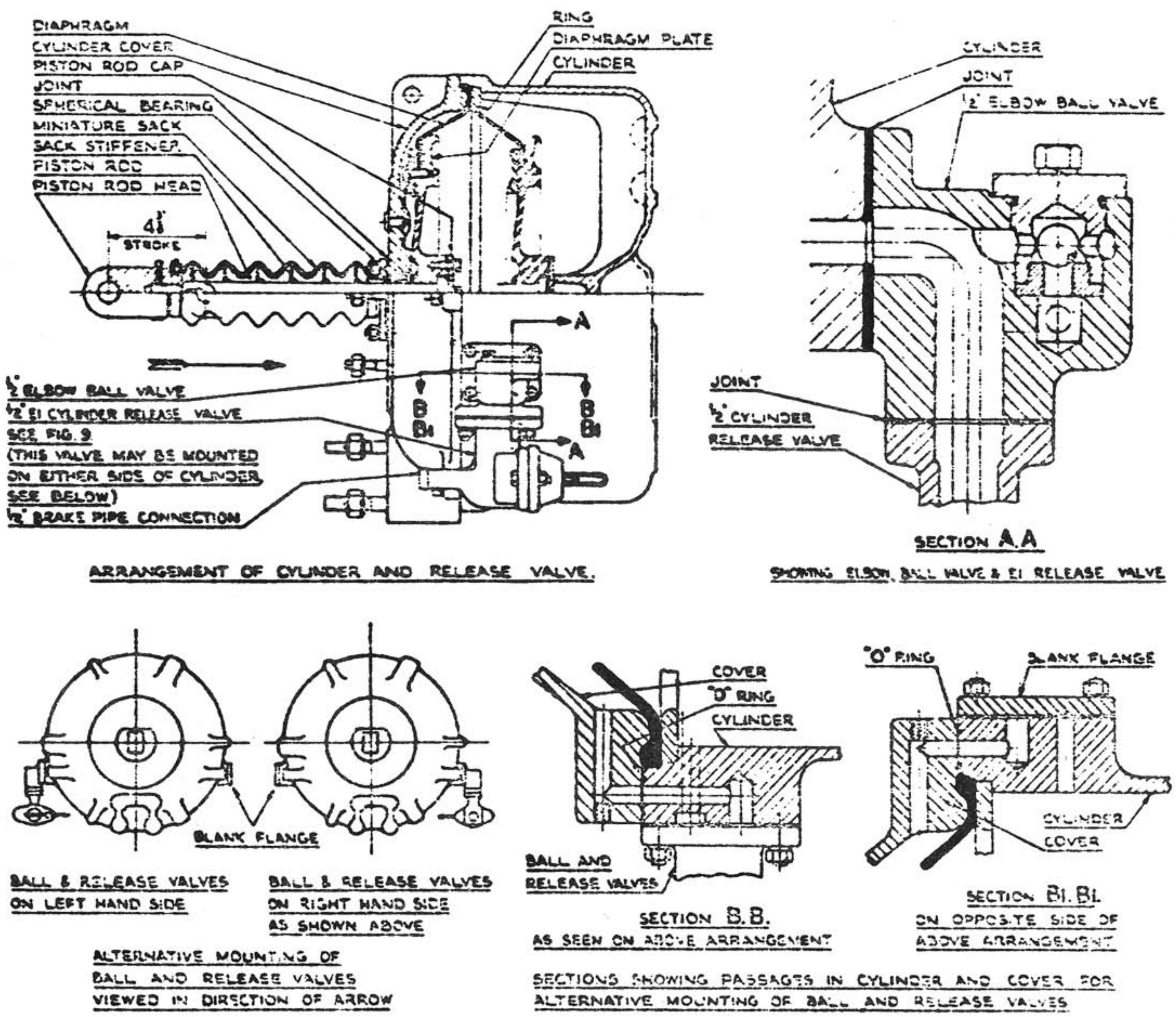
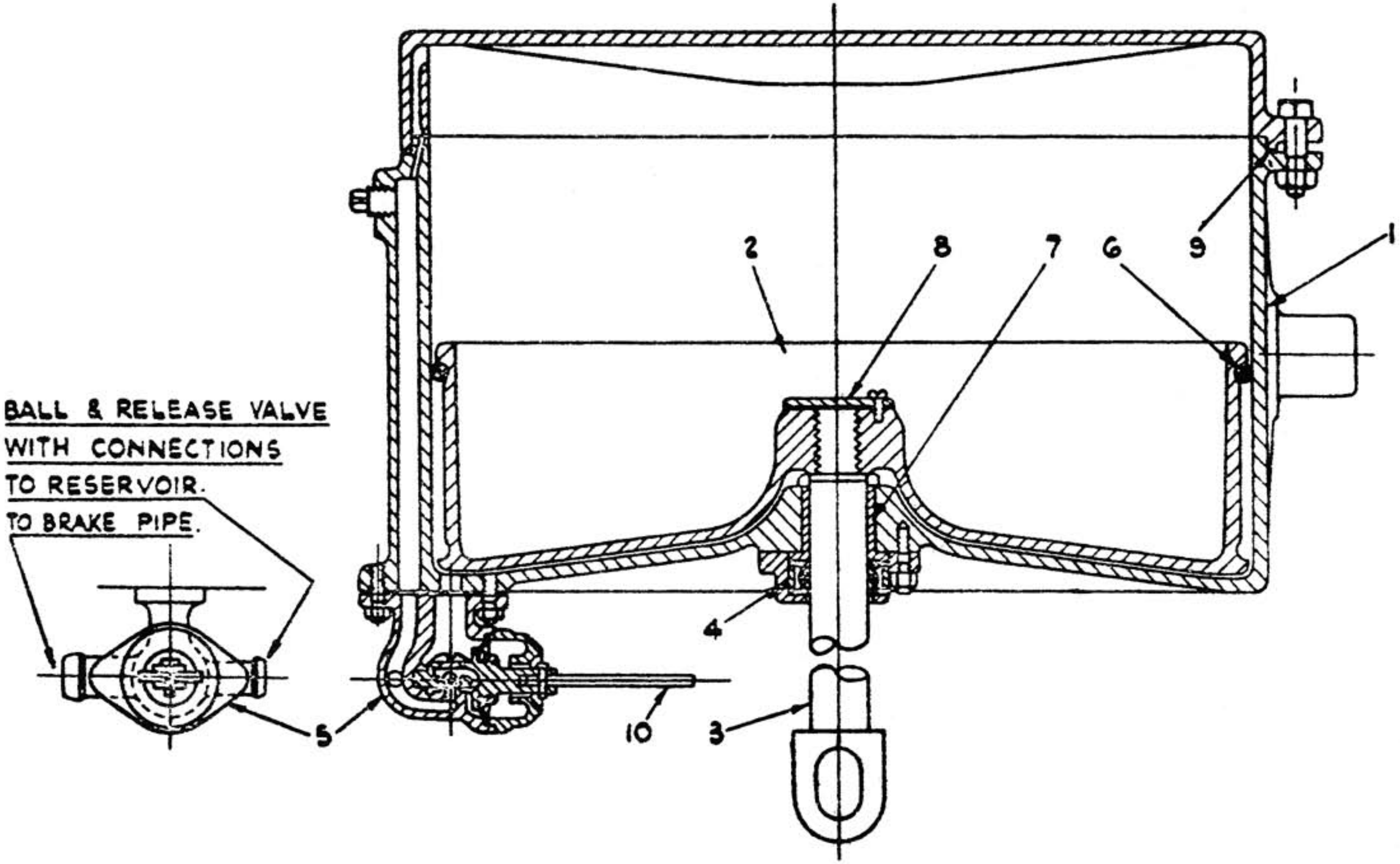


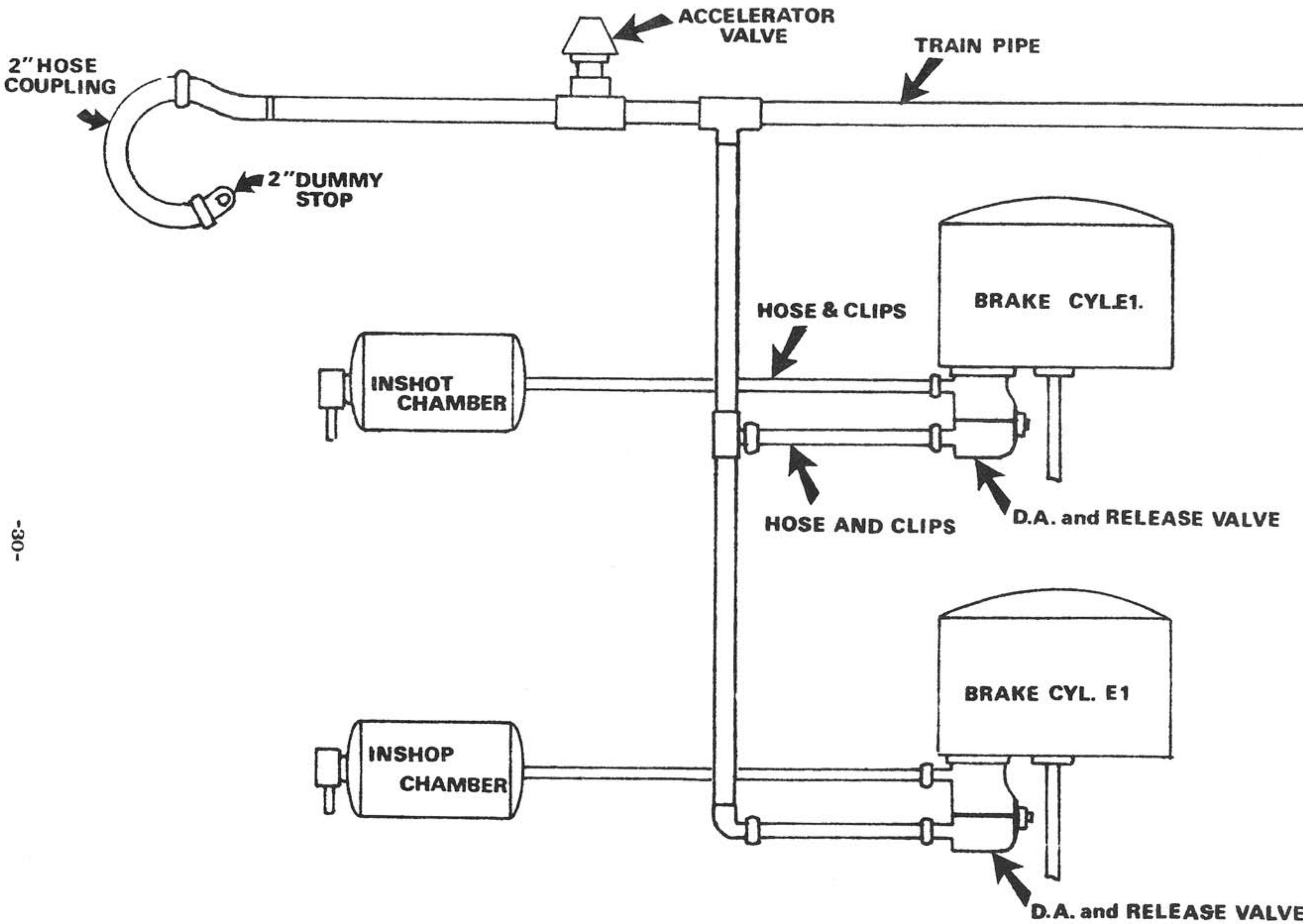
Fig 9 DIAPHRAGM BRAKE CYLINDER



DESCRIPTION OF PARTS

1. VACUUM CYLINDER
2. PISTON HEAD
3. PISTON ROD
4. PISTON ROD GLAND & PACKING
5. RELEASE VALVE
6. ROLLING RING
7. PISTON ROD GUIDE BUSH
8. PISTON ROD CAP
9. JOINT RING
10. RELEASE VALVE LEVER

Type 'C' Separate Brake Cylinder



AFI Vacuum System Brake Pipework Layout

(Two Cylinders Working Together)

NOTE:- A Class 'C' cylinder may become inoperative if the wrong type of release valve is fitted.

D. Class 'F' Type Rolling Ring Cylinder (Figs. 8)

The top portion of this cylinder is not linked to the bottom portion as with the other rolling ring types.

The release valve is connected to the side of the cylinder and has two branch pipe connections, one for the main train pipe or D.A. valve branch pipe, and the other for connecting a branch pipe to the top portion of the cylinder.

E. Diaphragm Type Cylinder (Fig. 9).

This cylinder has a diaphragm instead of a piston.

Some disc braked vehicles have a small, short stroked diaphragm cylinder, horizontally mounted, operating directly on to the brake calipers, in this case there may be a cylinder at each axle, and therefore a release cord at each end of the vehicle.

THE A.F.I. VACUUM BRAKE SYSTEM.

AUTOMATIC - FREIGHT DIRECT ADMISSION - INSHOT.

This system (primarily for freight vehicles) has been produced by Messrs. Gresham and Craven to give a quick propagation of the initial brake application along the whole length of the train, without the risk of the front portion of the train braking before the rear portion. This initial brake application can then be followed by an additional controlled rate of brake force if required.

An accelerator valve in the system gives a very rapid brake application during emergency braking only.

Vehicles fitted with the A.F.I. systems have a small plate marked A.F.I. fitted to the solebar.

Operation of A.F.I. Valve.

Releasing Brakes (Creation of Vacuum) (See Figs. 10

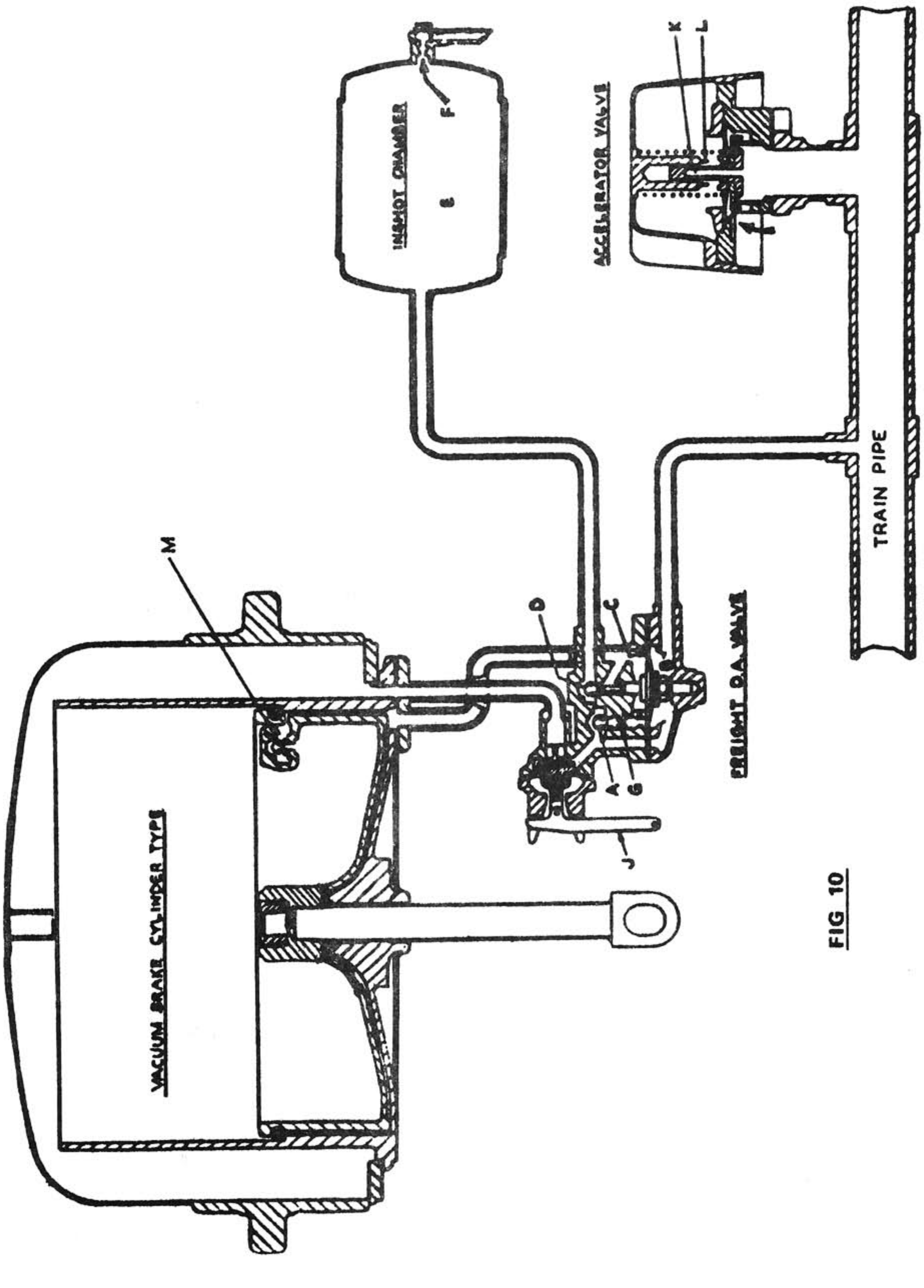
Air is withdrawn from the bottom portion of the cylinder, back to the main train pipe via the non-return ball valve 'A' in the combination release valve and freight 'D.A.' valve.

Air is also withdrawn from the top portion of the cylinder via the non-return ball valve in the cylinder piston head 'M'.

All internal cylinder parts are now under vacuum.

The piston falls by its own weight and the brakes are 'OFF'.

The inshot chamber and as far as ball valve 'D' in the freight 'D.A.' valve is charged with atmospheric air via timing choke 'F' in the inshot chamber. This amount of air is sufficient to give a rapid initial application of the brake blocks on to the wheels up to 10% of maximum application of the brakes when the brake is applied.



VACUUM BRAKE CYLINDER TYPE
M
INSHOT CHAMBER
E
F
ACCELERATOR VALVE
K
L
D
C
A
G
J
FREIGHT D.A. VALVE
TRAIN PIPE

FIG 10

Application of Brakes (Destruction of Vacuum) (See Figs.

Air is admitted into the main train pipe and into chamber 'B' below the diaphragm of the combination 'D.A.' and release valve, but cannot pass NON-return valve 'A'.

Diaphragm 'C' moves upward and unseats ball valve 'D' allowing air from the inshot chamber into the brake cylinder, thus applying the brakes up to 10% of the maximum braking power.

Any further admission of air into the cylinder is fixed by the timing port 'F' in the inshot chamber.

Normal service brake applications do not allow the vacuum to fall fast enough to operate the accelerator valve.

Release chokes are fitted in the freight 'D.A.' valve to give a release time of 40 - 45 seconds after a complete destruction of vacuum, or approximately 20 seconds from a service application to 10" of vacuum.

The effect of these release chokes is to ensure that the release times of the cylinders at the front and rear of the train are very little different from each other, and the full exhauster capacity to extract air can be used without the risk of the front portion of the train brake releasing first.

Manual Release of Brake Cylinder by Release Cord.

When the release cord is pulled on release valve lever 'J' it connects the top portion of the cylinder to the main train pipe.

NOTE:- The manual release of the brake cylinder will take longer than a normal brake cylinder.

Emergency Brake Application.

The Accelerator Valve (Fig. 11)

This valve is controlled by a spring loaded diaphragm (9), open to atmosphere on the underside 'A', and attached to a small vacuum chamber 'B' on the upper side. This chamber is charged from the main train pipe via a small feed port 'K'.

During emergency brake applications the vacuum under the main valve 'C' is destroyed more rapidly than in the small chamber 'B' and the diaphragm (9) moves up unseating the main valve (6), allowing air to enter the main train pipe through a 2" branch pipe. As the valve (6) moves up, it seats on a tubular stem having a still smaller feed port 'L' to the vacuum chamber. This orifice is designed to give a delay of 6 or 7 seconds before the vacuum in the small chamber can be destroyed. During this period the valve is held in the fully open position, but automatically reseats afterwards.

The wave of air admitted by the first accelerator valve augments the flow of air already taking place down the main train pipe, and as each valve opens in turn the propagation rate rises to the desired figure of approximately 800 feet per second.

Such a rate ensures a reasonable degree of braking will be available at the rear of the train, long before the front portion has actually stopped even when making an emergency stop at quite low speeds.

By these means dangerous shocks can be avoided.

FIG. 11.

AFI Vacuum Brake System Accelerator Valve