



AIR BRAKE SYSTEM

IRAB-1

BRIEF DESCRIPTION OF THE IRAB – 1 BRAKE SYSTEM

INTRODUCTION

IRAB – 1 brake system has been designed by RDSO and fitted with New Generation ALCO locomotives. This is a complete air brake version, in which only compressor unit is used instead of Expressor for creating air pressure in the brake system and all the brake valves are panel mounted.

SALIENT FEATURES OF IRAB – 1 SYSTEM

1. Locomotives Brakes can be applied and released through independent brake valve SA9, independently.
2. Formation brakes can be applied & released through Automatic brake valve A9.
3. Locomotive brakes are applied automatically when formation brakes are applied.
4. It is suitable for MU operation also, with which the brakes of trailing units are controlled from leading unit.
5. Brakes in the rear loco are synchronized with lead loco brakes.
6. Emergency brake application is available to have minimum possible braking distance, from any control stand and any loco.
7. Safety devices are incorporated to bring the engine to idle in case of emergency brake application and train parting.
8. In case of train parting between the locos, both the locos will have automatic brake application.
9. Automatic brake and Dynamic brakes are inter locked. So that, Auto Brake will be released automatically when the DB is applied.
10. The system can work either with single pipe / dual pipe.

AIR BRAKE SYSTEM VALVES

SL. NO	DESCRIPTION	PURPOSE
1.	A9. Automatic Valve	Brake application for Loco as well as formations.
2.	SA 9 Independent Brake Valve	Brake Application for Loco alone
3.	MU – 2B	M.U. Operation, used as gate valve
4.	F 1 – Selector	M.U. Operation, used as gate valve
5.	C ₂ . W. or Additional C ₂ . Valve	Feeding B. P. Pressure to the formation
6.	24 A. Double Check Valve	This will allow only one operation at a time.
7.	C ₃ . W. Distributor Valve	Proportionate Brake valve application during A9. application.
8.	C ₂ . Relay Valve	For Locomotive Brake.
9.	Pressure Switch	Loco will be brought to idle during A9 emergency application.
10.	D1. Emergency Valve	For Emergency brake application.
11.	D1. Pilot air valve	During Dynamic brake Loco brake will be released.
12.	Pressure Limiting Valve	Pilot air to C ₂ Relay valve for synchronized brake application is Limited to 2.5 kg / Cm ²
13.	M. R. Safety Valve	When M. R. Pressure goes beyond 10.5 kg / Cm ² This valve will operate and release excess pressure from MR.
14.	Duplex Check Valve Set at 6 kg / Cm ²	This valve will connect MR1 with feed valve when MR pressure exceeds 6 kg / Cm ²
15.	D 24 – Feed Valve	For Feed pipe Pr: 6 kg / Cm ² .

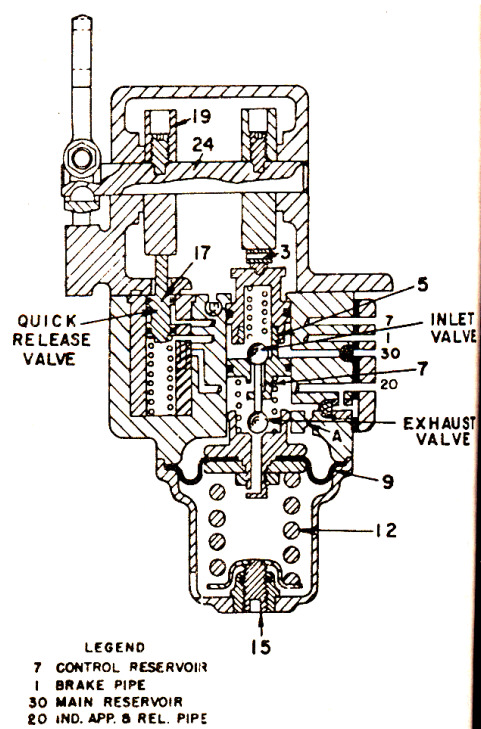
IMPORTANT VALVES PROVIDED IN IRAB – 1 SYSTEM.

SA 9 INDEPENDENT BRAKE VALVE: -

It is a variable pressure-reducing valve, sends pilot air to C2 relay valve to charge brake cylinder for application and release of loco brake independently. The outlet pressure can be varied from 0 to max (3.0 Kg / Cm²) by moving its handle. Its handle has three distinct positions.

1. Application
2. Release
3. Quick release – In IRAB, this position is not active.

The output pressure is zero at release position and the pressure is max (3.0 Kg / Cm²) at application position. The handle can be placed at any position between release and application to have desired out let pressure (i.e. Brake cyl pressure)

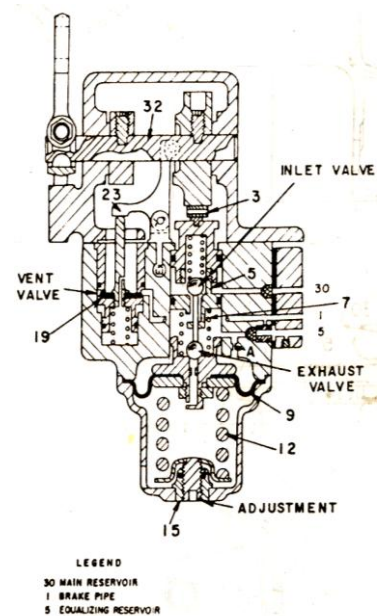


A9 – AUTOMATIC BRAKE VALVE

The valve is also a variable pressure-reducing valve. Its duty is to send pilot air for charging/exhausting B.P. pressure through C2W relay valve for releasing and application of loco and formation brake. In release condition it charges BP upto 5.0 Kg/cm²(max). The BP pressure can be varied by moving its handle. The handle has 5 distinct positions.

1. Release (BP= 5 Kg/cm²)
2. Minimum release (BP = 4.5 to 4.3 Kg/cm², BC = 0.5 to 0.7 Kg/cm²)
3. Full service (BP = 3.2 to 3 Kg/cm², BC = 2.5 Kg/cm²)
4. Over reduction (BP = 2.5 Kg/cm², BC = 2.5 Kg/cm²)
5. Emergency (BP = 0 Kg/cm², BC = 2.5 Kg/cm²)

The outlet pressure (Brake pipe) is maximum i.e. 5Kg/ cm² when the handle is at release position. The pressure will reduce when the handle is moved to application zone. The BP



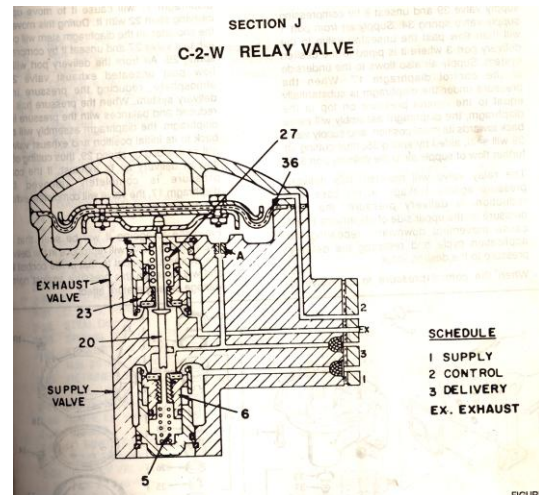
pressure will correspond to the position of the handle between Min and Full service and will be zero at emergency.

C₂ W and C₂ RELAY VALVES :-

C₂ RELAY VALVE

It is a high capacity relay air valve.

It gets pilot air from SA9/ A9 and supply MR air to the brake cylinders at a pressure equal to the pilot air pressure at a higher rate. Thereby it applies and releases the brake.



C₂ W – Relay VALVE :-

It is similar to C₂ relay valve with some additional features. It is connected to the BP charging/ exhausting system. It gets pilot air from A9 brake valve and it charges/ exhausts BP accordingly. As compared to C2 relay valve it is



having an additional diaphragm and pusher pin above the main diaphragm. If air is charged above this diaphragm, it pushes the main diaphragm and increases the pressure setting for the main diaphragm with the same pilot air from A9. This increment is limited by another arrangement so that the outlet pressure cannot build up more than 5.4 Kg/Cm². This function is called as overcharging function. It helps to release the brake binding in any of the variable from the locomotive cab.

C₃W- Distributor VALVE

It is an automatic brake application valve. It is used for conjunction brake application in the locomotive in proportion to the formation brake. It is having two air chambers. Control reservoir (CR) and Brake Pipe (BP). If $BP \geq CR$, Brake is released, i.e. $BC = 0$ and when BP

< CR brakes are applied. The difference between CR and BP pressure will decide the amount of BC pressure. As BP is common in the train and locomotive hence according to the BP droppage the brake application and release will be synchronized in the formation and locomotive

MU = 2B: -

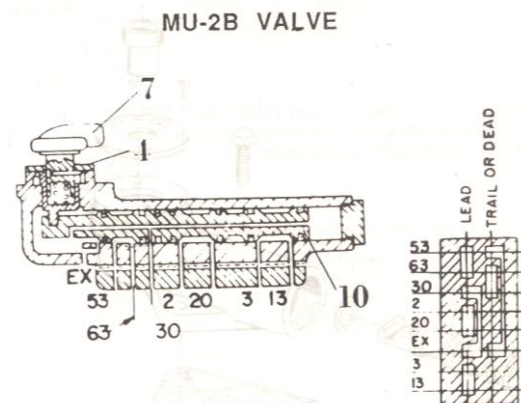
It is manually operated change over valve. It makes the system to be controlled from the same unit or the leading unit. It also isolates the drivers control for application and release of brakes in trailing loco.



The knob of this valve has 2 positions.

1. Lead
2. Trail or Dead.

There are many ports in this valve and their connections are changed as under:



Lead	2,20	3,13	63,53	60 – Exhaust
Trail or Dead	--	--	63 - 30	53 - Exhaust

F1 = SELECTOR: -

This valve is also a change over valve.

It has 2 positions:

1. Lead
2. Trail or dead.

The position is changed automatically according to the position of MU2B valve. Port 30 from MU2B is piped to

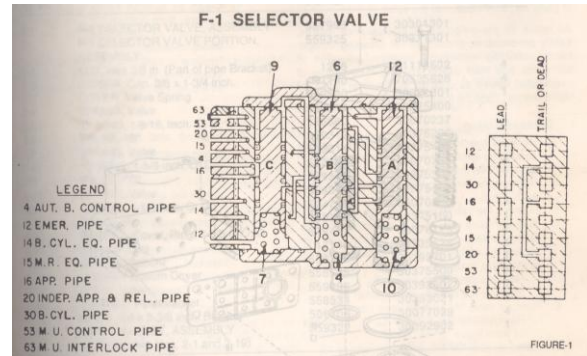


this valve. When there is no pressure in this port F1 selector will assume, lead position. If air pressure is supplied from the port, F1 selector will assume Trail or dead position.

This valve also has many ports and the connections are given below.

Lead	4-16	30 – 14
Trail or dead	14-16-20	

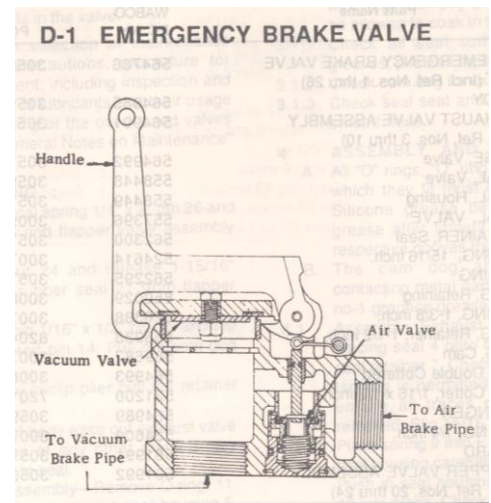
In co-ordination with MU2B, this valve makes the system to operate as a lead unit or trail unit.



D1 – EMERGENCY VALVE:-

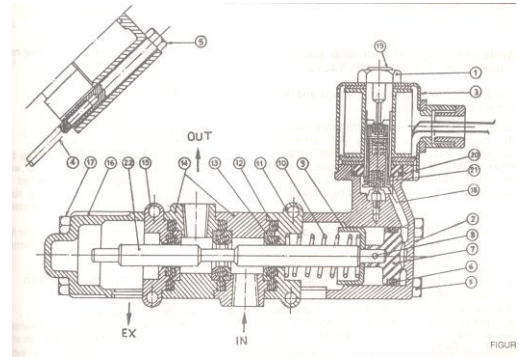
This valve is a flap valve with suitable lever. It is connected directly with the Brake pipe. If this valve is opened, BP drops to Zero at the faster rate and thus brake application is made very fast with maximum braking effort and minimum braking distance.

1. In case of emergency, when the assistant driver notices any obstruction / defect in track which the driver could not notice, the assistant driver can operate independently.
2. When the normal application of brakes is not possible or not affected, the driver or assistant driver can use this valve to stop the train.



D1. PILOT AIR VALVE CUM BRAKE ISOLATING VALVE

It is an electrically operated solenoid valve. Whenever Dynamic Brake is applied it disconnects the supply from C3W Distributor valve and connects it to Exhaust. Thus it nullifies the loco brake application through A9 when dynamic brake is applied.



PRESSURE LIMITING VALVE :-

This will control the Output pressure of C₃ W valve to the desired level. This valve is fitted at the outlet of C₃W valve to limit the Brake Cylinder pressure to 2.5Kg/Cm².



24 – A DOUBLE CHECK VALVE :

This connects two inlet passages in a common outlet. At a time it connects only one of the two inlet passages with the outlet by isolating the other.



AIR FLOW MEASURING VALVE

This valve indicates charging rate of BP / the leakage of BP pipe through an indicator, which is calibrated in term of No of wagons. Indicator is located at driver's control stand. MR air is connected to C2 W relay valve through Air Flow Measuring valve.

Construction:

MR air is connected to C2 W relay valve through inlet and outlet passages of AFM valve. Disc valve controls inlet and outlet passage of AFM valve. Disc valve has two small ports, one connects MR air to the top chamber of Disc Valve and other connects MR from top chamber of disc valve to Additional C2 Relay valve. Top chamber of Disc valve is the bottom of main diaphragm. Disc valve is pressed down through a follower & spring on its seat. Choke B is provided to connect MR air to top chamber of main diaphragm. Choke C is provided to supply 'main diaphragm top chamber air' to indicator, when diaphragm moves down word. Choke D is provided regulate air supplied through choke C towards indicator.

Working:

When the brake pipe is fully charged with air and the air brake is in the release condition, the air flowing from the main air supply through the Airflow measuring valve and to the brake pipe is that necessary to overcome leakage. In this condition the disc valve is closed as shown in diagram and air from the main supply passes through choke A in to the top chamber of disc valve and out to the Additional C2-Relay valve. It also passes in to the chamber under the diaphragm via the space around the follower. At the same time, air from the main supply passes through a filter and choke B in to the chamber above the diaphragm.

So long as the pressures above and below the diaphragm are equal, the diaphragm floats against the choke C. As brake pipe leakage occurs, the pressure at the outlet port and under the diaphragm falls and the diaphragm is moved down away from the choke C and permits air entering the chamber above the diaphragm via choke B, to flow through choke C to an indicator and through choke D to atmosphere.

Choke D is smaller than choke C and an intermediate pressure builds up in the passage between them and registers on the indicator. This intermediate pressure is related to the flow of air through choke C that is controlled by the diaphragm reacting to the pressure under it. As the pressure under the diaphragm depend upon the fall of pressure at the outlet port relative to the main supply pressure, being guided by the flow rate towards BP to make good the leakages during run. It also determines the flow of air through choke A. The indicator therefore provides a visual indication of the amount of air flowing to the brake pipe.

During initial charging or release of brakes, when a large quantity of air passed to the brake pipe, the pressure at the out let port and in spring chamber reduces sufficiently. It allows the supply pressure to lift the disc valve off its seat and permit unrestricted flow of air to the brake pipe through C2 W-Relay valve. Under these conditions a high intermediate pressure builds up in the passages between chokes C and D, and the indicator indicates a high rate of airflow.

Choke D is variable to facilitate calibration and may be altered by means of an adjusting screw, turning the screw clockwise reduces the aperture and turning it anticlockwise enlarges it.

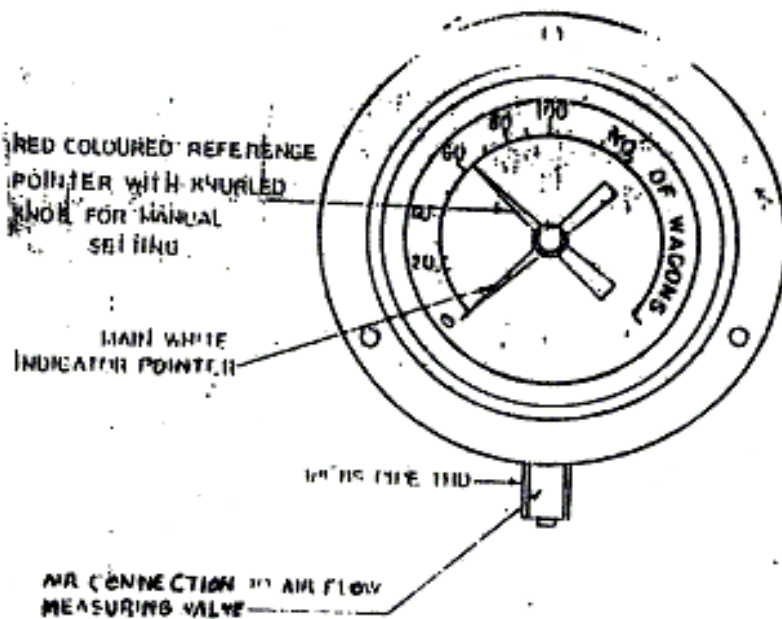
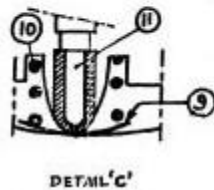
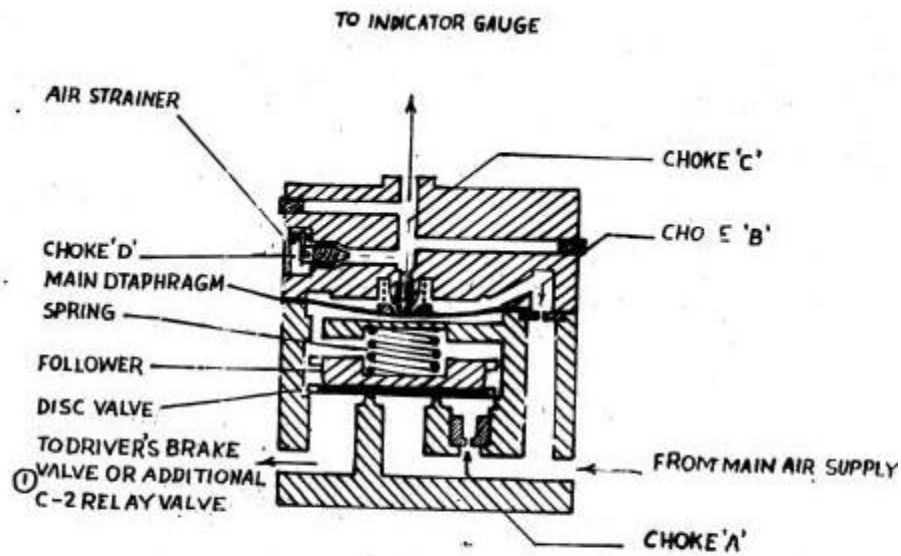
Calibration

The Airflow measuring valve includes a calibration choke enclosed by a vent plug. This feature is provided to facilitate the calibration of the equipment on the vehicle. There is a test stand, where the needle valve setting is calibrated on 130 psi charging line. Where AFM valve indicator gauge reads 70 psi/ 100 wagons reading.

AIR FLOW INDICATOR

It is an air pressure gauge with two pointers. Red pointer is called reference pointer, which is attached to a knurled knob and protrudes through the dial glass, so that it can be set manually in any desired position, where as the other pointer (White) moves on the scale

depending up on the air flow. The indicator is connected to the measuring valve through R-6 relay valve. The scale on the gauge is calibrated in terms of number of wagons. The 60 marks correspond to the maximum rate of airflow that can be accepted to overcome leakage on a 60 wagon train and so on.



INDEPENDENT BRAKE APPLICATION AND RELEASE.

Independent brake application and release is controlled through SA9 Brake handle.

When SA9 handle is kept in released position, Brakes are in released condition. When SA9 handle is moved to application zone, it supplies pilot air to C₂ relay valve through Port No: 20 to Port No: 2 of MU2B. In lead loco or single unit loco MU2B is kept in lead position. In this, Port No 2 & 20 are interconnected and air from MU2B will come out through port 20. This air acts as Pilot air for C₂ relay valve, entering at Port No 2 (Pilot port) through a double check valve. This pressure acts at the top of main diaphragm of C₂ relay valve. (In trailing loco the MU2B is kept in trail position, port No 2 & 20 are isolated hence brake cannot be applied from the trailing loco).

C₂ relay valve in turn will supply air to the Brake Cylinder through port 3 at a pressure equal to pressure at port 2.

There are two Brake cylinders in locos. The outlet air from C₂ relay valve goes to the brake cylinders and applies the brakes.

One branch from C₂ relay outlet is connected to F1 selector port 30. Since MU2B is in lead, F1 selector also will be in lead and hence the air at port 30 comes out through port 14 and charges the brake cylinder-equalizing pipe. Normally the COCs at both the ends of BC equalizing pipe are in closed condition. This pipe will be coupled to the trailing loco in MU operation to apply the brakes in trail loco.

If the SA9 handle is moved to release position, the pilot air supplied to C₂ relay port 2 will be withdrawn and exhausted through SA9 exhaust port. In turn, C₂ relay valve will withdraw the brake cylinder pressure and exhaust it through exhaust port, till the Brake cylinder pressure is equal to pilot air pressure at port 2. (In this case 0). The pilot air for Brake cylinder pressure will be proportionate to the position of SA9 handle during application and release. A gauge pipe is connected after the front truck Brake cylinder COC to indicate the BC pressure to the driver's control stand.

AUTOMATIC BRAKE APPLICATION AND RELEASE.

BP CHARGING

The charging and exhausting of BP is done through A9 Brake handle for application and release of formation brake in conjunction with Loco Brake.

When the A9 handle is kept in release position, it supplies pilot air at 5 Kg/Cm² to the port 2 of C₂W relay air valve through MU2B port 3 and 13. A volume reservoir is also connected at this line to dampen fluctuation of pressure. C₂W valve thus charges the BP equal to the pilot pressure. At the outlet of C₂W valve, a ¾" COC is fitted which should be open in single unit / lead unit and closed in trailing unit.

At the inlet to C₂W relay valve, an airflow-measuring valve is fitted which is connected to an Air Flow Indicator Gauge situated at Driver's Cab. The indicator indicates the rate of MR airflow through C₂W relay valve i.e. rate of charging of BP. This arrangement is used to find the condition of brake pipe. If the leakage in B Pipe is high, the indication will show a higher value. If there is no leakage the indicator show zero.

MONITORING OF BP CHARGING

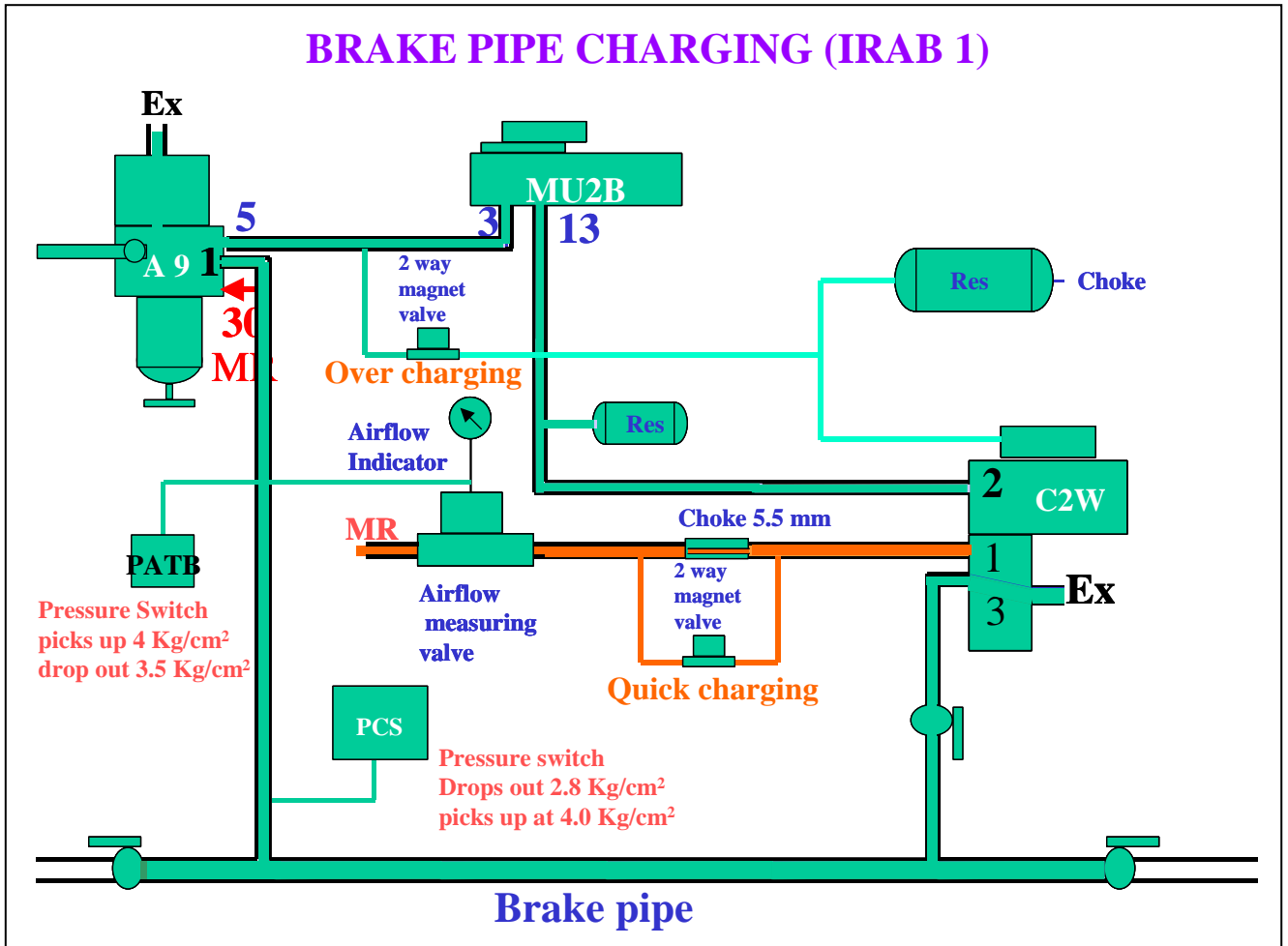
While starting a train after coupling and charging the Brake pipe, the driver should check the indicator reading. It should be less than the number of vehicles in that train. (The graduations are in 'No of wagons') and turn Red needle and align with the white needle. While working, if BP starts leaking, the white needle will overshoot the red needle. This is the indication of a problem / leakage in Brake pipe. On getting this indication, the driver should stop, investigate the reason for BP leakage and rectify.

When the A9 valve handle is moved to application zone i.e. to min. reduction, or more, A9 valve reduces the pilot air to C₂W and hence C₂W also reduces the brake pipe pressure (BP charging rate drops to zero).

When A9 handle is kept in Emergency, the Brake pipe drop to zero immediately causing emergency brake application in formation (BP charging rate drops to zero).

During release the rate of charging of BP is very high and the white needle deflection

of Airflow indicator shoots up and then stabilizes, which should not be misunderstood as defect in Brake pipe



AUTOMATIC / CONJUNCTION BRAKE IN LOCOMOTIVES:

The arrangements of valves are shown in sketch.

When there is a reduction in brake pipe, C₃W valve senses it and supply air pressure proportional to the reduction in BP for the brake cylinder. This air passes through the limiting valve and then to F1 selector valve Port 4. If the MU2B and also F1 selector are in lead, this pressure flows to the C2 relay valve port 2 through the double check valve and applies the loco brakes. When the BP is recharged, C₃W valve will withdraw the air and exhaust it causing the C2 relay to release the brakes in the loco.

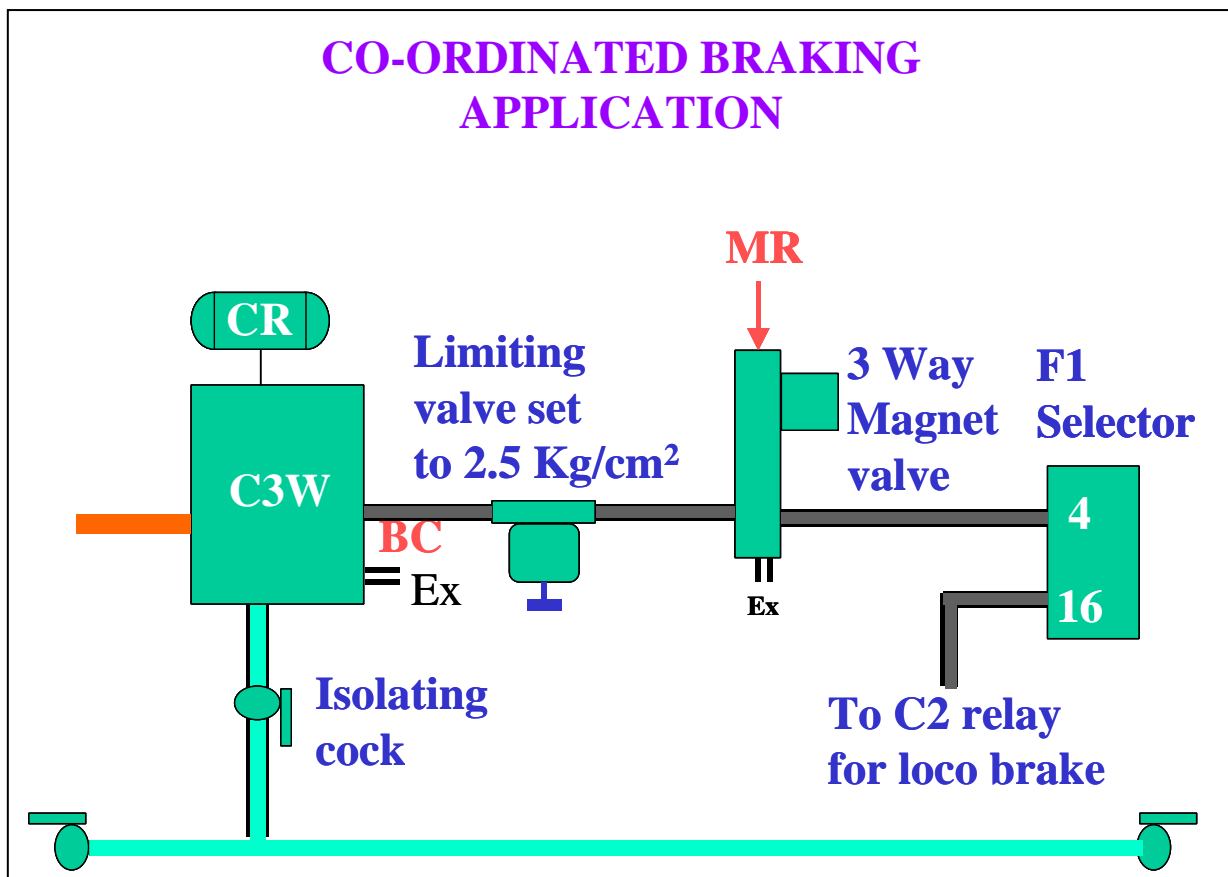
ACTION ON DYNAMIC BRAKE APPLICATION:

If dynamic brakes are applied, (while the Automatic brake is also ON) D1 pilot air valve fitted in between limiting valve and F1 selector will be energized causing the normal passage to cut off and air applied to C2 relay through F1 selector to be exhausted. This causes the loco brakes to release. This feature is provided to avoid excess (two brakes ON at a line) braking in loco and hence wheel skidding. When DB is released, normal operation of automatic brake is restored.

OVER CHARGING FUNCTION:

Generally, if there is brake binding in any of the vehicle in formation, the crew has to reach the particular vehicle and release the brakes manually. It will take several minutes. To avoid delay due to brake binding, the brake pipe is charged more than 5 Kg/Cm² (i.e.5 Kg/Cm² max). By doing so, the C₃W valves of all the vehicles will be forced to release the brakes, because as per general logic brake releases when BP is equal to or more than CR. This is done by the over charging function in this system.

For overcharging, the crew should press overcharging button, in certain cases switch. This switch energizes the 2-way magnet valve, supplying BP pilot air to C₂W relay valve. This pressure increases the setting of C₂W valve to 5.4 Kg/Cm² (this is done by charging the top diaphragm to an additional value). The overcharging continues till the button/ switch hold pressed. It is advisable not to allow the BP to rise more unnecessarily



long time to resume the normal operation. The switch should be released as soon as the BP rises to 5.2 Kg/Cm².

QUICK CHARGING FUNCTION:

Normally to meet the leakages in the BP line during running condition a 5.5 mm choke is provided at the inlet to the C2 relay valve, the purpose of providing choke is just to meet the loss of BP during run. Otherwise excess rate of charging will not reduce the BP for application of brake and indication in case of Chain pulling / guard's brake application. But during initial charging and releasing of brake BP need to be charged faster. To charge the pipes faster, a by pass for this choke is provided with a 2 way magnet valve. On energizing the magnet valve, the choke is bypassed to normal opening $\frac{3}{4}$ ", resuming the normal capacity of C₂W relay valve. This should be used to avoid auto flasher to switch ON during releasing the brakes (which takes place if the charging time is more than 60 sec).

SAFETY DEVICES:

These safety devices are shown in the sketches.

A9 EMERGENCY

The A9 emergency is applied BP will be reduced to zero. When the pressure is less than 2.5Kg/Cm² the PCS operate and brings the engine to idle.

TRAIN PARTING:

When train parting occurs, air leaks out heavily through the brake pipe causing Airflow indicator to shoot up. When the reading goes beyond 80 wagons (4.0 Kg/cm²) at the indicator pipe, the PCS operates and brings the engine to idle. If the trouble is rectified and the reading reduces to 70 wagons, (3.5 Kg/ Cm² at the indication pipe) this PCS resets and allow the engine to rise.