# DIESEL LOCOMOTIVE
# TWIN PIPE DUAL BRAKE SYSTEM

## Introduction

Diesel locomotives of Indian Railways are equipped with brake system designed by either M/S WABCO/ USA or M/S KNORR Germany or IRAB-1 Indian Railways or M/S KNORR Brake (NYAB). Initially locomotives were equipped with M/S WABCO, USA designed 28LV-1 Brake system for use in vacuum brake train only. In 80's locomotives were switched over to 28LAV-1 Brake system for use both in vacuum and air braked Trains.

In 90's some of the locomotives were equipped with IRAB-1 brake system, which are suitable for only air-braked trains.

Recently acquired WDG4 and WDP4 locomotives are equipped with CCB (computer control brake) system designed by KNORR BRIMSE (NYAB), which are suitable for air braked train only.

**Air circuits of 28 LAV-1 brake system**

1. Independent brake system (Loco brake)
2. Vacuum train brake system
3. Brake pipe system (Air train brake)
4. Feed pipe system
5. Proportionate brake system
6. Safety devices
7. Multi unit operation

**Important feature of the 28LAV-1 brake system**

1.Locomotive brakes may be applied with any desired pressure between the minimum and maximum. This pressure will be maintained automatically in the locomotive brake cylinders against normal leakage from them.

2. The locomotive brakes can be graduated on & off with either the automatic or the independent brake valve.

3. It is always possible to release the locomotive brakes with the independent brake valve, even when automatically applied.

4. The maximum braking position emergency, ensuring the shortest possible stops distance.

5. It is always possible to haul both vacuum / air brake trains.

6. Automatic brake application and power cut off with idle rpm of engine is always possible during train parting.

7. Multiple unit operation is also possible.

# Independent Brake system (Loco Brake)

## Introduction

Loco brake system is provided to stop the Locomotive, whenever it runs as light engine. It is purely compressed air brake system known as independent brake system. For this separate air circuit is provided in 28LAV-1 & IRAB-1 Brake system which is independent to other air circuit. SA9 Independent brake valve is provided in driving control stand for application & release of loco brake. Valve has three positions ie. quick release, release and application.

## Purpose of this system

Independent Brake System is designed to apply and release brake on locomotive. When locomotive is moving itself Independent Brake is applied.

## Loco brake valves

System consists SA9 Independent Brake valve, Double check valve and C2-Relay valve.

## Description of loco brake (Independent brake) system

The SA9 Valve handle is kept normally in release position (right side). MR air is always available at port no.30 of SA9 valve. When handle is brought in application potion (left side) than SA9 port 30 connects port 20 and starts supplying pilot air to C2-Relay air valve. The pilot air passes through MU2B Valve port no. 2&20 and inters to C2-Relay at port no.2. See the line diagram of loco brake system. The pilot air pressure depends upon the handle position, at maximum it is 3.5kg/cm2. The C2-relay air valve actuates after getting pilot air and connects MR pressure to brake cylinders of locomotive through port no.1&3. The brake cylinder pressure depends upon pilot air pressure, supplied into C2-Relay chamber through port no.2. For full brake application SA9 handle is moved to maximum travel position. In this way independent brake/loco brake is applied. There is a gauge line taken from front truck of locomotive to driver's cabin control stand for indicating brake cylinder pressure. When SA9 handle is placed in release position, loco brakes are released. How MR air is reduced to 3.5kg/cm2 see internal function of the SA9 valve & C2-Relay valve.

SA9 Brake valve handle is normally kept in release position. Loco brake can be applied through SA9 Valve handle. It can be applied any desired pressure between the minimum and maximum. This pressure will be automatically maintained in the locomotive brake cylinders against normal leakage from them. The locomotive brake can be graduated on and off with either the automatic (A9) or the independent brake valves (SA9). It is always possible to release the locomotive brakes with the SA9 valve.

# VACCUM BRAKE SYSTEM

## Introduction

Indian Railway runs both the trains vacuum and air brake. In vacuum brake train brakes are controlled through vacuum of train pipe. After coupling the locomotive to the vacuum brake train the vacuum is obtained in train pipe. An exhauster unit is provided to create the vacuum in the train pipe as well as the Vacuum cylinders of each coach/wagon. A9 automatic brake valve is provided in driving control stand through which vacuum is controlled. Normally valve handle is kept in release position.

## Purpose of this system

This system is designed to apply and release brakes on vacuum brake train. Which is achieved through A9 Automatic Brake valve.

## Vacuum brake system valves

System consists A9 Automatic Brake valve, VA1B Control valve and HS4 Control valve.

## Description of Vacuum Brake system

Locomotive and train has a long vacuum brake pipe, in which 56cm vac. is maintained through an exhauster unit. There is a VA1B control valve in between train pipe and exhauster unit, which controls 56cm vac.in train pipe. A9 automatic brake valve is provided in driving control stand to apply vacuum brake on train. When A9 handle is placed in application zone, train pipe vacuum drops and brakes are applied through vacuum cylinders of coaches.

The function of A9valve is to supply control pressure to Add.C2-Relay valve. The function of VA1Bcontrol valve is to maintain 56cm vac. in train pipe. The function of HS4 valve is to supply 1.7kg/cm2-air pressure to bottom chamber of VA1B control valve at port no.1. Other valves are provided in this circuit for MU operation. See line diagram of vacuum brake circuit.

Charging of system

Air at 8 to 10kg/cm2 pressure is charged at different valves through MR-2. See the line diagram of vacuum system. Port no.30 of A9 valve, port no.1 of Add.C2-Relay valve and port no.1 of HS4 control pressure valve. A9 valve handle is kept at release position normally. Simultaneously A9valve will supply control pressure to Add. C2-Relay valve, through MU2B valve. After getting supply of control pressure, Add.c2-relay valve will supply 5kg/cm2 pressure to BP pipe. BP pipe is connected to VA1B control valve top

chamber at port no.3. At port no.1 control pressure at 1.7kg/cm2 is supplied through HS4 control valve. VA1-B control valve maintains 56cm vacuum in train pipe.

Application of brake

A9 handle is moved in application zone for brake application. A9 reduces Control pressure to Add.C2 Relay valve. Add. C2 Relay reduces BP pressure in proportion to control pressure dropage. BP pressure may be zero if A9handle moved at over reduction position. If handle is placed at emergency position BP will drop to zero immediately within 3 sec. After dropping BP pressure brakes are applied.

Releasing of brake

When handle is moved to release position, A9 valve starts supplying full control pressure to Add. C2 Relay valve causing BP pressure start increasing to 5kg/cm2 and brakes are released.

**Vacuum trouble in train**

Following test are recommended:-

1. BLOCKAGE TEST: Remove one end of the vacuum hose pipe and raise it upwards. If more than 8cm vacuum is created, there is a blockage in the system.

2. EFFICIENCY TEST: Against an 8 mm leak disc, the loco should create 53 cm vacuum.

3. LEAKAGE TEST: Vacuum on dummy and on leak disc should be not vary by more than 3 cm.

The Board has therefore standarised the vacuum level in engine and brake van for all Railways both the traction.

| **Type of service** | **Engine** | **Brake van** | **Average** |
|---|---|---|---|
| M/E | 53 | 47 | 50 |
| Passenger | 50 | 44 | 47 |
| Goods | 46 | 38 | 42 |

# Proportionate brake system

**Introduction**

In prop/brake system locomotive brake works in proportion to train brake. If train brake is partially applied to slow down the train in proportion to that loco brake will be applied. This work is done through proportionate brake valve.

**Proportionate brake system valves**

Proportionate brake system consists SA9valve, MU2Bvalve, Proportionate brake valve, C2 Relay valve, Double check valve.

**Purpose of this system**

System is designed for Locomotive brake application during train brake application through A9 handle. This is known as synchronising brake system also.

**Description of the system**

In this system proportionate valve is connected to vacuum pipe and MR pipe, when vacuum is dropped to zero for train brake application, at the same time vacuum of prop/valve chamber A is also drops to zero. See the line diagram of proportionate brake system. Then Prop/valve supplies control /pilot air pressure to C2-Relay air valve and loco brakes are applied.

To avoid loco brake, in SA9 valve Quick Release position is provided. If handle is moved to Quick release position then loco brake will not take place. Prop/valve has two vac./chambers, which are connected to SA9 valve port no.1&7. At Q/Rel. position both ports are connected causing both chamber of prop/valve equalized. So there is no action inside the valve.

In IRAB-1 Brake system C3W-Distributor valve is provided in place of proportionate brake valve, which senses the BP pressure.

# Brake Pipe System

## Introduction

BP system is introduced to run Air Brake train, where train brake is controlled through BP pipe instead of vacuum pipe. Additional C2-Relay valve is introduced in this system to supply sufficient air to BP system.

## BP system valves

BP system consists A9 Automatic brake valve, MU2B valve, Add./C2-Relay valve, Air flow measuring valve,R-6 Relay air valve and Air flow indicator.

## Purpose of this system

This system is introduced to run air brake train. Air Brake system can sustain better brake power and can haul a long train.

## Description of BP system

MR air is connected to A9valve at port 30 and Add./C2-Relay valve at port 1. Normally A9 handle is kept at release position and maintains 5kg/cm2-air pressure in brake pipe. In this position brakes are found released position. When A9handle is moved to application zone, B P pressure drops through Add. C2-Relay valve, port 3 is connected to exhaust. In this condition brakes are applied.

Brake release

When A9 handle is moved to release position, Add. C2-Relay valve port3 is connected to port1 and B P pipe is charged to 5kg/ cm2 and brakes are released.

# Feed pipe system

## Introduction

Air Brake system has two brake pipes, BP pipe and FP pipe. BP Pipe is provided for brake application and release where as FP Pipe is provided to help in release time.

## FP system valves

System consists Feed valve and Duplex check valve, which are connected from MR-1.

## Purpose of the system

Feed Pipe system is introduced to reduced the release time after brake application in air brake trains.

## Description of the system

FP System is charged 6kg/cm2 through MR pipe and Feed valve. Air flows from MR-1 to Duplex check valve, which allows air to outlet when MR pressure becomes more than 5kg/cm2. Air reaches directly to Feed valve through cut-out cock. Feed valve supply air to feed pipe at 6kg/cm2. How Feed valve reduces the MR pressure to 6kg/cm2 see the internal function of the valve.

# A-9 AUTOMATIC BRAKE VALVE

## 1. Introduction

The A-9 Automatic Brake Valve is a compact, self-lapping, pressure maintaining brake valve, which is capable of graduating the application or release of locomotive and train brakes. The A-9 Automatic Brake Valve has five positions: Release, Minimum Reduction, Full Service, Over-reduction, and Emergency. The full service application position is preceded by a zone in which brake pipe air is supplied or exhausted in proportion to brake valve handle movement through this zone, thus providing the graduation of an automatic application or release of the locomotive and train brakes.

## 2. Objective

The A9 Automatic Brake Valve maintains 5kg/cm2-air pressure in Brake Pipe System against normal leakage at its release position. It also maintains air pressure drop in the system according to its handle position.

## 3. Construction

The A-9 Automatic Brake valve consists of a self-lapping regulating portion, which supplies or exhausts the brake pipe pressure, and a vent valve which is actuated only when the brake valve handle is placed in Emergency position for the purpose of venting brake pipe pressure at an emergency rate. The self-lapping portion is actuated by regulating cam dog 3 on the brake valve handle shaft 32 which controls the supply or exhaust of brake pipe pressure. The vent valve 19 is actuated by special cam dog 23 attached to the brake valve handle which is operative only in Emergency position of the brake valve handle.

The A-9 Automatic Brake Valve is provided an adjusting handle or set screw 15 which serves to permit the proper adjustment of the automatic brake valve to supply brake pipe air to the required operating pressure. There is a inlet valve assembly along with double ball check valve, which moves up and down, when handle moves.

## 4. Operation

Charging

The A9 automatic brake valve handle is kept at release position normally. The regulating cam dog 3 holds the inlet and exhaust unit at farthest down ward position. While the regulating valve spring 12 will cause the double ball check assembly 5 to be seated at the exhaust valve and unseated at the inlet valve (see diagrammatic). Main reservoir air is supplied at port No. 30 in the pipe bracket and passes through a strainer to the open inlet valve in to port No.5. This air in port 5 is also ported through a choke passage to the face of regulating valve diaphragm 9. When the pressure on the face of the regulating valve diaphragm 9 overcomes regulating valve spring 12 tension, the

regulating valve diaphragm assembly moves down ward and allow the inlet valve spring to seat the double ball check assembly at the inlet valve seat. The A-9 Automatic Valve resumes a lap position.

Application

When the brake valve handle is moved into the minimum reduction, service application zone or full service position, the regulating cam dog 3 on the brake valve handle shaft 32 will permit the inlet valve assembly to move away from the exhaust port by the exhaust valve spring 7. The inlet valve assembly will carry the double ball check assembly with it. This movement will unseat the double ball check valve at exhaust valve seat, thus allowing brake pipe air to flow to exhaust. With the reduction of pressure on regulating valve diaphragm 9, the regulating valve spring 12 will cause a movement of the diaphragm assembly toward the inlet valve and the double ball check valve assembly will be seated at the exhaust valve seat again. The brake valve to assume a lap position.

Pressure drop in

Minimum reduction—.5/.7kg/cm2
Full service----------1.7/2kg/cm2
Over-reduction--------2.5kg/cm2

Release after application

Movement of the brake valve handle toward release position will cause regulating cam 3 to move the inlet valve assembly toward the regulating valve diaphragm assembly. This movement will cause the double ball check valve 5 to be unseated at the inlet valve. Main reservoir air will then flow through the inlet valve to port No. 5. The supply of main reservoir air to the face of regulating valve diaphragm 9 will increase and move down word, resulting in the compression of the regulating valve spring 12. When the force have equalized across the regulating valve diaphragm 9, the double ball check assembly 5 will again seat at the inlet valve due to the force of the inlet valve spring and the brake valve will assume a lap position. Thus it can be seen that the brakes can be graduated off in proportion to the brake valve handle movement from an application position toward release position.

Emergency position

When the brake valve handle is moved to emergency position, the brake valve will perform all the service operations. In the emergency position, the emergency cam dog 23 is actuated through special cam dog 23 to open vent valve 19 and allow brake pipe air to be vented at an emergency rate. Release after an emergency is the same as previously described under release after service.

# SA 9 INDEPENDENT BRAKE VALVE

## 1. Introduction

The SA9 independent Brake Valve is a compact, self– lapping pressure maintaining independent brake valve, which performs the function of graduating the application or release of the locomotive air brakes independently of the automatic brake valve. The SA9 Independent Brake Valve is also capable of releasing an automatic brake application on the locomotive without affecting the application on the train brakes. The independent brake valve has three positions: Quick Release, Release, and Application. The quick release position is the farthest right-hand position of the brake valve and serves to release an automatic brake application on the locomotive. The application position consists of a zone in which regulated air pressure is supplied or exhausted in proportion to brake valve handle movement through this zone, thus piloting the graduating of brake cylinder pressure during an independent application or release.

## 2. Objective

The SA9 Independent Brake Valve maintains 3.5kg/cm2-air pressure in the independent brake system against normal leakage through C2-Relay valve. It is suppose to maintain graduated application and release according to its handle position.

## 3. Construction

The SA9 Independent Brake Valve consists of a self–lapping regulating portion, which supplies or exhausts air pressure for piloting the graduated application or release of brake cylinder pressure on the locomotive. This brake valve also includes a quick release valve. Both the self-lapping regulating portion and quick release valves of the SA9 Independent Brake valve is actuated by cams attached to the brake valve handle stem. It has regulating valve spring 12, which regulates supply pressure. Exhaust valve spring 7 regulates the movement of exhaust valve. Inlet valve spring keeps inlet ball valve at seat. Quick release valve 17 keeps port no.1&7 separate through its rubber ` o' rings.

## 4. Operation

Charging.

In the release position of the brake valve handle, the inlet valve, due to the spring tension of exhaust valve Sparing 7, is positioned at its farthest travel from the regulating valve diaphragm assembly. Which will unseat the double ball check valve at the exhaust valve while being seated at the inlet valve by the inlet valve spring. With the exhaust valve open, there is no air pressure in the independent application port no. 20. Main reservoir air is supplied through port 30 in the pipe bracket and a strainer to the spring chamber of the inlet valve where it is blanked.

Vacuum pressure in the vacuum brake pipe is supplied through port No. 1 in the pipe bracket to the spring chamber of the quick release valve where it is blanked. Vacuum reservoir pressure coming from the control valve is supplied through port No. 7 in the pipe bracket and is also blanked to the position of release valve 17.

Application

When the brake valve handle is moved in to the application zone, the regulating cam dog 3 on the brake valve handle shaft 24 forces the inlet valve assembly towards the regulating valve diaphragm assembly and causes the double ball check valve to seat at the exhaust port and open at the inlet valve, thus supplying main reservoir air through the open inlet valve in to the independent application and release pipe(Port 20) which will pilot the locomotive brake application. Main reservoir air is also ported through a choke passage to the face of the regulating valve diaphragm 9. When the pressure on the face of the regulating valve diaphragm 9 overcomes the force exerted by the regulating valve spring 12, the regulating valve diaphragm assembly will move down word. This will allow the inlet valve spring to move the double ball check assembly to the inlet valve seat, thus the brake valve will assume a lap position.

Release after application

When the independent brake valve handle is moved toward release position, the regulating cam dog 3 allows to move the inlet valve assembly up word, carrying the double ball check valve assembly with it, thus unseating the exhaust port while inlet valve remaining seated at the inlet valve seat. A graduated release of brake cylinder pressure will be there, in proportion to the movement of the brake valve handle. At the same time, pressure will be released from top of the diaphragm. When the forces across the regulating valve diaphragm 9 have equalized, the double ball check valve assembly will be seated at both the inlet and exhaust valve seats, and thus the independent brake valve will again assume a lap position.

Quick release position

The quick release position of the independent brake valve provides a means of releasing an automatic brake application on the locomotive without affecting the automatic brake application present on the train brakes.

When the independent brake valve handle is placed in the quick release position, the release valve cam 19 positions the release spool valve 17 to connect vacuum control reservoir port 7 to vacuum brake pipe port 1. Since the automatic brake application is in effect on the train, the vacuum pressure in the vacuum control reservoir will be greater than that of vacuum brake pipe, thus the vacuum control reservoir will be permitted to equalize with the vacuum brake pipe. This will cause the proportionate brke valve to assume a release position and subsequently cause the release of the brake cylinder pressure on the locomotive. The equalizing of the vacuum control reservoir and vacuum brake pipe will have no effect on the VA1–B control valve, thus the vacuum train brakes will remain applied.

# 24 – A DOUBLE CHECK VALVE

## 1. Introduction

Double check valve is used to provide control of two sources without interaction between the two.

## 2. Objective

The double check valve has two receiving ends, that is why this valve is used at several points in air brake system, wherever two air sources are possible.

## 2. Construction

There is an internal floating check valve with "O" ring seal 7, automatically directs the flow of air from one or the other of the two controlling devices to a common discharge. At the same time, prevents this air from flowing to the inoperative controlling device.

## 3. Operation

Referring to the assembly view, when a pressure differential exists between the two end ports, the higher air pressure forces the check valve 4 over to seal against its seat 3 on the flow pressure side. This closes the passage between the low-pressure port and the common port in the body 2. Air then flows from the high-pressure port through the common port to the control device.

# PROPORTIONATE BRAKE VALVE

## 1. Introduction

The Proportionate Brake valve is a vacuum operated, automatic, self-lapping, pressure maintaining type valve designed to be controlled by vacuum pressure. It supplies and exhausts brake cylinder air pressure on locomotive. The movement of the automatic brake valve handle in application zone effects the brake cylinder air pressure.

## 2. Objective

The Proportionate Brake Valve senses the vacuum drop in vacuum train pipe and applies proportionate brake on locomotive.

## 3. Construction

The Proportionate brake valve consists of a pipe bracket and a valve portion. The valve portion contains two diaphragms large and small selected to provide for proper reference of vacuum train pipe and loco brake cylinder pressure. Movement of the spool valve controls the supply of air to pilot the brake cylinder pressure. During a brake application, the spool valve and large diaphragm assembly moves up to open the application check valve 3. The spool valve element also serves to exhaust at the bottom of the brake valve, the air pressure controlling the supply to the brake cylinders. Port I is connected to vacuum train pipe and the chamber A under the large diaphragm as w ell as to the top chamber through a ball valve. Top chamber is connected to port 7 and vacuum reservoir pipe. At release position ball valve is lifted connecting both the chambers to train pipe for creating same vacuum. Thus, initially, the pressure in the vacuum control reservoir and the vacuum train pipe is the same.

## 4. Operation

MR air pressure is supplied to the top of the application check valve3 through port 30. When the A9 brake valve handle is moved to service position, brake pipe pressure is reduced. This pressure reduction affects the VA1-B control valve, which in turn, functions to admit atmospheric air in to the vacuum train pipe. Atmospheric air flows to port 1 of the proportionate brake valve where the vacuum in the chamber under the large diaphragm is destroyed. The increase of pressure in this chamber acts upon the diaphragm to move the spool valve stem up ward to open the application check valve 3. When the application check valve 3 is opened, the MR air through limiting valve flows to C2-Relay valve for piloting the loco brake cylinder pressure. Same air is ported through a choke to the spring chamber above the small diaphragm of Prop/valve. When the air pressure builds up and balances against force of the vacuum train pipe pressure on the large diaphragm. When this balance is reached, the spool valve moves down and closes the application check valve 3 at which time the spool valve will assume a lap position.

As the brake valve handle is moved towards release position, the brake pipe pressure is increased, thus the VA1-B control valve functions to connect the vacuum train pipe to the exhauster. In the train pipe vacuum is created as well as in the bottom chamber of large diaphragm. The diaphragm follower will resume the previous position. The brake cylinder pilot pressure will be exhausted through the service valve stem at port 10. The exhaust of brake cylinder pressure will be proportional to the brake pipe pressure. With each movement of the brake valve handle towards release position, a proportionate amount of brake cylinder pressure will be exhausted. Thus, it can be seen that when the brake valve handle is moved from service position towards release position, a graduated release of locomotive brakes take place.

The quick release of an automatic brake application on the locomotive is achieved through quick release position of SA9 valve. The vacuum control reservoir piped to port 7 is connected to the vacuum train pipe port 1. The equalization of pressures across the large diaphragm will permit the spool valve assembly downward. Thus causing the brake cylinder control air to flow through the spool valve and exhaust to atmosphere at port 10.

# C-2 RELAY VALVE

## 1. Introduction

The C-2 Relay Valve is a diaphragm operated, self-lapping valve which functions to supply and exhaust brake cylinder air pressure during brake applications and release.

## 2. Objective

The C2-Relay valve maintains 3.5kg/cm2-air pressure in locomotive brake system against normal leakage.

## 3. Operation

Application

While supply air pressure present in port 1 and no air pressure present on control diaphragm 36, both supply valve 6 and exhaust valve 23 will be seated by the respective springs. Assume that air pressure is admitted to the control port 2 of the valve. This pressure will be delivered to the upper side of diaphragm 36 causing it to move downward, carrying diaphragm stem 20 with it. During this movement, the diaphragm stem will contact the differential type supply valve 6 and unseat it by compressing supply valve spring 5. Supply air from port 1 will then flow past the unseated valve to the delivery port 3 where it is piped to the brake cylinders. Supply air also flows through a choke in the exhaust valve to the underside of the control diaphragm 36. When the pressure under the diaphragm is substantially equal to the control pressure on top of the diaphragm, the diaphragm assembly will move back toward its initial position, and supply valve 6 will seal, aided by spring 5 , thus cutting off further flow of supply air to the delivery port.

The relay valve will maintain this delivery pressure against leakage. In the case of a reduction in delivery pressure, the high pressure on the upper side of diaphragm 36 will cause movement downward, repeating the application cycle and restoring the delivery pressure to the desired valve.

Release

When the control pressure to the valve is reduced, the high pressure on the underside of diaphragm 36 will cause it to move upward, carrying stem 20 with it. During this movement, the shoulder on the diaphragm stem will contact differential type exhaust valve 23 and unseat it by compression of spring 27. Air from the delivery port will then flow past unseated exhaust valve 23 to atmosphere, reducing the pressure in the brake cylinders. When the pressure has been reduced to balance the pressure in the diaphragm, the diaphragm assembly will move back to its initial position and exhaust valve 23 will seal, aided by spring 27, thus cutting off the flow of brake cylinder air to exhaust. If the control pressure is completely removed from diaphragm 36, the valve will completely exhaust the delivery pressure to the brake cylinders.

# ADDITIONAL C2-RELAY VALVE

The construction and internal function of Additional C2-Relay and C2-Relay valves are same and both are interchangeable. But in Add. C2-Relay pipe bracket ¾"dia.outlet port is provided for faster charging and C2-Relay has ½" dia. outlet port.

# MU – 2B VALVE

## 1. Introduction

The MU- 2B valve is a two-position valve with a pipe bracket. It is used in multiple unit service. The MU-2B valve pilots the F-1 selector valve. It is a device that enables equipment of one locomotive to be controlled by equipment of another. It also controls the movement of the VA1 release valve. The two positions used in the MU-2B valve is "LEAD" and "TRAIL or DEAD."

## 2. Objective

This valve is provided to work in multiunit operation. In trail unit brake application valves are isolated through this valve.

## 3. Construction

MU2B Valve has two positions, which works as a spool valve. It has number of port connections.

## 4. Operation

In "LEAD" position, main reservoir air piped to port 63 is connected to port 53 and thus to the double check valve that leads to the piston of the VA–1 release valve. Independent brake control pressure is connected to port 2 &20 of the MU– 2B valve. Port 13 and port 3 are connected as a means of providing the passage to charge the brake pipe from the automatic brake valve. Port 30 connected to the F1 selector valve provides the connection for a supply of MR air that positions the F1 selector valve when the locomotive is used as a trailing unit.

When the unit is used as a trail locomotive, the MU-2B valve is positioned in "TRAIL or DEAD" position. Ports 2, 3, and 20 are blanked at the MU-2B valve. Port 53 is connected to exhaust at the MU- 2B valve. Main reservoir piped to port 63 is connected to port 30, which in turn, positions the F-1 selector valve of trail position operation. At the F- 1 selector valve, brake cylinder equalizing pipe air, port 14, is connected to ports 16 and 20, both of which are connected through a double check valve and thus to the control port of the relay valve. This provides a passage for air emanating from the lead unit during a brake application.

# F1 SELECTOR VALVE

## 1. Introduction

The F-1 Selector valve performs the function of arranging the brake equipment on the locomotive to lead or trail, other type of brake equipment. It performs the function of protecting a trailing locomotive brake equipment by automatically resetting the brake control to lead position in the event of a separation between locomotive units.

## 2. Objective

To apply loco brake on trailing locomotives during parting of multi unit locos. It works as a safety valve.

## 3. Construction

The selector valve consists of three sections and a pipe bracket. The pipe bracket has number of port connections. Port 15 controls the protection portion. The transfer sections are controlled by pressure in pipes Nos. 53 and 63. Connections are made as shown in the positioning chart for the positions "Lead", "Trail or Dead". There are three-spool valve no.6, 9 & 12. Which changes the port connections during trail and loco parting.

## 2. Operation

Operation of the selector valve is under control of the MU2B valve.

Lead position

When the 28LAV-1 equipped locomotive is the lead unit, air pressure to ports 53 and 63 of the selector valve is vented and connections made as shown in lead position of the position diagrammatic. Control valve pressure flows from port 4 to 16 and from there through a double check valve to the C-2 Relay valve. Pressure from the brake cylinder line flows from port 30 to 14, hence to the brake cylinder-equalizing pipe of the lead locomotive. The brake cylinder-equalizing pipe is used to control brakes on trailing units.

Trail position

When the 28LAV-1 equipped locomotive is the trailing unit or the dead unit, operation of the selector valve is achieved by supplying MR pressure to port 53 of the selector valve, causing the selector valve to assume the position as shown in the position diagrammatic under "Trail or Dead". Under this condition, air pressure from the brake cylinder equalizing pipe enters port 14 and flows to ports 16 and 20 and thus to the C-2 Relay Valve of the trailing or dead locomotive. Thus, automatic and independent brake applications initiated at the lead -locomotive are transmitted to the trailing or dead 28LAV1quipped locomotive and result in the same brake cylinder pressures as on the lead locomotive.

# VA1B CONTROL VALVE

## 1. Introduction

The VA1B Control valve controls the vacuum of train pipe. It connects the train pipe to atmosphere or exhauster as per variation in BP pressure. It is a very sensitive valve, which works on two deferent pressure 5kg/cm2 and 1.7 kg/cm2. It helps to operate the train vacuum brakes. This valve also acts as a pilot to operate the locomotive air brake through proportionate brake valve.

## 2. Objective

VA1B control valve is deployed in vacuum brake system to apply and release the train brake.

## 3. Construction

The control valve has three portions. Top cover, valve body and bottom cover with protection valve. The valve body contains sleeve, control valve 6, contacted on its upper side through its upper pusher pin 7 to small diaphragm 8 through diaphragm follower 9. It is also contacted on its bottom side through lower pusher pin 19 to large diaphragm 21 through diaphragm follower 22. The VA1B Control valve has six pipe connections (see piping diagram).

3 – Brake Pipe pressure
6 – Vacuum train pipe
2 --Vacuum train pipe
1 – Vacuum Control pipe
7 – Vacuum Reservoir Pipe to exhauster
8 – Atmosphere through GD-80 filter

Top diaphragm makes two chambers, chamber A is connected to B P pressure 5kg/cm2 through port 3 and chamber B is connected to atmosphere through a breather port. Bottom diaphragm makes two chambers, chamber C is connected to vacuum train pipe through port2 and chamber D is connected to vacuum control pressure 1.7kg/cm2 through port1.

## 3. Operation

The VA1B control valve is actuated through A9 valve. The deferent positions of A9 is described below.

Release

When 5kg/cm2 pressure is available in chamber A, 56cm vacuum in chamber C, and 1.7kg/cm2 pressure in chamber D, the valve remains in balanced or lapped position and all the ports are closed.

Suppose there has been a brake application, in chamber A pressure will drop and in chamber C vacuum will drop. When the A9 valve handle is moved in release position the brake pipe pressure starts increasing, the pressure in chamber A also increases, the control valve moves down connecting port 7 to port 6. In this way the exhauster starts creating vacuum in the train pipe. As the vacuum is restored in the vacuum train pipe and in chamber C of the control valve, the 1.7kg/cm2 pressure supplied to chamber D moves the diaphragm 20 and valve 6 upward. When the vacuum in chamber C is increased to approximately 56cm the upward movement of the valve 6 will lap itself leaving only enough opening to permit the exhauster to maintain vacuum against leakage in the train pipe.

Application

When the vacuum is restored in the vacuum brake system and it is desired to apply the brakes, the brake valve handle is moved to application position, causing a reduction in brake pipe pressure.

As chamber A of the VA1B Control Valve is connected to the brake pipe, a reduction in pressure in this chamber also takes place. The 1.7kg/cm2 pressure in chamber D then moves the diaphragm follower and control valve upward as the brake pipe pressure is reduced. The control valve connects pipe 6 and chamber C to atmospheric port 8. Thus, atmospheric air pressure enters the vacuum train pipe. Thereby the vacuum brakes are applied on train. The pipe connection no. 2 between chamber C and pipe 6 allows drop in vacuum in chamber C through a choke also and the valve comes to lap position. The constant braking force is maintained against normal leakage. It is understood that two pressure i.e. brake pipe and vacuum are varying and for different combination of these two forces the valve gets lapped position giving different braking forces.

Emergency

When it is desired to make the shortest possible stop, the brake valve handle is moved to Emergency position, causing an emergency rate of brake pipe reduction.

The HS4 control air valve also contains provision for reducing any excess pressure in the delivery pipe, as when the pressure called for by the setting of adjusting handle 15 is lowered. Excess pressure in the chamber above diaphragm 11 moves the diaphragm and exhaust valve seat 10 downward away from exhaust valve 5b, The excess air pressure then flows past the unseated exhaust valve 5b, through the exhaust valve spring chamber and the diaphragm spring chamber and out to atmosphere through the opening in the bottom cover.

# AIR FLOW MEASURING VALVE

## 1. Introduction

The air flow measuring valve is suitable for use on locomotives that are equipped to operate trains fitted with 28LAV1 brake system and is designed for fitting in the main air supply pipe.

## 2. Objective

This valve indicates the leakage of BP pipe through an indicator in term of wagon. Indicator is provided on driving control stand so that Driver can watch easily.

## 3. Construction

The AFM valve has two main connections, one is connected to main air supply and other to the Additional C2-Relay valve. Choke A is provided to supply MR air to top of disc valve. Disc valve has two small ports, one connects to MR air and other connects to Additional C2 Relay valve. Disc valve is pressed down through a follower & spring on its seat. Choke B is provided in between top chamber of main valve and MR supply line. Choke C is provided to supply `main diaphragm top chamber air' to indicator, when diaphragm moves down word. Choke D is provided for calibrating the valve.

## 4. Operation

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 Air flow measuring valve and to the brake pipe is that necessary to overcome leakage. In this condition the check valve is closed as shown in diagram and air from the main supply passes through choke A in to the space under the check valve follower 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 by the pressure above it. This 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 and at the outlet port relative

to the main supply pressure, also determines the flow of air through choke A, it follows that the intermediate pressure is related to this flow of air as well. 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 Additional C2-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.

# AIR FLOW INDICATOR

## 1. Introduction

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 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 not in the units of airflow but in numbers which normally indicates the 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.

## 2. Objective

It is a device through which BP (Air brake train ) leakage can be seen in the Driver's cabin.

## 3. Operation

When a train has been made up and the brake system is being charged with air before moving off, there is a high rate of flow of air to the brake pipe and the indicator pointer takes up a position in the uncalibrated sector of the scale. As the air pressure in the brake pipe rises and the rate of airflow consequently diminishes, the indicator pointer falls back. When the system is fully charged, it stabilises at a reading corresponding to the airflow, to overcome leakage. If the train comprises 60 wagons, for example, this reading is normally 60 or less, a higher reading indicates excessive leakage from the brake pipe.

At this stage, before starting the train, the driver sets the reference pointer to coincide with the indicator pointer and thereby fixes a datum point on the scale. The indicator pointer should return whenever the brake is fully released during the ensuing journey, so long as the make- up of the train is not changed.

Therefore, during the journey, the indicator pointer falls below the reference pointer or rises above it, indicates leakage decreased or increased respectively. During the release process, the indicator pointer falls back steadily towards the reference pointer and the deviation between the two pointers at any time indicates the state of release of the brake. When the system is fully recharged the two pointers approximately coincide again, if they do not coincide it is evident that the brake pipe leakage has changed and the amount of deviation between the two pointers gives the driver some idea of the magnitude of the change. An indicator pointer reading below the datum point shows that the leakage has been reduced, conversely a higher reading indicates an increase in the leakage. Some small variations are to be expected during a journey.

If a guard emergency brake valve is opened or a brake pipe coupling is parted or broken, the indicator pointer rises rapidly to a corresponding high reading.

Whenever the make–up of the train is changed, the reference pointer is reset manually to provide a new datum point.

**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.

# R-6 Relay Valve

## 1. Introduction

R-6 Relay valve is a simple relay valve which provides air pressure in 1:1 ratio and is mounted just near the AFM valve. It is required because of long piping from the AFM valve to the indicator.

## 2. Objective

This is a simple relay valve, which provides air pressure in 1:1 ratio and mounted in between the indicator and the AFM valve. It is required because of long piping from the AFM valve to the indicator and unavoidable leakage at joints in both the cabs.

## 4. Construction

R6-Relay valve consists of the cast aluminum cover, houses the spring loaded relay piston and tapped to receive an air pressure signal. The body also aluminum, contains the combined inlet and exhaust valve and is tapped to provide two supply and four delivery ports. A rubber disc protects the exhaust vent in the base.

## 5. Operation

When air pressure signal from AFM valve, is received at port A of the R-6 Relay valve, air flows in chamber C between the cover1 and the top of the relay piston assembly 2. A relatively small-applied pressure reacts quickly over the larger area of the relay piston 2 and forces the piston down against the spring 7. This movement of the piston closes the exhaust passage 6 and the valve sheet 13 opens the inlet/exhaust valve11, which is also moved down against the return spring 10. Air then flows from main reservoir through port B to chamber D and from there it passes out of the delivery port E. This flow continues until the force of the applied air pressure above the piston balances the combined forces of the piston, valve return spring and the air pressure beneath the piston. After getting balanced the piston moves up closing the inlet/exhaust valve. The valve is now in the lapped condition with both the inlet and the exhaust closed. If the signal pressure from air flow measuring valve is reduced at the port A the force below the piston is now greater , and the piston rises until the valve seat 13 is lifted clear of the valve allowing air to atmosphere past the rubber flap at 6 through the hollow passage in the piston at 5. The exhaust of the air continues within the force below the piston is reduced to balance t hat above the piston and the exhaust of air closes again, bringing the valve in lap condition. This phenomenon is repeated wherever the applied pressure at port A is varied, either up or down as the valve is self-lapping.

# AIR DRYER

## 1. Introduction

Air dryer is a complete air cleaning and drying unit, which is provided in between MR-1 and MR-2 of Diesel Locomotive. It helps to the Automatic Drain & Check valve also by purging the Dryer system. Purging is the removal of collected moisture from the desiccant beeds. Drying means the desiccant in the dryer is drying the compressed air by absorbing the water vapour from the air passing through that tower. It supplies dry and clean air to the locomotive brake system.

## 2. Objective

The primary purpose of the dryer is to provide dry, oil free and clean compressed air to the locomotive brake system.

## 3. Construction

The current design consists of a borosilicate coalescing filter known as pre coalescer and twin regenerative desiccant towers that operates simultaneously. These two towers are connected to pre coalescer to remove oil and water aerosols. Pre coalescer and dryer towers are connected by a common inlet and outlet manifold with solenoid assembly. All the electrical controls, which program the sequence of operation, are located in housing attached to the outlet manifold.

The first component is a multi layered Pre coalescing element. Two other layers are constructed by small microscopic fibers, which are random in size to enhance the collection of oil and water aerosols. The unit is mounted with aluminum housing with a pneumatically operated double seated drain valve, attached to the sump.

The second component is a pneumatically controlled inlet check valve located within the inlet manifold for each of the identically designed dryer tower. Each dryer tower consists of finned aluminum housing containing a desiccant canister. This canister includes a pneumatic compactor to hold the desiccant tightly within the canister to minimise attrition or dusting of the desiccant and a mesh filter that is attached to the bottom of the desiccant canister along with the pneumatically operated single seated purge.

The third component is a spring-loaded outlet check valve mounted in the outlet manifold of the dryer towers adjacent to the humidity indicators.

## 4. Function

Air from no.1 MR flows into the Air dryer inlet manifold down to the cell of the pre coalescing element and exits through the pre coalescing element where oil and water aerosols are collected. Air then flows up around the out side of the element and through the interning manifold to both of the dryer towers. Contaminants such as oil and water aerosols are collected in the element, migrate to the sump. These contaminants are then discharged to the atmosphere through a double seated pneumatically operated drain valve attached to the bottom of the pre coalescing sump. This valve is activated momentarily each time of the dryer cycles. Filtered air leaving the pre coalescing element passes through the manifold with pneumatically operated inlet check valve and inters the top of each of the air dryer tower.

The internal design of the housing slings the air down word around desiccant canister in a simplified path. This simplifical movement cools the air and separates moisture from the air, which settles in the sump at the bottom of each tower. The air then flows through a oval stainless steel mesh filter attached to the bottom of the desiccant canister. The secondary filter restricts and collects all droplets and contaminants not removed by the pre coalescing element. The filter is self cleaned each time the single seated pneumatically operated purge valve is operated at bottom. The actuation of the valve also expels to atmosphere any separated water, which is collected in the sump. The air passing through the secondary filter now passes upward through the desiccant bed where water vapour is absorbed by the desiccant beeds. The result is that the air existing top of the canister is very dry with an extremely low relative humidity. The dry airs now flows through the outlet manifold, which contains the humidity indicators and the outlet check valve prier to entering the locomotive air system. The identical airflow through both towers permits the maximum flow of air to charge the air system initially. When the locomotive air system pressure reaches a pre determined point normally 100 psi+/-5, a pressure switch within the dryer closes. This supplies power to the timing control circuit, which energises the solenoid on one tower and the tower start purging.

## 5. Drying and purging cycle

There is an arrangement of drying and purging cycle, which is governed by timer circuit. One tower drying by collecting moisture from air while the other purging the collected moisture from the desiccant beeds. It continues for one minute. After one-minute timer circuit changes the position, the tower that was drying begins to purge and the tower that was purging begins to dry air.

## 6. Timer circuit

The timer circuit is electronically timed to operate the tower. When air pressure reaches 100 psi, the pressure switch closes. The timing circuitry energises the solenoid on one tower, which provides pneumatic signal & closes the inlet check valve and at the same time opens the purge valve at the bottom of the housing. Simultaneously the spring loaded outlet check valve is closed and stops the flow of air to the tower. A

small amount of dry filtered air from the top of the drying tower flows through an internal orifice and to the desiccant beeds removing collected moisture. At the same time the opposite tower collects moisture from the compressed air, which passing through the desiccant beeds. After one minute the electronic timer reverses the operation of the tower. The purging tower now becomes the drying tower. The solenoid is de-energised which causes the inlet and outlet check valves to open and the purge valve to close permitting full air flow through the desiccant beeds that absorb water vapour. Simultaneously the solenoid circuit on the opposite tower is energised.

## 7. Checking the proper function of the air dryer system

This is accomplished by inspecting the humidity indicators, which indicates as follows.

Blue indicator--- indicates dryer has been performing correctly.
Lavender indicator--- dryer is suspect.
White indicator--- possible damaged dryer. Check for water in final filters.
Yellow or brown indicator--- damaged dryer.