AIR BRAKE COURSE NOTES
(FOOTPLATE STAFF)

FEBRUARY 1980

COURSE NOTES.

AUTO AIR BRAKE COURSE FOR FOOTPLATE STAFF.

INDEX

Contents.

These notes have been prepared for the guidance of staff and are to be used as a supplement to official publications available concerning Rules, Regulations and specific equipment.

TWO PIPE AIR BRAKE SYSTEM (INTRODUCTION).

REASON FOR SYSTEM.

An air brake system is by far superior to the conventional vacuum brake system in that:-

(a) Brake applies q .

(b) Brake is quicker to release.

(c) The brake more or less applies evenly throughout the train and also releases evenly as well.

(d) The braking force at the front and rear of the train are very much the same. (No tendency for the front part of the train to come to rest while the rear half of the train would still be moving, a cause of possible derailment or damage on a very long vacuum braked train).

(e) A need to run much longer trains, especially in view of the already high line occupation on most running lines, plus a need to also increase the speeds of freight trains.

(f) The anticipated interchange of traffic with the Continent.

DESCRIPTION OF TYPES OF SYSTEMS.

Continental system - This system which is U.I.C. (International Union of Railways) approved and consists of a one-pipe system, namely the Brake Pipe whose duty is to connect the locomotive driver's brake valve to the vehicle brake distributor (described later) and also charge up the brake supply reservoirs. The brake is held released at 72.5 p.s.i. and fully applied when the brake pipe pressure is lowered to 48.5 p.s.i. Provisions are made for the driver to increase the brake pipe pressure much higher than 72.5 p.s.i. The system also provides for individual vehicle brake isolation.

B.R. Two Pipe system - The two pipe system is also U.I.C. approved and consists of a brake pipe and a main reservoir pipe. The main reservoir pipe is charged from the locomotive main reservoir via a pressure control valve to 100 p.s.i., and is used to charge the brake supply reservoirs (auxiliary reservoir) via an isolating cock, check valve, strainer and choke, (described later). The brake pipe is used to connect the locomotive driver's brake valve to the vehicle brake distributors.

APPRECIATION

AIR BRAKED TRAINS

The brake equipment on these trains is designed so that they may be operated as on a one pipe system or a two pipe system.

When working with the one pipe system, the brake pipe is used to charge the brake distributors and their associated control and auxiliary reservoirs.

The brakes are released when the brake pipe is charged to a nominal 72.5 p.s.i.

A brake application is made by reducing the brake pipe pressure to some value between 72.5 p.s.i. and 48.5 p.s.i. the braking effort being controlled by the distributors and is proportional to the reduction in brake pipe pressure. The maximum braking pressure in the brake cylinders is 55 p.s.i. and is obtained when the brake pipe pressure is reduced to 48.5 p.s.i. The maximum pressure of 55 p.s.i. is not exceeded when an emergency brake application is made by reducing the brake pipe pressure to zero.

A partial release of the brakes is obtained by increasing the brake pipe pressure to any value between 48.5 p.s.i. and 72.5 p.s.i. At 72.5 p.s.i. the brakes are again released.

The one pipe system has the disadvantage of requiring the brake pipe to charge the auxiliary reservoirs during release of the brakes. This is particularly disadvantageous when working long trains when there would be some appreciable delay in completely releasing the brakes.

With the two pipe system, the brake pipe functions in the same manner as for the single pipe system. The additional pipe, the main reservoir pipe, ensures that the auxiliary reservoirs are constantly charged during application and release of the brakes.

The two pipe system has the distinct advantage in that when the brakes are released, it is only necessary to re-charge the brake pipe, the auxiliary reservoirs having been maintained fully charged from the main reservoir pipe. Thus the brake release is more rapid.

In the event of a defective Main Reservoir Pipe trains equipped with the two pipe system may be worked with the brake pipe only.

An isolating cock is provided in the Main Reservoir Pipe connection to the Auxiliary Reservoir on each vehicle.

An isolating cock is also provided in the brake pipe connection to each distributor. The normal operative position of this cock is when the handle is pointing vertically downwards. Should it be necessary to isolate the brake on a vehicle, this handle should be turned to the horizontal position and the release valve operated.

On some bogie vehicles the distributor does not supply air directly to the brake cylinders but to two load proportional relay valves, one to each bogie, which control the admission of air from the auxiliary reservoirs to the brake cylinders.

A feature of the load proportional relay valves is that they control the braking effort of individual bogies according to the load they carry. Thus the braking effect is the same for loaded, partly loaded or empty vehicles.

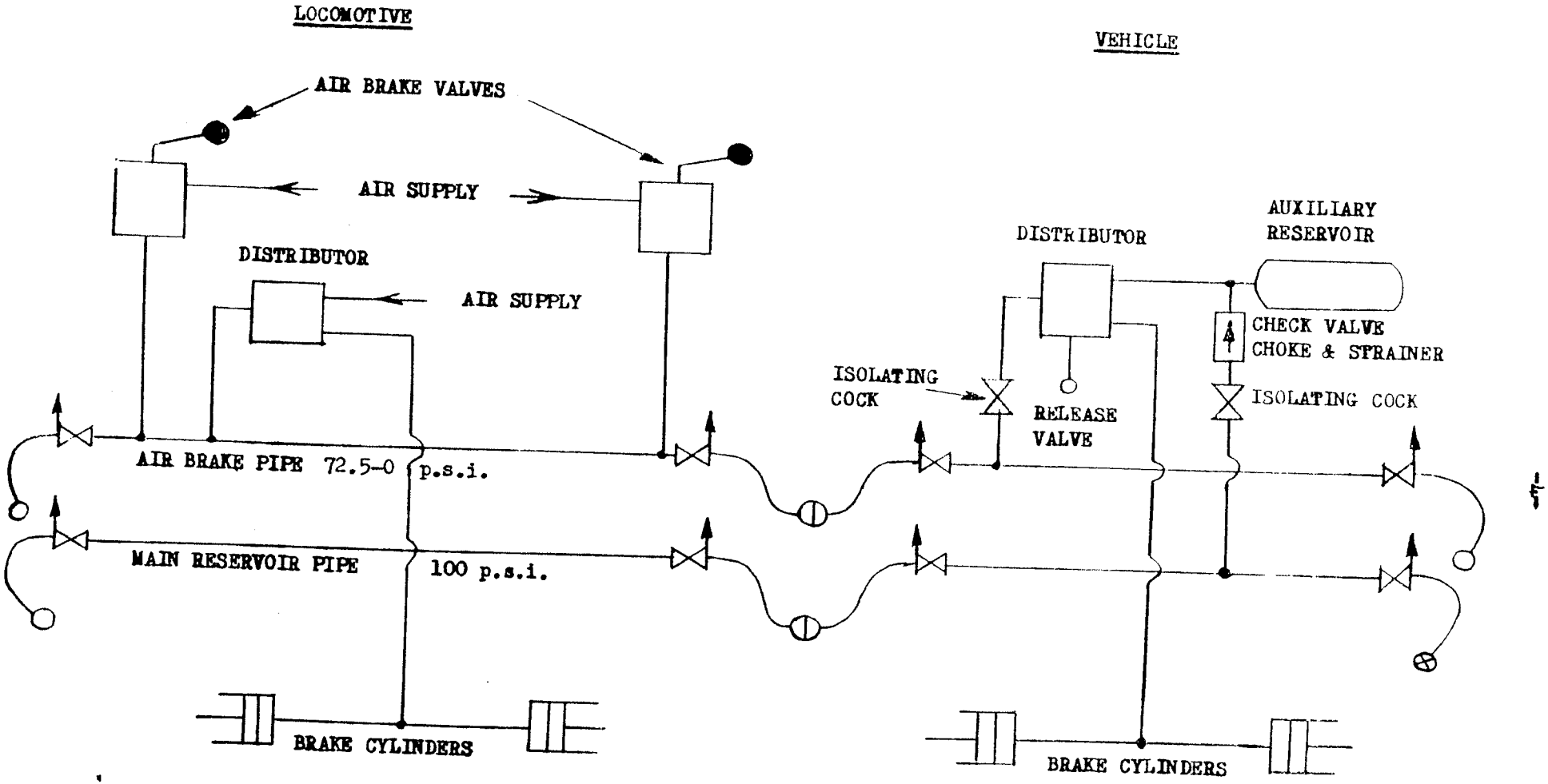
Locomotives equipped to work air braked trains have the following air connection at each buffer beam.

(1) The brake pipe, isolating cock and connecting hose with a 1" end coupling. Cocks and couplings coloured RED.

(2) The main reservoir pipe, fitted with an isolating cock, connecting hose and $\frac{3}{4}$" end coupling with sealing valve (this has two branches on Diesel locos). This pipe serves two purposes:-

(a) As the main reservoir pipe when working air braked trains.

(b) As a means of passing air from one loco. to another when coupled to other locos. Cocks and couplings coloured YELLOW.



SIMPLE TWO PIPE AUTOMATIC AIR BRAKE SYSTEM

DUAL BRAKED LOCOMOTIVES SYSTEM.

The brake system is designed so that the locomotive is capable of providing the following braking efforts:-

1. Independent Locomotive Air Brake.

   This braking effort is directly controlled by the driver by means of the straight or direct air brake valve. It is effective only on the locomotive on which the brake valve is operated. It is NOT effective on any locomotive which may be coupled in multiple or tandem.

2. Proportional Locomotive Air Brake.

   This braking effort is governed by, and is proportional to, the degree effort applied on the train the locomotive is hauling, whether air braked or vacuum braked.

3. Air Braked Trains.

   An air brake pipe is provided to enable the locomotive to work trains equipped with the air brake. Usually a second compressor and additional reservoir capacity are provided on locomotives.

4. Vacuum Braked Trains.

   A vacuum brake pipe is provided to enable the locomotive to work trains equipped with the vacuum brake. Exhausters are provided to evacuate the vacuum brake pipe.

The Driver's Automatic Air Brake Valve.

An automatic air brake valve is provided in each driving cab and controls the braking of air braked trains or vacuum braked trains by regulating the pressure in the locomotive air brake pipe. It directly controls the braking of air braked trains and through the medium of an air-vacuum relay valve, controls the braking of vacuum braked trains.

The automatic air brake valve has the following operating positions:-

"Release".

(a) Air Brake Train Working.

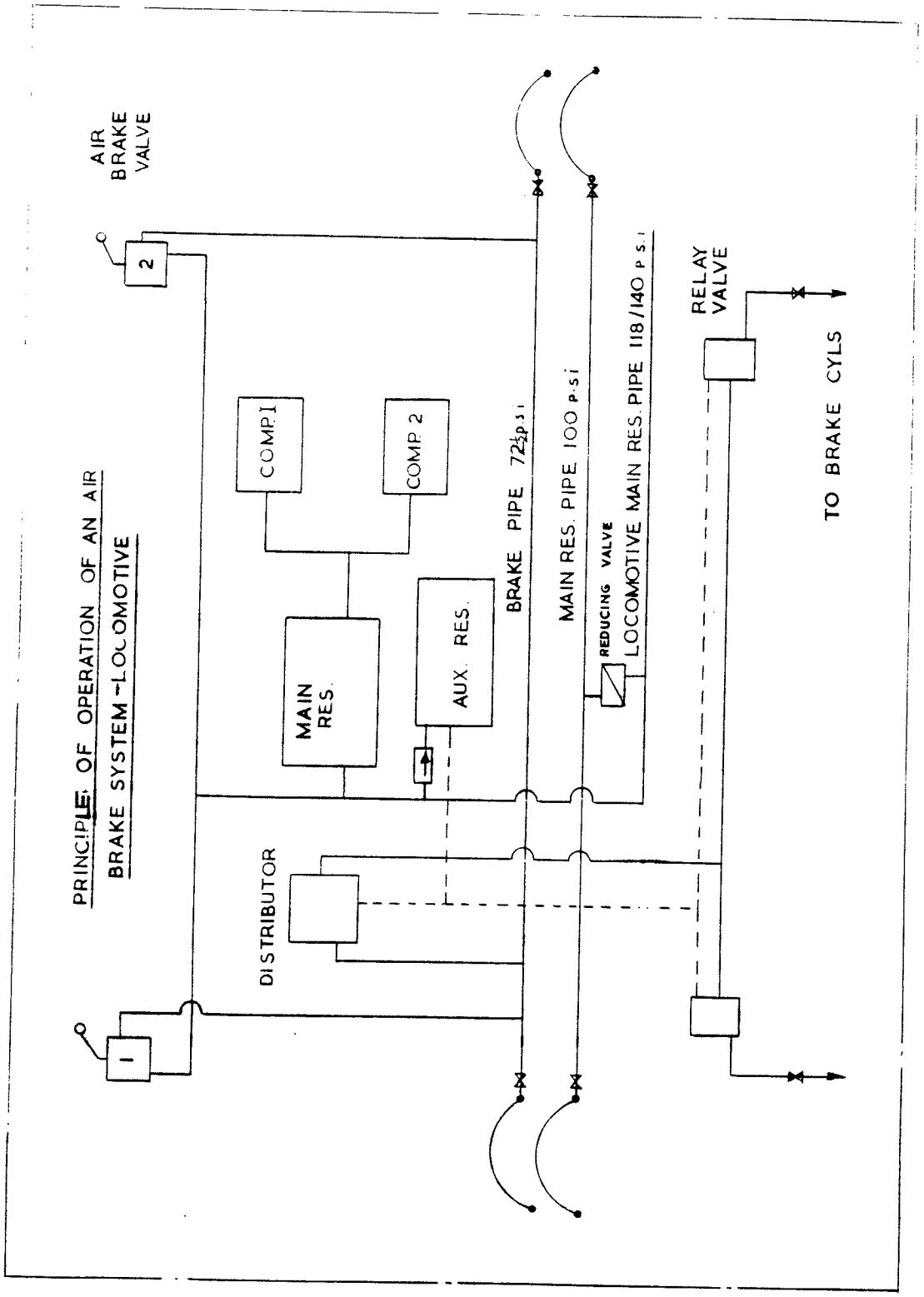
This position must always be used after a continuity test on attaching to a train, vehicle attachment or attaching locomotive to rear of train, and must be held in this position for a minimum of 60 seconds. The brake pipe is rapidly raised to approx. 78.5 p.s.i. to ensure a complete release of the air brake.

When the valve is returned to the "Running" position the brake pipe falls at a controlled rate to 72.5 p.s.i. known as "bleed down".

If a brake application is made during the "bleed down" time, the handle must be placed in "Release" once again for the requisite period.

(b) Vacuum Brake Train Working.

This position provides Exhauster Speed Up for rapid re-creation of vacuum in the vacuum brake pipe.


PRINCIPLE OF OPERATION OF AN AIR BRAKE SYSTEM - LOCOMOTIVE
AIR BRAKE VALVE
2
1
COMP 1
COMP 2
MAIN RES.
AUX. RES.
DISTRIBUTOR
BRAKE PIPE 72½ p.s.i
MAIN RES. PIPE 100 p.s.i
REDUCING VALVE
LOCOMOTIVE MAIN RES. PIPE 118/140 p.s.i
RELAY VALVE
TO BRAKE CYLS

Note: It is important that the brake valve handle be guided from "Release" into "Running" position. If the handle is allowed to spring back from "Release" it can result in the handle moving into a braking position causing the brake pipe to fall below its nominal "Running" pressure of 72.5 lb/sq.in. This will cause "dragging" brakes.

"Running".

The air brake pipe is maintained at the nominal 72.5 p.s.i. when the air brake is released and also, when working vacuum braked trains, the vacuum brake pipe is evacuated to 21" and the vacuum brakes released.

"Initial" (or First Application).

When a brake applica[illegible] be made the valve handle should be moved to at least this positio[illegible]nd according to the degree of braking required). The air brake pipe pressu[illegible]s reduced to 65.5 p.s.i. and brake distributors on the train "set". The valve handle must be moved directly to this position from the "Running" position. It must not be held in an intermediate position between "Running" and "Initial". When working vacuum braked trains, vacuum brake pipe is reduced to approximately 16" hg.

"Full Service".

The air brake pipe pressure is reduced to 48.5 p.s.i. which gives a full brake application when working air braked trains and vacuum brake pipe is reduced to zero when working vacuum braked trains. Between the "Running" and "Full Service" positions there will be a reduction in air brake pipe pressure from 72.5 p.s.i. to 48.5 p.s.i. according to the degree of movement of the brake valve handle and, on air braked trains, a brake application proportional to the reduction in air brake pipe pressure.

No lap position is provided as the valve is self lapping anywhere between the "Initial" and the "Full Service" positions both in application and release. When working vacuum braked trains there will be a reduction in vacuum brake pipe proportional to the reduction in air brake pipe pressure between 72.5 p.s.i. and 48.5 p.s.i. The air vacuum relay valve is self lapping both in application and release.

"Emergency".

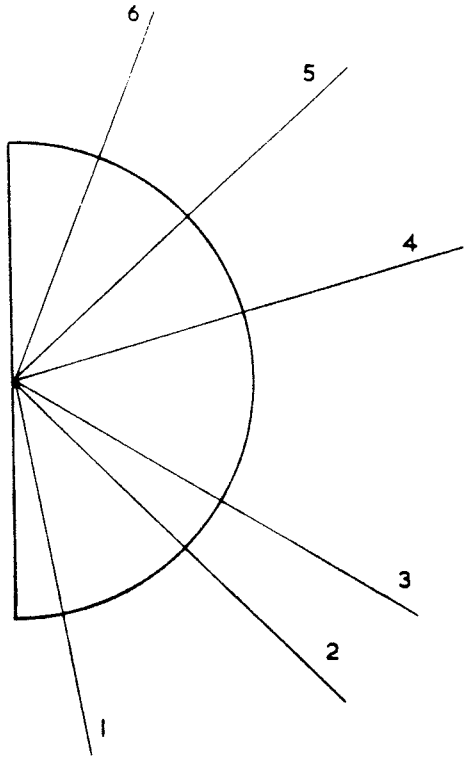
The air brake pipe is vented direct to atmosphere and the pressure reduced rapidly to zero resulting in a rapid and full air brake application throughout air braked trains.

When working vacuum braked trains the valve directly admits atmospheric air into the vacuum brake pipe ensuring a rapid and full vacuum brake application.

"Neutral" (or Shut Down).

This position can only be obtained by raising a locking pin. It is important (except where instructions are issued to the contrary) that the automatic brake valve is secured in this position in all non-driving cabs. In this position the brake valve neither charges up nor vents the air brake pipe.

When changing ends the brake handle in a driving cab must be first placed in "Emergency" until all brake pipe pressure is destroyed before being placed in "Neutral". If this is not done it is possible to retain air brake pipe pressure leaving the locomotive and train brake not fully applied.



HANDLE POSITION FOR DRIVER'S AUTO AIR BRAKE VALVE.

No.	BRAKE VALVE POSITION	B / PIPE PRESSURE	VACUUM B/PIPE	TYPICAL PRESSURES FOR LOCO BK/CYLS	TYPICAL PRESSURES FOR VEHICLE BK/CYLS
1	RELEASE	78·5	21" HG.	0 p.s.i.	0 p.s.i.
2	RUNNING	72·5	21" HG.	0 p.s.i.	0 p.s.i.
3	INITIAL	65·5	16" HG. APPROX.	10 / 12 APPROX	10 / 12 APPROX.
4	FULL SERVICE	48·5	0" HG.	70	55
5	EMERGENCY	0	0" HG.	70	55
6	SHUT DOWN	SEE NOTE OPPOSITE			

THE BRAKE SELECTOR SWITCH.

The switch is normally positioned with other locomotive auxiliary control switches.

The two left hand positions are for use when working air braked trains and are designated PASSENGER (upper position) and GOODS (lower position). The two right hand positions are for use when working vacuum braked trains and are designated PASSENGER (upper position) and GOODS (lower position).

The names of the four positions are self explanatory with the wording now used but the following table is given to show underneath the equivalent 'old' names which were previously used.

VACUUM GOODS.	VACUUM PASSENGER.	AIR GOODS.	AIR PASSENGER.
RIGHT LOWER.	RIGHT UPPER.	LEFT LOWER.	LEFT UPPER.
UNFITTED	FITTED		
UNBRAKED	BRAKED	GOODS	PASSENGER

These names are slightly abbreviated on switch labels and indicator panels.

Driver's Instructions BR.33056/1, page 3, give details of the correct Brake Selector Switch position for various types of train.

The position selected is repeated in each driving cab by means of an illuminated sign on a small panel located above the co-driver's door. The effect of selecting various positions of the switch are as follows:-

Air Passenger.

The second compressor will run and both exhausters are stopped. The vacuum control governor is "shorted out" so that the power control circuit can be "made" although there is no vacuum brake pipe. The Air Goods/Passenger E.P. valve causes a large choke to be open in the distributor and the locomotive proportional brake application is only slightly delayed.

Indicator in both cabs shows AIR PASS.

Air Goods

As Air Passenger and in addition the Air Goods/Passenger E.P. valve causes a smaller choke to be open in the distributor and locomotive proportional brake application has an extended delay should a brake application be initiated.

Indicator in both cabs shows AIR GOODS.

Vacuum Passenger.

The second compressor will not run.

Both exhausters will run provided that their respective switches are at the ON position.

The Vacuum Goods/Passenger electro magnet valve causes a large choke to be open in the distributor and the locomotive proportional brake application is only slightly delayed.

The vacuum control governor is in circuit and operative.

Indicator in both cabs shows VAC PASS.

Vacuum Goods — As Vacuum Passenger, in addition the Vacuum Goods/Passenger electro magnet valve causes a smaller choke to be opened in the distributor and the locomotive proportional brake application time is extended.

Also an E.P. valve connected to the A.W.S. and D.S.D. brake application valve is operated. With A.W.S. or D.S.D. operation the rate of drop of air brake pipe pressure is much slower compared with other three switch positions consequently the locomotive proportional brake application time is appreciably extended.

The indicator in both cabs shows VAC GOODS.

THE AIR/VACUUM RELAY VALVE.

The purpose of this valve is to regulate vacuum brake pipe according to the pressure in the air brake pipe as follows:-

(a) When the nominal pressure of 72.5 p.s.i. is present in the air brake pipe there will be 21" of vacuum in the vacuum brake pipe.

(b) When the pressure in the air brake pipe is reduced to 48.5 p.s.i. vacuum in the vacuum brake pipe will be reduced to zero.

(c) A reduction in vacuum brake pipe proportional to the reduction in air brake pipe pressure between 72.5 p.s.i. and 48.5 p.s.i.

THE DISTRIBUTOR.

The purpose of this valve is to operate the locomotive air brakes proportionally to the degree of braking effort applied to the train:

(a) Proportional to the reduction in air brake pipe pressure when working air braked trains.

(b) Proportional to the reduction in vacuum brake pipe (which is proportional to the reduction in air brake pipe pressure) when working vacuum braked trains.

(c) Rate of application of locomotive air brakes dependent upon the type of train being worked, i.e. position of Brake Selector Switch.

It should be appreciated that only the appropriate controlling medium, air brake pipe pressure or vacuum brake pipe according to the type of brake system in use on the train should control the distributor.

This is achieved by the air/vacuum isolating valve.

THE AIR/VACUUM ISOLATING VALVE.

This valve discriminates as to whether air brake pipe or vacuum brake pipe controls the distributor as follows:-

(a) Air Passenger, Air Goods.
Vacuum brake pipe and chamber at zero (exhausters not running).
Air brake pipe pressure will control the distributor.

(b) Vacuum Passenger, Vacuum Goods.
Vacuum chamber at 21". Level of vacuum brake pipe will control distributor.

PRESSURE CONTROL VALVE.

The purpose of the pressure control valve is to feed air from the locomotive main reservoir air at 118/140 p.s.i. to the Main Reservoir Pipe at a reduced pressure of 100 p.s.i.

A.W.S. and DRIVER'S SAFETY DEVICE (D.S.D.)

If either of these systems is operated and not reset by the Driver within the delay period the air brake pipe will be vented to atmosphere at a controlled rate by the DSD/AWS Brake Application Valve. This prevents braking shocks from occurring due to excessively rapid application of the train brakes.

In the event of either A.W.S. or D.S.D. brake application it is essential to stop the Auto. Air Brake brake valve feeding air into the Air Brake Pipe and overcoming the brake application. This is achieved by connecting an electrically or air operated isolating valve in either:

(a) Main Air supply to the Brake valve

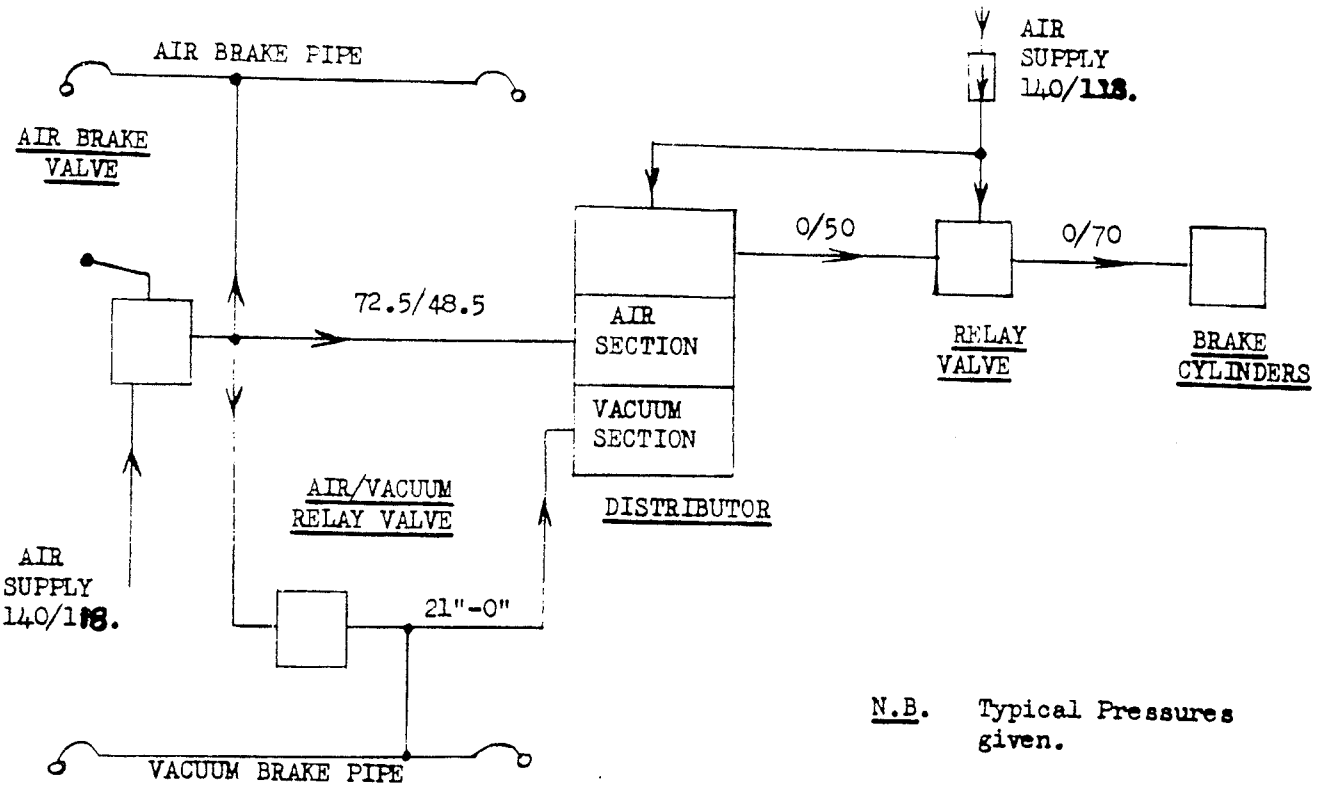
or (b) Brake supply to the Air Brake pipe.

In the event of A.W.S. or D.S.D. application the valve will close.

These valves are known as Brake Feed Cut Off Valves or Brake Valve Isolators.

DUAL BRAKE LOCOMOTIVES.

BLOCK DIAGRAM SHOWING RELATIONSHIP BETWEEN VALVES, AIR AND VACUUM WORKING.



N.B. Typical Pressures given.

Air Brake Working.

When the Brake valve is moved towards a braking position the reduction in Air Brake Pipe pressure will operate the Air section of the Distributor which will pass increasing pressure to Relay valve which, in turn, will operate to pass air to the locomotive brake cylinders.

The Air/Vacuum Relay Valve and Vacuum section of the Distributor will have no effect on the operation since the Exhausters do not run in Air working therefore no Vacuum is available.

Vacuum Working.

When the Brake valve is moved towards a braking position the reduction in Air Brake Pipe pressure will operate the Air/Vacuum Relay valve which will decrease vacuum brake pipe by a proportional amount. The reduction in Vacuum will operate the Vacuum section of the Distributor which will pass increasing pressure to the Relay valve which, in turn, will operate to pass air to the locomotive brake cylinders.

The Air section of the Distributor will have no effect on the operation since it will have been made inoperative by the Air/Vacuum Isolating valve (not shown on diagram).

NOTE: The principles outlined above are incorporated into both Davies & Metcalfe and Westinghouse equipment explained in the following notes. The construction and operation of components and layout of equipment will vary dependent upon the manufacturer.

DAVIES & METCALFE DUAL BRAKED LOCOMOTIVES.

Note: There is considerable variation in the equipment fitted to different locomotive classes and the following notes indicate typical arrangements.

MAIN AIR SYSTEM.

On most dual braked locomotives two Davies & Metcalfe Oerlikon electrically-driven compressors, Type 2 A 115, are fitted capable of delivering up to 37.5 cubic feet/min. at 140 p.s.i., one being operational at all times, and the second in conjunction with the first for use when working air braked trains.

The compressors are of the two stage reciprocating type, two cylinders compressing the air initially then passing on via an intercooler to the high pressure cylinder.

After the air has been compressed it passes on to an after-cooler drip cup and non-return valve into the main reservoir.

The compressors are controlled by a compressor governor to maintain the pressure between 130/140 lb. p.s.i. To avoid excessive pressure in the system a safety valve is provided set at 150 lb. p.s.i. An isolating cock is provided to enable the compressor governor to be isolated.

A low main reservoir pressure governor connected to the main reservoirs cuts off locomotive power and initiates a D.S.D. brake application should main reservoir pressure fall below 60 lb/sq.in. An isolating cock is provided to enable the governor to be isolated.

An isolating cock is provided to enable the compressors and reservoirs to be isolated from the locomotive equipment.

From the main reservoirs the air is supplied to the locomotive main reservoir pipe which supplies air to the following:-

(1) Horns, Wipers and Sanding - Cocks provided for isolation.

(2) Direct air brake system, Driver's brake valves and relay valves - Isolating cocks provided for bogie isolation.

(3) Auto-air brake valves FV.4.

(4) Boiler feed.

(5) D.S.D. E.P. valve.

(6) A.W.S. equipment - main air feed to both A.W.S. change end switches and A.W.S. (Baldwin) E.P. valves.

(7) Auxiliary reservoirs serving the auto-air brake distributor and relay valves. These feeds are taken via check valves, which prevent leak back of air should the main reservoir system fail.

(8) Pressure control valve set 100 lb. p.s.i. to the main reservoir pipe. This pipe has two functions, i.e.

(a) When working 2-pipe air-braked trains the end coupling is connected to the train main reservoir pipe coupling (coloured yellow) and provides a 100 lb. p.s.i. feed to the train brake auxiliary reservoirs.

(b) When working in multiple as a pipe allowing pressure at 100 lb. p.s.i. to pass to another locomotive whose main reservoir is at a lower pressure. In reverse air can be fed into the locomotive system from another locomotive via the check valve connected between the main reservoir pipe and locomotive main reservoir pipe.

Note: If a leak develops on the train main reservoir pipe the locomotive main reservoir pressure will reduce. On some locomotives this is restricted to 75 lb./sq.in. by means of a Duplex check valve.

CONTROL AIR SYSTEM.

An isolating cock is provided to enable the Control Reservoir to be isolated from the Main Reservoir.

The system is controlled by a check valve and pressure reducing valve to 70 p.s.i. from which the air passes into the Control Air Reservoir for use by the following equipment:-

(1) Electrical cubicle - for operation of air operated electrical equipment.

(2) Control air pressure gauge.

(3) Anti-slip E.P. valve - when energised passes an air feed to the Distributor making a partial brake application.

(4) Accelerator valves (power-handle operated).

This is the conventional system of engine speed control - air passes from the accelerator valve to the regulating air pipe and through solenoid valve E.S.V. to the engine governor.

(5) A.W.S. and D.S.D. Equipment.

AUTO AIR AND VACUUM BRAKE SYSTEM.

1. Driver's Brake Valve.

One D. & M. FV4A Driver's Brake Valve is provided in each cab. The valve controls brake pipe pressure as detailed in previous notes and a vacuum valve is fitted which destroys vacuum train pipe when the handle is placed to "Emergency".

An electrical contact is fitted which closes in "Release" to speed up the exhausters and operates the Exhauster Choke Valve.

An isolating cock is provided in the air supply pipe to each brake valve enabling the brake valve to be isolated for maintenance or under fault conditions.

2. Air/Vacuum Relay Valve.

One D. & M. DV2 Air/Vacuum relay valve is provided and operates during "Vacuum" working to give proportional decrease in vacuum brake pipe to correspond to decrease in air brake pipe pressure.

An isolating cock is provided in the vacuum brake pipe connection to the valve to be used under fault conditions.

A release valve (button type) is provided to enable the air control chamber pressure of the valve to be released. If chamber retains an overcharge the Vacuum/Air Brake pipe proportionality will be affected, also locomotive and train brakes may 'drag' when brake valve handle is placed in 'Running'.

3. Distributor.

One D. & M. LST3 Distributor (formerly called a Triple Valve) is provided which responds to change in Vacuum Brake Pipe or Air Brake pipe pressure to apply or release the locomotive air brakes.

A hand operated release valve is provided to enable the Distributor air control chamber pressure to be released. This would be used to release the locomotive brake if air brake pipe pressure was not available.

Two hand operated release valves, one in each cab, are provided to enable the distributor vacuum control chamber to be destroyed. This would be used to release the locomotive brakes when changing over from vacuum to air working or if vacuum could not be created.

Note: It should be noted that during changeover from vacuum to air working or after depot maintenance the distributor air control chamber pressure may be reduced. Under these conditions a full auto air locomotive brake application may not be available and up to four minutes should be allowed to recharge the distributor air control chamber.

4. Air/Vacuum Isolating Valve.

One D. & M. air/vacuum isolating valve is provided and when working in vacuum positions, the valve renders the distributor auto air brake section inoperative.

5. Auto Air Relay Valves.

One D. & M. D1 relay valve is provided for each bogie and apply the locomotive air brake initiated by the distributor. Bogie isolating cocks are provided in the feed from each relay valve to the brake cylinders.

6. D.S.D. and A.W.S. Brake Application Valve.

One D. & M. TMV7 valve is provided and is initiated by either D.S.D. or A.W.S. system operation to reduce air brake pipe pressure.

In addition, should the main reservoir pressure fall below 60 lb./sq.in. the low main reservoir pressure governor will initiate a D.S.D. brake application.

An isolating cock is provided in the D.S.D. air brake pipe connection to the TMV7 and can be used to isolate the D.S.D. system under fault conditions.

Note: IF THE D.S.D. IS ISOLATED AS ABOVE IT IS ESSENTIAL THAT THE D.S.D. PEDAL IS DEPRESSED AT ALL TIMES WHEN THE LOCOMOTIVE IS UNDER POWER IN ORDER TO MAINTAIN AIR BRAKE PIPE PRESSURE (Davies & Metcalfe equipped locos. only).

The A.W.S. equipment may be isolated by placing the cab A.W.S. change end switch isolating handles in both cabs to the "OFF" position.

7. Vacuum Brake Pipe Governor.

A vacuum governor is connected to the vacuum brake pipe and cuts off locomotive power if vacuum falls below 13". When in air working, the brake selector switch shorts out the vacuum governor.

8. Air Brake Pipe Governor.

A governor is connected to the air brake pipe and cuts off locomotive power if pressure falls below 48 lb./sq.in.

9. Cab Gauges.

Gauges are provided in each cab to indicate main reservoir pressure (140/118 lb./sq.in.), air brake pipe pressure, brake cylinder pressures, vacuum brake pipe and vacuum chamber.

On some locomotives an additional gauge is fitted to indicate main reservoir pipe pressure (100 lb./sq.in.)

10. Brake Valve Isolators.

One electrically operated Brake Valve Isolator is connected in the Main Reservoir supply to each Brake valve and closes in the event of a D.S.D. application.

One air operated Brake Valve Isolator is connected in the Brake valve feed to the Air Brake pipe and will close in the event of an A.W.S. application.

Schematic Brake Layout. Dual Braked Locomotives (D. & M.)

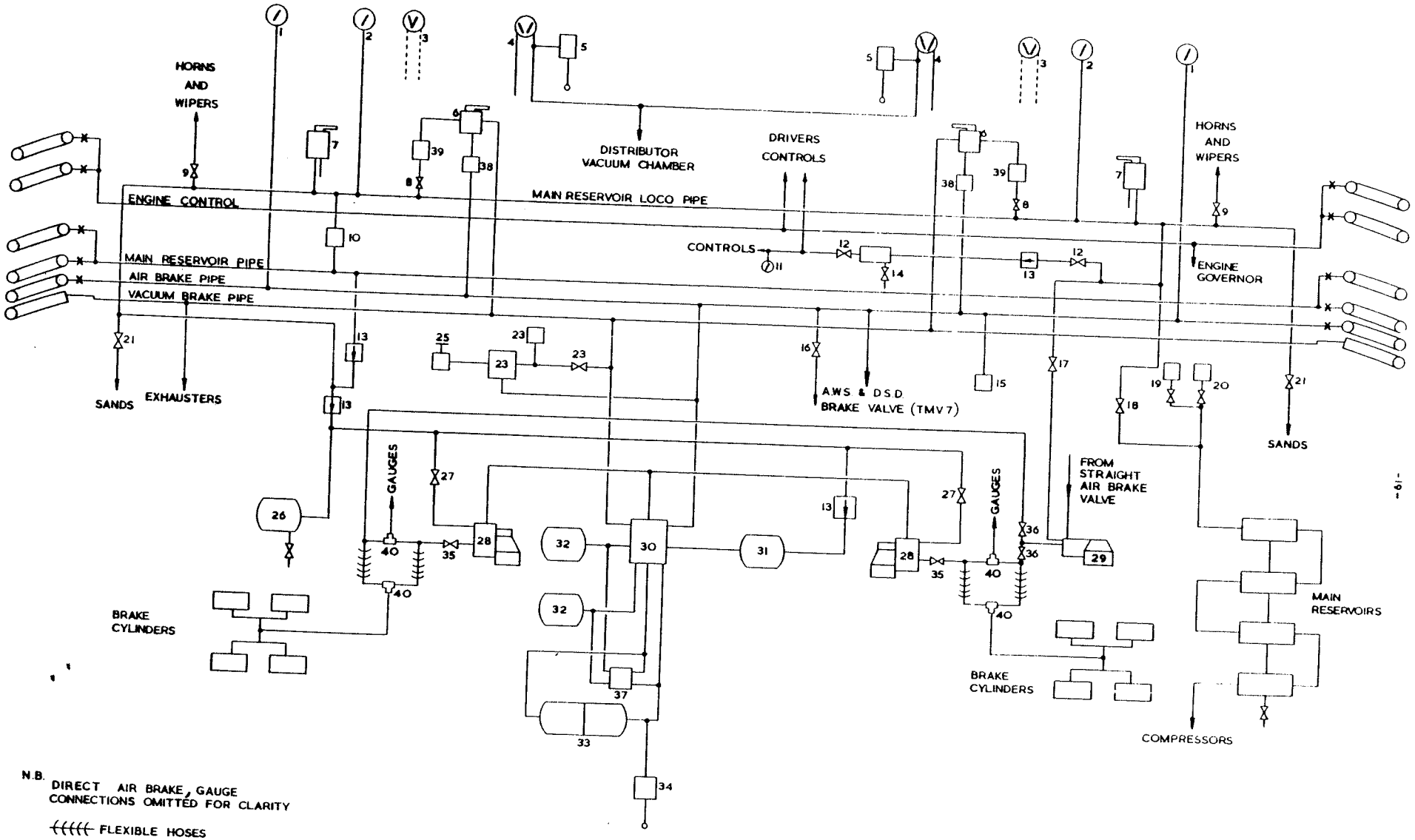
Attached is a typical schematic diagram detailing principal components and isolating cocks.

For detailed information of specific locomotive equipment and equipment location refer to Locomotive Conversion descriptive notes for relevant locomotives.

Schematic Brake Layout. D. & M. Dual Braked Locomotives.

Principal Components and Isolating Cocks.

No.	Component.
Isolating Cocks and Release Valves.	
5	Vacuum chamber release valve.
8	Auto air brake valve.
9	Horns and windscreen wipers.
12	Control air reservoir.
16	D.S.D. isolation.
17	Supply to Direct Air brake relay valve.
18	Main Reservoir supply.
21	Sanding valves.
22	Air/Vacuum relay valve.
25	Release valve Air/Vacuum relay valve.
27	Supply to Proportional brake relay valve.
34	Distributor Air control chamber release valve.
35	Bogie isolation cocks, proportional brake.
36	Bogie isolation cocks, direct air brake.
Gauges.	
1	Air Brake pipe.
2	Main Reservoir pressure.
3	Brake cylinder pressure.
4	Vacuum brake pipe and chamber.
11	Control Reservoir.
Pressure Switches.	
15	Air Brake pipe governor.
19	Compressor governor and isolating cock.
20	Low Main Reservoir governor and isolating cock.
23	Vacuum governor.
Valves.	
6	Auto Air brake valve.
7	Direct Air brake valve.
10	Feed valve (100 lb./sq. in.)
13	Check valve/Reducing Valve.
14	Control Air reservoir (70 lb./sq.in.)
24	Air/Vacuum relay valve.
26	Proportional brake relay valves supply reservoir.
28	Proportional brake relay valves.
29	Direct Air brake relay valve.
30	Air/Vacuum Distributor.
31	Distributor Supply reservoir.
32	Distributor Vacuum reservoir.
33	Distributor Air reservoir.
37	Air/Vacuum Isolating valve.
38	Brake Valve Isolator (A.W.S.)
39	Brake Valve Isolator (D.S.D.)
40	Double Check Valve.



N.B. DIRECT AIR BRAKE, GAUGE CONNECTIONS OMITTED FOR CLARITY

FLEXIBLE HOSES

SCHEMATIC BRAKE LAYOUT OF PRINCIPAL COMPONENTS AND ISOLATING COCKS TYPICAL D. & M. DUAL BRAKED LOCO

WESTINGHOUSE DUAL BRAKED LOCOMOTIVES.

Note: There is considerable variation in the equipment fitted to different locomotive classes and the following notes indicate typical arrangements.

MAIN AIR SYSTEM.

The main air system is charged from either one or two air compressors, which under the control of a compressor governor, keep the system charged to a pressure of 118/140 p.s.i. The running of the compressors being under the control of the "brake selector switch". An isolating cock is provided to enable the Compressor governor to be isolated.

The normal main reservoir equipment is fitted such as safety valve, automatic drain valves, dirt collectors, check valves, anti-freeze devices, etc.

A summary of the various equipment, reservoirs, etc. supplied by the main air system is given below:-

(1) Horns and Sanding valves - cocks provided for isolation.

(2) Windscreen wipers.

(3) Direct Air Brake System, Driver's Brake valves and Relay valves, isolating cocks provided for bogie isolation.

(4) Auto air brake valves M8A.

(5) Auxiliary Reservoir/s serving Distributor and Proportional brake relay valves. These feeds are taken via check valves which prevent leak back of air should the main reservoir system fail.

(6) Pressure control valve set 100 lb./sq.in. to A.W.S. and D.S.D. brake application valve and through a Duplex check valve to the Main Reservoir feed pipe. This pipe has two functions:

(a) When working 2 pipe air braked trains the second coupling is connected to the train main reservoir pipe coupling (coloured Yellow) and provides a 100 lb./sq.in. feed to the train auxiliary reservoirs.

(b) When working in multiple as a pipe allowing pressure at 100 lb./sq.in. to pass to another locomotive whose main reservoir is at a lower pressure. In reverse air can be fed into the locomotive system from another locomotive via the Duplex check valve and feed valve.

The 100 lb./sq. in. supply is taken to the Control reservoir reducing valve. This may be taken from either side of the Duplex check valve dependent on locomotive type.

(7) Power handle operated accelerator valves. Supply may be taken from Main reservoir supply at 140 lb./sq. in. or Main reservoir pipe supply at 100 lb./sq. in.

CONTROL AIR SYSTEM.

The system is supplied through a 70 lb./sq. in. reducing valve and check valve to a reservoir which supplies the following equipment:-

(1) Electrical cubicle, air operated equipment.

(2) Control air pressure gauge.

(3) Equipment governor, which cuts off locomotive power if Control air pressure falls below 50 lb./sq. in.

AUTO AIR AND VACUUM BRAKE SYSTEM.

1. Driver's Brake Valve.

One Westinghouse M8A Driver's brake valve is provided in each cab. The valve controls air brake pipe pressure as detailed in previous notes and vacuum valve is fitted which destroys vacuum brake pipe when the handle is placed to "Emergency".

In "Release" position exhauster speed up is achieved through an air pressure switch connected to the brake valve which responds to overcharge pressure.

On some locomotives the air brake pipe overcharge is achieved through a push button located on the Driver's desk.

2. Air/Vacuum Relay Valve.

One Westinghouse VA1 or AV2 air/vacuum relay valve is provided and operates during "Vacuum" working to give proportional decrease in vacuum brake pipe to correspond to decrease in air brake pipe. An isolating cock is provided in the 2" vacuum brake pipe connection to the valve to be used under fault conditions.

3. Distributor.

One Westinghouse distributor is provided which responds to change in vacuum brake pipe or air brake pipe pressure to apply or release the locomotive air brakes.

A hand operated release valve is provided to enable the distributor air control chamber pressure to be released. This would be used to release the locomotive proportional brake if air brake pipe pressure was not available.

Two hand operated release valves, one in each cab, are provided to enable the distributor vacuum control chamber to be destroyed. This would be used to release the locomotive proportional brake when changing over from vacuum to air working or if vacuum could not be created.

Note: It should be noted that during changeover from vacuum to air working or after Depot maintenance the distributor air control chamber pressure may be reduced. Under these conditions a full auto air locomotive air brake application may not be available and up to four minutes should be allowed to recharge the distributor air control chamber.

4. Vacuum Operated Air Isolating Valve.

One Westinghouse vacuum operated air isolating valve is provided. When working in vacuum positions the valve renders the distributor air brake pipe section inoperative.

5. Auto Air Relay Valves.

One Westinghouse relay valve is provided for each bogie and applies the locomotive air brakes initiated by the distributor. Bogie isolating cocks are provided in the feed from each relay valve to the brake cylinders.

6. A.W.S. and D.S.D. Application Valve.

One Westinghouse Brake Application unit is provided and is initiated by either D.S.D. or A.W.S. system operation to reduce Air Brake pipe pressure.

In addition the valve incorporates a section which will reduce air brake pipe pressure if Main Reservoir pressure falls below 70 lb./sq.in. N.B. This feature can ot be isolated.

An isolating cock is provided in the air feed to the D.S.D. E.P. valve and can be used to isolate the D.S.D. system.

The A.W.S. equipment may be isolated by placing the cab A.W.S. change end switch isolating handles in both cabs to the "OFF" position.

7. Vacuum Brake Pipe Governor.

A Vacuum governor is connected to the Vacuum brake pipe and cuts off locomotive power if Vacuum falls below 13". When in air working the Brake Selector switch shorts out the Vacuum Governor.

8. Air Brake Pipe Governor.

A governor is connected to the Air Brake pipe and cuts off locomotive power if pressure falls below 48 lb./sq.in.

9. Cab Gauges.

Gauges are provided in each cab to indicate Main Reservoir Pressure (140/118 lb./sq.in) Air Brake Pipe Pressure, Brake cylinder pressures, Vacuum brake pipe and Vacuum chamber.

10. Brake Feed Cut Off Valve.

One air operated Brake feed cut off valve is connected in the Main Reservoir supply to each Brake valve and closes in the event of A.W.S. or D.S.D. application.

Schematic Brake Layout. Dual Braked Locomotives (Westinghouse).

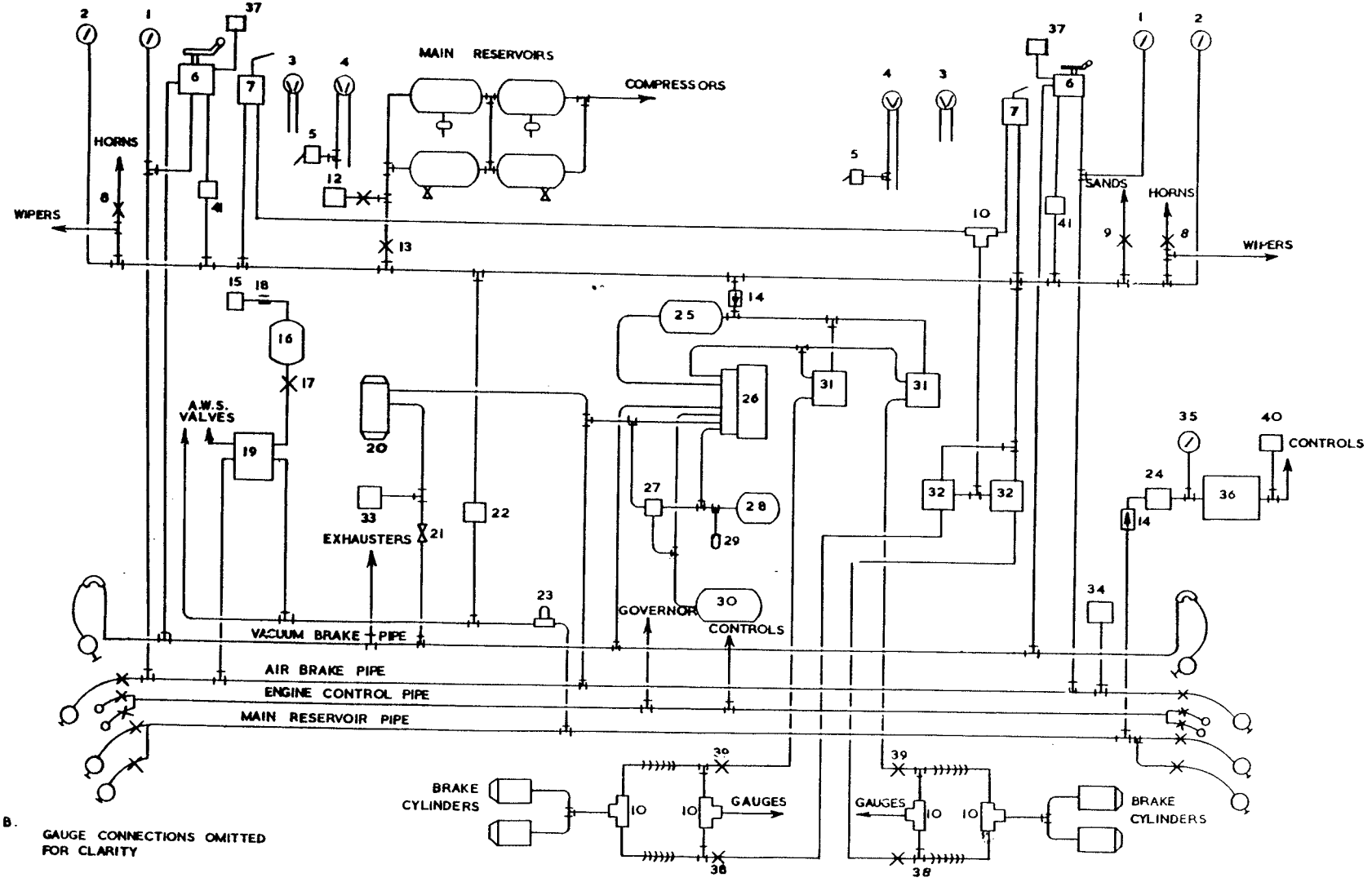
Attached is a typical schematic diagram detailing principal components and isolating cocks.

For detailed information of specific locomotive equipment and equipment location refer to locomotive conversion descriptive notes for relevant locomotives.

Schematic Brake Layout. Westinghouse Dual Braked Locos.

Principal Components and Isolating Cocks.

No.	Component.
Isolating Cocks and Release Valves.	
5	Vacuum chamber release valve.
8	Horns.
9	Sanding Valves.
13	Main reservoir supply.
17	D.S.D. isolation.
21	Air/Vacuum relay valve.
29	Distributor air control chamber release valve.
38	Bogie isolation direct air brake.
39	Bogie isolation proportional brake.
Gauges.	
1	Air Brake pipe.
2	Main reservoir pressure.
3	Brake cylinder pressure.
4	Vacuum brake pipe and chamber.
35	Control Reservoir.
Pressure Switches.	
12	Compressor governor and isolating cock.
33	Air Brake pipe governor.
34	Vacuum governor.
37	Exhauster speed up governor.
40	Equipment governor.
Valves.	
6	Auto Air Brake valve.
7	Direct Air Brake valve.
10	Double check valve.
14	Check valve.
15,16,18.	D.S.D. E.P. valve, timing reservoir and choke.
19	D.S.D. and A.W.S. Brake application unit.
20	Air/Vacuum relay valve.
22	Feed valve (100 lb./sq. in.)
23	Duplex check valve.
24	Limiting valve (70 lb./sq.in.)
25	Distributor and Proportional brake supply reservoir.
26	Distributor.
27	Vacuum operated Air Isolating valve.
28	Distributor Air control Reservoir.
30	Distributor Vacuum reservoir.
31	Proportional Brake relay valve.
32	Direct Air Brake relay valve.
36	Control Reservoir.
41	Brake Feed Cut Off Valve.



TYPICAL BRAKE SCHEMATIC DIAGRAM

WESTINGHOUSE DUAL BRAKED LOCOS

PRINCIPAL COMPONENTS AND ISOLATING COCKS

APPRECIATION OF EQUIPMENT FITTED TO AIR BRAKED VEHICLES.

EQUIPMENT DESCRIPTION. AIR BRAKED VEHICLES.

The Distributor controls the application and release of the brake on the vehicles in response to pressure changes in the brake pipe. It includes a control reservoir, isolating cock and release valve, also air-line filters.

1" Brake Pipe. Coupling heads and cocks painted RED, charged to 70 p.s.i. to release the brakes.

1" Main Reservoir Pipe. Coupling heads and cocks painted YELLOW, charged and maintained to 85 - 100 p.s.i. and serves to keep the auxiliary reservoir charged to this pressure.

Auxiliary Reservoir in which compressed air is stored for applying the brake, a drain plug is fitted with a "T" drilling enabling the reservoir to be drained of water, dirt, etc., without completely removing the plug. (Note that some later vehicles are fitted with Auto Drain Valves).

Brake Cylinders for applying the brake pads to the brake discs or brake blocks to the wheels. In some cases automatic slack adjusters are fitted.

Hoses and Couplings used to connect the brake pipe and main reservoir pipe between adjacent vehicles, two types of couplings are employed to avoid coupling the wrong pipes. A valveless plain headed coupling is employed for the brake pipe and a coupling with a valve fitted for the main reservoir pipe, this pipe can also be identified by the square nut on the head of the coupling.

Coupling Cocks at each end of the vehicle brake pipe and main reservoir pipe are fitted to close these pipes at the end of the train. These cocks are of the self-venting type to facilitate uncoupling of vehicles with a charged system.

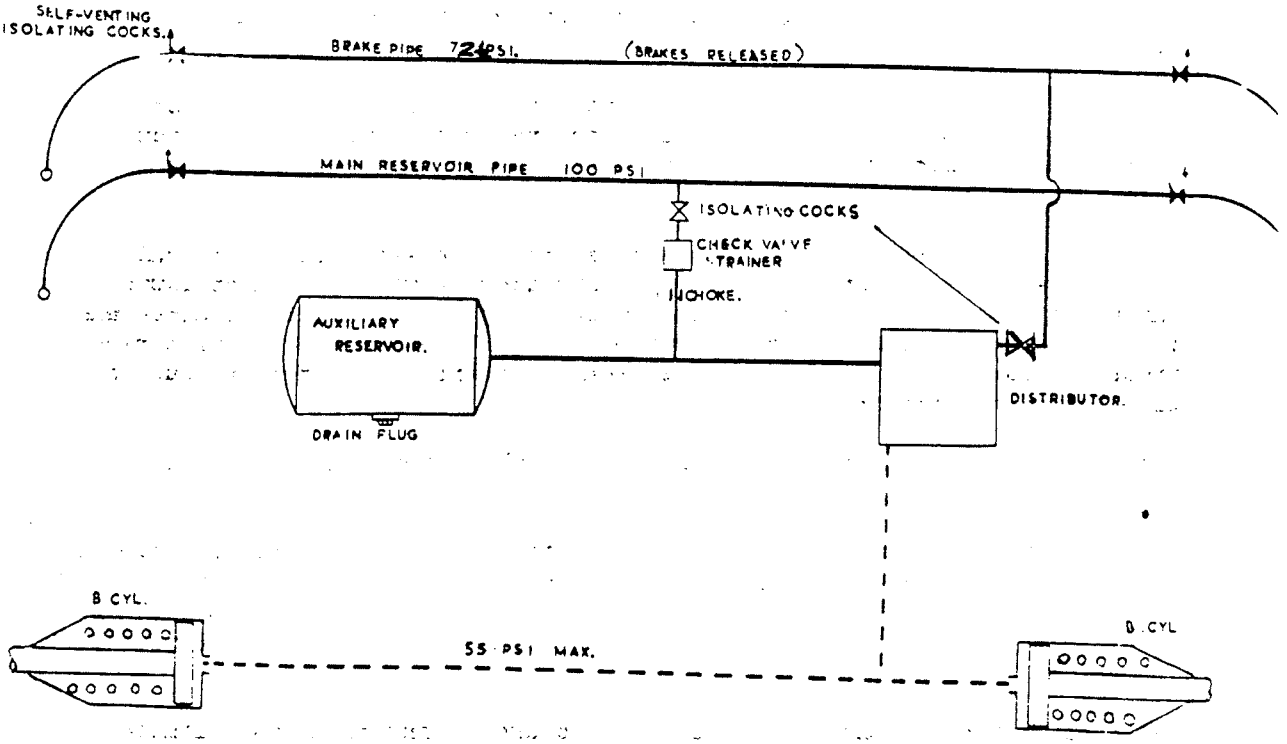
Isolating Cock to close the air feed from the main reservoir pipe to the auxiliary reservoir for maintenance and other purposes. (Isolation purposes etc.)

Strainer, Check Valve and Choke Unit which controls the rate at which air pressure flows into the auxiliary reservoir from the main reservoir pipe, and also prevents a back flow of air from the reservoir to the main reservoir pipe.

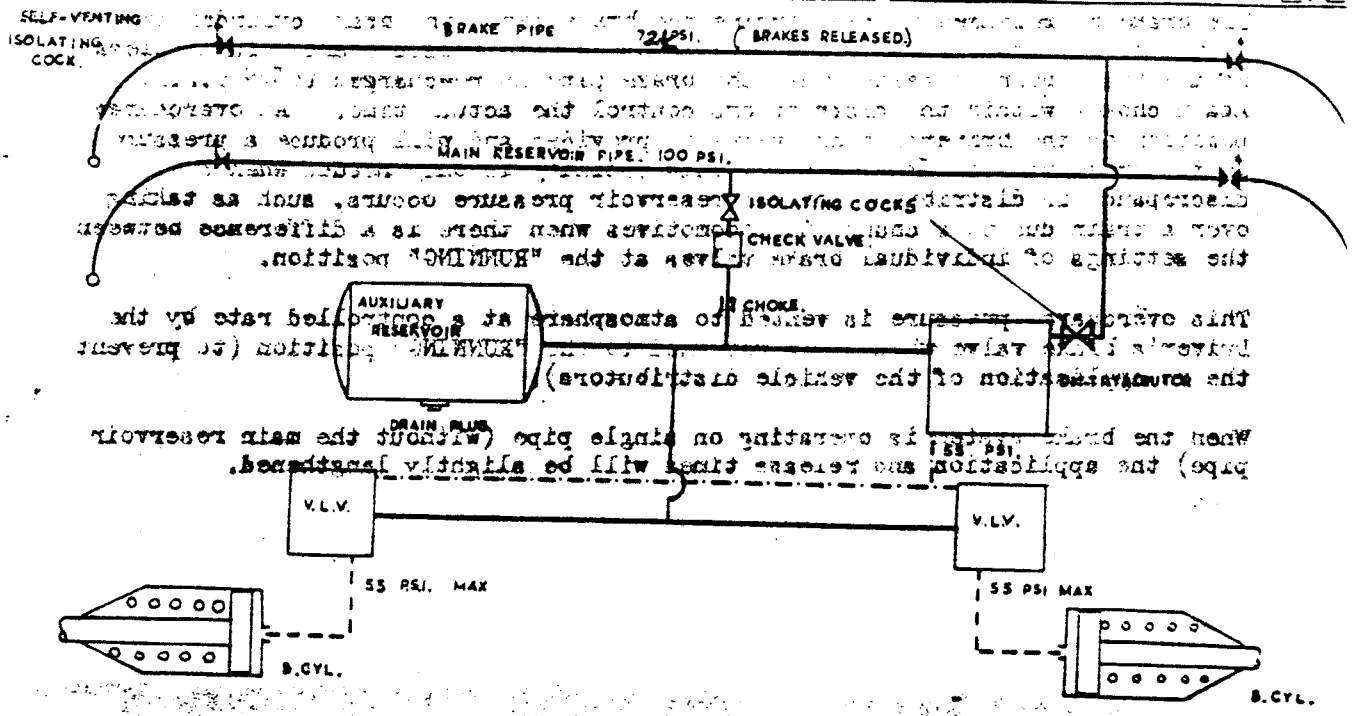
Variable Load Valves are fitted on certain types of vehicles (Cartic, Freightliner vehicles etc.), these valves control the air pressure in the brake cylinder according to load on the respective bogies. By regulating the brake cylinder pressure in direct proportion to the load on each bogie the braking distance at any given speed is virtually constant regardless of the load. Two valves are fitted, normally under the control of one distributor.

Two-Stage Pressure Relay Valve is fitted to certain air braked vehicles (100 ton oil tanks etc.) providing an EMPTY/LOADED braking condition, the valve is controlled by changeover valve to give either "TARE" brake cylinder pressures (21 p.s.i.) when the vehicle is empty or "LOADED" brake cylinder pressures (55 p.s.i.) when the vehicle is at gross weight. The valve is again under the control of a distributor.

2 -PIPE AIR BRAKE SYSTEM.



2-PIPE AIR BRAKE SYSTEM WITH VARIABLE LOAD VALVE



OPERATION OF THE AIR BRAKE VEHICLE EQUIPMENT.

The brake is held released but ready for use when the brake pipe and the control reservoir of the distributor are charged to 72½ p.s.i. and the auxiliary reservoir is charged to 100 p.s.i.

The brake is applied by reducing the brake pipe pressure which operates the distributor to pass air from the auxiliary reservoir (via the distributor) to the brake cylinders to a pressure depending on the reduction in brake pipe pressure.

By reducing the brake pipe pressure in steps the brake cylinder is raised in proportion up to a maximum set by a limiting valve in the distributor. Maximum brake cylinder pressure is nominally 55 p.s.i. and is obtained when the brake pipe pressure is reduced to 48½ p.s.i. Reduction of brake pipe pressure below 48½ p.s.i. will not increase the brake cylinder pressure but will reduce the application time.

When the distributor operates to apply the brake, three distinct functions occur:-

(1) A controlled local reduction in brake pipe pressure in each distributor occurs, this speeds up the 'propagation' of the brake application along the length of the train and ensures that all distributors move quickly into the application position. This being known as the "Quick Service" action.

(2) A rapid flow of air is made into the brake cylinders up to a limited pressure (10 p.s.i.) so that brake pads etc. are quickly brought into contact with the brake discs. This is known as the "inshot" feature.

(3) Following "inshot", the rate of brake cylinder pressure build up is controlled by the application chokes within the distributor (either GOODS or PASSENGER filling times), so that the brakes on all vehicles apply at the same rate.

The brake is released by re-charging the brake pipe, the brake cylinder pressure is reduced in proportion to the rise in brake pipe pressure and a full release of the brake being obtained when the brake pipe is re-charged to 72½ p.s.i. Again chokes within the distributors control the actual time. An overcharge position on the Driver's brake valve is provided and will produce a pressure in the brake pipe of 78½ p.s.i., this facility is only needed when a discrepancy in distributor control reservoir pressure occurs, such as taking over a train due to a change in locomotives when there is a difference between the settings of individual brake valves at the "RUNNING" position.

This overcharge pressure is vented to atmosphere at a controlled rate by the Driver's brake valve when it is returned to the "RUNNING" position (to prevent the re-application of the vehicle distributors).

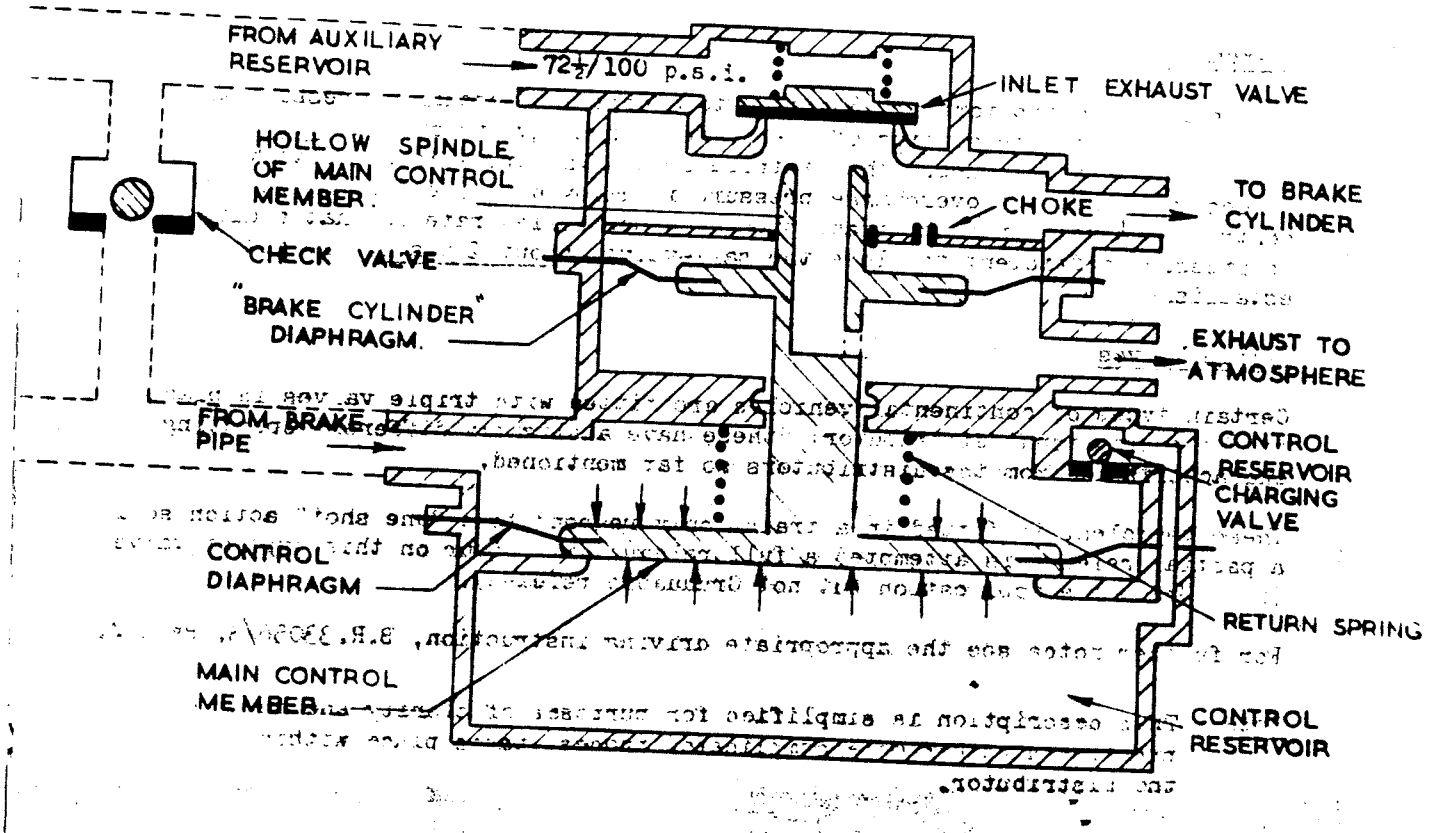
When the brake system is operating on single pipe (without the main reservoir pipe) the application and release times will be slightly lengthened.

DESCRIPTION

As shown the brake pipe supplies the distributor brake pipe reservoir direct, the control reservoir is charged via the charging-valve (ball valve).

Any reduction in brake pipe will reduce the brake pipe reservoir in the distributor, but due to the charging-valve acting as a non-return valve, the control reservoir remains at 72½ p.s.i. The difference between brake pipe and control reservoir pressure will result in the main control member moving to open the inlet/exhaust valve, so connecting the auxiliary reservoir to the vehicle brake cyliners, hence applying the brake. A release of the vehicle brake is effected by increasing the air pressure in the brake pipe reservoir (restoring the brake pipe to a nominal 72½ p.s.i.) This will lower the main control member allowing the brake cylinder pressure to discharge to atmosphere via the hollow spindle of the main control member.

DIAGRAM TO SHOW PRINCIPLE OF OPERATION OF AN AIR BRAKE DISTRIBUTOR.



CONTROL RESERVOIR CHARGING CHECK-VALVE

A special type of charging check valve is fitted to vehicle distributors, this valve performs three distinct functions:-

(a) It allows the distributor control reservoir to be charged at a controlled rate.

(b) It acts as a non-return valve to isolate the control reservoir from the brake pipe during braking.

(c) Allows the control reservoir to bleed-back into the brake pipe after the distributor has been overcharged. The rate of bleed back being controlled by two factors:-

1. The size of choke in the distributor charging valve.

2. The rate at which the brake pipe overcharge pressure is released at the driver's brake valve.

Charging

The ball check valve is held off its seat by the spring assisted valve, air can now flow into the control reservoir via the charging ports.

Braking

When the brake pipe pressure is lowered to operate the locomotive and vehicle brakes, a pressure difference is caused between the brake pipe and the control reservoir (due to the choke not allowing the control reservoir to follow immediately the drop in brake pipe pressure). The pressure on the ball valve overcomes the spring force moving the whole assembly down, isolating the control reservoir from the brake pipe during the whole braking operation.

Overcharging

All vehicle distributors are designed to accept an overcharge pressure which is determined by the setting of the driver's brake valve and the time it is subject to this pressure. The distributor and the driver's brake valve are so designed that the overcharge pressure is allowed to bleed back from the control reservoir into the brake pipe at a controlled rate so that a difference in pressure sufficient to close the ball-valve (about 2 p.s.i.) is not established.

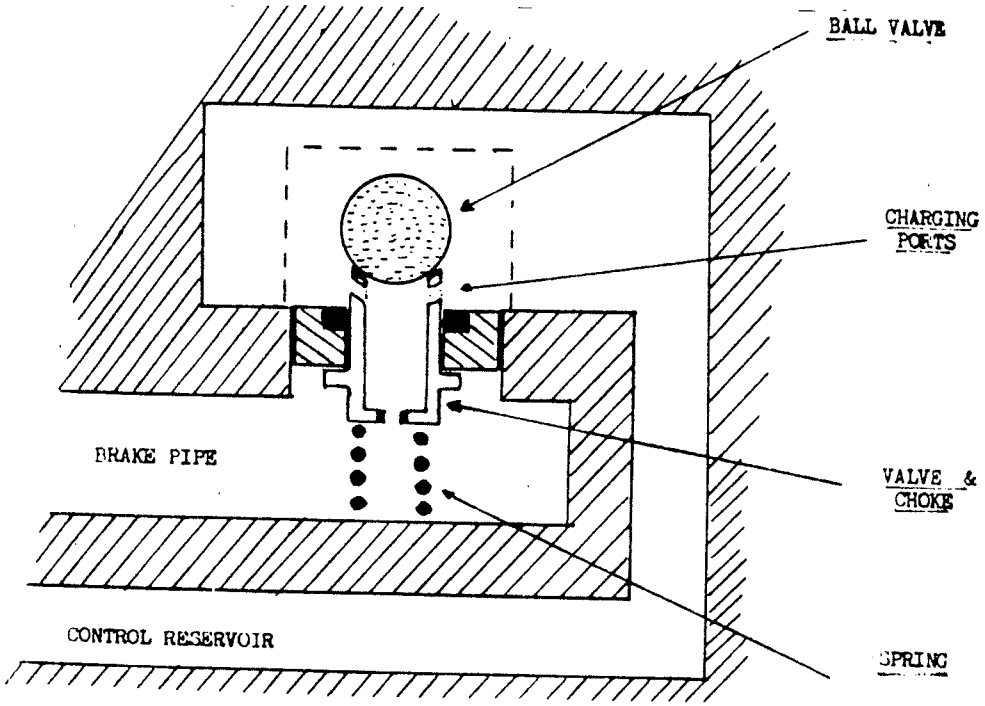
Triple Valves

Certain types of continental vehicles are fitted with triple valves in place of the conventional distributor; these have a slightly different operating characteristic from the distributors so far mentioned.

These vehicles, if fitted in a train, only respond to a "one shot" action so if a partial release is attempted a full release will occur on this type of valve. (i.e. Graduable application but not Graduable release).

For further notes see the appropriate driving instruction, B.R.33056/3, Page 4.

Note: This description is simplified for purposes of clarity and in practice a rather more complicated process takes place within the Distributor.


BALL VALVE
CHARGING PORTS
BRAKE PIPE
VALVE & CHOKE
CONTROL RESERVOIR
SPRING