TEGNESTUEN

CLAYTON DEWANDRE LIGHT RAILCAR AIR PRESSURE CONTROL EQUIPMENT

1 Serie

CLAYTON DEWANDRE CO. LTD
TITANIC WORKS
LINCOLN

CLAYTON DEWANDRE LIGHT RAILCAR
CONTROL EQUIPMENT.

INTRODUCTION.

In developing Railcar Control Equipment certain fundamental requirements were required to be fulfilled and before describing the details and functions of the equipment it will be advisable to outline these requirements which meet most operating conditions. They are:-

1. The provision of controls covering:-

Throttle operation, "Dead Man's Valve", Braking and Sanding: All these to be achieved by two handles mounted on the dash and capable of operation by a sitting driver. The throttle operation to be mechanically arranged by rods and levers from one of the driver's handles, the other three functions to be performed pneumatically. Control to be possible from both ends of the vehicle.

2. The system to be on the "inverted line" principle so that failure of couplings, leaks etc., become a "failure to safety", i.e. either apply the brakes or prevent them being released.

3. The "Dead Man's" valve to be linked with the throttle control and arranged that release of the throttle handle causes the brakes to be applied and the engine either shut down to idling or stopped. A time lag of approximately 10 seconds to be included in this action.

4. The inclusion of a passengers emergency valve which when opened applies the brakes and shuts down the engine.

5. Braking and Sanding to be capable of independent or combined operation by the same control handle, the brake power to be proportional to the effort and movement of the handle.

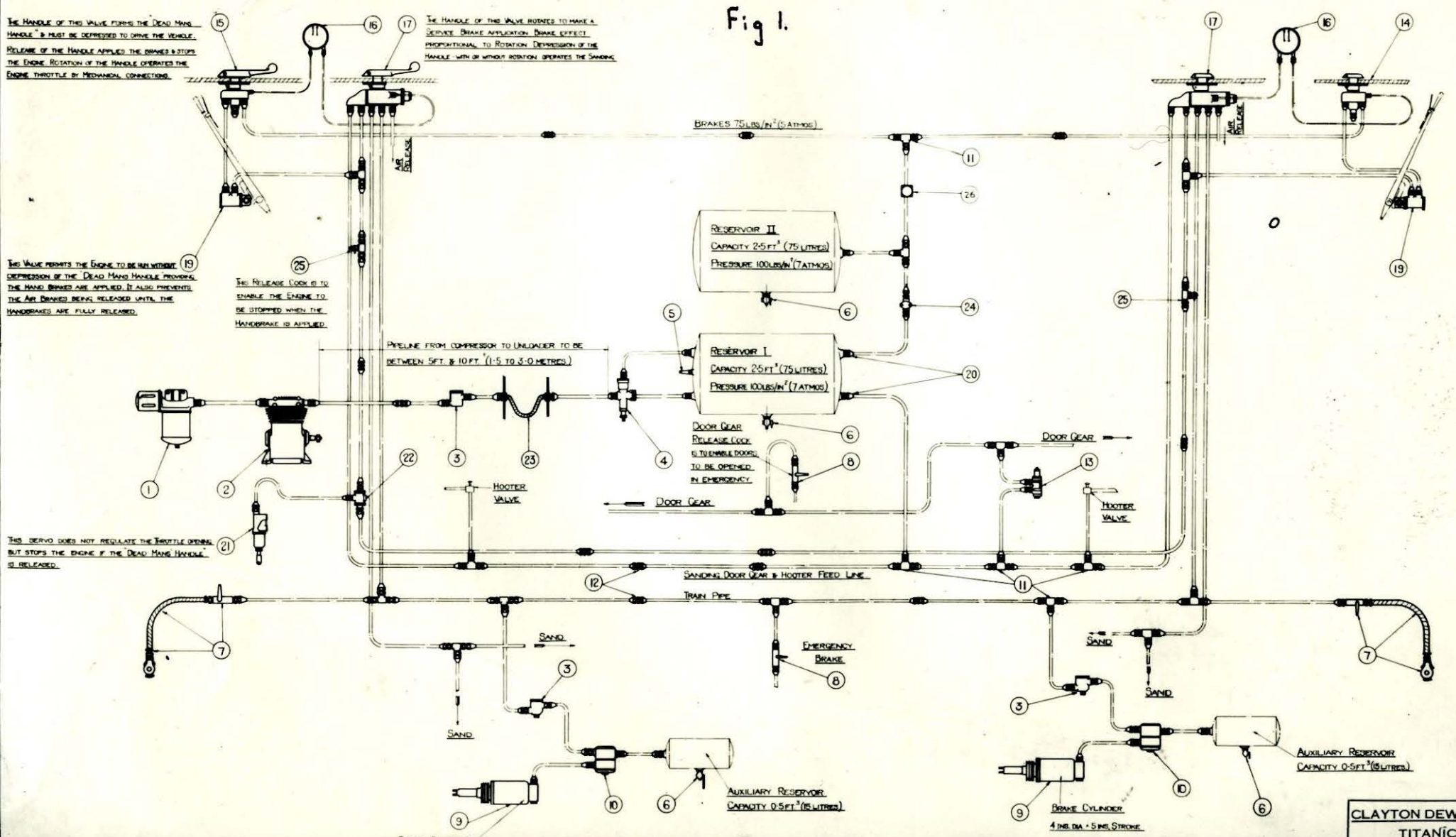
6. The complete system to be such that a trailer vehicle or second motor vehicle (with dead engine) can be coupled at either end of the first motor vehicle and the train driven from either end of the first motor vehicle.

7. Provision whereby the engine may be run for testing or while waiting at a station, etc, without continuous depression of the "dead mans valve and automatic cancellation of this provision when the railcar is driven.

Fig 1.

EQUIPMENT SUPPLIED BY CLAYTON DEWANDRE Co. LTD. TITANIC WORKS, LINCOLN.

Ref	Part No.	Description	No.	Wt.
1	APSA 372-1	Anti-Freezer c/w Conns.	1	
2	PCGA 33-16	Compressor c/w Conns.	1	57 lbs.
3	APSA 209-5	Pipe Line Filter c/w Conns.	3	4 lbs. 1oz.
4	APSA 182A-6	Unloader Valve	1	
5	SA 400-1	Safety Valve	1	2 oz.
6	APSA 252	Drain Taps	4	3 oz.
7	APSA 396-1	Coupling Shut off Valve & Hose Assly.	2	6 lbs. 12 oz.
8	APSA 301-2	Emergency Application Valve c/w Conns.	2	3 lbs. 6 oz.
9	APSA 477-2	Servo Cylinders c/w Conns.	2	14 lbs. 4 oz.
10	APSA 549-1	Inverted Line Valve c/w Conns.	2	
11	APSA 382	Tee Piece Assly.	17	1 lb. 2 oz.
12	APSA 399	Pipe Line Union Assly.	12	4 oz.
13	APSA 448-3	Reducing Valve	1	
14	APSA 1003-2	Throttle & Dead Mans Valve c/w Conns. (less handle)	1	31 lbs.
15	APSA 1003-3	Throttle & Dead Mans Valve c/w Conns. (with handle)	1	33 lbs.
16	SF 555	Double Pressure Gauge c/w Conns.	2	2 lbs. 6 ozs.
17	APSA 1007-2	Brake & Sanding Valve c/w Conns. (less handle)	1	36 lbs.
18	APSA 1007-3	Brake & Sanding Valve c/w Conns. (with handle)	1	40 lbs.
19	APSA 1005-1	Hand Brake Valve c/w Conns.	2	8 lbs.
20	APSA 514	Union Assly. (for Reservoirs)	7	3 ozs.
21	APSA 2020-1	Servo for Throttle Control	1	4 lbs.
22	APSA 66-2	Change over Valve c/w Conns.	1	5 lbs.
23	APSA 467B-8	Hose Assembly c/w Conns.	1	
24	APSA 68-3	Non-Return Valve	1	
25	APSA 499	Drain Tap & Tee Piece Assly.	2	
26	APSA 446-9	Reducing Valve	1	



All items shown in full are supplied by C.D.C. Ltd. Lincoln, England.

Note: Tubing to be Solid Drawn, Vacuum Annealed, Seamless Steel.

Diagrammatic Layout of Air Pressure Equipment — 4 Wheel Car

Clayton Dewandre Co. Ltd.
Titanic Works,
Lincoln.

Drg. No. G.A. 1188

8. Provision of air supply for sanding, hooter and door gear operation such that normal usage of air by these devices does not affect the brakes, but excessive usage causes a failure to safety.

The system designed to meet these requirements is diagrammatically illustrated in Fig.1.

The brakes working on the inverted line system is similar to normal railway air brake practice in that air pressure in the "train pipe" holds the brakes off and destruction of train pipe pressure causes the brakes to be applied.

The train pipe is that air conduit running the length of the train connecting the various controllers and valves, and coupled between the cars with flexible hoses and quick detachable couplings.

OPERATION OF THE SYSTEM.

Referring to Fig.1. in detail compressed air is provided by the compressor (2) which draws air at atmospheric pressure through the air cleaner and anti-freezer (1) and delivers it via the line filter (3) to the unloader valve (4) and into reservoir I. From here reservoir II is charged via non-return valve (24). When these two reservoirs are fully charged to the working pressure the unloader valve diverts the delivery of the compressor to atmosphere and allows the compressor to run on light load until the reservoir pressure drops sufficiently to bring the unloader valve to the charging condition. This portion of the system provides the source of the air pressure power together with its means of storage in the two reservoirs.

The auxiliary services draw their air supply from reservoir I and the braking equipment from reservoir II. This arrangement meets requirement 8.

The controls at each end of the car are duplicates but there is provided only one pair of handles which have to be transferred from one end of the car to the other when the driving position is changed. The removal of the handles is arranged so that only controllers with the handle in position are effective and escape of air from a handless controller is prevented. The air feeds from reservoir II to the controllers are interrupted by two valves, the dead man's handle valve and the handbrake valve. When the dead man's handle is released, the supply of air to the controller is

interrupted and in addition a small leak is introduced in the feed line on the controller side of the dead man's valve. This leak allows the train pipe pressure to be released and the brakes applied. The throttle closing servo (21) is also coupled to the same section of the feed line (via changeover valve (22), which enables the single servo to function from either driving position) and hence release of the dead man's handle also stops the engine. This arrangement meets requirement (3).

The second valve acting as interrupter is the handbrake valve (19). In the off position of the handbrake this valve is open and permits full flow of air either from feed line to controller or back from train pipe through controller to the leak in the dead man's valve. When the handbrake is applied the valve is closed and in this position release of the dead man's handle does not release air from the train pipe and apply the brakes nor, if the air brakes are already applied, can they be released until the handbrake is returned to the "off" position. This deals with requirement 7.

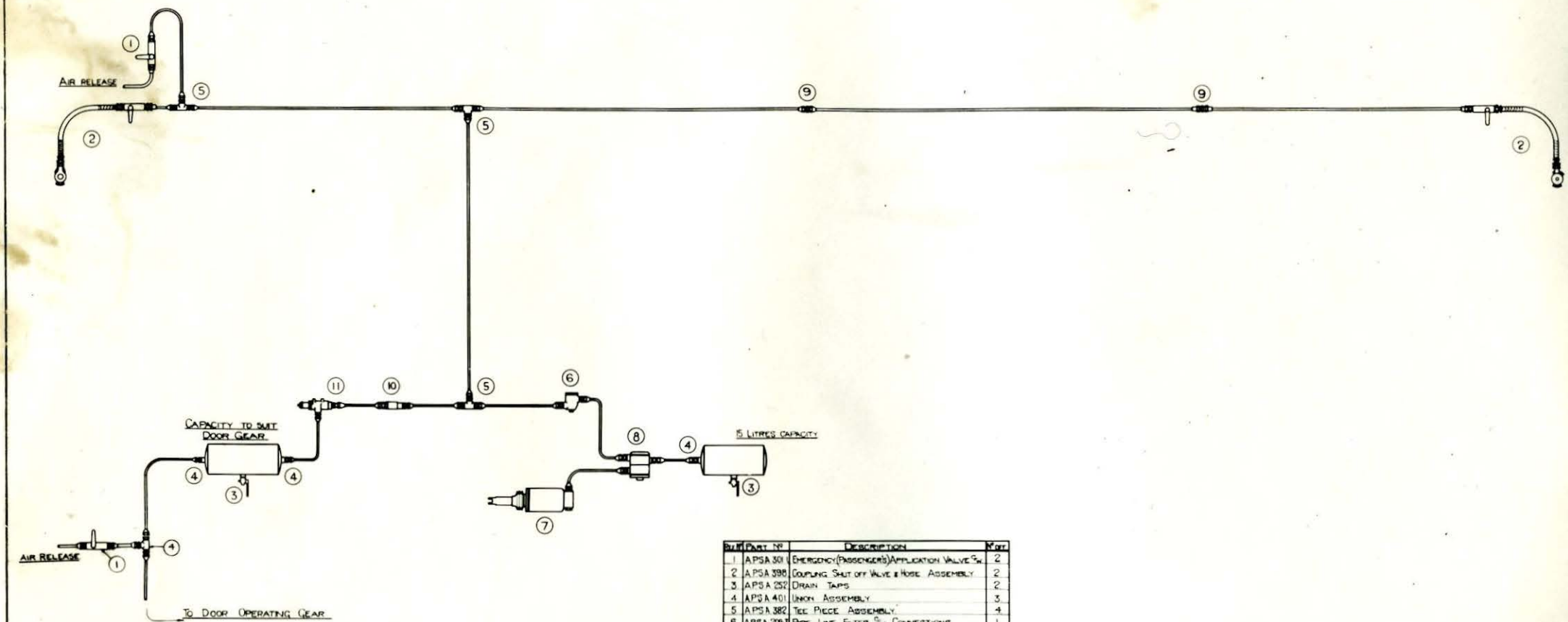
The controllers themselves, i.e. throttle controller and brake controller, at each end of the car, consist of handles capable of rotating about a vertical axis and also capable of being depressed about a horizontal axis. The two handles are thus between them capable of performing four functions and these are:-

For the left hand controller, operation of throttle opening and closing of dead man's valve;

For the right hand controller, operation of the brakes and the sanding apparatus.

Of these functions, the operation of the throttle is purely mechanical, i.e. a shaft extends from the controller and is mechanically connected to the engine throttle by rods and levers (not supplied as part of the equipment). The other three functions, dead man's valve, brakes and sanding, are performed pneumatically.

Rotation of the brake controller handle in a clockwise direction operates a valve, the function of which is progressively to release air pressure from the train pipe and thus apply the brakes. The valve is of the reaction principle and "feel" is imparted to the handle. The brake power produced is proportional to the amount of



Ref	Part No	Description	No off
1	APSA 301	Emergency (Passenger's) Application Valve ⅜	2
2	APSA 398	Coupling Shut off Valve & Hose Assembly	2
3	APSA 252	Drain Taps	2
4	APSA 401	Union Assembly	3
5	APSA 382	Tee Piece Assembly	4
6	APSA 209 ⅜	Pipe Line Filter ⅜ Connections	1
7	APGA 477	Servo Cylinder ⅜ Connections Type APSA 32	1
8	APGA 549	Inverted Line Relay Valve ⅜ Connections	1
9	APSA 399	Pipe Union Assembly	2
10	APSA 68-2	Non-Return Valve ⅜ Connections	1
11	SK 6537	Reducing Valve (Door Operation) ⅜ Conns	1

Equipment supplied by Clayton Dewandre Co Ltd

TRAILER CAR EQUIPMENT

Fig. 2.

Note Tubing to be Solid Drawn Vacuum Annealed Seamless Steel Tubing suitable for Bending & Tinning .625 ⅜ x 16 S.W.G. (.064")

rotation and to the effort required to cause this rotation. Release of the handle permits it to return of its own accord to the "off" position and restore the pressure in the train pipe. Requirement 5 is thus met by this arrangement.

The actual brake applying units consist of a cylinder (or cylinders) an inverted line valve and an auxiliary reservoir. While normal running of the car proceeds and there is pressure in the train pipe the auxiliary reservoir is charged. When a pressure decrease occurs in the train pipe the inverted line valve brings about a corresponding increase in pressure in the brake cylinder, i.e. it inverts the pressure change. Restoration of train pipe pressure decreases and finally releases the pressure in the brake cylinder.

From the safety aspect this arrangement is important as the energy and control to make an emergency brake application is wholly contained within these three items, the cylinders, the I.L. valve and the auxiliary reservoir. A failure or accident to any other part of the whole system cannot prevent the railcar from being brought to a stop. This arrangement adequately covers requirement No.2.

Requirement No.4 - passengers' emergency valve - is simply provided by a cock accessible to passengers and which discharges the air from the train pipe.

When a trailer car equipped as per. Fig.2. is coupled to the motor car the train pipe forms the pneumatic connection between the two systems, The trailer auxiliary reservoir, inverted line valve and cylinders are similar to those of the motor car and operate in the same manner hence operation of the two vehicles together is no problem. Further vehicles could also be attached, the limit being decided by the capacity of the compressor to charge all the reservoirs at the rate corresponding to the air used by the stops per mile of the service. The speed of filling and emptying the train pipe when a long train is employed also limits the number of vehicles. It can be seen the greater the length (volume) of the train pipe the greater the time taken to apply and release the brakes. With the size of piping specified (1/2" bore) a train length of 150 feet can be controlled satisfactorily.

If it is necessary to tow a motor car its braking system can be operated correctly from the towing car if both pairs of controllers in the towed car have their handles removed. This isolates the pressure supply part of the system and leaves the remainder or operative side exactly equivalent to the system on the trailer car.

It is not possible to utilise air from both compressors to feed a single train because the engine of the "towed" car cannot be run without the handbrake being applied, owing to the action of throttle closing servo.

FUNCTION AND OPERATION OF COMPONENTS.

1. THE COMPRESSOR.

The function of the air compressor is to provide the compressed air power for the brake system and other control apparatus.

The crankshaft is a one piece steel forging running in ball bearing journals with white metalled big end bearings. The crankshaft is drilled from the centre oil pump bearing to feed the big ends. Oil thrown from the big ends lubricates the cylinder walls and the main bearings.

The oil pump is anchored in the sump and is of oscillating cylinder design, the ram having a split cap embracing an eccentric centre bearing on the crankshaft. Delivery from the pump is through the ram itself to a groove in the crankshaft with which the oilways communicate.

Suction to the oil pump is through an extension dipping deeply into the sump oil space. A plate relief valve is incorporated in the pump head. Oil pumps are tested and set at the correct working pressure before assembly.

The compressor pistons are of orthodox design with two compression rings and a scraper ring at the piston skirt. The connecting rods are steel stampings with bronze bushes for the small end pins and white metal bearings for the large ends.

A crankcase breather is incorporated and permits breathing without loss of oil. Oil level is indicated by a dipstick, the top portion of which forms the oil filler cap.

GENERAL MAINTENANCE.

Check and if necessary replenish the oil in the compressor

sump, at the same periods this attention is given to the engine.

Completely drain and refill sump every 5,000 kms. The drain plug is in the base of the sump.

The delivery valves and springs should be removed and examined every 20,000 kms. running and any carbon deposits removed. If the valves have become ridged or distorted they should be replaced and if found in this state it is probable the springs also will need replacement. The delivery valve seat can be removed and relapped if necessary.

Cleanliness of the air inlet filter is very important and this should be cleaned thoroughly by washing in Petrol or Kerosene at regular intervals. A choked filter element is a potential cause of loss of output from the compressor.

If the compressor be dismantled for overhaul it is not advisable to alter the oil pump valve settings unless facilities exist for testing the oil pump separately. In manufacture the pump is fitted to a shaft replica of the crankshaft eccentric and the relief valve set such that pressure generated lies between 0.7 kg/sq. cm. and 1.0 kg/sq.cm, with the pump running at 500 rpm. (The stroke of the oil pump is 6.35mm, or 0.25ins.)

For testing the compressor itself on the bench a 40 litre reservoir is a convenient size to use, and with this size of reservoir, the time in seconds to attain a pressure of 5.5 kg/sq.cm. at the speeds quoted is as the following table:-

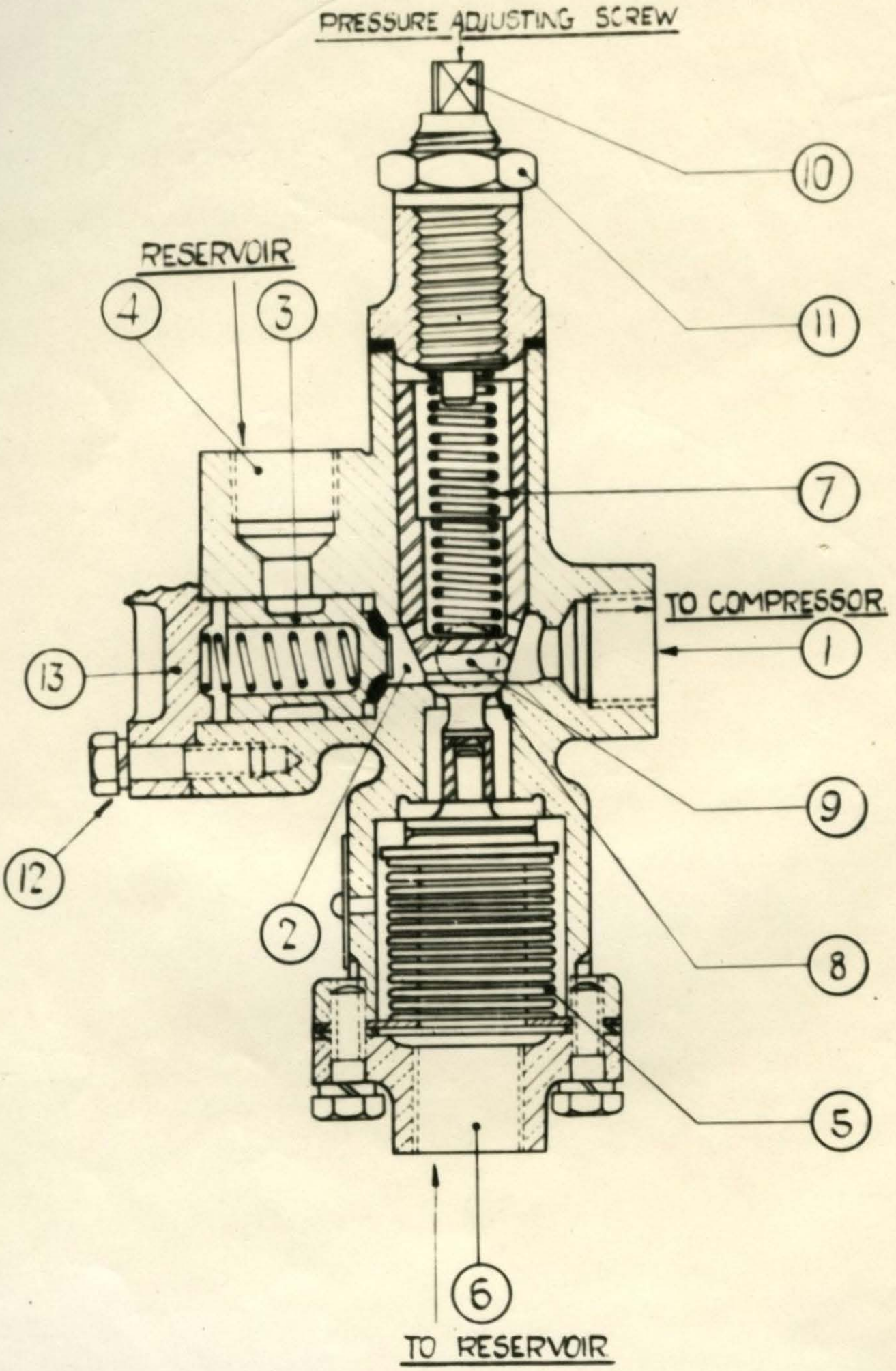
Speed of Compressor.	RPM. 650	RPM. 1,000	RPM. 1,500
Time to attain 5.5 kg/sq.cm. in 40 litre reservoir.	80 secs.	55 secs.	40 secs.

If the test is made on the railcar the volume of the reservoirs should be ascertained and a time directly proportional to the above will give the performance expected.

2. THE COMBINED AIR FILTER AND ANTI-FREEZER.

The function of this component is that of mixing a percentage of spirit with the moisture in the air thus lowering the freezing point of the mixture to a temperature not likely to be reached under normal conditions.

The anti-freezer shown as No.1 in Fig.1. is designed to operate with Methanol as the working fluid, as this spirit has very little



UNLOADER VALVE

FIG 3.

water content. To some extent it does, however, absorb water from the atmosphere if stored exposed.

The operating principle employed is the passing of the main air drawn from the filter to the compressor through a somewhat "Venturi Shaped" orifice in the side of which are two holes communicating with the container holding the "Methanol". Due to the restriction of the orifice some of the air is diverted over the surface of the Methanol.

Contact with the surface of the Methanol gives the air a small percentage of Methanol vapour which is sufficient to prevent freezing of the moisture. The contents of the Methanol container (approximately 1.5 litres) are sufficient under normal operating conditions for approximately 16 hours running of an installation using a 300 litre compressor.

It is only necessary to fill the "Methanol" container in cold weather and when doing this it is advisable to drain off any residual Methanol from the container as this will have absorbed a certain amount of moisture and may be appreciably diluted.

If the weather is warm and protection from freezing not required the container should not be filled with Methanol.

THE UNLOADER VALVE (FIG.3).

The unloader valve is interposed between the compressor and the air reservoir.

Its purpose is to relieve the compressor of most of the pumping load when the reservoir is fully charged.

Incorporated in the unloader valve is a non-return valve which retains the air in the reservoir when the unloader valve permits air from the compressor to be released to atmosphere.

OPERATION.

Referring to Fig. 3. this shows a sectioned view of the valve. Air from the compressor enters the valve via Port (1) and when the reservoir pressure is below that at which the valve is set to unload, travels via passage (2) and non-return valve (3) into the reservoir via port (4). When the reservoir pressure reaches the pre-determined setting of the unloader valve, this pressure is communicated to the unloader valve bellows (5) via port (6) and expands the bellows which overcomes the spring (7), lifts the unloader valve from its seat (8)

and permits air from the compressor to exhaust to atmosphere via breather (9) the non return valve (3) prevents leakage back from the reservoir. The unloader valve is adjustable within limits by means of the pressure adjusting screw (10) and locknut (11).

Usage of air for any service reduces the pressure in the reservoir until the pressure inside the unloader bellows is reduced below the value of the unloader valve spring and the unloader valve closes on its seat forcing the compressor to charge the reservoir to full pressure again.

ATTENTION IN SERVICE.

Should the reservoir leak back through the unloader exhaust, this is due to the non-return valve seat being damaged and can be detected when the compressor is stopped.

Failure of the unloader valve to seat correctly may be detected by a continuous leak from the exhaust port while the compressor is running.

To remove the non-return valve for inspection and cleaning, remove the hexagon headed bolts (12) securing the flange (13) and withdraw the non-return valve (3) complete. No adjustment is necessary on replacement.

N.B. The non-return valve seat is of synthetic rubber and care should be exercised when cleaning.

Wiping with a clean cloth is recommended and in no circumstances should an attempt be made to clean the valve seat by use of abrasive compound or cutting tools.

To remove the unloader valve for cleaning it is necessary to remove both top and bottom covers and undo the screw inside the bellows which holds same to the unloader valve stem. A flat strip should be used in the slots in the end of the unloader valve to prevent it turning while a box spanner is inserted to reach the screw head within the bellows.

It is not necessary or desirable to loosen the adjusting screw (10) and locknut (11) when removing the top covers. Light lapping of the unloader valve to seat with mild abrasive such as metal polish is permitted, but great care is necessary to avoid scoring the seat. A narrow seating is less likely to cause leaking than a wide one.

OVERHAUL.

The life of an unloader valve varies considerably with different operating conditions but in course of time the valve may become partially choked with carbon or oily grit. Dismantling and cleaning restores serviceable condition unless the valves and bores are worn so much air tight seating is impossible. The non-return valve and bore usually wear first and if the slackness exceeds approximately .25mms. the parts should be replaced. It is essential both non-return valve and unloader valve move freely in their guides.

When testing an unloader on the bench it is essential to use a reciprocating compressor with not more than 3 metres of piping between the compressor and unloader. The unloader will not operate properly when connected to a shop air line where there is no pulsation of the pressure.

No lubrication of the valve is necessary between periods of overhaul but when assembling, the parts can be lightly smeared with lubricating oil.

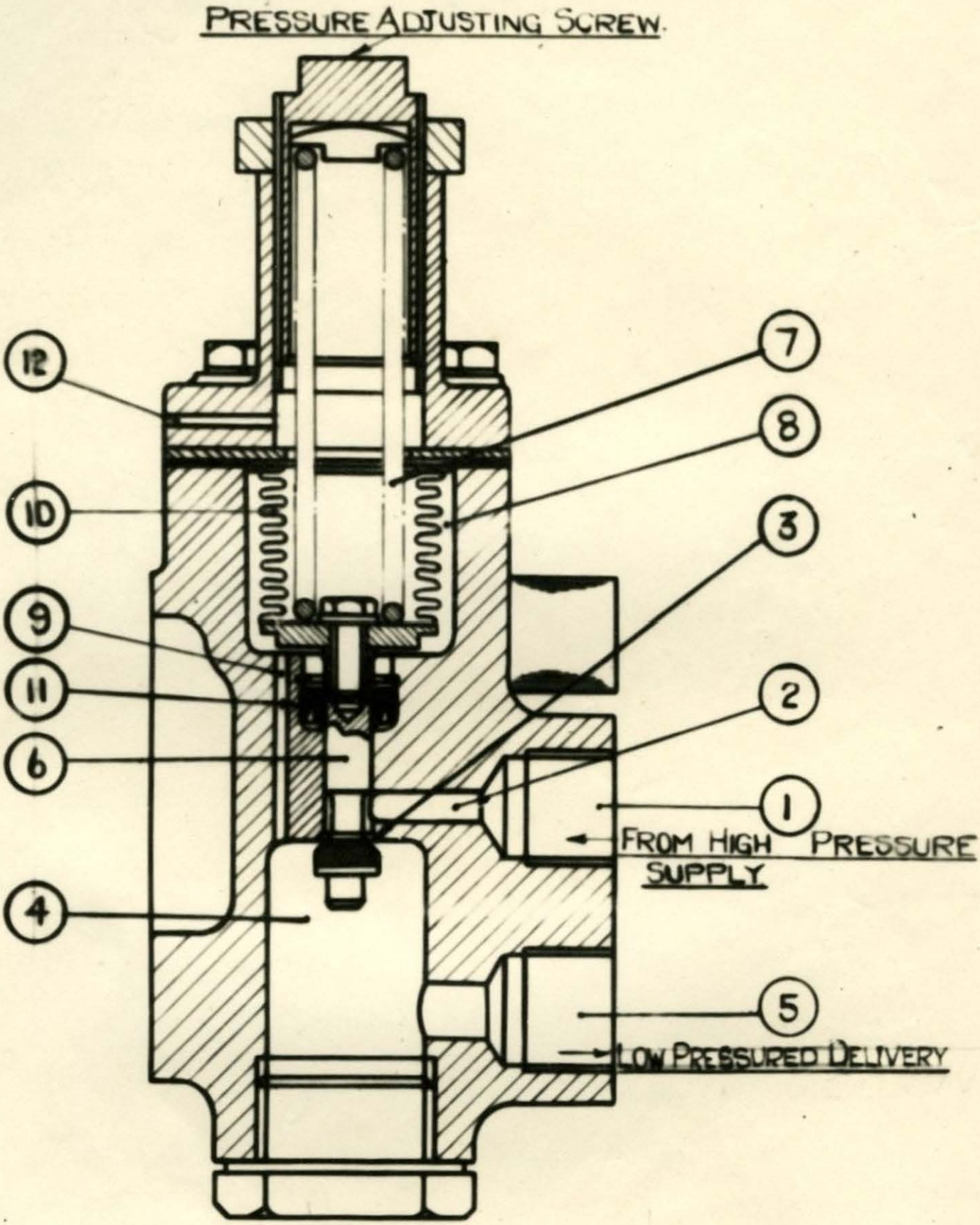
REDUCING VALVE FOR BRAKE SUPPLY AND FOR DOOR GEAR SUPPLY.

FUNCTION.

There are two reducing valves in the system, one between the reservoirs and the controllers and one in the feed to the door gear. The first ensures a constant pressure supply at 5 atmos. to the controllers in spite of variations occurring in the reservoirs due to the unloader range. The second provides a supply of air at low pressure, 1.5 atmos. for door gear operation.

DESCRIPTION OF OPERATION.

Referring to Fig.4. this shows a sectional view of the valve under conditions in which the door gear is receiving air from the high pressure reservoir I. Air enters the valve port (1) travels along drilled passage (2) past the valve seat (3) into the valve chamber (4) and to the door gear via connections (5). The valve (6) is held off its seat (3) by the action of spring (7), and pressure balance between



REDUCING VALVE

FIG 4

the valve chamber (4) and the bellows chamber (8) is maintained by transfer passage (9). When the pressure in the door gear reaches the pre-determined setting, air at this pressure acting on the bellows (10) via the transfer passage (9) causes the bellows to collapse and overcome the spring (7) closing valve (6) on its seat (3) cutting off the air supply from the high pressure reservoir; when air is used by the doors and pressure in chamber (4) fails the spring overcomes the action of the bellows and unseats the valve (6) admitting a further supply of air from the high pressure reservoir. A seal (11) around the valve stem is fitted to prevent leakage of high pressure air past the valve stem into the bellows chamber during the time when the valve is closed. Similar action takes place in the reducing valve feeding the brake controllers but the valve is set to give a higher pressure.

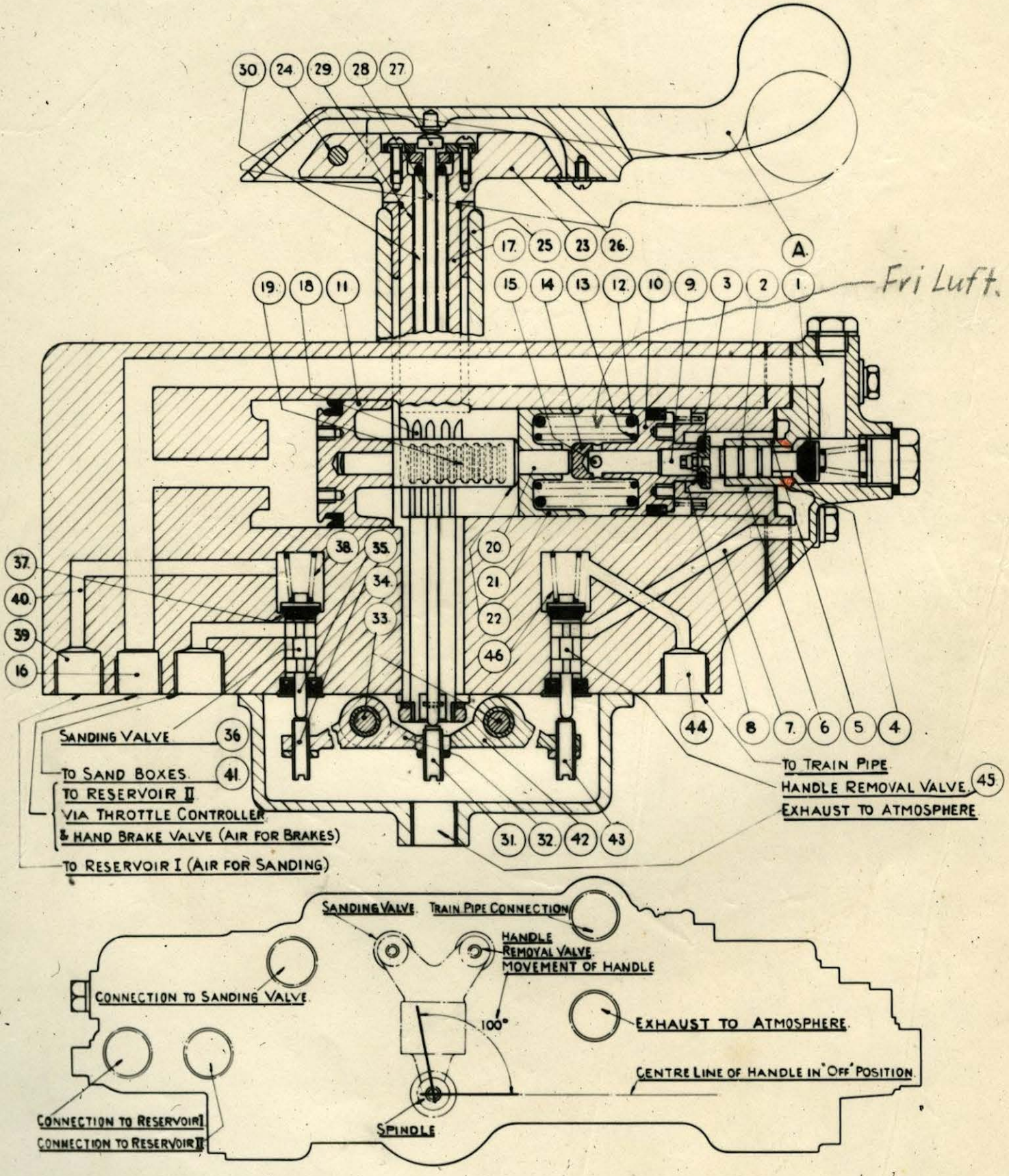
ATTENTION IN SERVICE.

This valve requires extremely infrequent service attention, occasional cleaning being all that is required. After long service the gland may be worn and require renewal or the valve head seat become deeply grooved in which case this also should be replaced.

Leakage through the breather hole (12) indicates a faulty bellows assembly and replacement of bellows is necessary. The valve can be adjusted by connecting between two reservoirs, the one having the lower pressure being fitted with accurate pressure gauge.

BRAKE AND SANDING CONTROLLER. FIG 5.

This control is duplicated at each end of the car and includes the means of applying the brakes and applying air pressure for sanding the rails. Removal of the control handle, renders the controller ineffective until the handle is re-affixed. A spindle protruding from the body of the valve carries at its lower extremity teeth which engage a rack on the valve spindle, and at the upper extremity provides means for attachment of the control handle, which is secured in position by a pin passing through the handle and spindle head. Rotary movement of the handle applies the brakes and downward pressure on the handle, whether or not rotation takes place, permits air pressure to be transmitted to the sand boxes. Within the valve body is a reaction valve, the components of which comprise an inlet valve (1) mounted on a stem (2) which carries a release valve (3)



WORMS EYE VIEW OF CONNECTIONS

SCHEMATIC LAYOUT - CONTROLLER - BRAKES & SANDING A.P.G.A. 1007E ETC.

FIG 5

The valve (1) seats on a fixed seat (4) and when in the open position, as shown in Fig. (5), allows compressed air to pass through the seating, through port (5) to an annular chamber (6) from which a passage (7) connects to a valve chamber in which is mounted the "Handle Removal Valve". The valve (1) is normally held off its seating to allow full pressure of air to be exerted in the ~~the~~ train pipe.

The release valve (3) abuts against an annular seating (8) and normally closes a passage (9) passing centrally through a piston (10) which is normally held in the position shown in Fig.5 by a piston (11) acting through springs (12) and (13). The extension (14) as well as containing the through passage (9) also has port (15) communicating with atmosphere.

The piston (11) is held in the operative position as shown, by compressed air which enters the valve housing by the connection (16) and since piston (11) is greater in diameter than piston (10) irrespective of the pressure in the supply line the piston (10) will always be held in the position shown until moved by the effort supplied from the operator through the control handle. The effort applied from the operator is transmitted through a vertical shaft (17) operated by the handle (A) which carries a pinion (18) engaging rack teeth (19) cut in piston extension (20). Springs (12) and (13) are interposed between the reaction piston (10) and a guide (21) which abuts against a shoulder (22) on piston extension (20). These springs, compressed or expanded by the movement of the handle (A) gives the operator effort as well as positional control in that they enable him to feel the increasing resistance to increased operation of the brake.

In Fig.5 the handle (A) is shown in the "Full Off" position in which the compressed air supply is acting on the piston (11) compressing springs (12) and (13) and imposing on the left hand side of the piston (10) a load in excess of the air pressure reaction in the annular chamber (6). These conditions cause the valve (3) to engage its seat (8) as shown. As the handle (A) is operated by partially rotating it, a position representing some intermediate pressure in the brakeline between maximum and zero is reached at which

the valve (1) is seated on its seat (4) and the valve (3) upon seat (8). Air pressure in the chamber (6) acting through the piston (10) would then oppose an equal and opposite force to that applied by the springs (12) and (13). These springs also exert a similar force on the rack (19) but this effort is less than the air pressure on the larger piston (11), the difference being represented by the load upon the pinion (18) through the handle (A). Any further rotational movement of the handle (A) tending to oppose the thrust from piston (11) diminishes the compression and hence the loading of the springs (12) and (13). In restoring the equilibrium between the springs and the air pressure the piston (10) moves momentarily to the left and releases a certain amount of air from the chamber (6) until the pressure in that chamber corresponds to the reduced thrust of the springs (12) and (13). This operation can take place an infinite number of times between the "Full Off" and "Full On" positions of the handle (A) resulting in a pressure fall in the chamber (6) and hence in the train pipe as the handle (A) is moved, between its extreme "Off" and "On" positions.

Movement of the handle in the reverse direction to that described causes the valve (1) to be lifted momentarily from its seat until the rising air pressure in the chamber (6) corresponds to the increasing effort transmitted by the springs (12) and (13) and in turn corresponding to the reducing torque applied by the rack (19) to the pinion (18).

The control handle (A) is pivotally connected to a head (23) on the vertical shaft (17) by means of a removable pivot pin (24). The pivot pin is normally held in position by a spring locking device but capable of removal by hand when control is to be transferred from one end of the rail car to the other. The shaft (17) is rotatably mounted in a fixed support (25) and is provided with a stop plate (26) which engages beneath the head (23) to prevent the handle being lifted upwards from the position shown.

To operate the rail sanding apparatus the handle is arranged to be depressed about its pivot pin (24).

This operation causes a stud on the underside of the handle to press upon the head (27) of a vertical rod (28) extending through a passage (29) within the vertical shaft (17). The rod (28) is thereby moved downwards against a spring (30) and causes the lower end of the rod, which is in contact with a tappet (31) mounted in one end of a pivoted lever (32) to rock the lever about its pivot (33). This causes a tappet (34) mounted in the other end of the lever (32) to lift a valve (36) normally engaging a seating (37) under the action of a spring (38).

Lifting of the valve (36) allows compressed air to pass from a port (39) connected to the inlet pipe (40) to an outlet (41) communicating with the sanding apparatus. When downward pressure on the handle is relaxed the springs (30) and (38) expand, the one restoring the handle (A) and rod (28) to their upper positions, and the other seating the valve (36) to shut off supply of compressed air from the sanding apparatus. By depressing and partially rotating the handle (A) the brakes and sanding apparatus can be operated simultaneously.

The pivoted lever (32) has a second branch (42) carrying a tappet (43) which bears upon the lower end of the handle removal valve (45) and normally maintains the valve off its seating. When the handle (A) is removed for transfer to the other end of the rail car, the rod (28) is raised slightly by the action of its spring (30). The pressure on the lever (42) is thereby removed allowing the spring (46) to seat the valve (45) and shut off the valve housing from the train pipe.

Attention in Service.

In normal service it is only necessary to lubricate the spindle from time to time. A lubricator nipple is provided and one or two "shots" with an oil gun every 10,000 kms. will provide sufficient lubricant.

Dismantling, cleaning and readjusting are desirable at intervals of approximately 100,000 kms. and when dismantled any worn piston seals or indented valve faces should be replaced. Re-assembling should be scrupulously clean and a smear of light oil is beneficial.

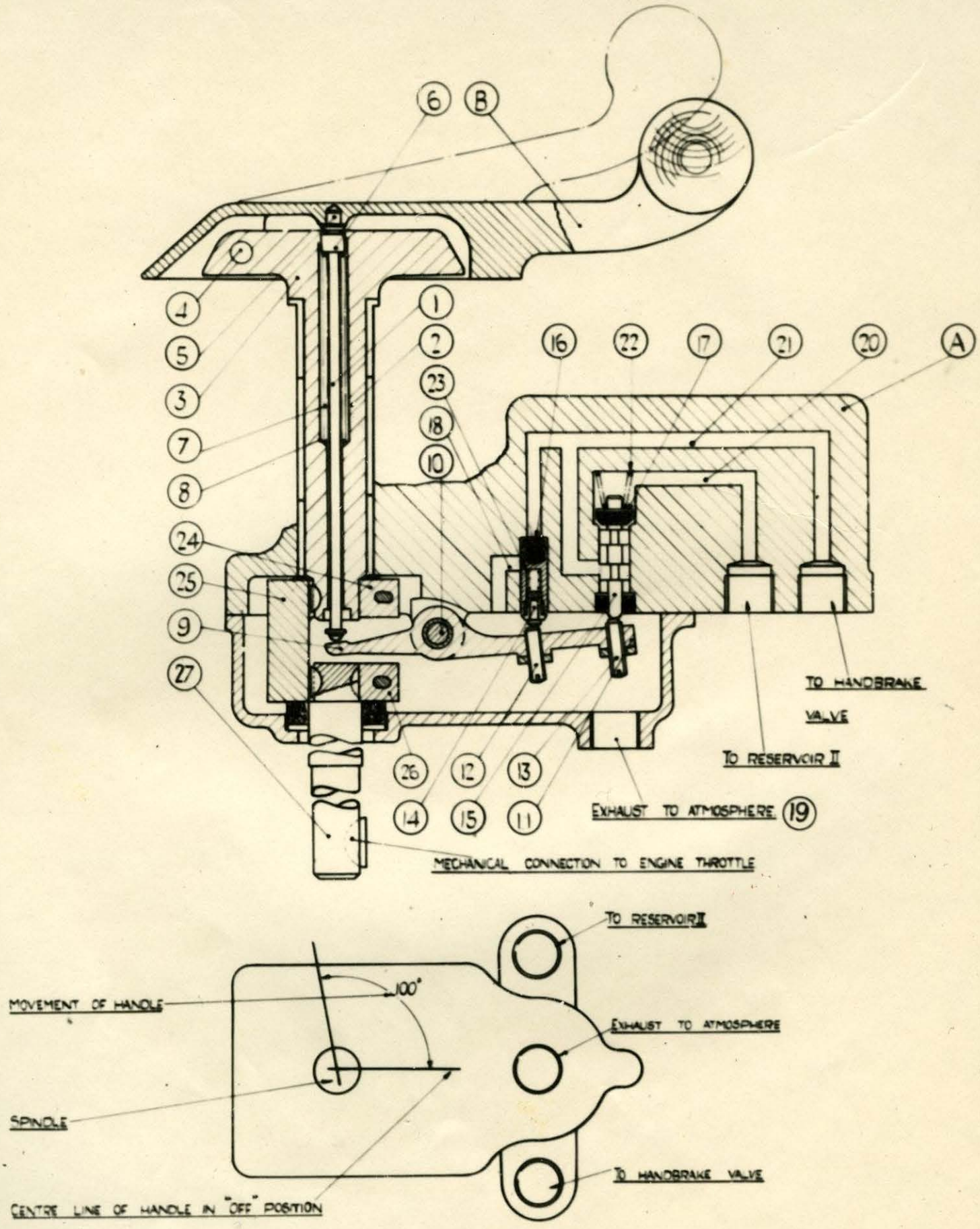
Regarding adjustments of the sanding and handle removal valves, these are not very critical but should be so arranged that only when the handle is depressed is air blown to the sanding equipment and only when the handle is actually removed should the removal valve be closed.

A full check to ascertain whether a brake controller valve is in good order may be made as follows:-

1. Check handle for correct position and movement (See Fig.5)
2. Check for clear passage of air through valves in open position.
3. Check valve operation as follows:-
   (a) Connect ports (16) and (39) to air supply through stop cock and pressure gauge.
   (b) Connect port (44) to second pressure gauge and when air supply rises to 5½ atmos. handle should attain the "Off" position and full pressure be recorded at port (44). Check that air passes freely through valve in this position. When handle is fully rotated in clockwise direction gauge at port (44) should not record pressure, this having fallen in proportion to the amount of clockwise rotation of handle. Check that air does not flow from port (41) and through gland of valve (45) during test.
4. Check that air passes freely from port (41) when handle is depressed.
5. With air pressure applied at port (16) remove handle and rotate stem by holding upper portion (23); full pressure should be recorded at port (44) but operator should not be able to release this air by counter rotation of stem.
6. Check valve for leaks by closing stop cock after applying pressure with handle in "Off" position. Gauges at (16) and (39) should not record a drop in pressure.

THE THROTTLE CONTROL VALVE AND DEAD MAN'S HANDLE.

The throttle control valve, figure 6 comprises a housing in which is arranged a vertical stem (1) movably mounted within a vertical sleeve (2) which is surmounted by a head (3) to which an operating handle (B) is pivotally mounted at (4). The underside



SCHEMATIC LAYOUT - CONTROL THROTTLE AND "DEAD MAN'S" VALVE

FIG 6.

of the operating handle carries a stud (5) bearing upon the head (6) of the stem (1) and depressing it against the action of spring (7) disposed between the head (6) and the base of a cylindrical recess (8) in the sleeve (2). The lower end of the stem (1) bears upon the end (9) of a lever, movable about a fixed pivot (10), and carrying at its opposite end (11) two tappets (12) and (13) to operate respectively stems (14) and (15) of valves (16) and (17).

The valve (16) is normally seated as shown, to cut off communication between a passage (21) and a port (19) communicating with atmosphere. The valve (17) is normally raised, as shown, to permit passage of compressed air from the supply pipe, to the pipe supplying compressed air to the hand brake valve via passages (20) and (21) within the valve housing. The valve (17) is lifted to the position shown in Fig.6. against the action of a spring (22) and a spring (23) is embodied within the operation of valve (16) to ensure its being held normally on its seating.

By the arrangement described the pivoted operating handle (B) has to be depressed from the broken line position to full line position before the brakes can be released and if the driver of the rail car relaxes his grasp of this handle for any cause the "Dead Man's Handle" function becomes operative as the spring (7) automatically lifts the stem (1) to a position in which the valves (16) and (17) are set for brake application. Such operation seats the valve (17) while the air pressure in the train pipe forces the valve (16) off its seating and exhausts the train pipe.

The control of the engine throttle is by partial rotary movement of the operating handle (B), this movement being transmitted through the sleeve (2), whose lower end engages a flange (24), formed integral with a link (25) and a flange (26). The flange (26) is fixed on a shaft (27) which is connected through mechanical linkage to the engine throttle.

In the operation of the throttle control valve the depression of the handle (B) closes valve (16) and opens valve (17) and allows compressed air to pass from Reservoir II via passages (20) and (21), the handbrake valve and the brake sanding valve

into the train pipe to release the brakes. This condition continues as long as the driver is depressing the operating handle (B) but should this handle be released the air supply to the brake relay valves is interrupted and the compressed air in the brake side of the throttle control valve is allowed to escape to atmosphere through the valve (16) and port (19) thus lowering the pressure in the train pipe and causing application of the brakes.

At the same time pressure is released from the throttle servo enabling its spring to close the throttle or operate the engine stopping device, thereby ensuring that the engine is stopped as well as the brakes applied in the event of the "Dead Man's Handle" being released.

To prevent momentary release of the "Dead Man's Handle" from affecting the brakes and to graduate to some extent the rate of their application, the passage (21) is reduced in area where it forms the seating for valve (16) this small seating forming a metering orifice and allowing 7 to 10 seconds delay in application of the brakes.

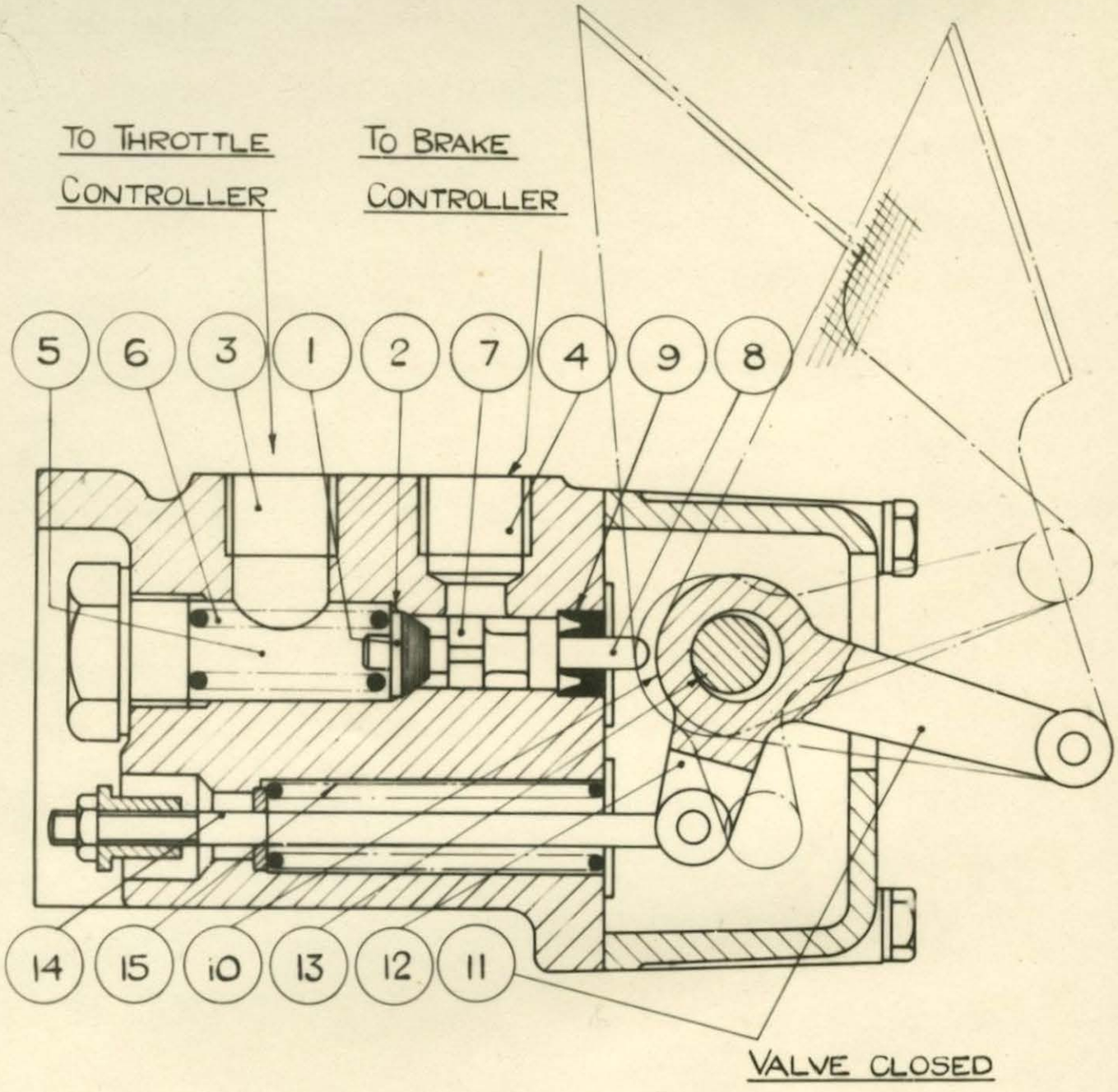
ATTENTION IN SERVICE.

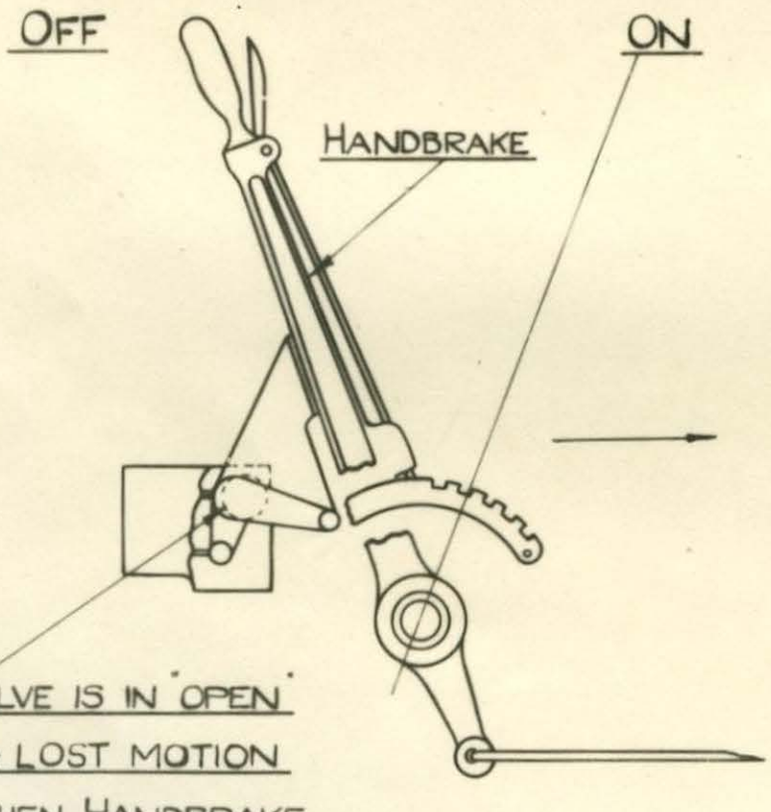
In normal service it is only necessary to lubricate the spindle from time to time. A lubricator nipple is provided and one or two "shots" with an oil gun every 10,000 kms will provide sufficient lubricant.

Dismantling, cleaning and re-adjusting are desirable at intervals of approximately 100,000 kms and when dismantled any worn parts or indented valves should be replaced. Re-assembling should be scrupulously clean and a smear of light oil is beneficial.

Adjustment of the valves and check for correct functioning is important and can be carried out as follows:-

1. Check handle for correct angular movement. The "Off" or anti-clockwise position must be in correct relationship to the holes in the mounting flange (See Fig. 6).
2. Check valve (17) is seated and valve (16) is approximately 1.0 mm. off its seat when "Dead Man's Handle" is in the released position.
3. Check valve (16) seats before valve (17) opens when handle is depressed. Valve (17) should be open approximately 1.5 mm. when handle is fully depressed.





NOTE:- VALVE IS IN 'OPEN' POSITION & LOST MOTION TAKEN UP WHEN HANDBRAKE IS IN 'OFF' POSITION.

HANDBRAKE VALVE FIG. 7.

4. Check for clear passage of air through valves in open positions.

5. Check valves for leaks by connecting port (20) to air supply through a stop cock, plugging gauge connection to connecting port (21) to pressure gauge. See that handle is in the released position and the pressure gauge should not register, nor any leak from valve (16), until the handle is depressed to the driving position. If the handle is maintained depressed and the stop cock in the air supply closed, the gauge should not indicate pressure fall.

THE HAND BRAKE VALVE (FIG 7).

The hand brake valve provides a means whereby the handle of the throttle control valve can be released without applying the air brakes and without stopping the engine. The hand brake valve mechanism is shown in detail in Fig.7 and includes a valve (1) co-operating with a seat (2) to open or close communication between the ports (3) and (4). The port (3) is connected to a chamber (5) in which is a spring (6) tending to seat the valve (1). When the valve is unseated communication is made between chamber(5) and chamber (7). The valve stem projects through a gland (9), which seals one end of chamber (7) and then is engaged by the base (10) of a bellcrank lever (11) and (12), this base having a lost motion mounting relative to the fixed pin (13). The arm (12) of the bellcrank lever is connected to one end of a rod (14) capable of absorbing, against spring (15) any movement of the bellcrank in excess of that permitted by the lost motion and after the valve (1) has been unseated. The arm of the bellcrank (11) is fitted with a plate shaped in such a manner as to contact the handbrake lever when it is in the "brakes off" position. When the handbrake is applied the lever ceases to contact the plate and the bellcrank is released allowing the valve (1) to seat and close air communication between ports (3) and (4).

The handbrake lever is arranged so that operation of the valve (1) takes place in the first movement of the lever from the "off" position. In this manner the operation is rendered independent of the state of adjustment of the Brakes. To avoid mal-operation the first few teeth of the quadrant are removed

so avoiding the lever being accidentally left in the "nearly off" position.

The handbrake mechanism serves several purposes, for example, it may be required to run the engine for warming up or testing and during that operation it is not desirable that a man should have to hold the handle (B) in the depressed position to prevent the "Dead Man's Handle" function from becoming operative. By applying the handbrake, the "Dead Man's Handle" function and that of the throttle control servo are interrupted. The handbrake also allows the driver of the railcar to leave the controls while at a station without stopping the engine, providing that before leaving the controls, he applies the handbrake.

The handbrake valve being connected between the "Dead Man's Handle" valve and the Brake and Sanding Valve, the supply of compressed air to the brake control is shut off when the handbrake lever is applied to allow the spring (6) to seat the valve (1).

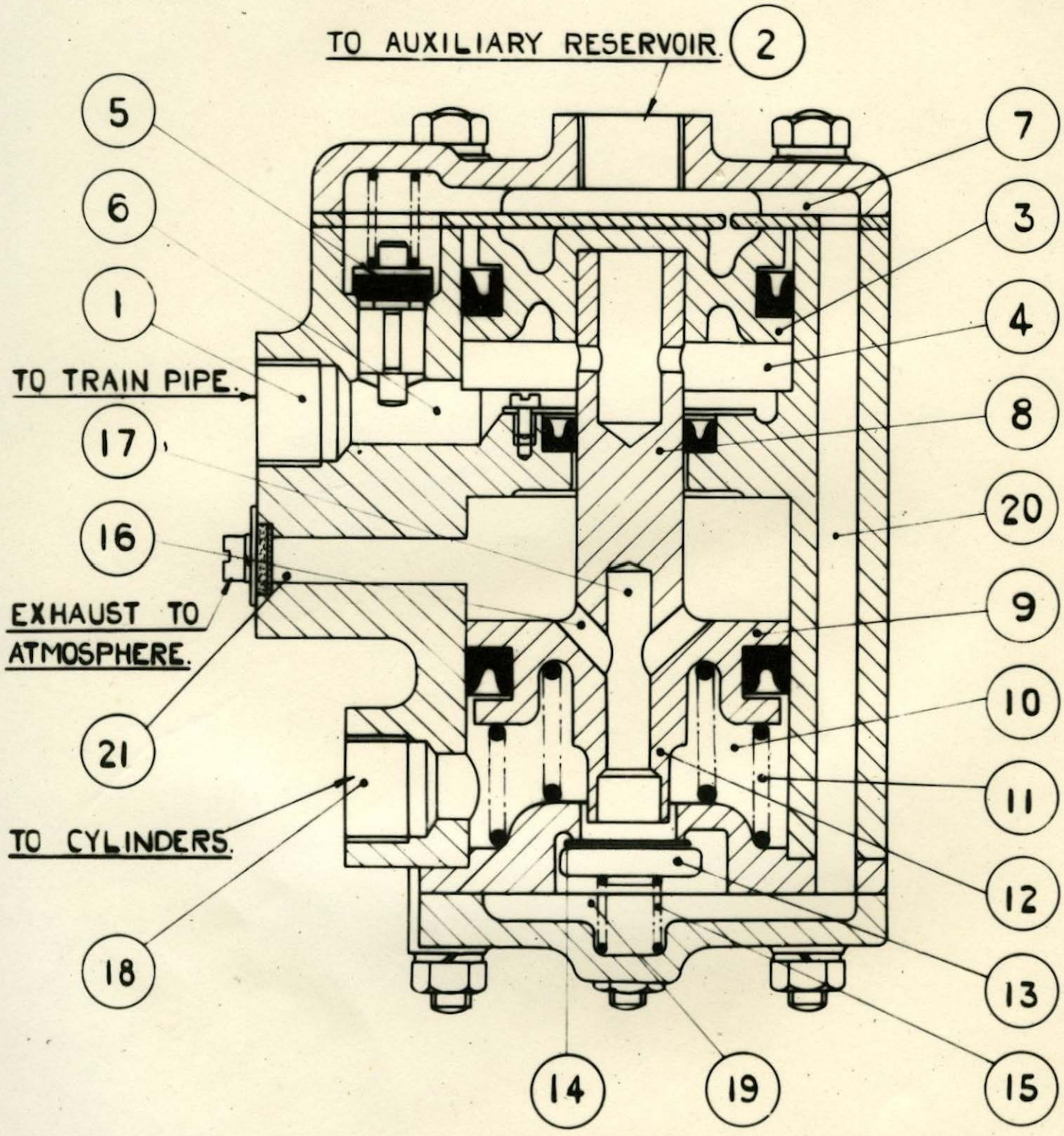
ATTENTION IN SERVICE.

The handbrake valve should require negligible attention in service, periodical cleaning and checking for adjustment or leaks being all that is necessary.

Owing to the position of the valve dust and grit may in time cause deterioration or defective operation and it is advisable to protect the valve as far as possible from the ready entry of dirt. The gland (9) will wear in time and when dismantling for cleaning it is advisable to renew this gland. If the valve seating is deeply indented the valve too should be replaced.

After dismantling and re-assembling the valve operation should be checked as follows:-

1. With air supply connected to port (3) no leak at port (4) should be apparent until valve (1) is lifted by operation of the bellcrank.
2. When the valve (1) is lifted there should be a clear passage from port (3) to port (4) allowing free flow of compressed air.
3. If port (4) is plugged there should be no leak of air at gland (9)



SCHEMATIC LAYOUT - INVERTED LINE VALVE.

FIG. 8

while the valve (1) is lifted and air supply connected to port (3).

4. The spring (15) should be of sufficient strength to enable valve (1) to be opened against a pressure of 8 atmos. at port (3). Check that this can be done. If it is not possible spring (15) has weakened and should be replaced. No adjustment of rod (14) will accommodate a weakened spring, this adjustment is provided to control the position of the bellcrank when the valve (1) is lifted and should be set to suit the handbrake lever travel on installation.

The Inverted Line Valve.

For applying the brakes an inverted relay valve, shown in Fig.8. is employed which is connected to the train pipe by the port (1) to the auxiliary reservoir by port (2). Within the housing is a piston (3) movable in a cylinder (4).

The port (1) communicates by way of a non return valve (5) with the auxiliary reservoir port (2) and also communicates freely with the lower end of the cylinder (4) by way of a port (6). When the air pressure in the train pipe is reduced, the reduction of pressure below the piston (3) allows the auxiliary reservoir pressure above piston (3) to push the piston and its piston rod (8) downwards. The piston rod also carries a second piston (9) in a cylinder (10). The pistons are biased to the upper position by springs (11). The piston has a central downward extension (12) to engage a valve (13) and to move it off its seating (14). The valve (13) is normally retained seated by spring (15). Exhaust ports (16) in the head of piston (19) communicate with a central passage (17) in the extention (12). A chamber (19) below the valve (13) communicates by a passage (20) with a chamber (7) at the head of the upper cylinder (4).

When the train pipe pressure is reduced by operating the handle (A) of the Brake Controller, the reduction in pressure below the piston (3) allows the pressure from the auxiliary reservoir acting above that piston to push the piston (3), rod (8) and piston (9) downwards. This operation seats the extension (12) on the valve (13) isolating the brake cylinder from atmosphere and moves the valve (13) off its seating (14) and allows air from the auxiliary reservoir

to pass from chamber (7) through passage (20), chamber (19) into the space below the piston (9), to the port (18) and brake cylinders thus causing operation of the brakes. When the pressure in the brake operating cylinder has risen to a value proportional to the decrease in pressure in the train pipe, the reaction of the piston (9)lifts that piston allowing valve (13) to close and restore equilibrium. The pressure in the brake operating cylinder is thus inversely proportional to the pressure existing in the train pipe. A rise in pressure in the train pipe reduces the downwards acting force on pistons (3) and (9) and allows some of the air from the brake operating cylinders to escape through an exhaust breather (21) communicating with the space above the piston (9), thus partially relaxing the brakes until equilibrium is restored. When the pressure in the train pipe becomes equal to or greater than that in the reservoir, the brake cylinders are fully released.

When no brake operation is taking place the auxiliary reservoir is charged by compressed air passing through the non-return valve (5), the chamber (7) and port (2).

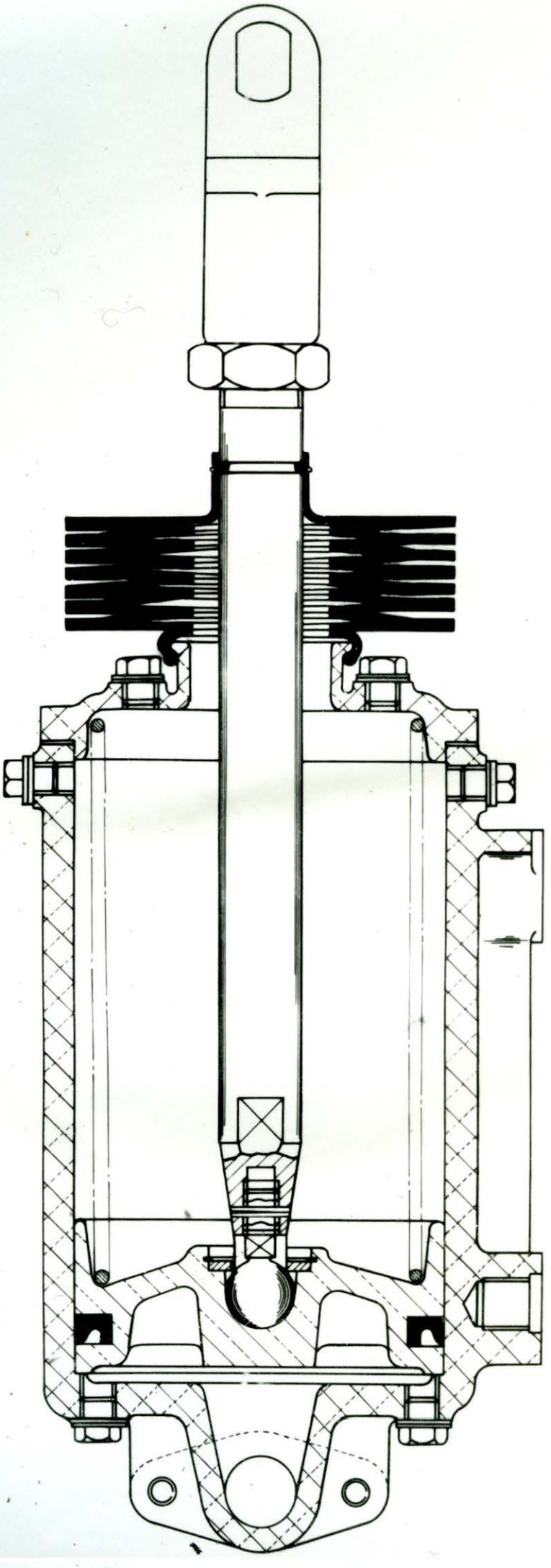
ATTENTION IN SERVICE.

This valve should need no attention in normal service except regular cleaning at intervals of say 100,000 kms.

When dismantling great care should be taken the sharp edges of the piston and gland seals are not cut or damaged. If any damaged seal is found this must be replaced or unreliable operation may result. On assembly lubrication with a smear of light engine oil is beneficial.

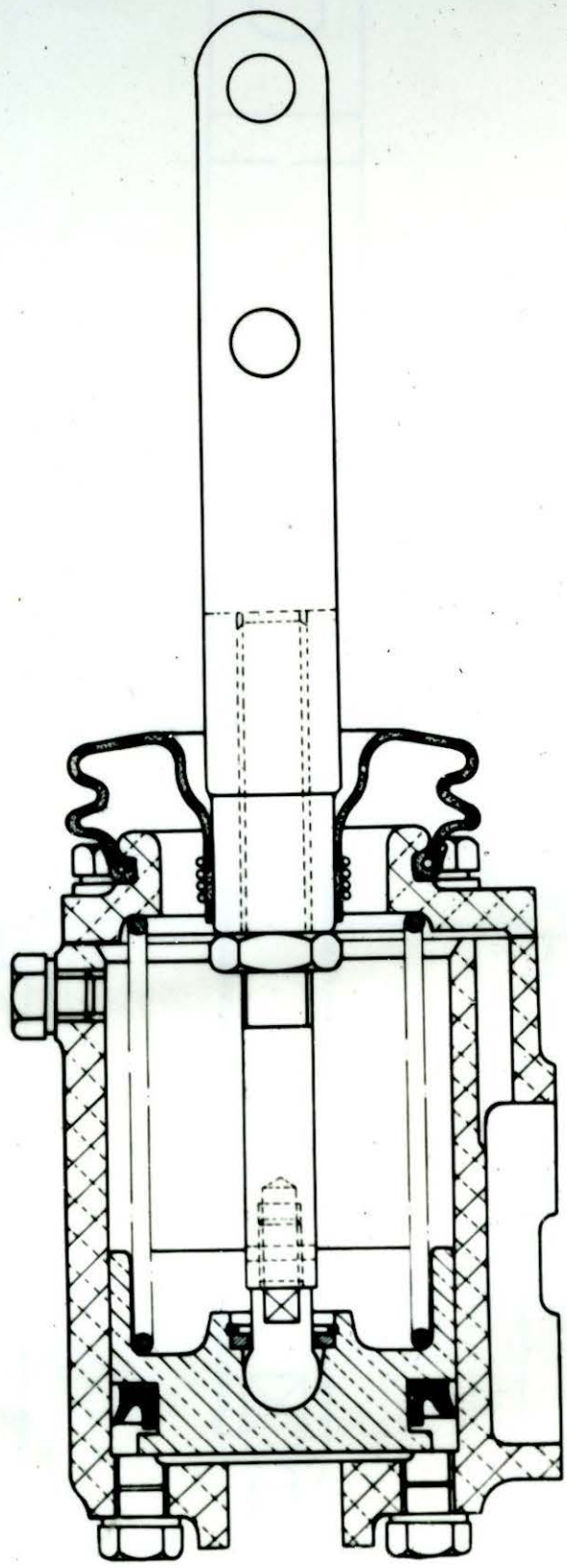
after assembly the valve can be checked for correct operation as follows:-

1. Connect a small reservoir with pressure gauge to port (2) and a source of air pressure supply with stop cock and gauge to port (1). Admitting air to port (1) should charge the reservoir to within 0.35 atmos. of the supply pressure and removal of the supply connection should leave the reservoir fully charged and without leak if cylinder connection (18) is plugged. The reservoir should be charged to - and observed at 5 atmospheres.



BRAKE CYLINDER

FIG. 9.



BRAKE CYLINDER

FIG. 10.

2. Restoration of air supply to port (1) should exhaust the small amount of air contained in space (10) via the exhaust opening (21) to atmosphere. While full pressure of 5 atmos. is maintained in the supply connection to port (1) there should be no slight leak from the exhaust opening.

3. If a pressure gauge is connected to port (18) and the pressure to port (1) is raised and lowered (between the limits of 0 and 6 atmos.) then the pressure registered at port (18) should vary inversely with the supply pressure.

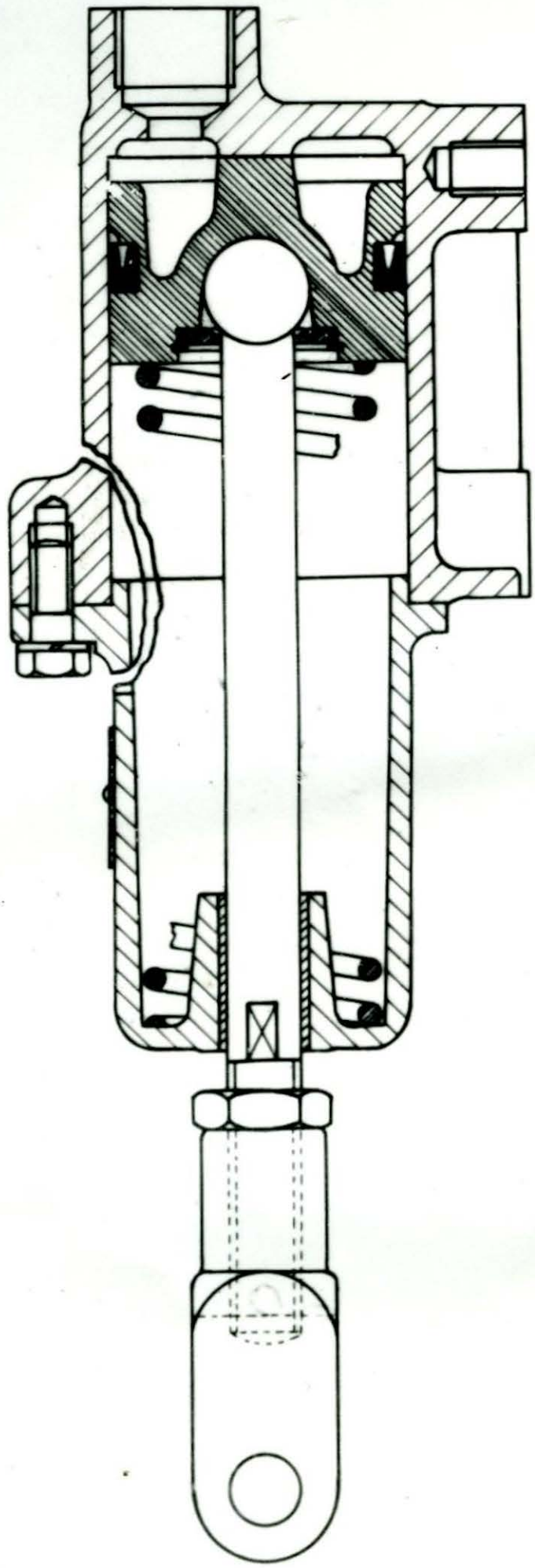
When the supply pressure to port (1) is reduced a slight fall is permissible before pressure rise is indicated at port (18) but rise should occur by the time the pressure at port (1) has fallen from 5.5 atmos. to 4 atmos. If pressure rise at port (18) does not commence at 4 atmospheres at port (1). then the valve is incorrectly assembled or is unnaturally stiff.

BRAKE CYLINDERS. (Figs. 9 & 10).

The brake cylinders are the means of converting the stored energy in the air system to mechanical energy for brake operation. The construction consists of an aluminium body in which is incorporated the means of mounting the cylinder on the vehicle and formed in the body is the cylinder proper fitted with a sliding piston sealed by a piston ring of synthetic rubber of special section. The thrust from the piston is carried by a push rod, the outer end of which is attached to the brake operating lever. The atmospheric side of the piston is vented to atmosphere in the case of the larger cylinders through a felt element and the smaller units (fig.10) by vents to the hollow fixing feet.

ATTENTION IN SERVICE.

The only attention in service required by the brake cylinders is lubrication. It is recommended that at 100,000 kms. intervals approximately 150 cc. of oil for the larger cylinders and 50 cc. of oil for the small cylinders, should be inserted into the brake cylinder. This oil should be of the same general type as heavy grade engine oil and can be inserted via the breather openings.



THROTTLE CLOSING CYLINDER.

FIG. 11.

THROTTLE CLOSING CYLINDERS. (FIG.11).

This unit is very similar in construction to the brake cylinders except that the piston is opposed by a strong spring. The spring itself provides the energy to stop the engine thus any failure of air prevents continued operation of the engine. The normal running position is with the piston rod extended, the spring being overcome by the air pressure from the controllers. Servicing should be similar to the small type brake cylinders.

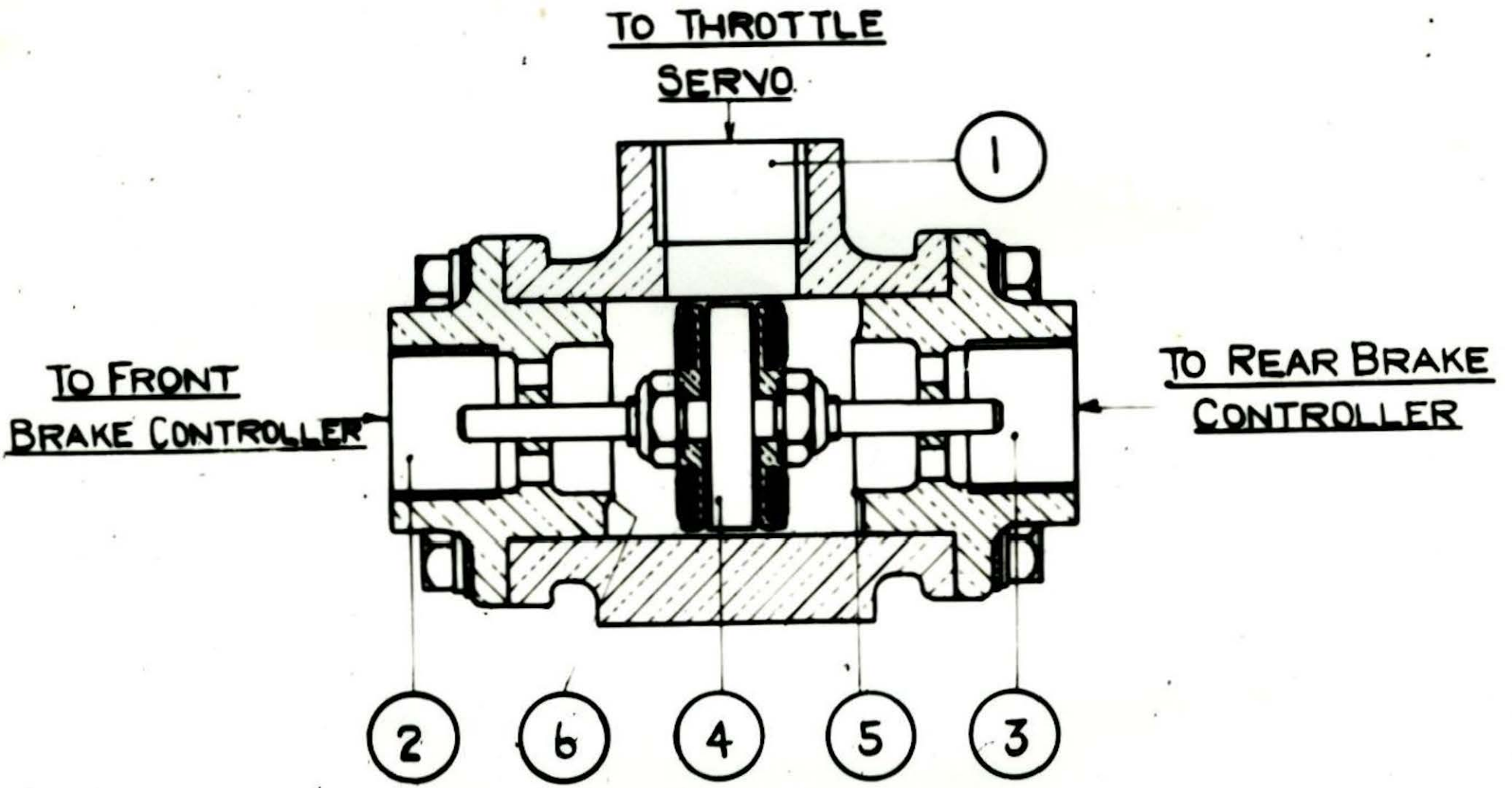
EMERGENCY VALVES FOR EMERGENCY OPERATION OF DOOR OPERATING GEAR AND EMERGENCY BRAKE OPERATION.

These valves are situated in the train pipe and in the air supply for operation of the door gear, sanding and hooters.

The valve consists of a body housing, a valve which seats under pressure of a spring, and the action of the air pressure. The end of the valve stem, abuts an eccentric spindle, which is capable of rotation by a hand lever.

Under normal conditions, the hand lever is in the "valve closed" position at 90 to a line formed by the pipe connections and in this position the valve is seated. When it becomes necessary to employ emergency operation the hand lever is moved through 90 to the valve open position and by so doing the eccentric on the spindle lifts the valve from its seat and permits pressure from the train pipe or from the supply pipe to escape to atmosphere. In the case of emergency "brake application" a reduction of pressure in the train pipe causes automatic operation of the brakes and in case of emergency "door operation" exhaustion of the air from the supply line permits opening of the doors by hand. It is important the valve is connected with the air flow in the correct direction.

The valve should require no attention in service except occasional cleaning. When dismantling the valve for cleaning of the seat, the internal parts should be coated with a light film of engine oil before assembly. Great care should be taken during assembly to ensure the open and closed positions of the valve correspond with the same positions as shown by the hand lever.



CHANGE OVER VALVE

FIG. 12

CHANGE-OVER-VALVE (FIG.12).

The change-over-valve is an important item of the equipment in that is permits the stopping of the engine to be achieved by a single throttle control cylinder although the air fed to this cylinder comes from two sources which must not interconnect. The side port (1) communicates with the throttle cylinder and the end ports (2) and (3) with the front and rear brake controllers respectively. When the handles are on the brake controller connected to port (2) air enters port (2) pushes piston (4) along to seating (5) and seals the air from escape via port (3). When controlling from the opposite end of the railcar the reverse action takes place, the piston (4) resting against seating (6).

ATTENTION IN SERVICE.

This valve is a little apt to be sensitive to particles of dirt and scale in the system, and although the unions are fitted with small gauze filters it is advisable to dismantle and clean at intervals of approximately 20,000 kms. When the air lines are disconnected at the valve for this purpose it is advisable to blow air through to remove any dirt or scale lodging in the pipes. This can be effected by putting the handbrake lever in the "off" position and depressing the "Dead Man's Handle" for two or three brief periods. Changing the controller handle to the other end of the car and repeating will clear the other side of the pipe lines.

FAULT FINDING TABLE.

(1) Slow Build Up of pressure in reservoirs.

(a) Check cleanliness of felt element in compressor air filter and clean in petrol or replace as required.

(b) Leakage of piping or connections between the compressor and reservoir. Check by applying soapy water to all joints with compressor pumping.

(c) Leakage of air from reservoirs or from remaining portions of equipment. Check by charging reservoirs then stop engine and compressor and remove controller handles leaving controllers at both ends of car without handles. Watch pressure gauge and if pressure drop exceeds 0.25 atmos. in

10 minutes examine reservoirs, connections on same and piping via reduction valve from reservoirsto controllers and to door gear. Listen to detect any air leakage. If this test is satisfactory replace handles on one pair of controllers and if greater leak occurs then examine remainder of piping. If when handles are replaced on one pair of controllers an air leak is heard at the throttle controller at the remote end of the car then the change-over valve (Item 22) should be dismantled, examined for dirt and cleaned.

If the door gear lines are suspected of leaking remove connection from Reservoir I and replace by plug and re-test as above. If no leak then occurs the door gear valves and units should be inspected individually.

(2) Loss of Pressure from Reservoirs.

Treat as in (c) above.

(3) Failure to Unload the Compressor.

(a) Connections between compressor and unloader or unloader itself fouled with carbon deposit. Dismantle, examine clean and replace (see description for details of unloader setting.)

(b) Tightness of unloader valve due to dirt or carbon. Dismantle and clean.

(4) Continual Leak at Unloader Exhaust Port.

Seating of unloader valve damaged by dirt or tightness of unloader valve. Dismantle and clean and grind in valve with metal polish or light grinding medium as required. Examine also the seating of the non-return valve in the unloader.

(5) Brakes apply themselves and engine stops with vehicle running.

(a) Emergency application valve opened - close again.

(b) Insufficient air pressure available - See Items 1 or 2.

(c) Leakage from train pipe or reservoir - see Items 1 or 2.

(6) Engine Stops while vehicle is standing.

(a) Leakage of air from pipe line between handbrake valve and cylinder for throttle control including change-over-valve. The volume of air isolated in this section of the system by

the application of the handbrake is small and a slight leak soon lowers the pressure and allows the throttle controlling cylinder to stop the engine. Most probably the leak is through the change-over-valve, because of dirt or pipe scale collected on the seatings. Cleaning of this valve should restore normality but if not examine piping joints of the isolated section at the end of the car where the fault is evidenced.

The nuisance of this defect, if occurring in service can be avoided by depressing the "Dead Man's Handle" and releasing the handbrake lever for a few seconds to re-charge with air the isolated section, before its pressure has fallen low enough to allow the engine to be stopped.

(7) Low Air Pressure on Reservoir Gauge.

The available pressure indicated on the dash gauge should be 5 atmos. If this is low it may be due to defects as items 1 or 2 or it may be due to incorrect setting of the reduction valve (26). Re-adjust valve as necessary after checking gauge is not defective.

(8) Brakes Fail to Release.

(a) Handbrake has not been released. Note that air brakes cannot release until released handbrake opens the handbrake valve.

(b) Insufficient air pressure available in Reservoir II.
Run engine for longer period to generate higher pressure.
If this is not effective examine for leaks as under items 1 and 2.

(c) Too much air may have been used for door operation, hooter or sanding and this may have to be replaced before sufficient pressure can be generated in train pipe to release the brakes.

(d) Couplings between cars or coupling cocks may have been left open.

(e) Inverted line relays (Item 10) may be tight due to dirt or long period without cleaning and lubrication. Dismantle clean and lubricate lightly.

9. Brakes Fail to apply at release of "Dead Man's Handle."

The "Dead Man's Handle" valve is dirty and is sticking against its seating (see parts 14 & 16 on Fig.6). The release of this valve should be checked frequently and cleanliness observed.

10. Brakes Fail to apply by Controller Handle.

(a) Sticking inverted line relay valve (Item 10). See 8.e.

(b) Sticking piston in main brake controller. This can be checked by opening a coupling cock or emergency valve which will apply brakes. Dismantle controller, clean, lubricate lightly and replace.