THE WESTINGHOUSE "AB" FREIGHT BRAKE EQUIPMENT

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Foreword

Freight train operating requirements have been growing in magnitude and complexity for a number of years. Higher schedule speeds, longer trains and greater tonnage per car and per train have necessitated major improvements in motive power, rolling stock, track and road bed. The Westinghouse Air Brake Company has long recognized the need for corresponding major improvements in brakes used for freight train service to secure better and more economic operation and to enable the railroads also to realize the full benefit from their investments in the other major improvements cited.

Extensive research has been continuously conducted by the Westinghouse Air Brake Company in its laboratory and in its observation and study of road service, to determine what features of design, construction and operation could be improved or developed to satisfy these ever-increasing requirements.

These being matters of vital interest to all railroads, the American Railway Association deemed it advisable to survey the problem on their own account and to that end conducted extensive laboratory tests at Purdue University, which were followed by road tests on the Southern Pacific Railroad. Several forms of freight brake equipment were tested in addition to the existing standard type "K" equipment. During the progress of the American Railway Association investigation the Westinghouse Air Brake Company was permitted to maintain continuous contact with the tests and their results.

The scope and importance of the data thus made available from these various sources far exceed any information heretofore assembled regarding the operating characteristics and requirements of freight trains and freight train brakes. These data, added to those previously available, were thoroughly analyzed, including a detailed consideration of the specific operating principles outlined by the Interstate Commerce Commission as essential in the performance of a satisfactory brake equipment—following their inquiry into the adequacy of the existing standard air brake used on freight cars to meet present-day operating requirements.

The conclusions from these studies were reduced to a fundamental specification covering the specific requirements for a freight brake equipment to meet the economic and safety needs of modern train operation.

Based upon these fundamental specifications, a new freight car brake, designated as Type "AB," has been developed and built by the Westinghouse Air Brake Company and subjected to extensive laboratory tests to prove its adequacy in meeting these requirements. A resumé of the outstanding features embodied in this equipment follows.

Distinctive Features

Service Features

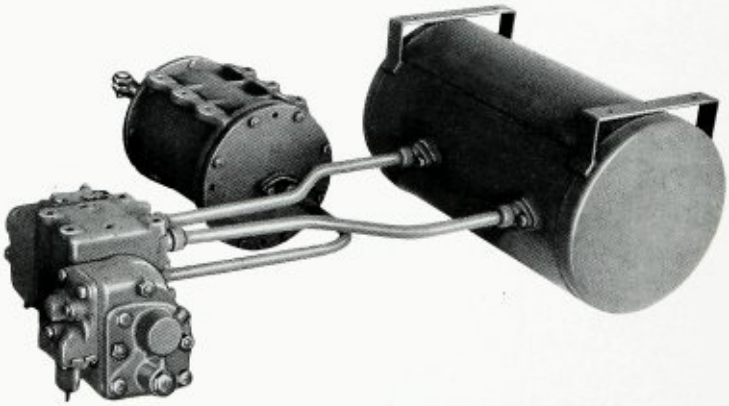
1. Initial Quick Service Action—positively closes all feed grooves and initiates service application.
2. Positive and Adequate Fixed Value Secondary Quick Service—insures a desired uniform brake cylinder pressure on all cars.
3. Brake Pipe Surge Dissipated.
4. Stability of Brake Cylinder Pressure for all Values.
5. Modified Degree of Quick Service on Descending Grades—giving increased flexibility of control.
6. Effective Stabilization—avoids undesired applications.
7. Accelerated Service Propagation—propagation speed is substantially uniform with all degrees of tolerable brake pipe leakage and more than twice as fast as former standard.
8. Accelerated Initial Recharge after Service.
9. Accelerated Release Initiation.
10. Positive Release.
11. Controlled Release of Brake Cylinder Pressure at a Single, Fixed, and Slower Rate.
12. Uniform Recharge—accomplished by automatically restricted charging passage under high charging pressure.

Emergency Features

13. Undesired Quick Action Eliminated.
14. Quick Action Chamber Adequately Guarded Against Overcharge.
15. Emergency Propagation, with more Effective Emergency Brake Cylinder Pressure Available, Under Any Condition of Previous Application or Release.
16. High Pressure in Emergency.
17. Accelerated Emergency Propagation Rate—about 40% faster than with previous standard.
18. Controlled Brake Cylinder Build-up in Emergency to Fit Operating Requirements.
19. Positive and Accelerated Release after Emergency Applications.

General Features

20. Improved Dirt Collector.
21. Hair Strainer—for protection of valve parts against floating dust.
22. Duplex Release Valve—to permit draining one or both reservoirs.
23. Bracket Mounting—pipeless.
24. Reenforced Flanged Pipe Fittings.
25. Brake Pipe Anchorage—branch pipe tee provided with lug for anchoring to car frame.
26. Adaptable for cars weighing more than 58,000 pounds.
27. Improved Brake Cylinder Design, including Piston Packing, Dust Protection, Grease Gun Lubrication, etc.
28. Double Compartment (Auxiliary and Emergency) Reservoir.



View of the "AB" Freight Brake Assembly

Service Features

1. Initial Quick Service:

Service reductions initiated at the engineer's brake valve are relayed through the train by the initial quick service action of each valve. Piston and graduating valve movement alone closes the feed groove and initiates service application by a local venting of brake pipe to a bulb. Propagation rate is thereby greatly accelerated and every valve in the train functions dependably, regardless of brake pipe gradient economically tolerable. Dependable and fast propagation of service applications are two of the basic requirements in securing prompt train retardation with smooth train slack control.

Valves with normal friction will assume service position with the brake pipe pressure drop resulting from equalization into the bulb. For valves having abnormal resistance to application movement through service use, a controlled vent port to atmosphere continues the brake pipe reduction, once initiated by the movement of the graduating valve until the valve assumes service position when this vent port is cut off. This insures all valves applying irrespective of variations in frictional resistance.

2. Secondary Quick Service:

Secondary quick service continues the reduction of brake pipe air through the valve to the brake cylinder until the cylinder pressure reaches the predetermined initial value. This insures a fixed minimum brake pipe reduction and a moderate, predetermined, uniform brake cylinder pressure throughout the train, so essential to the accomplishment of effective and flexible brake action, and to smooth train slack action.

3. Brake Pipe Surge Dissipated:

A very rapid initial brake pipe pressure drop is necessary to secure prompt and positive service brake application through long trains. The resulting surging in brake pipe pressure that follows a prompt and substantial quick service activity is dissipated by materially reducing the rate in the final stage of quick service reduction. This avoids the possibility of undesired release of brakes.

4. Stable Brake Cylinder Pressure:

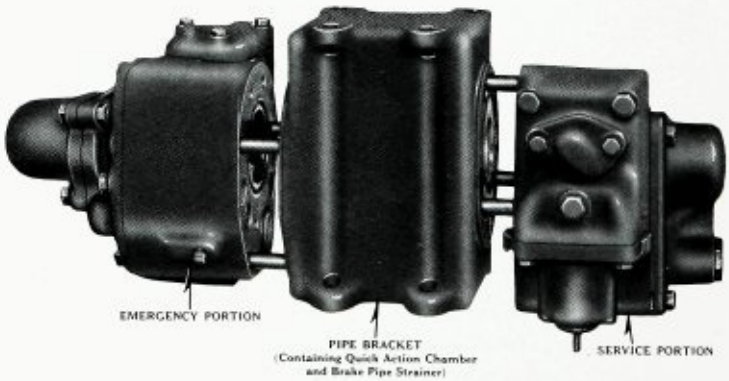
All quick service activity is ended when the predetermined initial brake cylinder pressure is secured so that with a tight brake pipe any brake cylinder pressure beyond this fixed value is entirely within the control of the engineer. Except as directly influenced by improper and undesired brake pipe leakage, this permits the engineman to fully control the degree of brake application to that required.

5. Modified Quick Service on Grades:

Quick service action, being controlled by a predetermined brake cylinder pressure, is automatically made to fit the differing requirements of level road and grade operation.

For grade braking a lower degree of quick service activity is essential and is provided so that substantially all retaining valves may be employed without liability of stalling the train or the necessity of operating at excessive speed. This will result in more uniform distribution of work and consequently lower average temperature of shoes and wheels. The safety and economy of operation is thereby increased.

For level road service an increased degree of quick service reduction is desirable and is now practicable and available for the first time.



View of the "AB" Valve Showing the Operating Portions and Pipe Bracket

6. Stabilization Against Undesired Service Applications:

The needed degree of stability of the valve against the inevitable minor fluctuations of brake pipe pressure is provided by a relatively large charging port in normal release position supplemented by a release stabilizing spring. The stabilizing spring also performs the service function of a graduating spring.

7. Accelerated Service Propagation Rate:

The rate of propagation of service application is at least twice as fast as that obtained with any former equipment, thus directly reducing the forces producing slack shocks in long trains.

8. Accelerated Initial Recharge:

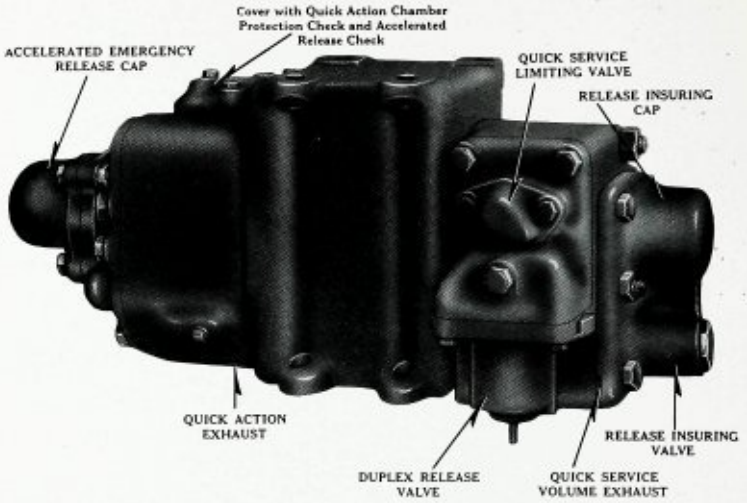
The use of the emergency reservoir air for the initial recharge of the auxiliary reservoir provides prompt restoration of pressure up to the equalization of the two volumes. Substantial recharge is effected in this manner and a prompt and effective reapplication is available.

9. Accelerated Release Initiation:

In service application the emergency reservoir is isolated and its pressure held at full charge. During release of brakes the auxiliary reservoir is partially recharged from this local volume in place of from the brake pipe, therefore brake pipe pressure is developed more rapidly and the rear brakes released sooner and with more certainty.

10. Positive Release:

Triple Valves frequently acquire, through service use, abnormal resistance to release movement. A release insuring feature functions to accomplish the release of each brake when the normal release differential is attained, irrespective of any excessive resistance of the valve to the release movement. This further improves the uniformity and certainty of brake release.



Front View of the "AB" Valve Showing Location of Various Details

11. Controlled Release of Brake Cylinder Pressure:

The valve in release position provides only one brake cylinder exhaust rate which is substantially the restricted rate of the "K" triple valve in retarded release position. While variable (Retarded) release was ideal for trains of moderate length, it became inadequate with longer trains. Uniform restricted release, being positive in its action and extending farther back from the locomotive than is possible with retarded release, will permit train slack to stretch gradually while releasing brakes in modern trains.

12. Uniform Recharge:

A two-sized auxiliary reservoir charging groove is provided. During release, if the brake pipe pressure becomes approximately three pounds higher than auxiliary reservoir pressure the piston is forced against a spring into retarded recharge position, where the smaller size of charging port controls the auxiliary reservoir charging. When this differential does not exist, the Retarded Recharge Spring holds the Piston in normal recharge position and the larger size of charging port governs the rate of charging. As the high differential prevails on the head portion of the train, the recharge of the brakes is made sufficiently uniform.

Emergency Features

13. Undesired Quick Action Eliminated:

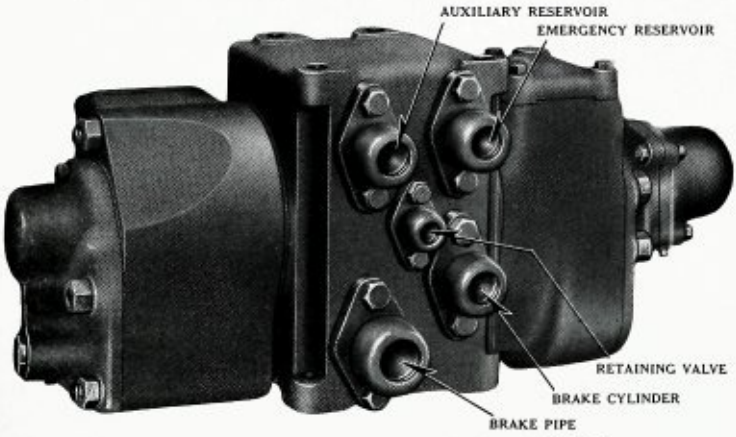
Service and emergency parts and functions are independent of each other. This permits construction which insures against undesired quick action arising during a service rate of brake pipe reduction, without impairing the desired quick action feature.

14. Protection Against Quick Action Chamber Overcharge:

The volume of the quick action chamber must be small and, if permitted to overcharge during full release movement of the brake valve, could cause undesired emergency. To prevent such an overcharge, the quick action chamber automatically discharges any surplus air to the large emergency reservoir which is below normal pressure during the first stage of brake release.

15. Availability of Emergency Quick Action at Any Time:

When an emergency rate of brake pipe reduction is produced at any point in the train at any time, irrespective of the state of service application or release of the train brakes, emergency quick action is started and rapidly propagated throughout the train. Also, a brake cylinder pressure higher than full service pressure is secured. No situation, therefore, can arise in which increased retarding force is not quickly available.



View of the Pipe Bracket Face of the "AB" Valve Showing the Reenforced Pipe Fittings

16. High Pressure in Emergency:

The use of an Emergency Reservoir volume to supplement the Auxiliary Reservoir volume provides twenty per cent higher brake cylinder pressure in emergency than in full service.

17. Accelerated Emergency Propagation Rate:

The rate of propagation of emergency action has been increased 40% above that of the Type "K" Valves, thus directly reducing the forces producing slack shocks in long trains.

18. Controlled Brake Cylinder Pressure:

The development of brake cylinder pressure in emergency applications may be so controlled as to produce the shortest stop that may be accomplished without causing unsafe train slack shocks. The construction permits adjustment to secure a faster brake cylinder pressure development than was employed in the final A. R. A. tests, as recorded in Table 295, A. R. A. Report. This faster development of brake cylinder pressure makes shorter stops practicable. (With improved automatic control of engine brakes the stopping distance can be further reduced without producing objectionable shocks). The emergency stopping distance can be further reduced by the acceptance of slack shocks which do not exceed the service shock stops recorded in Table 294 of A. R. A. Report.

19. Positive and Accelerated Release Following Emergency:

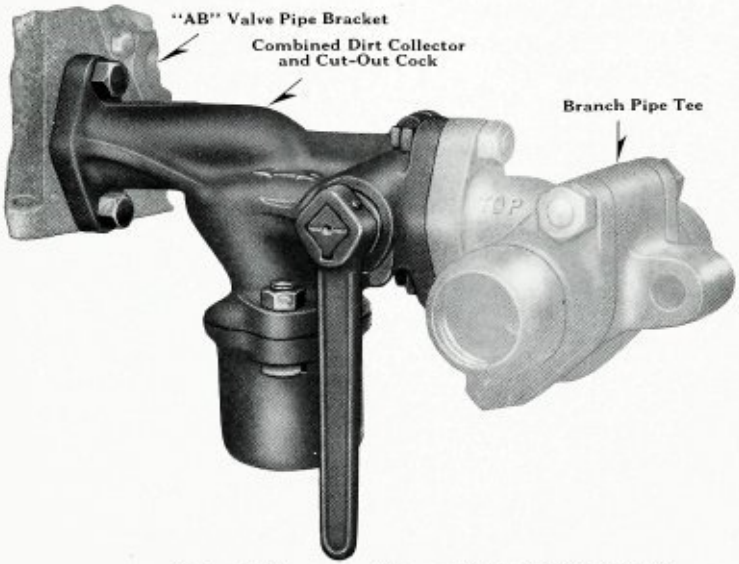
When the release of an emergency application is initiated and brake pipe is charged to about 20 pounds the emergency slide valve first isolates the emergency reservoir, thus conserving its pressure for partially recharging the auxiliary reservoir—as with service application—when the individual brake starts to release. Then, it functions to reduce the auxiliary reservoir and brake cylinder pressures by venting them to the brake pipe until these pressures are within about two pounds of equalization.

This results in a faster rate of increase of brake pipe pressure while brakes are being released and, therefore, a more certain and uniform release of all brakes. Also, the release occurring with a relatively low auxiliary reservoir pressure, the time required to release emergency applications is greatly reduced.

General Features

20. Improved Dirt Collector:

Combining the dirt collector with the branch pipe cut-out cock eliminates two pipe joints. The separating chamber of the dirt collector separates the dirt from the air and traps it in the storage chamber against brake pipe reductions of any rate and degree. Branch pipe volume is reduced by attaching the dirt collector directly to the pipe bracket of the "AB" valve and joining the branch pipe tee to the cut-out cock flange as illustrated. The complete branch pipe is relieved of all strain by permanent attachment to the car underframe at the branch pipe tee which has a bolting lug for that purpose.



Combined Dirt Collector and Branch Pipe Cut-Out Cock

21. Hair Strainer Protection:

After passing through the Improved Dirt Collector, all air coming in contact with packing rings and slide valves is passed through a special form of strainer which removes and holds dust too fine to be caught by the dirt collector. Since the relatively rapid wear of moving valve parts requiring rather frequent reconditioning is due chiefly to fine grit, this strainer will greatly extend the life and dependability of the brake.

22. Duplex Release Valve:

To avoid necessity of operating two release valves to vent the auxiliary and emergency reservoirs, a duplex valve with one operating lever is provided. The construction is such that a limited degree of movement vents the auxiliary reservoir only and a greater movement vents both simultaneously.

23. Pipeless Bracket Mounting:

A bracket mounted permanently on the car carries the valve portions and all pipe connections. Therefore, when removing a valve portion for cleaning, no pipe connections need be broken.

Provision is made for adding the elements needed to adequately brake cars weighing in excess of 58,000 pounds when empty.

24. Reenforced Flanged Pipe Fittings:

Flanged unions are provided for all pipe connections, thus insuring permanently air tight joints. In addition, the pipe connections in the flanged unions are made mechanically strong by solidly supporting the pipe beyond the threads so that pipe failures are eliminated.

25. Brake Pipe Anchorage:

The branch pipe tee fitting has a mounting bracket for securely anchoring it on the car underframe. This prevents those pipe movements now common to freight brakes, which cause air leakage and pipe joint failures.

26. Brake Cylinder Capacity for Cars Weighing Over 58,000 Pounds:

To adequately brake freight cars weighing more than 58,000 pounds when empty, a special brake cylinder, a transfer valve and a pipe bracket are available. These elements function to produce the needed increase in brake cylinder capacity without increase in air consumption over that of the standard 10" Freight Brake.

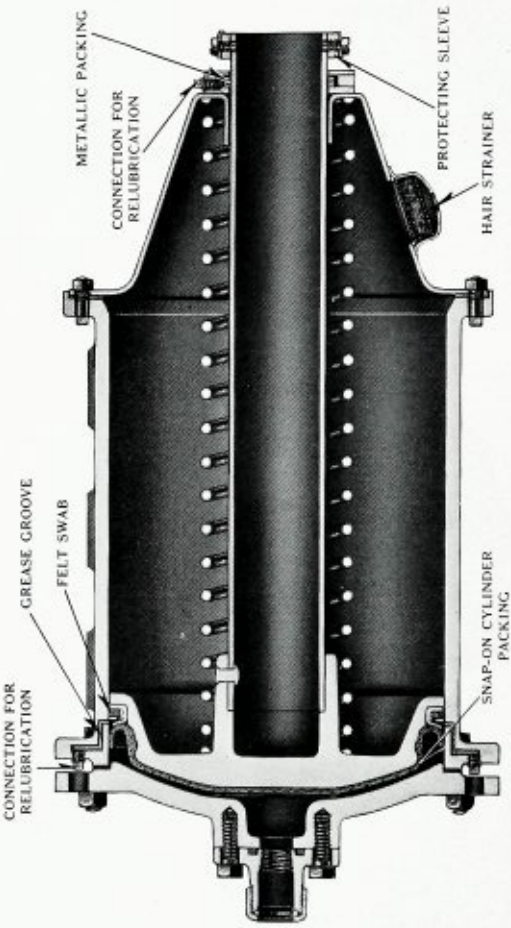
27. Improved Brake Cylinder:

The brake cylinder construction eliminates leakage through the packing, permits the packing and cylinder walls to be relubricated without opening the cylinder, and with a felt swab applies a film of lubricant on the cylinder walls with each movement of the piston, thus greatly reducing packing wear. The cylinder is also effectively protected against the entrance of dirt by a hair strainer and by a metallic packing on the piston rod. Means are provided for relubricating the packing without dismantling. These improvements will insure a brake cylinder free from leaks over a greatly extended service life and correspondingly lengthen the time between cleaning periods. The hollow piston rod is also fitted with a protecting sleeve.

Exterior View of the Improved Brake Cylinder

28. Double Compartment Reservoir:

The combined auxiliary and emergency reservoir is constructed of steel instead of cast iron, which results in a weight reduction of 40% over that of the present single cast iron auxiliary reservoir. Reenforced pipe fitting pads and brackets for convenient mounting are provided on the reservoir as illustrated on page 8.



Sectional View of the Improved Brake Cylinder.

Operation of the Equipment

Plate 1

A piping diagram of the complete "AB" freight brake equipment is shown on Plate 1.

Full Release and Charging Position
Plate 2

Brake pipe air from pipe *b* passes through the combined branch pipe cut-out cock and dirt collector into passage *b* and thence through curled hair strainer 6 to the faces of service piston 33 and emergency piston 116. A branch of passage *b* also leads to the space between by-pass check valves 48 and 48*a*. The purpose of these check valves is to insure the application and release of the brake in the event that the hair strainer 6 becomes clogged with dirt due to improper maintenance. Check 48*a* will open to allow brake pipe air to flow to the face of the service piston when releasing, and check valve 48 will open to allow brake pipe air to flow from the face of the service piston when applying the brake upon the development of approximately two pounds differential across the strainer and check valve.

Brake pipe air on the face of service piston 33 passes through the feed groove to the slide valve side of the piston and through passage *a* and pipe *a* to the auxiliary reservoir. The feed groove in this position has its maximum opening allowing full charging flow to the auxiliary reservoir.

The emergency reservoir is charged from auxiliary reservoir air by way of the service slide valve chamber, through restricted port *e*4 in the slide valve at the left end of the graduating valve, to passages *e*2 and *e* thence through pipe *e*.

Brake pipe air on the face of emergency piston 116 flows through the charging choke 138 to the slide valve side of the piston and to the quick action chamber.

Emergency reservoir air is connected to the underside of the emergency slide valve 115 by passages *e* and *e*3. In order to prevent the slide valve 115 being unseated when the quick action chamber is not charged the slide valve is balanced by spring 101

and diaphragm loaded stem 103. Emergency reservoir air is connected to the upper side of diaphragm 99 through passage *e*5 and port *e*6 and exerts pressure in a downward direction to keep the slide valve seated when there is no air pressure above the slide valve. When the quick action chamber is charged, the pressure in the emergency slide valve chamber holds the slide valve to its seat and the pressure on both sides of the stem diaphragm 99 is the same; consequently the stem is balanced, removing downward stem pressure except that of the light spring 101 which does not increase slide valve friction materially.

A branch *b*4 from brake pipe passage *b* leads to the right of quick action vent valve 113.

During a service brake application the emergency reservoir remains at the pressure charged previous to the brake application. When the service slide valve returns to release position, the emergency reservoir is connected through pipe *e*, passage *e*2 and restricted port *e*4 through the slide valve, located at the left end of the graduating valve, to the service slide valve chamber and auxiliary reservoir. This provides the quick recharge feature and also more positive and prompt release of all brakes by recharging the auxiliary reservoirs during initial release from emergency reservoirs and permitting a quicker build-up of brake pipe pressure throughout the train than possible if all recharge were from the brake pipe.

The brake cylinder is connected to atmosphere through pipe *bc*, passage *bc*, past inshot valve 126, passages *bc*2 and *bc*3, cavity in the service slide valve and passage Ex to the retainer.

Inshot valve volume *bc*8 is connected through port *bc*7 to a cavity in the emergency slide valve, thence through port *bc*6 and passage *bc*3 to the service slide valve cavity which is open to the retainer through exhaust passage Ex.

Protection Against Quick Action Chamber Overcharge

Plate 2

Emergency reservoir air is connected through port *e*5 to the spring chamber above ball check 95 and rubber seated valve 97. The underside of ball check 95 is connected by a choked passage to the emergency slide valve chamber and quick action chamber.

In the event of the quick action chamber becoming overcharged, as might occur on the head end of a long train by reason of improper use of release position of the brake valve, when quick action chamber pressure becomes a small amount higher than emergency reservoir pressure, as determined by the rubber seated check valve spring 98, ball check 95 and the spring loaded check valve 97 will be unseated and the overcharge of quick action chamber air will flow to the emergency reservoir and prevent undesired operation of the emergency portion. The use of the spring loaded rubber seated check valve 97 and ball check 95 provides double protection against the quick action chamber charging from the emergency reservoir.

Quick action chamber air is connected through port *h* in the emergency slide valve to passage *h*2 leading to the left of holding piston 144. The right of the holding piston is also exposed to quick action chamber pressure and, therefore, the piston is in a balanced condition and remains in this position to the extreme left, out of contact with the emergency piston except when an emergency application has been made as described under "Emergency."

Uniform Release
Front End Retarded Recharge
Plate 3

When during release the brake pipe pressure is more than approximately three pounds higher than auxiliary reservoir pressure, the retarding spring 43 at the end of the service slide valve stem is compressed and the service piston 33, slide valve 36 and its graduating valve are moved to their extreme right hand position.

In this position the flow of air from the brake pipe to the auxiliary reservoir is restricted by a smaller feed groove than obtains in full release position. As only front end brakes assume retarded recharge position, brake pipe air flow to auxiliary reservoirs is restricted on the front end of the train while brake pipe and auxiliary reservoir pressures are built up on the rear portion of the train at an increased rate, thus providing a sufficiently uniform recharge.

The brake cylinder is connected to exhaust in this position as described under "Full Release Position," the rate of brake cylinder release being the same in both positions.

The slide valve 36 blanks the quick service port *b*5, cutting off flow to the graduating valve to prevent the latter being unseated during initial charging of the equipment.

On head end cars the emergency piston 116 and slide valve 115 may assume "Accelerated Release" position by reason of brake pipe pressure being enough higher than quick action chamber pressure to compress spring 137, but this will have no effect as brake pipe pressure will be higher than brake cylinder pressure except when an emergency application has been made as covered under "Release Position after Emergency."

Preliminary Quick Service Position
Plate 4

When a service brake pipe reduction is initiated, the service piston 33 first moves to the left far enough for the stabilizing stem 40 in the end of the piston stem to engage the slide valve where the piston closes the feed groove.

The stabilizing spring 39 and stem 40 stabilize the preliminary quick service so that a predetermined differential of auxiliary reservoir and brake pipe pressures is required to move the triple valve piston and graduating valve to preliminary quick service position. Undesired quick service activity which might otherwise occur, due to moderate fluctuations of brake pipe pressure, is thereby prevented.

As the brake pipe pressure reduction continues, enough differential is created to compress the stabilizing spring 39 and move the graduating valve 34 on the slide valve 36 to connect brake pipe air in slide valve port *b*5, cavity and restricted port *k* in the graduating valve to the quick service port in the slide valve and finally to the quick service chamber.

This preliminary local reduction of brake pipe pressure, controlled by the graduating valve, results in rapid quick service propagation throughout the train.

The quick service chamber is permanently connected to atmosphere through choke 31 and by this means local brake pipe reduction is continued until the slide valve moves. After the quick service

chamber has been cut off by the movement of the slide valve, accumulated air pressure in the quick service chamber is exhausted through choke 31.

During preliminary quick service, the emergency piston 116 and graduating valve assume service position as described under "Service Position."

Service Position
Plate 5

When the slide valve is in service position brake pipe air flows at a restricted rate through the limiting valve to the brake cylinder until a uniform pressure of predetermined amount obtains.

Brake pipe air in passage *b*5 flows through a cavity in the service slide valve thence through choke 32, lifts rubber seated check 64 and flows past limiting valve 64*a* to the underside of the limiting diaphragm 47 to passages *bc*4, *bc*3, *bc*2, past unseated inshot valve 126, to passage *bc* to the brake cylinder.

At the same time auxiliary reservoir air in the service slide valve chamber is flowing past the right end of the graduating valve, through slide valve service port *bc*5 to passage *bc*3. A branch *bc*6 leads through a cavity in the emergency slide valve to passage *bc*7 to inshot volume *bc*8 and to the left of inshot piston 117. Therefore, brake cylinder pressure is acting on both sides of inshot piston 117 and as the spring 124 on the left of this piston is stronger than the spring 125 on the right of inshot valve 126, the piston and valve are held in open position and allow a direct build up of brake cylinder pressure.

As pressure is built up in the brake cylinder, it also increases under quick service limiting diaphragm 47. When the pressure reaches approximately nine pounds, the diaphragm is deflected upward against the force of spring 63, allowing spring 57 under limiting valve 64*a* to move the valve up to closed position. This cuts off the flow of brake pipe air to the brake cylinder, terminating quick service activity.

When cycling on descending grades and the brake is re-applied with the retainer in holding position, quick service activity is limited to the degree obtained from preliminary quick service

position as described. The additional quick service, brake pipe air flow to brake cylinder, always obtained with an initial brake application, is cut off by the quick service limiting valve when ten pounds or more brake cylinder pressure is retained.

When a service rate reduction of brake pipe pressure causes the pressure on the face of emergency piston 116 to become slightly lower than quick action chamber pressure on the slide valve side of the piston, the piston and graduating valve move to the right until the tail spring stop 130 strikes the left end of the emergency slide valve. In this position the piston closes the charging choke 138, and the vent port *v* through the graduating valve registers with port *v*2 in the slide valve. Port *v*2 is connected to the exhaust port in the slide valve seat, thereby reducing quick action chamber pressure, back of the piston, at the same rate as brake pipe pressure is being reduced on the face of the piston. This action keeps quick action chamber pressure from attaining a differential over brake pipe pressure sufficient to compress the tail spring 131 enough to cause the graduating valve to uncover port *v*3 which would cause emergency application.

By this means the valve is stabilized against undesired emergency, and emergency application is made available at any time, as described under "Emergency."

Service Lap Position

Plate 6

When the desired amount of brake pipe reduction has been made and auxiliary reservoir pressure is reduced slightly below brake pipe pressure, the service piston 33 and its graduating valve move to the right until the piston stem engages the slide valve, in which position the graduating valve blanks service port *bc*5 in the slide valve and cuts off further flow of auxiliary reservoir air to the brake cylinder.

The emergency piston 116 and graduating valve return to charging position.

Emergency Position—Plate 7

First Stage

When an emergency rate brake pipe reduction takes place from any cause, quick action chamber pressure cannot reduce through the vent port *v* in the graduating valve 133 and port *v*2 in the emergency slide valve to atmosphere at the same rate; therefore, sufficient differential is built up across the emergency piston to compress the tail spring 131 and allow the graduating valve 133 to move far enough on the slide valve to uncover port *v*3 in the slide valve and seat, allowing quick action chamber air to flow to the left of vent valve piston 107. This unseats the vent valve 113, opening a large and direct passage from brake pipe to atmosphere. The rapid venting of brake pipe air causes an emergency reduction rate of brake pipe pressure to pass serially and rapidly through the train due to the same operation of connected valves, and insures the prompt movement of valves on other cars to emergency position.

The rapid reduction of brake pipe pressure causes the emergency piston and slide valve to move to the extreme right position.

The emergency slide valve now connects emergency reservoir air from passage *e*3 through the slide valve to passage *bc*6 whence it flows through passages *bc*3 and *bc*2. Meanwhile, the emergency rate of reduction in brake pipe pressure has caused the service piston and slide valve to move to the extreme left position where the graduating valve uncovers the service port *bc*5 through which auxiliary reservoir air flows to passage *bc*2, combining with the flow from emergency reservoir. The combined air pressures now flow past the unseated inshot valve 126 to passage *bc* and pipe *bc* to the brake cylinder.

The emergency slide valve has blanked port *bc*7 leading to inshot volume *bc*8 and the spring side of inshot piston 117. The inshot piston spring 124 holds the inshot valve 126 open to allow air to flow at an unrestricted rate to the brake cylinder until approximately 15 pounds brake cylinder pressure is developed, when the force of the inshot piston spring 124 is overcome and the piston moves to the left, allowing the inshot valve 126 to close.

Emergency Position

Second Stage—Delayed Build-Up

Plate 7—Middle View

With the inshot valve now closed, brake cylinder pressure build-up continues at a slower rate through choke 127.

There is a conical choke 109 through the vent valve piston 107. This allows quick action chamber air to flow to atmosphere at a restricted rate, permiting the spring 112, acting on the right of the vent valve 113 to return this valve to its seat in a predetermined time in order to permit the restoration of brake pipe pressure when release of the brake is desired.

Emergency Position

Third Stage—Final Build-Up

Plate 7—Left Hand View

Quick action chamber pressure is on the left of timing valve 69*b* while brake cylinder pressure is connected to the right of this valve. Brake cylinder pressure is increasing while quick action chamber pressure is being reduced through the vent valve piston choke 109 to atmosphere. When quick action pressure has reduced to a certain relation to brake cylinder pressure, timing valve 69*b* will be unseated and air can flow to the brake cylinder through choke 153 in addition to choke 127, producing a faster rate of final brake cylinder build-up.

This three stage operation just described provides an initial inshot of pressure from the combined emergency and auxiliary reservoirs to the brake cylinder of limited amount but at an unrestricted rate, followed by a delayed build-up and finally a fast rate to equalization.

This controlled brake cylinder pressure development is modified when a partial service brake application precedes an emergency application and is completely annulled when the service brake application has developed thirty pounds brake cylinder pressure or more before the emergency application is made. The amount of inshot pressure and delay time before final build-up is dependent

upon the amount of brake cylinder pressure in inshot volume *bc*8 and on the left of inshot piston 117 at the time emergency takes place.

As both the emergency reservoir and auxiliary reservoir equalize into the brake cylinder during emergency, a higher brake cylinder pressure is obtained than is possible from a full service application.

Movement of the emergency slide valve to emergency position blanks port *h* at the slide valve seat thereby cutting off the chamber at the left of holding piston 144 from quick action chamber pressure. A cavity in the slide valve now establishes connection between passages *h*2 and *e*3, and emergency reservoir air, which is also brake cylinder air at this time, flows to the back of the holding piston 144. Quick action chamber pressure on the right of the holding piston is gradually depleted to zero by way of the choke 109 in the vent valve piston 107 following an emergency application and, therefore, emergency reservoir pressure on the left of the holding piston moves it to the right.

Release After Emergency Application
Plate 8

When brake pipe pressure on the face of the emergency piston is restored after emergency application, the piston is prevented from returning to release as the holding piston 144 was moved to the right during the preceding emergency application. The emergency piston spider now comes in contact with the stem 148 of the holding piston, thereby arresting further movement of the emergency piston until approximately 20 pounds brake pipe pressure has been built up on the face of the emergency piston. At this pressure holding springs 150 and 151 are compressed and the emergency piston and slide valve start to move toward release position. Movement of the slide valve first cuts off the connection between passages *e*3 and *h*2 (See Plate 7) and then establishes connection between passage *h*2 and port *h* in the slide valve (See Plate 8). Quick action chamber pressure is now acting on both faces of the holding piston, putting the latter in balance. The twenty pound release differential previously established causes the emergency piston to move to the extreme left (Accelerated Release

Position) compressing emergency piston spring 137 and returning the holding piston 144 to its left hand position.

Accelerated Emergency Release

Plate 8

The emergency slide valve is now in Accelerated Release Position where the emergency reservoir port *e*3 under the slide valve is blanked so that no air flows to the emergency portion from this source. The brake cylinder is now connected through pipe *bc*, passage *bc*, past inshot valve 126, through passages *bc*2, *bc*3 and *bc*6 to a cavity in the emergency slide valve thence to port *bc*9 leading to the under side of ball check 94 and rubber seated check 93. As the auxiliary reservoir is still connected by the service slide valve, which still is in application position, to the brake cylinder and the pressure in these volumes under rubber seated check 93 is higher than brake pipe pressure above the check, the check is lifted from its seat and air from the brake cylinder and auxiliary reservoir flows through passages *b*4, *b*, the centrifugal dirt collector and branch pipe cutout cock to the brake pipe, thereby permitting brake cylinder and auxiliary reservoir air to flow into the brake pipe until these pressures are within about two pounds of equalization thus providing a quick, serial initial build-up of brake pipe pressure.

Since auxiliary reservoir pressure is being partially reduced while the brake pipe pressure is being initially built up throughout the train, the development of that brake pipe pressure needed to release the brakes is accomplished much sooner than it would be by raising brake pipe pressure through the brake valve alone and, therefore, a very prompt and positive release of the brake is accomplished.

The quick action chamber is being charged through the charging choke 138. Spring 137 will move the emergency piston and slide valve from Accelerated Release to charging position as soon as the pressures on both sides of the emergency piston become substantially equal. This closes the connection between brake cylinder port *bc*9 and brake pipe *b*4 at the emergency slide valve seat.

When brake pipe pressure becomes slightly in excess of auxiliary reservoir pressure the service piston and slide valve are moved

to either retarded recharge or full recharge and the brake will be released and reservoirs recharged as previously described.

Release Insuring

Excessive release differential resulting from service use would greatly increase the release hazard. A release insuring feature functions to accomplish the release of each brake when the normal release differential is slightly exceeded.

When brake pipe pressure on the left of release insuring diaphragm 45 exceeds by not more than one and one-half pounds the pressure in the auxiliary reservoir on the right of the diaphragm, the latter will be deflected to the right and unseat valve 75, which will allow auxiliary reservoir air to flow through port *r* and choke 79 to a cavity in the service slide valve and the exhaust port to the retainer. This will reduce auxiliary reservoir pressure until enough differential is created across the service piston to move it and the slide valve to release and charging position. In release position of the service slide valve the connection between passage *r* and retainer exhaust passage Ex is closed, and reduction of auxiliary reservoir pressure by way of the release insuring valve is prevented.

Release Valve
Plate 2

A duplex release valve is attached to the service portion by which the auxiliary reservoir air may be drained alone or both auxiliary and emergency reservoir air may be drained simultaneously.

The release valve handle 72 may be moved in any direction to open the release checks. The plunger 70 has two stems which are lifted to unseat the release checks 69 and 69*a* when the handle 72 is moved. There is less clearance between auxiliary release check 69 and its plunger stem than between emergency reservoir release check 69*a* and its stem. Therefore, if handle 72 is moved part way the auxiliary reservoir release check 69 is lifted from its seat and the reservoir is drained without opening the emergency reservoir release check 69*a*. If handle 72 is moved its full travel both release checks are unseated and both reservoirs drained.

General

Check valves 93 and 94 in the emergency portion prevent brake pipe air flowing to the brake cylinder if for any reason the emergency slide valve is forced to Accelerated Release position when brake cylinder pressure is lower than brake pipe pressure. In normal charging position of the emergency slide valve the connection *bc*9 between brake pipe and brake cylinder is cut off by the slide valve.

Check 64 in the service portion prevents air flowing from the brake cylinder to brake pipe in the event of an over reduction of brake pipe pressure and also prevents the loss of brake cylinder air past the quick service limiting valve 64*a* to empty brake pipe in emergency position.

The port *m* shown in the top of the service piston bush is for the purpose of providing auxiliary reservoir air to the transfer valve, used with the 4-12 brake equipment, when the service slide valve is in application position. In other positions of the service piston brake pipe air is used as the transfer valve supply.

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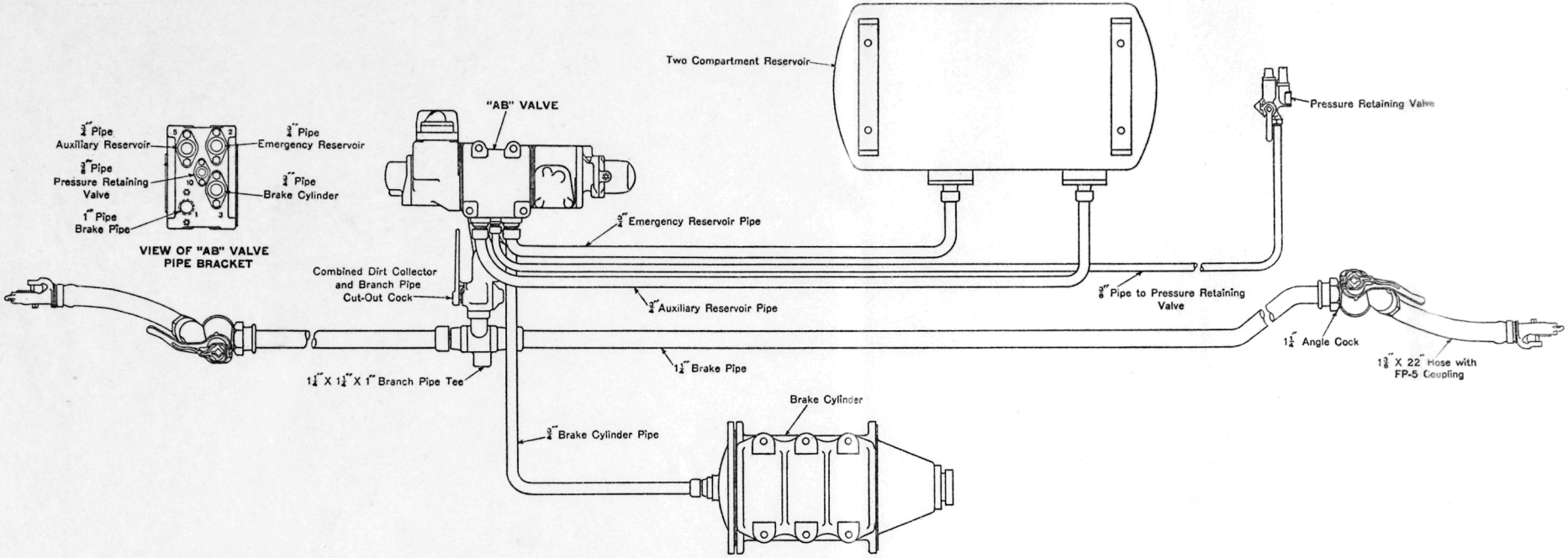


Plate 1 Piping Diagram of the Complete "AB" Freight Car Brake Equipment

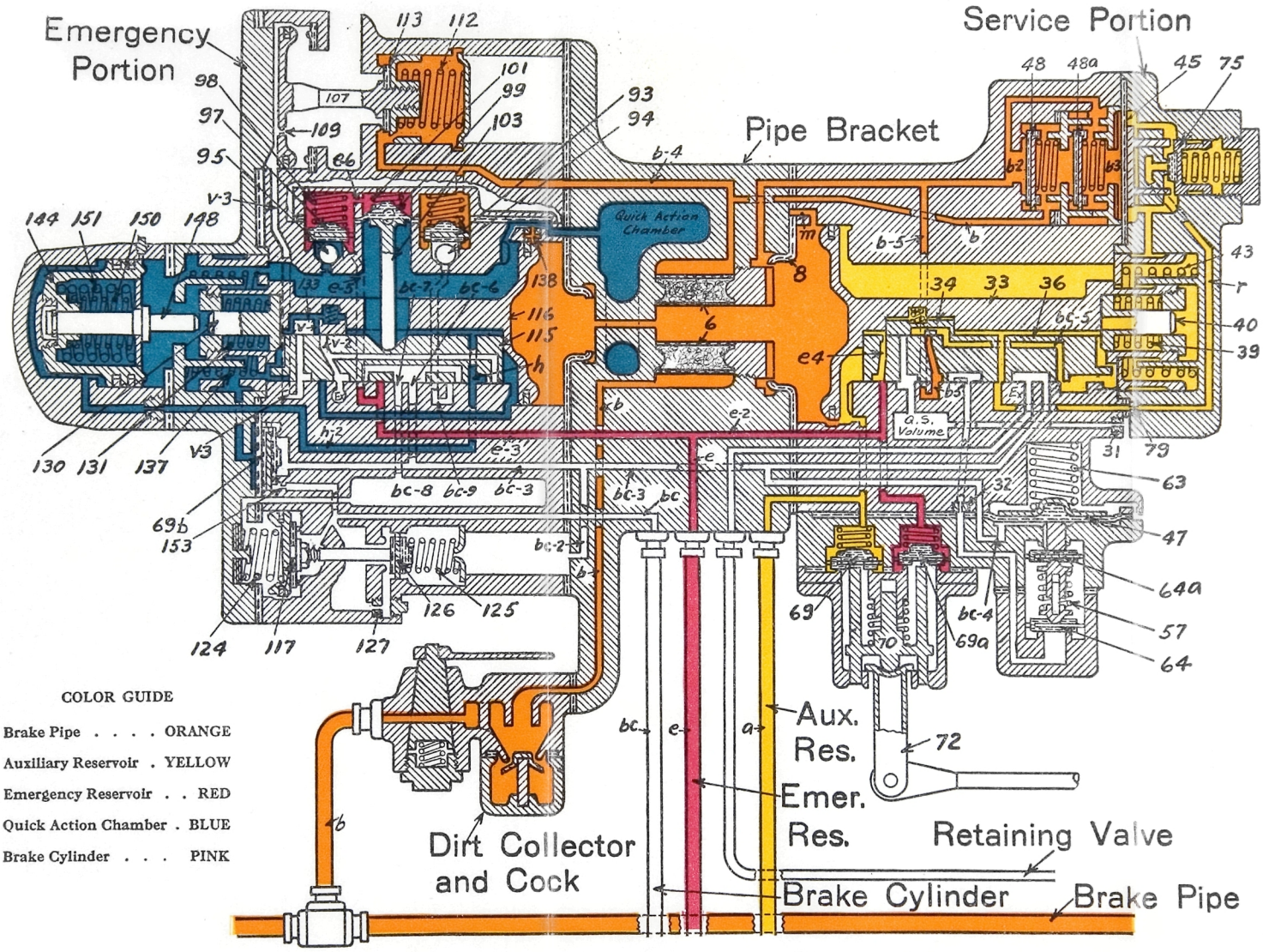


Plate 2 Full Release and Charging Position—Diagrammatic View

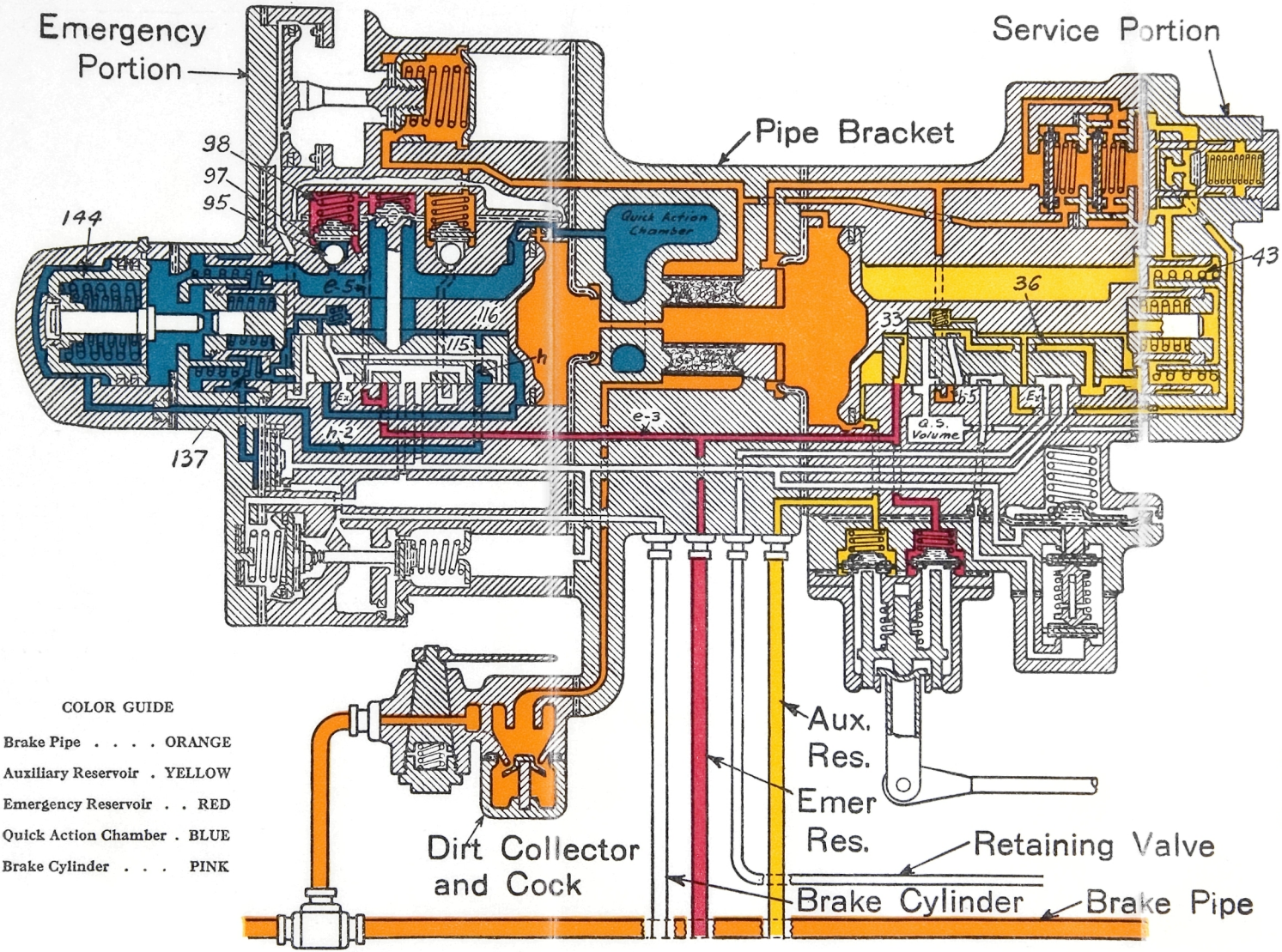


Plate 3 Uniform Release (Front End Retarded Recharge) Position—Diagrammatic View

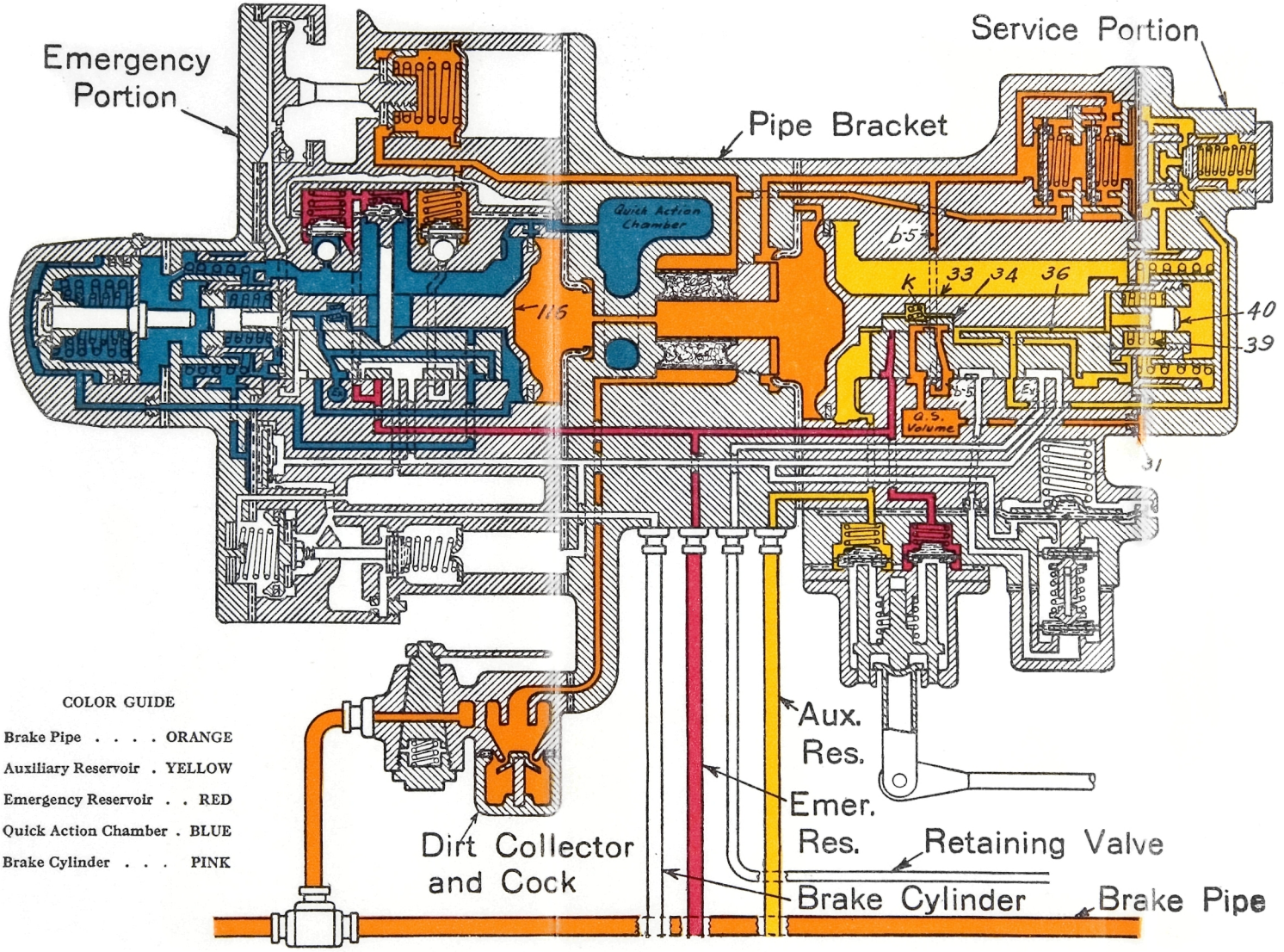


Plate 4 Preliminary Quick Service Position—Diagrammatic View

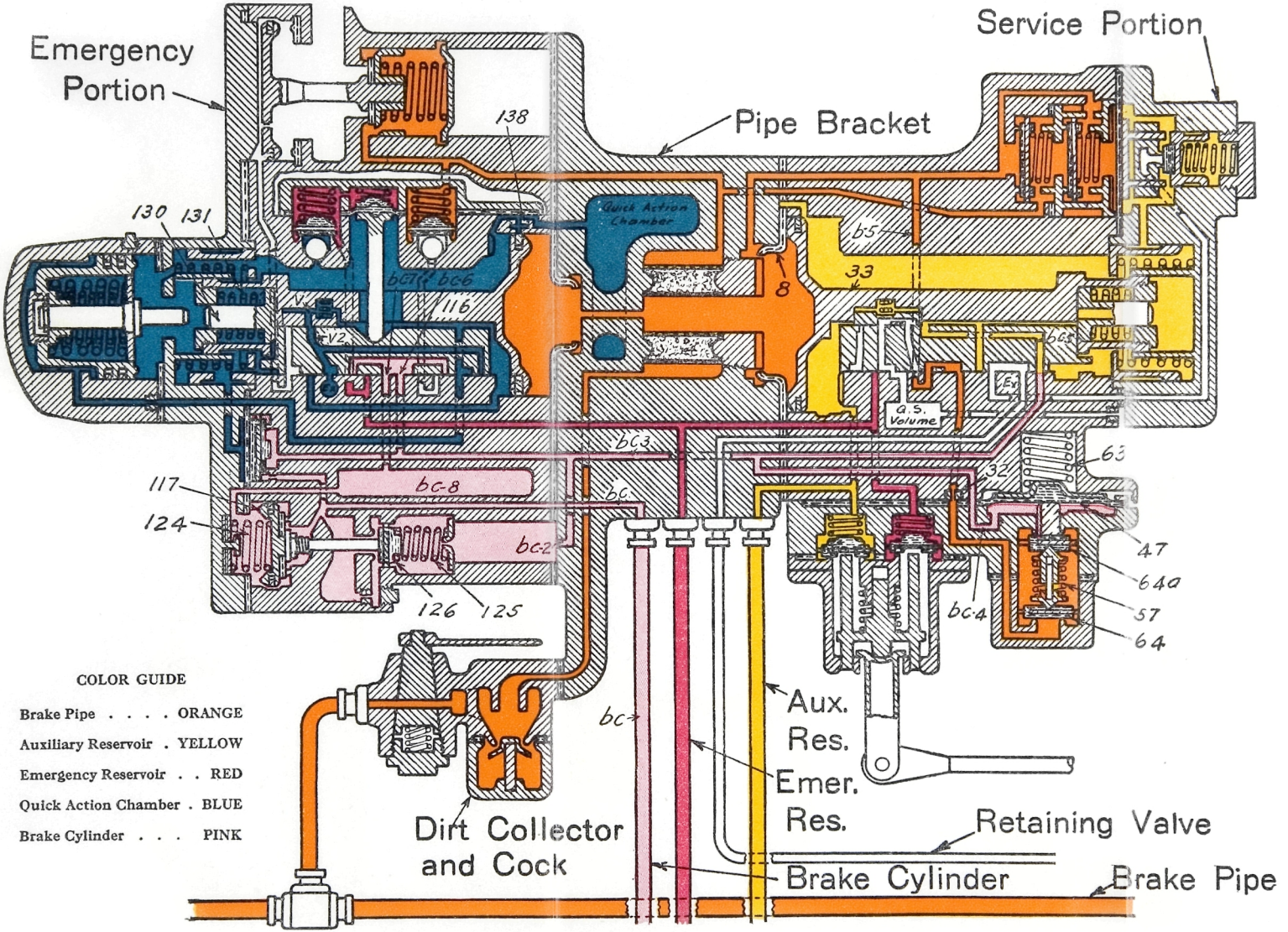


Plate 5 Service Position—Diagrammatic View

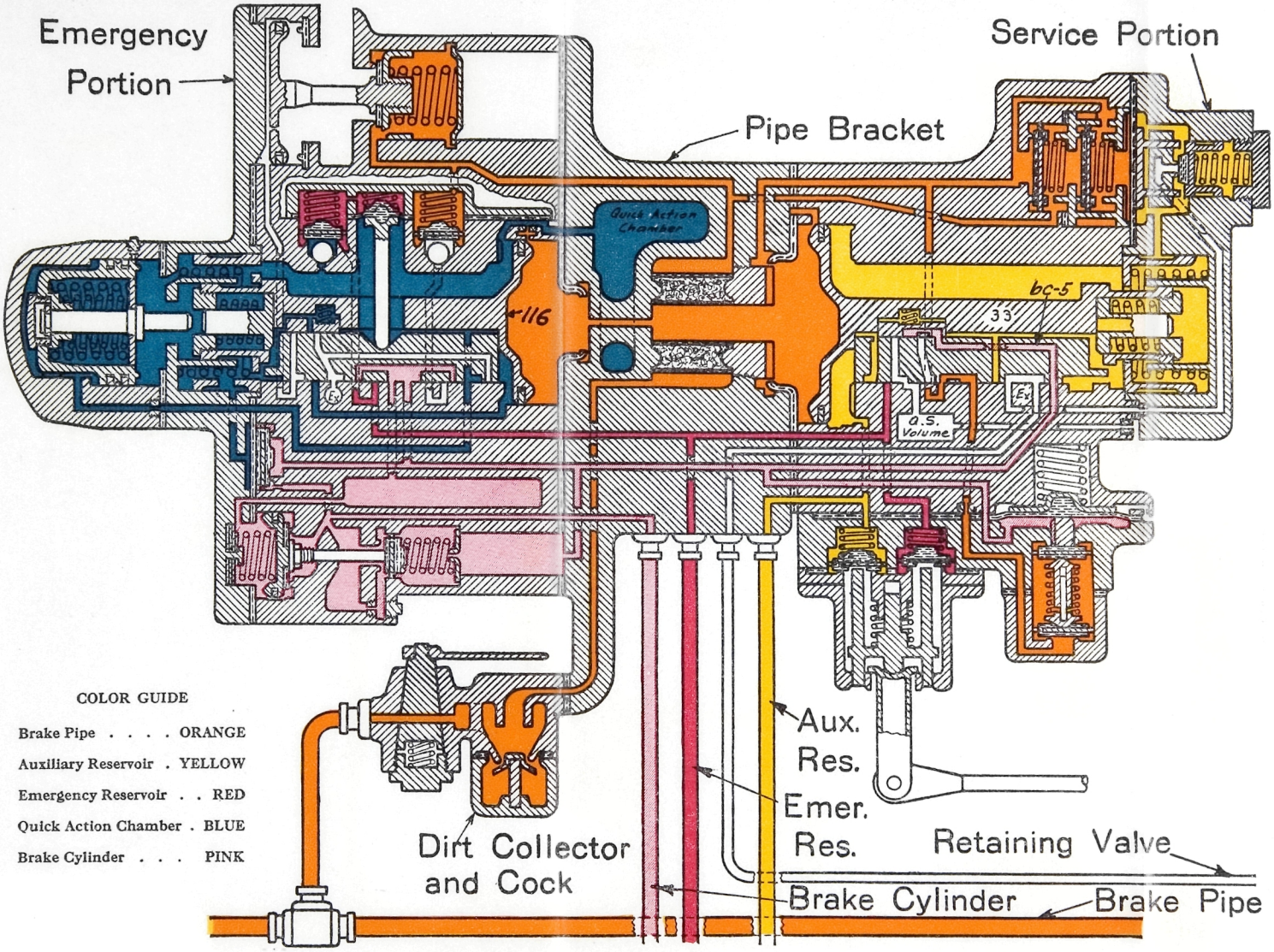
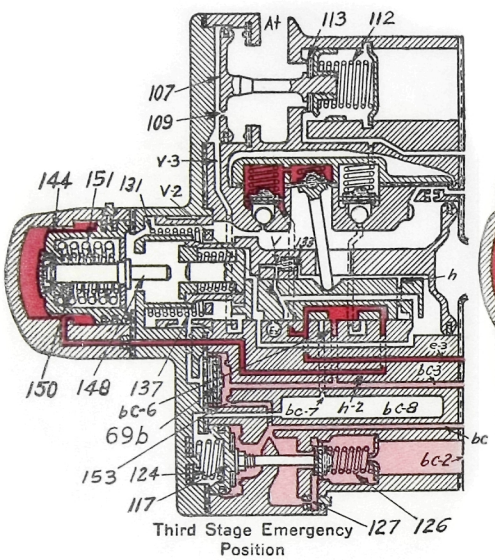
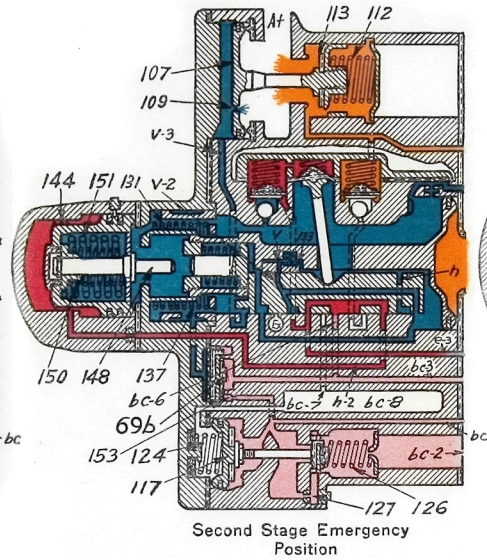


Plate 6 Service Lap Position—Diagrammatic View



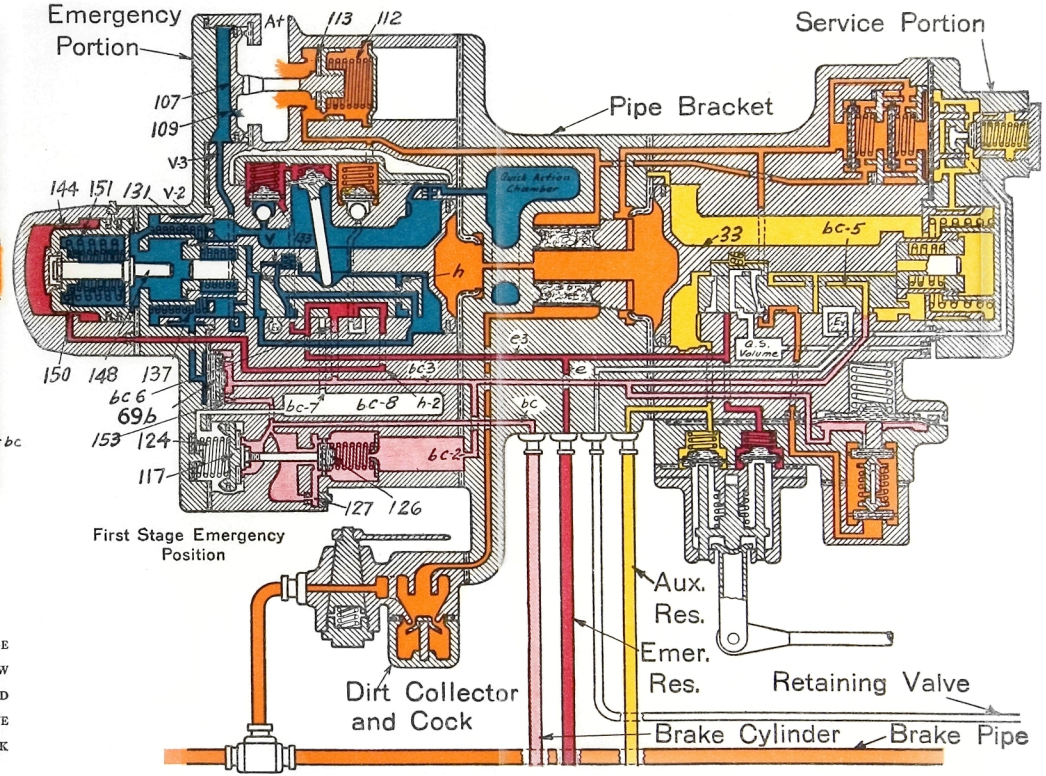
Third Stage Emergency Position



Second Stage Emergency Position

COLOR GUIDE

Brake Pipe	ORANGE
Auxiliary Reservoir .	YELLOW
Emergency Reservoir . .	RED
Quick Action Chamber .	BLUE
Brake Cylinder . . .	PINK



First Stage Emergency Position

Plate 7 Emergency Position—Diagrammatic Views showing the First, Second and Third Stages of the Emergency Operation

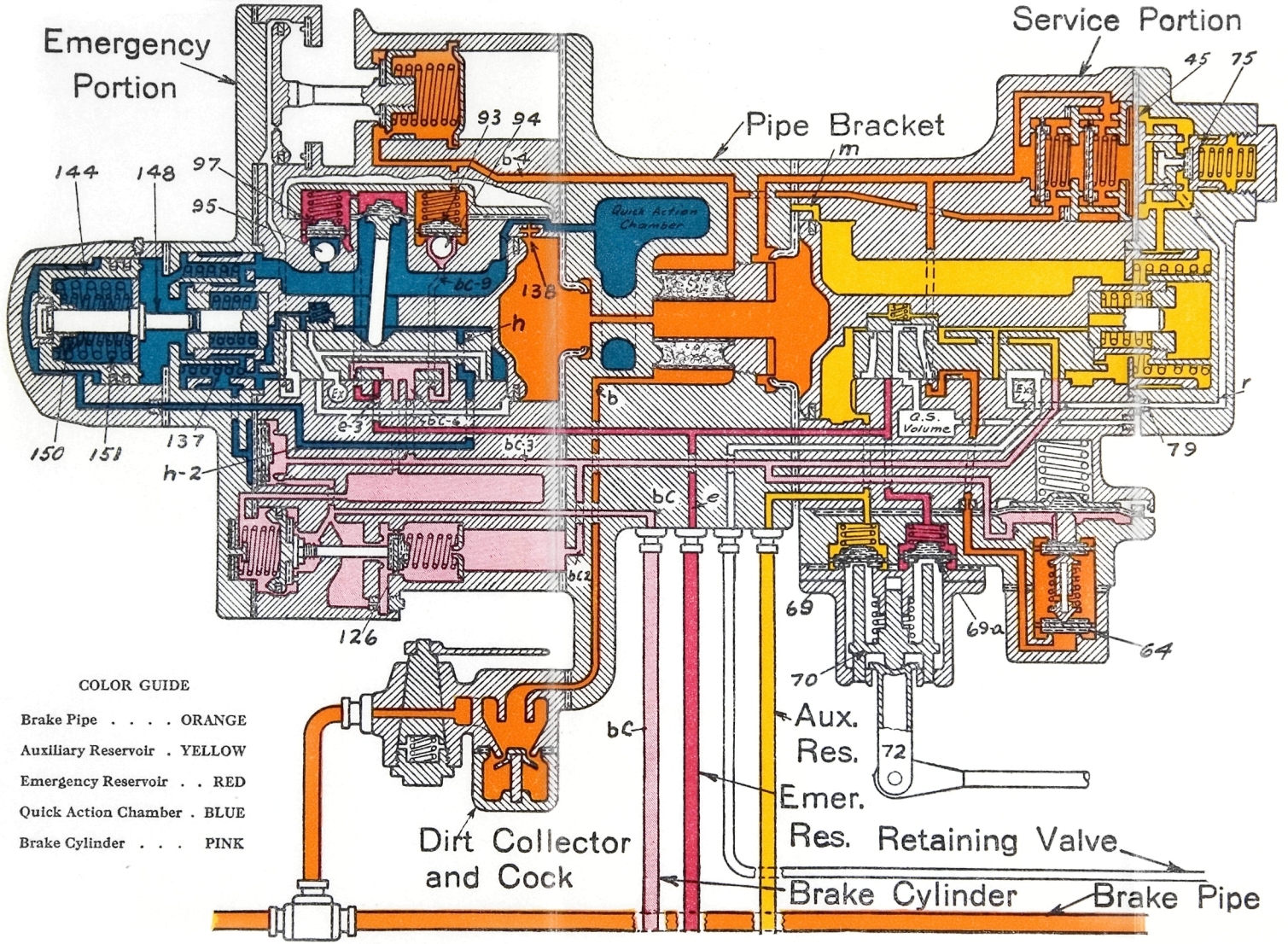


Plate 8 Release after Emergency Application—Diagrammatic View