Train Brakes at Sumpter Valley RR

Revised April, 2021 by Eric Wunz

Introduction

It is essential that all SVRR train crew members understand the basics of train air brakes and how they function. This is a description of train air brakes used at SVRy. The 6 BL Brake Stand in No. 19 is included in the description. The Brake Stand is No. 3 is an A-1, one of the first of the automatic type produced. There are several differences between the two types, but train operations are the same for either. The main difference is an additional position on the 6 BL termed "Holding" which releases the train brakes but retains application on the locomotive brakes (this position is not used in normal operations). The other is the arrangement of the independent locomotive brake: on the 6 BL it is integral and the locomotive brakes are applied when the train brakes are applied (and are normally bailed off), on the A-1 the locomotive brakes are completely independent. Also, the 6 BL has a pressure maintaining locomotive brake which replaces air pressure lost to leakage whereas the independent on the Heisler does not.

Most of the brake systems on the Sumpter Valley RR are designs that are over one hundred old. While they have been constantly updated and replaced by more modern designs on mainline railroads, they continue to work reliably and effectively here. This description does not include information on mainline standard gauge railroads, nor does it necessarily describe the system and components used on other tourist lines be they standard or narrow gauge.

Brake System Components

Air Compressors and Main Reservoirs. The Air Compressors are driven by steam pressure at approximately a 1:1 ratio, if the steam pressure is 80 PSI then it cannot produce more than 80 PSI air pressure. No. 3 has a single stage air compressor while the No. 19 has a two stage cross-compound air compressor. The air compressors supply compressed air to the Main Reservoirs. The maximum pressure in the Main Reservoirs is set by an adjustable governor valve in the steam supply pipe to approximately 90 PSI on No. 3 and approximately 110 PSI on No. 19. The No. 3 has one main reservoir is located on the Fireman's side of the locomotive, on No. 19 there is a radiator to cool the compressed air which is stored in two main reservoirs. The Main Reservoirs supply air to the Brake Stand in the locomotive and to operate the sanders (and the Power Reverse and bell ringer on the No. 19). The Main Reservoirs supply the air needed to charge and maintain the Brake Pipe at 70 PSI.

Brake Stand. The 6-BL Brake Stand is located in locomotive No. 19 cab on the Engineer's side. It includes the H-6 Automatic Brake Valve, Independent Brake Valve, Forward and Reverse Sanding Valves and a Bell Ringer Valve. The Brake Stand includes provisions for adjusting and regulating the Brake Pipe pressure. An additional valve for the "Doublehead Engine" feature is included for cutting out the Brake Stand on the following engine to allow brake control from another locomotive. The A-1 Brake Stand on the No. 3 operates the train brakes only, it has a Doublehead Valve also. The locomotive's Independent Brake Valve is located to the right side of the engineer. The 720 has a 14 EL brake system that is functionally similar to the 6-BL.

Equalizing Reservoir and Distributing Valve. The movement of the brake handle on the brake stand increases or reduces the air pressure in the equalizing reservoir (a small volume space) and the distributing valve then matches the brake pipe pressure to that in the equalizing reservoir. This is the "automatic" feature of the brake stands, so that the engineer only has to make one reduction in the equalizing reservoir and the distributing valve does the work of reducing the brake pipe pressure to that value. Otherwise the lag in movement of the air through the brake pipe would need constant attention by the engineer to maintain the desired brake application.

Air Gauges. Two duplex air gauges on the No, 19 indicate pressures in the Main Reservoir, Brake Pipe, Equalizing Reservoir and Independent (locomotive and tender) brakes. The gauges on the No. 3 indicate the Main Reservoir and Brake Pipe pressures. Air gauges located on the train indicate the Brake Pipe pressure at that point.

Automatic Brake Valve. The Automatic Brake Valve sets and releases brakes on all cars in the train by setting the Brake Pipe pressure. The Automatic Brake has positions for release, running, holding (19 only), lap, service, and emergency. Applying brakes with the Automatic Brake Valve also applies the locomotive brakes on the 19, which can be released with the Independent Brake Valve. In normal operation the Engineer moves the valve to the Service position until the desired amount of brakes have been applied, then moves the valve to the Lap position to hold the brake setting. To release the train brakes, the valve is moved to the Running position. The Release position is rarely used, as it is possible to overcharge the brake pipe as full main reservoir pressure is added to the brake pipe and can cause unwanted brake actions. Holding position is not used as it causes the slack to run in between the locomotive and the train.

Independent Brake Valve. The Independent Brake Valve provides a means for setting and releasing the locomotive and tender brakes without affecting the train brakes.

Emergency Valve. This valve is located in the cab on the firemans side. It is used in an emergency to apply the brakes when the fireman cannot get to the Automatic Brake Valve.

Brake Pipe. The locomotive and each car in the train have an iron pipe that run the length of the car with an Angle Valve (or Angle Cock) and Air Hose on each end. The Brake Pipe supplies air from the Brake Stand for all car brakes in the train.

Angle Valve (Angle Cock). Located on each end of the cars and locomotive, this valve is used to block or allow air to pass between cars and the locomotive. When closed, cars beyond the valve will NOT have controllable air brakes. In normal operation all Angle Valves are open. The last car in a train must have the Angle Cock closed, unless the Air Hose is connected to a pressure sensor or a portable Conductor's Valve. If the last car has the Angle Cock closed, the glad hand must be attached to the Air Hose end to prevent dirt and debris from getting into the brake system. The Angle Valve on the uncoupled end of the locomotive must also remain closed with a glad hand on the end of the Air Hose.

Conductor's Valve. Located on selected cars in the train, these valves are used by the train crew to make emergency applications of the train brakes. The Conductor's Valve CANNOT be used to bring the train to a controlled stop. They are intended for quick release of Brake Pipe pressure only (emergency application).

Auxiliary Reservoirs. Located on each car and connected to the Brake Pipe via the Triple Valve. These reservoirs supply the air needed to apply car brakes when the Brake Pipe pressure is decreased.

Cutout Valve. Located between the Triple Valve and the Brake Pipe, this valve must be open during normal operation. This valve is closed when it is necessary to disable an individual car's brake system, possibly due to faulty operation. The open position of this valve is with the handle 90 degrees to the pipe.

Triple Valve. Located on each car, the Triple Valve has three functions. It *charges* the Auxiliary Reservoir, *applies* the brakes and *releases* them. Operation of this valve is precipitated by sensing differences between the brake pipe pressure and the pressure in the auxiliary reservoir.

The Triple Valve is mounted on the Auxiliary Reservoir and connected to the Cutout Valve, which in turn is tee connected to the Brake Pipe.

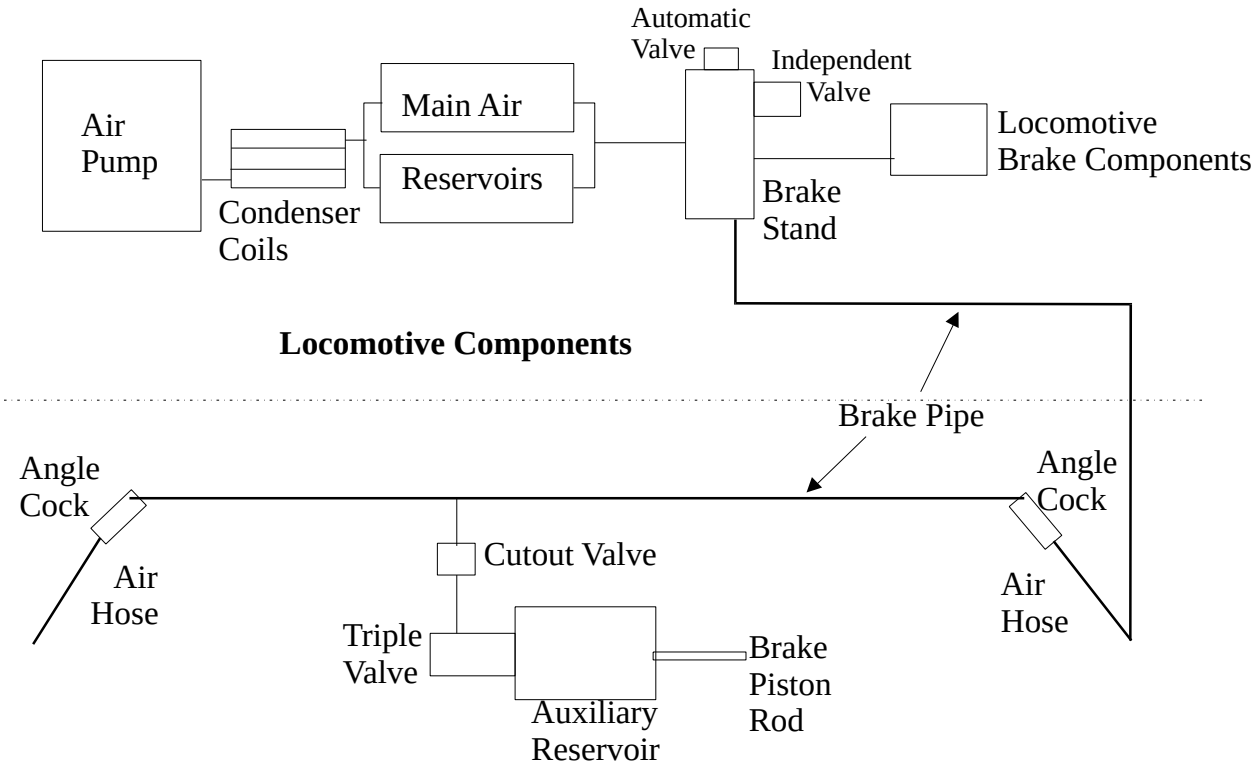
Brake Cylinder, Brake Piston and Piston Rod. Air pressure in the Brake Cylinder allows movement of the Piston and Piston Rod and a system of rods, levers, brake beams and brake shoes on each car. The brake cylinder may be bolted directly to the auxiliary reservoir or separately mounted to the car with a pipe connection.

Bleed Valve. This valve releases air from the Auxiliary Reservoir to release brakes. When uncoupling, the Brake Pipe pressure decrease to zero PSI, fully applying the train brakes. The Bleed Valve releases air in the Auxiliary Reservoir, thus releasing the brakes.

Retainer. This valve retains air in the car brake cylinder when the lever is in the up position. The typical retainer has 3 lever positions, Off in the down position, 5 PSI retention at 45 degrees up, and 10 PSI retention in the 90 degree up position. The function of the retainer is to keep the brakes applied on long, steep downgrades so the engineer can cycle the brakes and adequately recharge the car auxiliary reservoirs without the train running away. We do not use the retainers in regular train service as we do not operate on mountain grades. Most of the retainers on Sumpter Valley equipment are not attached to the exhaust port of the triple valve so they will not be accidentally engaged preventing the release of the brakes.

Air Brake Operations

In the diagram below the steam driven Air Compressor compresses the air. Air gains heat when compressed and is cooled in Condenser Coils and then stored in the Main Reservoirs. As the air is cooled in the radiator condenser coils and air reservoirs, water condenses out of the air and is trapped there instead of being propagated throughout the rest of the train braking system. This water must be drained periodically, the frequency depending on atmospheric conditions but never less than daily. A Governor on the steam supply line is adjusted to allow steam to drive the Air Pump until the air in the Main Reservoirs is approximately 110 PSI (90 PSI on No. 3) at which time the Governor shuts off the steam supply. Air to the Brake Pipe running throughout the length of the train is supplied from the Main Reservoirs by the Distributing Valve at a pressure of 70 PSI.



With the Automatic Brake Valve in the **Running** position, the Brake Pipe pressure is kept at 70 PSI. The Triple Valve charges the Auxiliary Reservoir on each car in the train to the Brake Pipe pressure. With equal pressure on both faces of the triple valve, the piston in the Triple Valve is in an equalized position, and the brakes are released. .

When the Automatic Brake Valve is moved to the **Service** position, the pressure is reduced in the Equalizing Reservoir on the locomotive to the desired level. Once the desired reduction is obtained, the valve is moved to the **Lap** position retaining the reduced pressure in the Equalizing Reservoir. The Distributing Valve then reduces the Brake Pipe pressure until it is the same as the Equalizing Reservoir. The Triple Valve senses the difference between the decreased pressure in the Brake Pipe and the pressure in the Auxiliary Reservoir on each car. It moves in proportion to the difference in pressure and introduces approximately 2 ½ times that difference into the Brake Cylinder. The Brake Piston moves against the spring that is inside the cylinder and applies pressure to the braking rigging and the brake shoes. The greater the reduction in Brake Pipe pressure, the greater the pressure against the piston and the greater the brake shoes push against the wheels.

To release the train brakes, the Automatic Brake Valve is moved to the **Running** position, (the Holding position is not used since it leaves the locomotive brakes set) and the Equalizing Reservoir and thus the Brake Pipe are once again charged to the operating pressure of 70 PSI. The Triple Valve senses the difference between the increased pressure in the Brake Pipe and the reduced pressure in the Auxiliary Reservoir on each car. It moves back to its original position and releases the air pressure from the Brake Cylinder. The spring inside the Brake Piston moves it into the released position and releases the pressure to the braking rigging and the brake shoes. Meanwhile the triple Valve also is recharging the pressure in the Auxiliary Reservoir to equal that of the brake line again (70 lb.).

When the Automatic Brake Valve is moved to the **Emergency** position a large and direct reduction is made in the Brake Pipe pressure causing the Triple Valve to rapidly apply the Auxiliary Reservoir pressure into the Brake Cylinders, yielding a rapid and maximum Brake Piston and Piston Rod travel and thus maximum braking. In addition, pressure from the Brake Pipe is also introduced into the Brake Cylinder which increases the rate of Brake Pipe air pressure reduction to the back of the train. Similarly, when a Conductor's Valve is opened on the train, a large and direct reduction is made in the Brake Pipe pressure and the train brakes are set to emergency. The inherent safety feature of train air brakes is that when the Brake Pipe pressure is released rapidly for any reason including broken pipes or air hoses, or an unexpected uncoupling, the train brakes are set into emergency.

In normal operation, when train brakes are set on #19, the Independent Brake is released, or bailed off. This reduces the amount of heating to the driver tires (if overheated they can slip or come off of the cast wheel centers), reduces wear on the locomotive brake shoes, and most importantly, reduces slack action within the train.

Comments on Use of Air Brakes

The rule book requires the use of the hand brakes to hold the train, not the air brakes. This is because any leakage in the braking system can cause the brakes in the train to gradually release. Never "park" the train with the air brakes applied. Once the hand brakes are applied, release the air brakes so that you know the hand brakes are sufficient to hold the train.

Maximum brake application is reached with a 20 lb. Brake Pipe reduction (20lb. x 2 ½ = 50lb. pressure in the Brake Cylinders). Reducing Brake Pipe pressure further does not apply the brakes any harder on the cars, as all the air in the Auxiliary Reservoir has been used.

Frequent Brake Pipe reductions with little time between them to recharge the Auxiliary Reservoirs throughout the train can deplete the air pressure in the Auxiliary Reservoirs to the point that there is little pressure available to apply the brakes. For example, if the Auxiliary Reservoir pressure is 60 PSI, the Brake Pipe pressure must be reduced to 55 PSI to achieve any movement of the triple valve and apply brakes with would have otherwise been a 65 PSI application. The recharging rate is a function of the difference between the Main Reservoirs and the Brake Pipe pressure and the number of cars in the train. Generally speaking a "recharge" time of 30 seconds to a minute seems to be sufficient to maintain Auxiliary Reservoir pressure at an adequate level with our usual 5 car consists.

If the above occurs, stop the train with what braking power is left, hold the train with the locomotive brake (or hand brakes) and recharge the Auxiliary Reservoirs by moving the brake handle to Running for several minutes before resuming moving.

The K type Triple Valves used on most SVRy equipment have internal parts that move in response to differences in air pressure in the Brake Pipe and the Auxiliary Reservoir. There is a certain amount of friction between the moving surfaces and they do not respond well to slight differences in air pressure. If a 2 lb. reduction is made nothing may happen, then when another reduction is made it may all of sudden move and cause a sudden application to the brakes to that car. It may even cause an emergency application of the brakes throughout the train. Therefore, the minimum reduction should be no less than 3 or 4 lb.

Once the initial brake pipe reduction is made, additional reductions can be made if more braking force is desired. Brake releases with SVRy equipment cannot be done in steps, however. They must be fully released and then reapplied if the application was too much.

If the brake application is small, say 5 to 10 PSI, the locomotive can continue to move the train but with some difficulty. If however, a large application is made of 20 PSI or more, the locomotive may find it too difficult to move the train, and it will stop or spin the driver wheels.

Independent Brake differences between locomotives #19 and #3

While the Automatic (train) Brake operations are very similar for both of the steam locomotives, the Independent (locomotive) Brakes are quite different.

On the #3 the locomotive brake is totally independent of the train brake. Applying the train brakes does not apply the locomotive brake. In addition, once the locomotive brake is applied, any leakage in the system is lost to the atmosphere and the brakes will gradually release. Never

leave the cab without putting down the chains to block the wheels or applying hand brakes to a coupled train.

On the #19 the locomotive brake can be applied and released independently of the train brakes, but it also is applied when the train brakes are applied. Therefore, it must be "bailed off" as described earlier if it is not desired to be applied (normal operations). It is also pressure maintained by the brake system, meaning that if 50 lb. is applied to the brakes and there is a leak, the difference is made up to keep the brakes at 50lb. As long as there is adequate pressure in the Main Reservoirs, it will be kept applied regardless of any leakage. Obviously, the Air Compressor must be operable to maintain the Main Reservoir pressures. Chains do not need to be put down any time the engineer leaves the cab, but are still recommended if not in the immediate vicinity of the locomotive.

FAQs.

If the Independent Brake is applied won't this stop the train?
Yes, In most cases it will stop the train.

If the answer to the questions above is yes, why not use the Independent Brake instead of the Automatic Brake?
Because, with no brakes applied to the train, there will be slack action. If the train is being pulled, the cars will bunch toward the locomotive, and stop with considerable force. The cars furtherest from the locomotive will receive a severe jolt which could injure passengers or crew, or damage wooden frame cars. Similarly, if the train is being pushed, the cars will tend to continue to move, eventually stopping, but causing terrific force on the cars, passengers and crews.

Why is it necessary to bail, or release the Independent Brake after applying the Automatic Brake?
The Automatic Brake is applied to slow or stop the train and/or control slack action. If the locomotive brake is left applied the engine may not continue to move the train. If the locomotive continues to move there will be excessive wear and heat on the engine brake shoes. Excessive heat on the engine brake shoes can cause the tires to heat up and slip on the rim.

What is the function of the Automatic Brake Valve positions and how are they used?
Release position directly connects the Main Reservoirs to the Brake Pipe. This position is rarely used. The train brakes are designed to operate at a pressure of 70 PSI. Improper use of the

release position can allow the full 90 or 110 PSI Main Reservoir pressure to be applied to the Brake Pipe and can cause damage to gaskets, hoses or Brake Piston rings. It can also cause erratic brake applications since the Auxiliary Reservoirs are overcharged in relation to the Brake Pipe. Over charging the Auxiliary Reservoirs will cause a brake application (possibly an emergency application) when the Automatic Brake is returned to the Run position. This occurs because when the Automatic Brake is returned to the Run position, the Brake Pipe pressure will be lowered to 70 lbs and the triple value has 70 lbs on one side and a higher pressure on the Auxiliary Reservoir side thus applying the brakes by sending this higher pressure to the brake cylinder.

Overcharged Auxiliary Reservoirs should have the pressure reduced by draining the excess pressure with the Bleed Valve on each cars reservoir.

Running position is the normal operating position of the Automatic Brake with no brake application. In this position all train brakes are released and the Brake Pipe and Auxiliary Reservoirs are recharged to 70lb.

Holding position releases the train brakes, but keeps the locomotive brakes applied (only on No. 19). This position is very seldom used, and should NOT be used in normal train operations because there will be excessive slack action and wear on the locomotive brake shoes.

Lap position is used to hold brake applications. After an Automatic Brake application has been made in the **Service** position, the valve is moved to the **Lap** position to maintain the application. If an emergency application has been made, the valve should be moved to this position to enable the Main Reservoir to recharge and regain full pressure. This position should also be used to stop the uncontrolled release of air from a broken pipe or hose or if an angle cock has been not closed.

Service position is used to make a train brake application. Brake Pipe pressure will gradually decrease in this position. The longer the Automatic Brake Valve is left in this position, the lower the Brake Pipe pressure will drop, and the harder the brake application. Once a desired brake application has been made, the valve is moved to the **Lap** position to hold the application.

Emergency position give a direct and rapid reduction in Brake Pipe pressure. Once initiated, Triple Valves on the train will cause a rapid reduction in the Brake Cylinder pressure on each car yielding a maximum brake application on the entire train. Following an emergency application,

the Automatic Brake Valve must be moved to the **Lap** position to hold the application and prevent depletion of the Main Reservoir pressure.

If the train becomes uncoupled while running, what should the train crew do?
Send the Rear Brakeman out to flag the Fire Train or any other trains on the main line. Set all hand brakes immediately. Determine if there are any passenger injuries. The Conductor and Engineer should inspect the train and determine the problem and how to alleviate the problem. Recouple the train, recharge the Auxiliary Reservoirs, perform and set and release brake test on the end car of the train, and proceed.

Describe a typical operation of the train brakes.
After coupling to the train at McEwen Depot, ½ of the hand brakes are set, the Automatic Brake Valve is moved to the **Running** position, to allow the train brake Auxiliary Reservoirs and Brake Pipe to fully charge, and the Independent Brake is set to full application. Experience has shown that allowing one minute per car will yield the best results during the Terminal Brake test. Following a crew meeting and a Terminal Brake Test, the Automatic Brake Valve is again released (moved to the **Running** position). The Independent Brake remains applied in the locomotive.

Prior to departure, the Conductor and Rear Brakeman release all hand brakes. After a proper hand signal is received by the Engineer, he moves the throttle to begin departure and releases the Independent Brake. After the train has left the McEwen Yard and reached sufficient speed, the Engineer does a Running Brake Test by moving the Automatic Brake Valve to the Service position and decreases the Brake Pipe by 5 PSI (65 PSI on the Brake Pipe gauge), then moves the valve to the Lap position to retain the setting and immediately bails off the Independent Brake. Once the Engineer is satisfied the train brakes are operating properly by slowing the train, he moves the valve to the Running position and adjusts the throttle for required speed, continuing to Sumpter. If for any reason the Engineer determines the brakes do not appear to be functioning properly, he will inform the Conductor the train is stopping and a determination must be made as to the problem with the train brakes.

After the train is underway the Engineer may elect to apply train brakes to periodically slow the train or to keep the slack stretched in the train. The first occurrence is typically to slow the train before reaching Hawley Siding. As the train approaches Whitney Hwy crossing, the Engineer will make a minimum application again. This is done to prevent slack action in the train as it passes over the dip in the tracks on the west side of Hwy 7.

Approaching Austin St. the Engineer will once again make a minimum train brake application to control slack action and slow the train for spotting at the depot.

Operations downhill to McEwen require periodic brake applications to keep the train speed within safe speeds. Generally, the brakes are cycled on and off to keep recharging the Auxiliary Reservoirs and to keep the application from becoming excessive due to normal brake pipe leakage. Also, cycling the brakes will release any sliding wheels that may occur, reducing the occurrence of flat spots on the wheels.

Pretrip Locomotive Air Brake Test

A. Prior to leaving the service facility at the beginning of the day, an application and release test of the locomotive brakes must be made in the following order:

1. Ensure brake pipe pressure is set to prescribed pressure.
2. Apply independent brake fully and observe that brakes apply on the locomotive. Release independent brake and observe that brakes release on the locomotive.
3. With equipment fully charged, make a 10 psi brake pipe reduction and observe that brakes apply on the locomotive. Bail (release) independent brake and observe that the brakes release on the locomotive.
4. Reduce brake pipe pressure an additional 10 psi and observe that brakes apply on the locomotive. Release automatic brake and observe that the brakes release on the locomotive.

   Note: Steps 3 and 4 do not apply to the Heisler.

B. Locomotive brake pipe leakage at the beginning of each day that the locomotive is used.

1. Take a 20 psi reduction on the automatic brake valve.
2. Wait 1 minute for the brake pipe pressure to equalize.
3. Observe brake pipe pressure for one minute. Leakage should not exceed 5 psi per minute.

Initial Terminal Brake Test

Before operating the train, a Terminal Brake test must be performed. The Terminal Brake test steps are as follows. It is the job of the Head Brakeman to perform the Terminal Brake test.

1. After the Brake Pipe has begun charging, allow one minute per car for the brake system to release and stabilize. For example, in a 5 car train, allow 5 minutes before proceeding with the test.
2. While the system is equalizing, inspect both sides of the train for possible brake system damage and air leaks. Inspect to see that all brakes are released.

3. Give a clear hand signal to the Engineer requesting a brake application. Wait for the Engineer to give a service application. The Engineer will reduce the Brake Pipe pressure by 20 PSI, from 70 to 50 PSI, and indicate the application has been made with a short whistle signal.
4. Inspect each car to see that the brake piston rod has extended and thus applied brakes. The piston extension range should be between 6" to 8". Inspect both sides again to make certain all brakes have been applied properly.
5. . Allow brake pipe to equalize for one minute prior to timing for leakage.
6. Wait one minute for the Engineer to note any leakage. Leakage greater than 5 PSI in one minute must be corrected before the train can proceed.
7. Give a hand signal for release. Wait for the Engineer to indicate full release with two short whistle signals.
8. Inspect each car's brake piston rod. The piston rod must fully retract for full brake release. After completion of the Terminal Brake test, the Head Brakeman reports the results to the Engineer.

Set and Release Brake Test

If no changes are made in the train consist it is NOT necessary to perform a Terminal Brake test again during the day's operations. However, whenever the locomotive is uncoupled and re-coupled to the train, it is necessary to perform a Standing Brake test as described below, and once again this is done by the Head Brakeman.

1. After coupling the locomotive to the train, slowly open the Angle Cock on the first car in the train to charge the Brake Pipe.
2. While walking from the locomotive to the end car, inspect all cars to see that their brakes have released.
3. Once it is determined that all brakes are leased, hand signal for a brake set.
4. The engineer does a 20 PSI reduction and give a short whistle signal.
5. Inspect the last car only to see that the brakes are applied. Also, check the air gauge on the last car to verify that a 20 lb. reduction has been made. (See Safety Rule 4608.)
6. If the brakes on the end car apply satisfactorily, hand signal the Engineer for a release.
7. After the release, inspect the end car to determine if the brakes release satisfactorily. Check the air gauge on the last car to verify that the train line is charged to 70 lbs. If brakes have released and the gauge shows the proper pressure, then the brake test is complete.

6-BL Brake System (as on No. 19)

White hands are used to indicate equalizing reservoir and brake pipe pressures on gages having black face dials with white figures.

H-6-L BRAKE VALVE

An H-6-L Brake Valve is built around a pipe bracket which is designed to be mounted to a vertical wall or supporting member with pipe connections on its rear or mounting face. The pipe bracket mounts an H-6 Automatic Brake Valve Portion on top, an LA-6-P Independent Brake Valve Portion in front, and a sanding operating valve and a bell ringer valve, one on either side. Flanged fitting pads are provided on the piping face for the main reservoir, brake pipe, and feed valve connections. Other connections are made to ⅜" pipe taps.

The H-6 Automatic Brake Valve Portion is substantially the same as that used with the No. 6-ET Equipment. A recent minor change, consisting of a small milled slot as shown on Fig. 13, has been made in our standard rotary valve seat for this portion. This change in no way affects interchangeability of the H-6 Brake Valve on standard 6-ET Equipments. The purpose of the slot is to provide a warning port for Full Release Position that will afford an audible warning regardless of the type feed valve used, since the supply of air comes from main reservoir rather than from the feed valve. The standard automatic brake valve rotary valve used with the H-6-L Brake Valve is now the so-called "X" type. It differs with the old standard H-6 rotary valve in that the function of the governor port is changed so that it is not interchangeable with those used on

New York Air Brake 6-BL

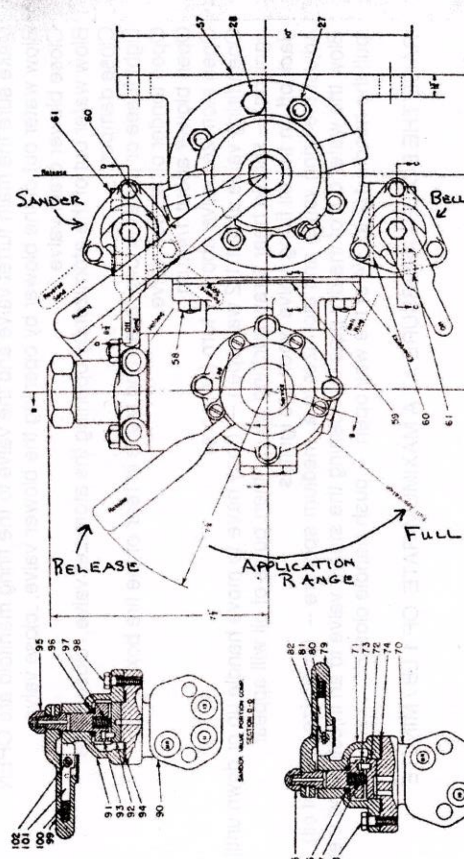


Fig. 10. H-6-L Brake Valve

from the pipes to the respective ports in the brake valve. It is secured to the three upper sections of the brake valve by means of four bolts and nuts *27*, Fig. 14, which is a view looking down on the top case of the brake valve. The bolts pass entirely through the four parts of the valve and have the nuts on top.

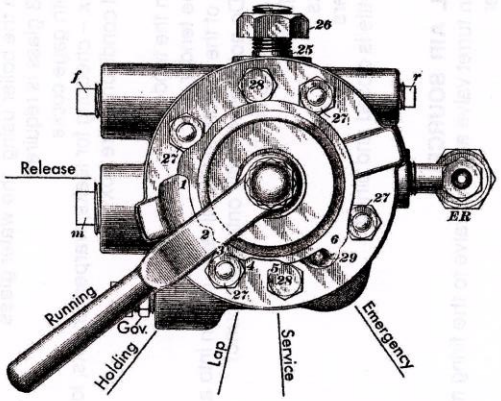


FIG. 14

The two capscrews *28*, secure the three upper sections *2*, *3*, and *4*, Fig. 13, together. The brake valve, if desired, can be removed or changed by simply removing the four bolts and lifting the three upper sections off the pipe bracket, thus permitting repairs to be made without breaking pipe joints.

Suitable shoulders or stops numbered *1*, *2*, *3*, *4*, *5*, *6*, Fig. 14, are cast on the projecting flange of the top case as shown, and the different positions of the brake valve are indicated when the latch in the brake-valve handle engages these stops. The brake valve has six positions, full release, running, holding, lap, service, and emergency.

The gaskets *17*, *18*, and *19*, Fig. 13, prevent air from leaking between the ports or to the atmosphere. Gasket *18* is leather and gaskets *17* and *19* are rubber. The gaskets are applied with the smooth side down.

30. The equalizing piston *15* operates within the bottom case *2*, Fig. 13. The piston is normally balanced between equalizing-reservoir pressure on its upper face and brake-pipe pressure beneath it. The equalizing discharge valve *E* controls the passage of brake-pipe air through the service-exhaust fitting *31*, which is screwed into the center of the bottom case *2*. The emergency exhaust port *E.r* leads out to an opening in the side of the rotary-valve seat, directly over the bracket stud.

The rotary valve *6* operates within a ring cast on the interior of the top case *4* and is moved on the rotary-valve seat by the rotary-valve key *7* which obtains its movement from the rotary-valve handle *9*. The rotary-valve key is connected to the rotary valve by a wedge-shaped projection on the key, which fits into a slot in the rotary valve. The rotary-valve spring *30* holds the rotary-valve key *7* up against the key washer *8*, and also holds the rotary valve *6* on its seat during the time the brake valve is not charged with air pressure.

The leather key washer *8* prevents the escape of air past the key *7* where it passes through the top case. The oil passage shown in the rotary-valve key is used to apply oil to the key washer *8* when the handle locknut *14* is removed. The rotary valve can be lubricated by removing oil plug *29*, after the pressure in the brake valve has been exhausted.

31. Pipe Bracket.—A bottom view of the pipe bracket *5* turned completely over is shown in Fig. 15. The pipe bracket has eight pipes connected to it. The 1-inch main-reservoir pipe is connected at *MR*, the $\frac{3}{4}$-inch feed-valve pipe at *FV*, the low-pressure operating pipe at *Gov*, the 1-$\frac{1}{4}$-inch brake pipe at *BP*, the equalizing reservoir pipe at *ER*, the $\frac{3}{8}$-inch release pipe at *3*, the $\frac{3}{8}$-inch application cylinder pipe at *2*, and the $\frac{1}{4}$-inch emergency relay valve pipe at the connection indicated. If desired, the main reservoir pipe, the feed-valve pipe and the release pipe may be connected to the side of the pipe bracket

H-6 Brake Valve and Positions

A. With the exception of the number of cylinders and the type of main slide valve, it is of the same general plan.

Q. Which are the steam cylinders and which are the air?

A. The two upper cylinders are the steam and the two lower the air, this arrangement being the same as that of the other Westinghouse compressors.

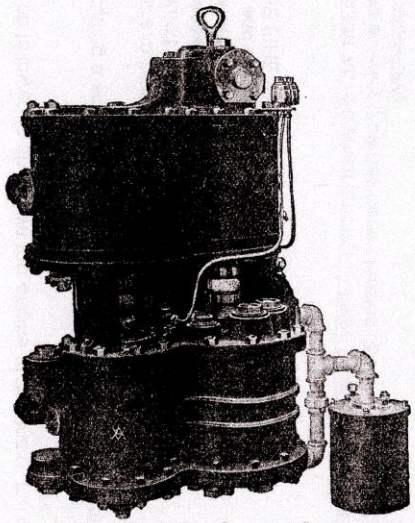


Fig. 43.—8½-Inch Cross-Compound Compressor

Q. What are the diameters of the respective cylinders?

A. The smaller steam cylinder is 8½ inches, the larger is 14½ inches, in diameter; the smaller air cylinder is 9 inches, and the larger 14½ inches in diameter.

Q. What names are used to distinguish these cylinders?

A. The smaller cylinders are called the high-pressure steam and the high-pressure air, while the larger ones are called the low-pressure steam and the low-pressure air.

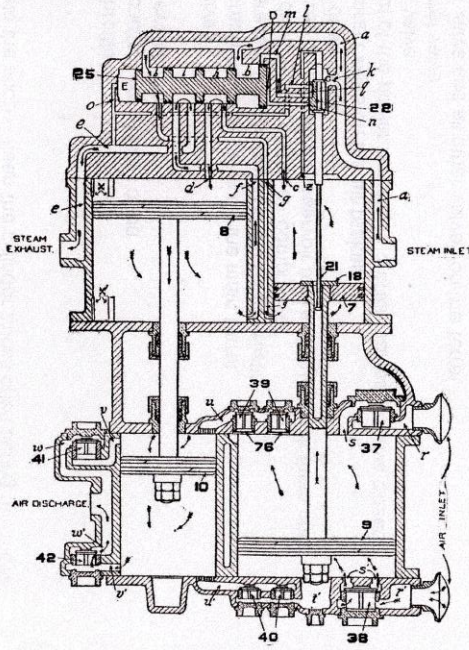


Fig. 44.—Diagram of Cross-Compound Compressor. Up Stroke, High-Pressure Side

Cross Compound Air Compressor

Typical Car Air Brake Components (Brake Cylinder may be separate)

This equipment is known as the type K freight-car brake equipment, and is designed to overcome the objectionable features of the brake equipment that used the H triple valve.

The purpose of any triple valve is to apply its brake, release the brake, and recharge the auxiliary reservoir, and it is due to these triple functions that the valve obtains its name.

The K triple valve performs the same functions as the H triple valve, and also has the following new features: (*a*) A quick-service feature, so called because, when the brakes are applied in service on a long freight train, the triple valves assist the brake valve in reducing the brake-pipe pressure, the result being a more rapid, positive, and uniform application of the brakes throughout the train; (*b*) a uniform release feature, so called because, when the brakes are being released, the triple valves discharge the air slowly from the brake cylinders on the front part of the train, and at the normal rate from the brake cylinders on the rear part of the train, thereby making possible a more uniform release of all brakes; (*c*) a uniform recharge feature, so called because, when the auxiliary reservoirs are being recharged, the triple valves restrict the passage of air to the auxiliary reservoirs on the front portion of the train where the pressure is highest and permit a normal rate of feed to the auxiliary reservoirs on the rear, thereby causing all of the reservoirs to recharge at about the same rate.

The object of the quick-service feature is therefore to bring about a more rapid service application of the brakes, and the object of the uniform release and uniform recharge features is to cause the brakes to release and the auxiliary reservoirs to recharge at about the same rate.

PIPING DIAGRAMS OF TYPE K EQUIPMENTS

7. Types of Equipment.—The type K freight-car brake equipment is classified according to the arrangement of the auxiliary reservoir and the brake cylinder. The equipment is referred to as the type K C when the auxiliary reservoir and the brake cylinder are combined as shown in the piping diagram in Fig. 1, because a type K triple valve and a type C brake cylinder are used. The detached equipment is shown in Fig. 2, and

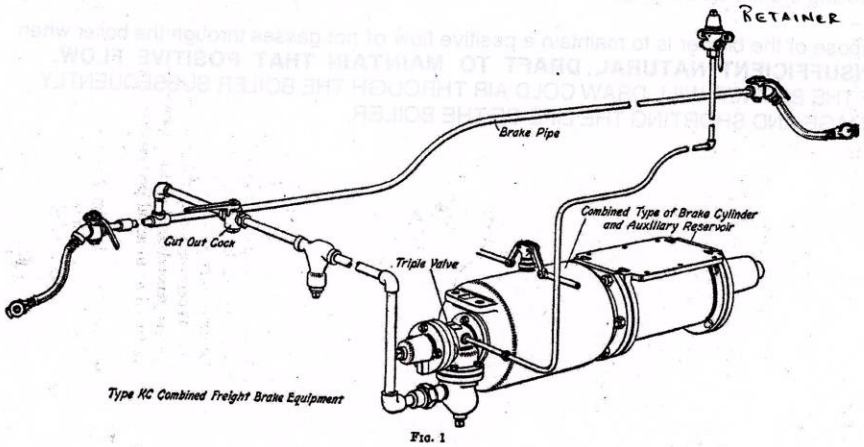


FIG. 1

Typical Car Brake Rigging