S. G. NEAL.

AIR BRAKE APPARATUS.

APPLICATION FILED AUG. 1, 1917.

1,314,974.

Patented Sept. 2, 1919.

4 SHEETS—SHEET 1.

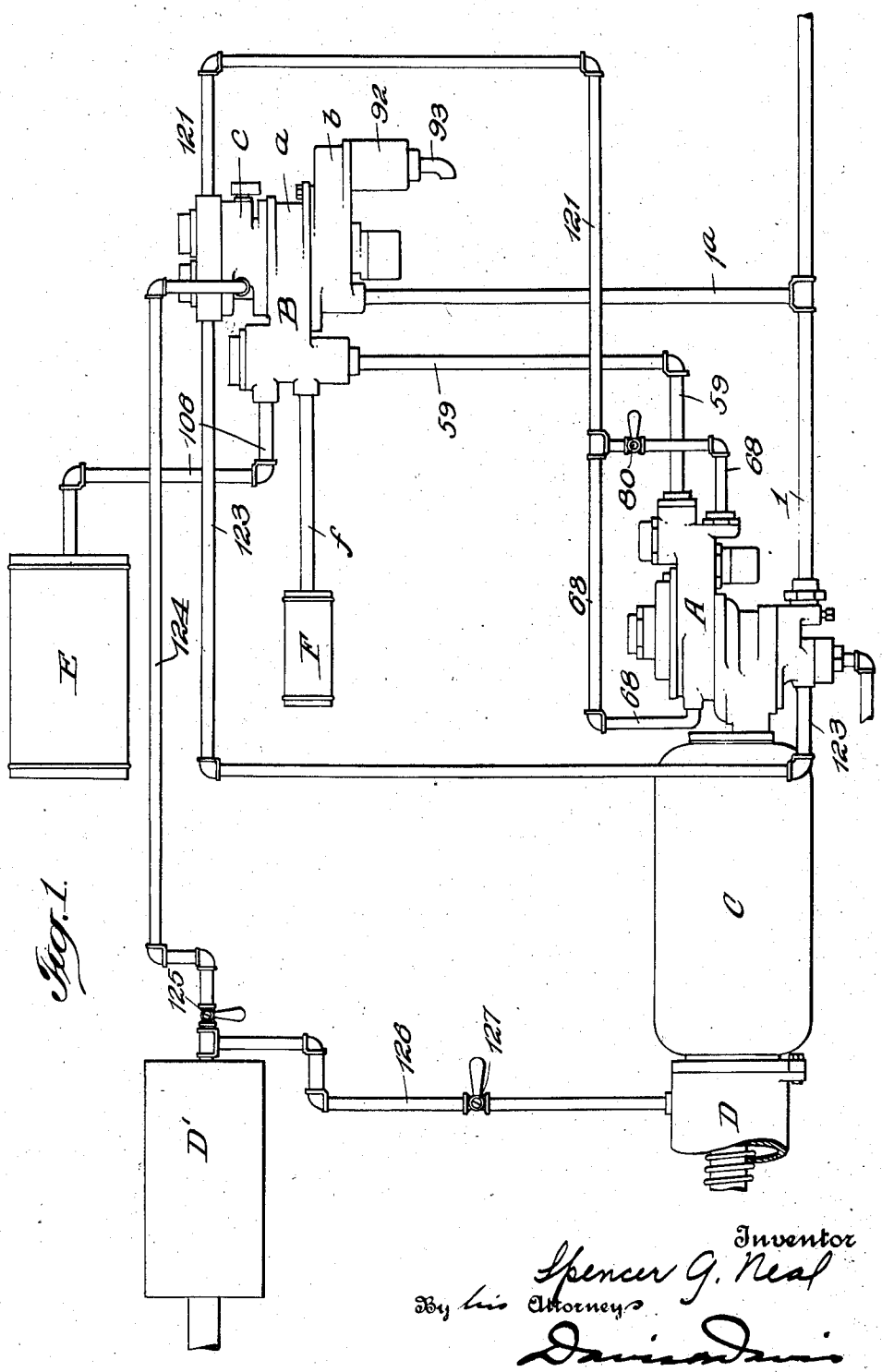


Fig. 1.

Inventor

Spencer G. Neal

By his Attorneys

Davis & Davis

S. G. NEAL.

AIR BRAKE APPARATUS.

APPLICATION FILED AUG. 1, 1917.

1,314,974.

Patented Sept. 2, 1919.

4 SHEETS—SHEET 2.

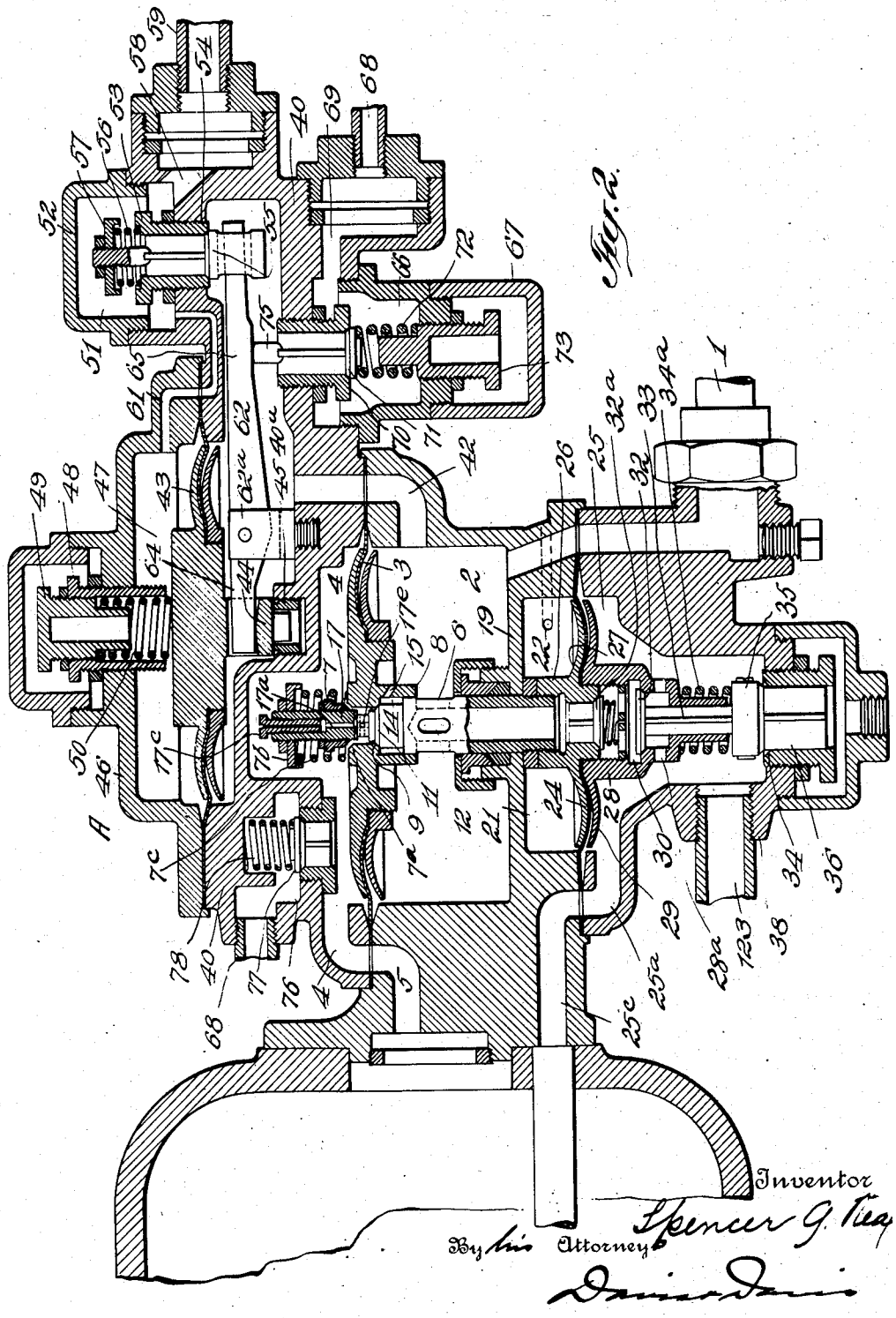


Fig. 2.

Inventor

Spencer G. Neal

By his Attorney

Daniel Davis

S. G. NEAL.

AIR BRAKE APPARATUS.

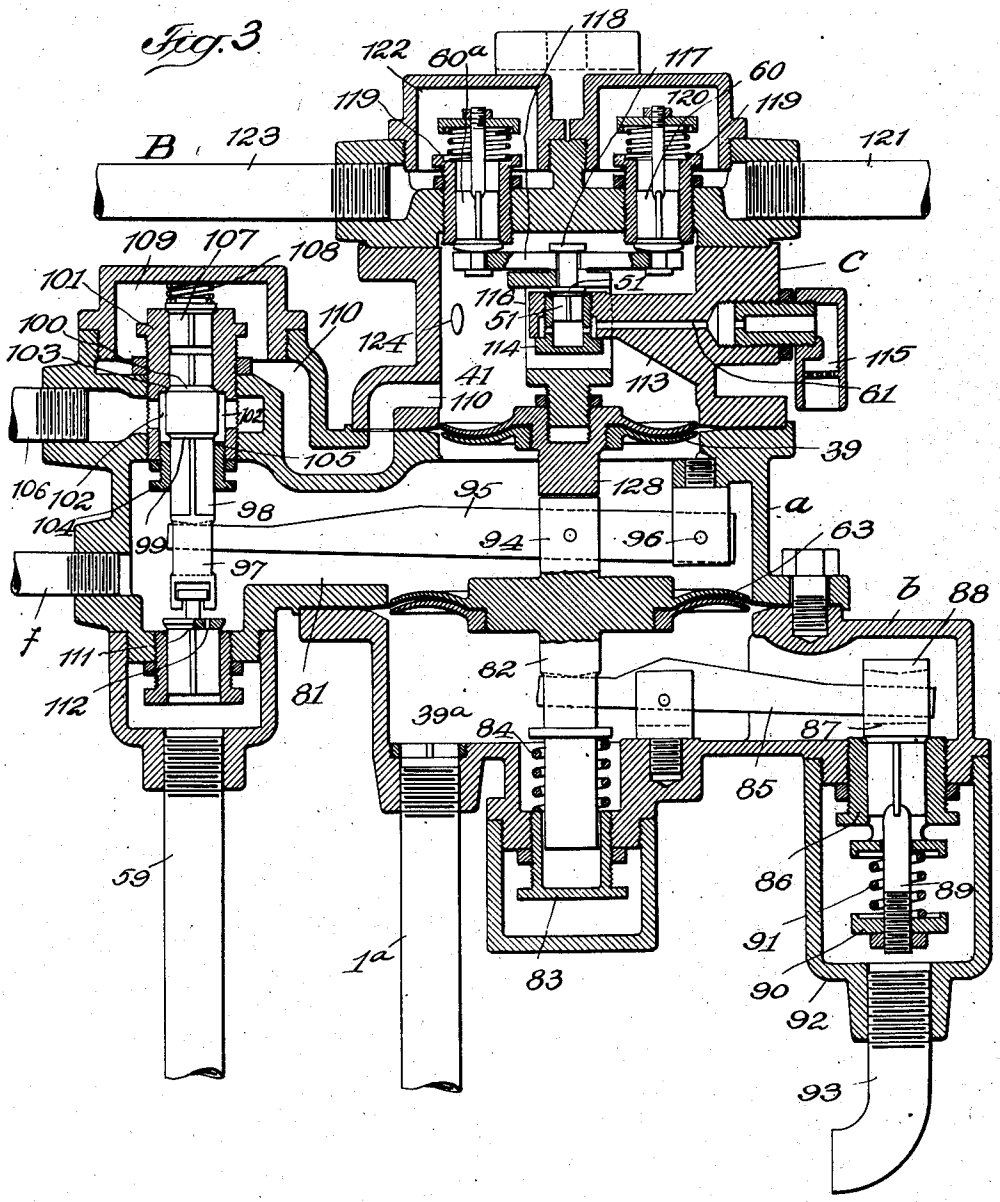
APPLICATION FILED AUG. 1, 1917.

1,314,974.

Patented Sept. 2, 1919.

4 SHEETS—SHEET 3.

Fig. 3



Inventor

Spencer G. Neal

By his Attorneys

Daniels Davis

S. G. NEAL.

AIR BRAKE APPARATUS.

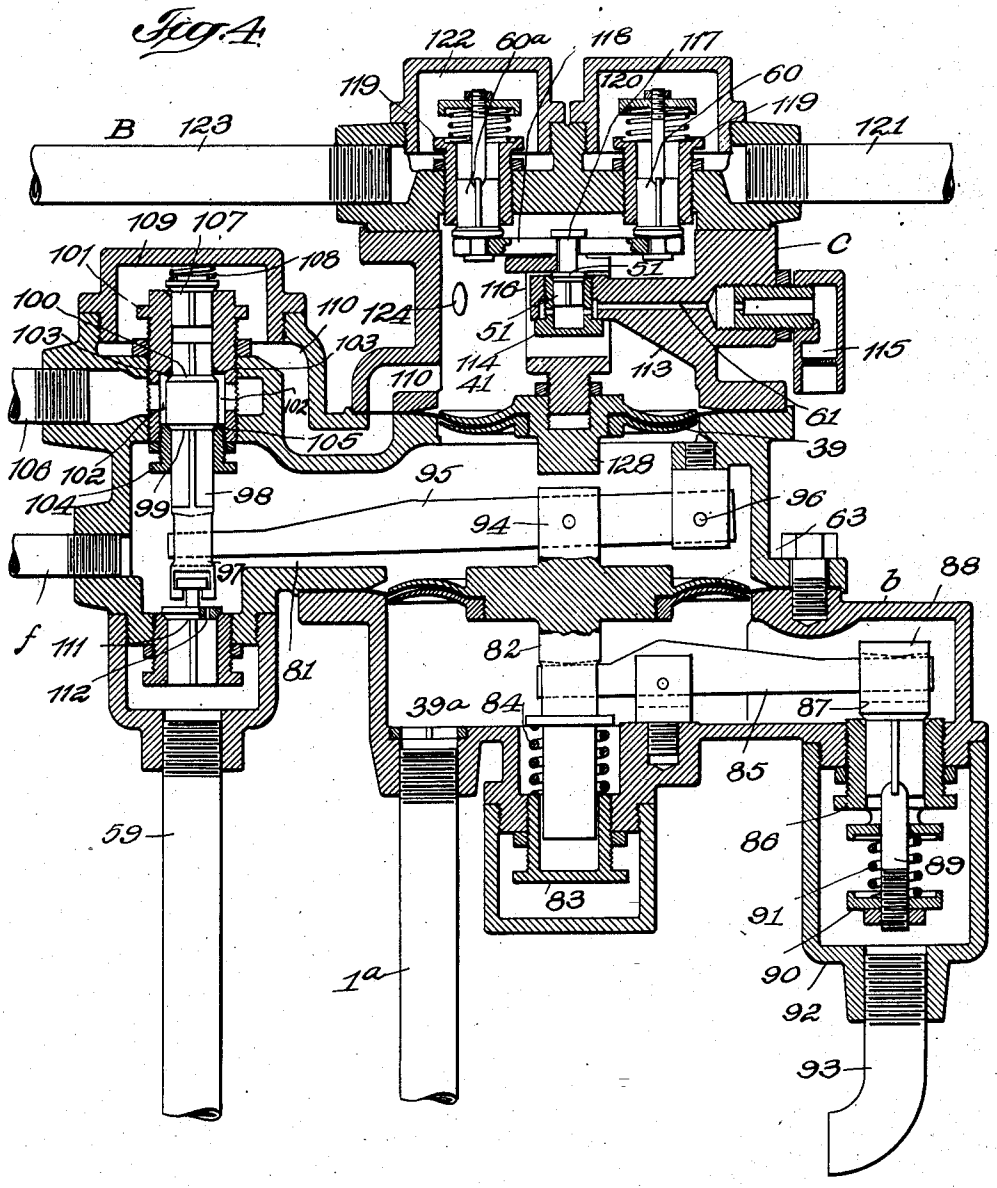
APPLICATION FILED AUG. 1, 1917.

1,314,974.

Patented Sept. 2, 1919.

4 SHEETS—SHEET 4.

Fig. 4.



Inventor

Spencer G. Neal

By his Attorneys

Davis Davis

UNITED STATES PATENT OFFICE.

SPENCER G. NEAL, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC STRAIGHT AIR BRAKE COMPANY, OF WILMINGTON, DELAWARE, A CORPORATION OF DELAWARE.

AIR-BRAKE APPARATUS.

1,314,974. Specification of Letters Patent. Patented Sept. 2, 1919.

Application filed August 1, 1917. Serial No. 183,886.

To all whom it may concern:

Be it known that I, SPENCER G. NEAL, a citizen of the United States, and resident of the borough of Manhattan, city, county and State of New York, have invented certain new and useful Improvements in Air-Brake Apparatus, of which the following is a specification, (Case No. 31.)

This invention relates more particularly to improvements in that type of air brake apparatus illustrated in Patent No. 1,183,103, dated May 16, 1916, and in my application for patent filed November 17, 1916, and serially numbered 131,818.

One of the important objects of this invention is to provide simplified means whereby upon a sudden reduction of train pipe pressure to secure an emergency application of the brakes the train pipe will be vented to atmosphere at each triple valve. By providing means whereby the train pipe will be vented to atmosphere at each triple valve and for each braking unit, the train pipe reduction will be secured throughout the train with great rapidity, causing the almost simultaneous operation of all of the triple valves without regard to the length of the train.

Another object of the invention is to provide simplified means whereby upon an emergency application of the brakes the train pipe reservoir will be so connected to the train line that if the pressure therein is greater than the pressure resulting from the equalization of the emergency reservoir into the brake cylinder, the train pipe reservoir pressure will be added to the said equalized pressure. If, however, the train pipe reservoir pressure is not greater than the emergency reservoir pressure and brake cylinder pressure, the said train pipe reservoir will be sealed from the train pipe and from the brake cylinder. During the ordinary service applications of the brakes the train pipe reservoir is in communication with the train pipe for the purpose of augmenting the train pipe volume, as described in the patent and application for patent mentioned herein.

Another object of the invention is to provide means in the service section of the triple valve and operating upon an increase of train pipe pressure, to place the emergency reservoir in communication with the train pipe for a quick-release of the brakes.

A further object of the invention is to provide the emergency section of the triple valve with means operating upon a sudden reduction of train pipe pressure to place the emergency reservoir in communication with the brake cylinder; to seal the train pipe reservoir from the train pipe; to permit the train pipe reservoir air to flow into the brake cylinder if the said reservoir pressure exceeds the brake cylinder pressure upon an emergency application of the brakes, and further to provide means whereby after the equalization of emergency reservoir pressure into the brake cylinder the said equalized pressure may flow slowly into the train pipe reservoir if said equalized pressure is greater than the pressure in said train pipe reservoir.

There are many other important objects and advantages of the invention, resulting from the novel construction and arrangement of the apparatus described herein, all of which will more fully appear hereinafter.

In the drawings, Figure 1 is a diagrammatic view of a braking unit embodying the invention;

Fig. 2 a central vertical sectional view of the service section of the triple valve;

Fig. 3 a vertical central sectional view of the emergency and change-over section of the triple; and

Fig. 4 a similar view showing the parts in complete emergency position.

Referring to the various parts by reference characters, A designates the quick-release and service section of the triple valve; B the emergency and change-over section; C the emergency reservoir; D the service brake cylinder; D^1 the auxiliary brake cylinder; E the train pipe reservoir; F the quick-action reservoir.

As illustrated in the drawings, the section A of the triple contains the parts by which the service applications of the brakes are secured and through which the release of the brakes is obtained, and also through which the apparatus is charged. This section also contains the parts by means of which the quick-release of the brakes is secured by an increase of train pipe pressure. Section B of the triple valve contains the parts which control the emergency applications of the brakes, and those parts which seal the train pipe reservoir from the train pipe and connect it to the brake cylinder

upon an emergency application of the brakes, and also the devices by means of which the train pipe reservoir will be sealed from the brake cylinder whenever the brake cylinder pressure equals or exceeds the pressure in the train pipe reservoir.

The parts in the service section A of the triple valve for controlling the charging of the apparatus and securing service applications of the brakes and the graduated release of the brakes, are constructed almost precisely as shown in the Patent No. 1,183,103 and my application Serial No. 131,818, and operate as described in said patent and in said application. For this reason it is thought unnecessary to minutely and particularly describe herein every part of section A of the triple valve, and its operation. Section B of the triple, however, is modified considerably and this part of the apparatus will be fully described both as to structure and operation.

The train pipe 1 leads into the main train pipe chamber 2, said chamber being in section A of the valve. Above said chamber 2 and separated therefrom by the main abutment or diaphragm 3, is an emergency reservoir chamber 4 in constant communication with the emergency reservoir through passage 5. In order that said abutment 3 may operate valves hereinafter described, the same is made to coöperate with a hollow upright valve stem 6 provided with a reduced upper end. The main diaphragm 3 carries a sliding head 8 which has a working fit around the stem 6 and is provided with a downwardly facing valve seat 9, which cooperates with the charging valve 11, this latter valve being a part of upright rod or stem 6. Said valve stem 6 forms a guide for the sliding head 8, so that the air pressure upon the diaphragm 3 may be utilized to positively open and close said valve 11.

Referring more in detail to the construction and operation of the valve device within the head 8, the hollow rod 6 is open at its lower end, but the bore in said rod terminates at a point a little below the valve 11, as indicated by dotted lines in Fig. 2. Air is admitted through inlets 12 into the upper portion of the bore of said rod 6. A plurality of ports 15 lead through the wall of the head 8 to admit air to a clearance 14. The upper portion of hollow rod 6 is provided with a somewhat reduced portion which forms the valve 11 already referred to. Above said valve 11 the stem is provided with a more reduced portion 17, the clearance around which will conduct the air to chamber 4 from around the hollow rod 6 when the valve 11 is opened.

Secured to the reduced portion 17 of the stem 6 above the abutment 3, is a downwardly tapered valve 7 which is adapted to fit a corresponding seat 7^a in the top of the head 8 of the abutment 3. The valve 7 is so placed on the stem 17 that when valve 11 is seated valve 7 will be a considerable distance above seat 7^a. Valve 7 is locked in its adjusted position by a suitable lock nut, as shown in Fig. 2. On the upper end of the stem 17 is a disk 7^b, between which and the upper surface of the sliding head 8 is confined a coil spring 7^c. This spring exerts a force tending to bring valve 11 to its seat 9. The disk 7^b is locked on the stem 17 by means of a suitable lock nut, and, of course, may be adjusted in order to cause the spring 7^c to exert the desired pressure on the abutment 3. There is a considerable clearance between the sliding head 8 of the abutment or diaphragm 3, and the stem 17, so that when the head is between the valves 7 and 11 there will be an air passage of considerable capacity through the abutment.

The stem 17 is bored axially as at 17^a, from its upper end to the transverse port 17^e. A governing screw 17^c is threaded into the end of the bore 17^a, said screw being longitudinally apertured. The port 17^e opens into an annular groove in part 17, between the valve seats 7^a and 9.

Upon a reduction of train pipe pressure in chamber 2 for the purpose of securing a service application of the brakes, abutment 3 is moved downwardly by the superior pressure in chamber 4, and valve 11 seated on the valve seat 9, thereby closing communication between the chambers 2 and 4. Upon an increase of pressure in train pipe chamber 2 for the purpose of securing a release of the brakes, the abutment 3 and the stem 6 will be moved upwardly, thereby closing valve 32 and opening exhaust valve 35. This upward movement of the abutment continues until the lock ring on the stem 6 abuts against the under side of the cross wall 19. Should pressure in chamber 2 exceed the pressure in chamber 4, abutment 3 will be moved upwardly to the valve 7, and air will slowly pass valve 11 and through ports 17^e, 17^a and screw 17^c, into chamber 4. When the pressure in chamber 4 has equalized with the pressure in chamber 2, the spring 7^c will move the abutment downwardly to bring valve 11 to valve seat 9. When the abutment 3 is in position to free both of the valves 7 and 11, air from chamber 4 may pass around said valves to chamber 2 if the pressure in chamber 4 exceeds the pressure in chamber 2.

In originally charging the apparatus if the rise of train pipe pressure is rapid, air will pass from chamber 2 around valve 11, slowly through 17^e, bore 17^a and screw 17^c to chamber 4 and to emergency reservoir. If the rise of pressure in the train pipe and in chamber 2 is slow, air will pass rapidly and in considerable quantities around valve 11, through the clearance between the head

8 and the stem 17, around valve 7, into chamber 4, and at the same time air will pass through the bore 17ª and screw 17ᶜ. This will provide a very quick charge of the chamber 4 and emergency reservoir.

It is only when there is a considerable excess pressure in chamber 2 that the valve 7 will be seated and the slow charge will take place through the ports in the stem 17 and screw 17ᶜ.

Beneath the train pipe chamber 2 and separated therefrom by a cross wall 19 is a chamber 21. An equalizing abutment 24 extends across the lower side of the chamber 21 to separate said chamber from an equalizing chamber 25. Chamber 21 is vented to atmosphere through port 22. In the embodiment of the invention illustrated in the drawings, the main abutment 3 has about twice the area of the equalizing abutment 24. Therefore, the reduction of train pipe pressure ten pounds will cause approximately twenty pounds pressure to be built up in the brake cylinder and in the equalizing chamber 25 before there will be enough pressure beneath said equalizing abutment to lift the rod 6 and close valve 32, all of which is clearly set out in my aforesaid patent. Hollow rod 6 at its lower end screws into a hub 26 formed on the upper side of flange 27 of the equalizing abutment 24. A nut locks the hub to the stem and said nut is adapted to engage the under side of the cross wall 19 to limit the upward movement of the rod. The flange 27 is formed with a central depending hollow stem which screws into the upper end of a valve cage 28, said valve cage carrying the lower abutment flange 29 for the abutment 24. The said valve cage and rod afford communication between the equalizing chamber 25 and the train pipe chamber 2. The valve cage 28 forms a small chamber 30, the outlet of which is controlled by the valve 32 seating downwardly and having a downwardly extending stem 33 carrying at its lower end an exhaust valve 35 which opens and closes a vent 36. The lower end of the stem 33 is loosely connected to the valve 35 whereby said valve will be free to seat squarely and truly on the valve seat 34. The valve cage 28 is also provided with passages 28ª below valve 32. Equalizing chamber 25 is formed by casing 38 upon the lower end of which is screwed a protecting cap. Chamber 25 is in direct communication with the brake cylinder through port 25ª and passage 25ᶜ.

A valve 32ª is held to its seat by means of a spring, the lower end of said spring being seated in a spider arm within the chamber 30, said arm being spaced sufficiently far above the valve 32 to permit it to have a free opening movement. Valve 32ª prevents air passing back to the train pipe chamber 2 during an emergency application of the brakes when the brake cylinder pressure exceeds train pipe pressure, all of which is fully set out in my aforesaid application for patent. Valve 35 is held yieldingly to its seat by spring 34ª.

Secured to the top of the main body portion of the service section of the triple is a supplemental body part 40, said supplemental body part 40 forming the upper wall of the emergency reservoir chamber 4 and containing the supplemental train pipe chamber 40ª, said chamber being connected to the main train pipe chamber 2 through a passage 42. A vertically movable quick-release diaphragm 43 forms the upper wall of the supplemental train pipe chamber 40ª, said diaphragm carrying a central depending stem 44 which is guided at its lower end in a vertically adjustable tubular stop 45. The diaphragm 43 is secured in position by a cap plate 46 which forms a chamber 47 directly over the said diaphragm. Adjustably secured in the cap plate 46 is a stop sleeve 48 into which is screwed a plug 49. Within the sleeve 48 and compressed between the central hub portion of the diaphragm 43 and the plug 49, is a spring 50. By properly adjusting the sleeve 48 the diaphragm 43 will be stopped at the desired point in its upward movement; and the tension of spring 50 may be varied by adjusting plug 49. The sleeve 48 and the plug 49 are locked in their adjusted positions by suitable lock nuts, as shown in the drawings. It is manifest, therefore, that the upper and lower positions of the diaphragm 43 may be very accurately determined. In the upper part of the supplemental body portion 40 is formed a train pipe reservoir chamber 51, said chamber being closed by a cap 52. Chamber 51 is at times in communication with the supplemental train pipe chamber 40ª, said communication being through an adjustable sleeve 53 the lower end of which is beveled to form a valve seat 54.

In the train pipe chamber 40ª is a valve 55 which is arranged to seat upwardly on the seat 54, the stem of said valve extending upwardly through the sleeve 53. Surrounding the said stem in the chamber 51 is a spring 56, said spring being compressed between the upper end of the sleeve 53 and a cap plate 57 which is adjustable on the stem of the valve 55. The spring 56 holds the valve 55 seated, and by adjusting the plate 57 the pressure of the spring 56 on said valve may be varied. Chamber 51 is connected to the train pipe reservoir through the passage 58, and pipe 59. The said chamber 51 is also in communication with chamber 47 through an open passage 61 so that train pipe reservoir pressure will always be registered in the chamber 47 and

on top of the quick-release diaphragm 43. In the supplemental train pipe chamber 40^a a quick-release lever 62 is pivoted on block 62^a, its shorter arm 64 fitting in a slot in the stem 44 of the quick-release diaphragm. In its normal position the lower edge of the arm 64 engages the bottom wall of said slot, as shown clearly in Fig. 2. The longer arm 65 of said lever extends into a slot formed in the valve 55, the said slot being somewhat wider than the end of said lever, and in its normal position the said lever extends through said slot out of contact with the upper and lower walls thereof so that there is considerable lost motion between the lever and the valve, for a purpose that will be fully hereinafter set forth.

In the lower part of the supplemental body portion 40 is formed a quick-release chamber 66, said chamber being closed by a cap 67 and being in communication with pipe 68 through a passage 69. The quick-release chamber 66 is at times in communication with the supplemental train pipe chamber through a vertically adjustable sleeve 70. The lower end of said sleeve forms a seat for an emergency reservoir release valve 71, said valve being yieldingly maintained on its seat by means of a spring 72 arranged within the quick-release chamber. The pressure of this spring on the valve may be regulated by means of a vertically adjustable screw 73. It is manifest that the position of the valve seat may be varied and that the pressure of the spring on the valve may be nicely adjusted. The upper end of the valve 71 is formed with a vertical stem 75 which is normally in engagement with the under side of the long arm 65 of the quick-release lever.

The emergency reservoir chamber 4 is formed with an outlet 76, which is closed normally by a downwardly seating check valve 77, said valve being yieldingly held to its seat by a spring 78. Outlet 76 is connected to the pipe 68 in which is arranged a maintaining valve 80, said valve being closed when it is desired to release the brakes gradually, and being opened when the triple valve is arranged for quick-release operations.

The operation of the service section of the valve for service braking and for graduated releases need not be described. The quick-release features of the triple valve operate as follows:

Upon an increase of train pipe pressure the train pipe air flows into chamber 40^a through passage 42, lifting the diaphragm 43. This operation, through the lever 62, will depress and open emergency reservoir release valve 71 thereby permitting emergency reservoir air to flow past valve 77 through pipe 68, passage 69, past valve 71 into the supplemental train pipe chamber and thence to the train pipe through passage 42 and train pipe chamber 2. After the valve 71 is opened quick-release lever 62 will engage and move downwardly valve 55, thereby opening train pipe reservoir chamber to the supplemental train pipe chamber and permitting the train pipe reservoir to be charged through chamber 51, passage 58 and pipe 59. The pressure in chamber 51 will equalize with pressure in chamber 47 through passage 61, and when said pressures equalize with the pressure in chamber 40^a the parts will return to their normal positions and valves 55 and 71 will close. The recharging of the emergency reservoir will take place through the triple valve, precisely as described in my hereinbefore mentioned patent and as further described in my hereinbefore mentioned application for patent, and the train pipe reservoir will be charged through the valve 55, chamber 51 and pipe 59.

For all service applications of the brakes, train pipe reservoir air will pass into the supplemental train pipe chamber 40^a past valve 55 and thence into the train pipe chamber 2. Spring 56 lightly holds the valve 55 to its seat and there is sufficient lost motion between the valve head and the end of the lever 62 to permit said valve to be opened by the train pipe reservoir air without moving the said lever.

It is to be noted that there is lost motion between the arm 65 of the lever 62 and the head of the valve 55, when the said arm is moved downwardly from its normal position. The purpose of this is to insure the opening of valve 71 before valve 55 is unseated. By this arrangement of valves the emergency reservoir air is discharged into the chamber 40^a and thence into the train pipe before the differential of pressures above and below diaphragm 43 can be disturbed by the opening of valve 55. It also insures the discharge of the emergency reservoir air into the chamber 40^a before the train pipe reservoir is recharged. It is also to be noted that the arm 65 of lever 62 normally is free of the valve 55 in order that said valve may be opened by train pipe reservoir air during all service applications of the brakes.

A differential of pressures will be maintained in chamber 47 and supplemental train pipe chamber 40^a, due to the tension of the springs 50 and 72 tending to seat valve 71 and return the lever 62 to its normal position. When the pressure in chamber 47, plus the tension of springs 50 and 72, is sufficient to overcome the pressure in chamber 40^a, the quick-release diaphragm 43 will be returned to its normal position. By varying the tension of springs 50 and 72 the desired differential of pressures may be maintained. By employing the two springs

the tension of spring 72 may be much lighter and a better adjustment of the parts may be secured.

After an emergency application of the brakes a release may be secured by a very moderate rise in brake pipe pressure. It is to be noted that after an emergency application the pressures in chambers 4 and 25 are equal, and that chamber 21 is vented to atmosphere through port 22. The pressure in chamber 25, therefore, opposes the pressure in chamber 24, and it is only necessary to build up in chamber 2 a brake pipe pressure which, plus the pressure in chamber 25, will overcome the emergency reservoir pressure in chamber 4. With the diaphragms 3 and 24 in the proportion shown in Fig. 2, the pressure in chamber 2 need be about one-half the pressure in chamber 4. This makes it possible to secure a release after an emergency application, in a short time and without the necessity of building up brake pipe pressure to an equality with emergency reservoir pressure.

The construction and operation of the parts contained in section B of the triple valve are as follows:

The supplemental train pipe chamber 40^a of section A of the triple is in direct communication with the quick-action chamber 81 of section B of the triple valve, through pipe 59. A portion of the lower wall of the chamber 81 is formed by the movable quick-action abutment 63; and a portion of the upper wall of said chamber is formed by the movable emergency abutment 39. Below the abutment 63 is formed the emergency train pipe chamber 39^a; and above the emergency abutment 39 is formed the emergency brake cylinder chamber 41. The quick-action chamber is formed in a central casting *a;* the emergency train pipe chamber 39^a is formed in a casting *b*, and the emergency brake cylinder chamber 41 is formed in a casting *c*, said castings being secured together by suitable bolts. The emergency train pipe chamber 39^a is connected directly to the train pipe through branch pipe 1^a. The quick-action chamber 81 is in direct communication with the quick-action reservoir F, through pipe *f*.

Depending from the abutment 63 is a central stem 82, which is guided at its lower end in a sleeve 83 adjustably mounted in the lower wall of the casting *b*. Surrounding said stem and bearing between a collar thereon and the upper end of the sleeve 83 is a spring 84, the tension of which may be varied by adjusting the sleeve 83. Pivoted in a suitable fulcrum block in the chamber 39^a is a lever 85, the shorter arm of which extends through a slot in the stem 82 so that said lever will be vibrated on its pivot by the vertical movement of the diaphragm 63. Chamber 39^a is open to atmosphere through a vertically adjustable sleeve 86, the upper end of which is beveled to form a seat for an exhaust valve 87 which seats downwardly. The longer arm of the lever 85 fits loosely in a slot in a head 88 of the valve 87. The lever 85 normally is out of contact with the upper and lower walls of the said slot, so that there will be some lost motion between the lever and the valve head before the valve is opened through the movement of said lever. The valve 87 is provided with a depending stem 89 which is threaded to receive an adjusting cap 90; and between said cap and a rigid part of the sleeve 86 is a spring 91, said spring normally holding the valve 87 on its seat. It is to be noted that the valve seat may be vertically adjusted through the movement of the sleeve 86 in order to secure the proper timing of the valve; and that the tension of the spring 91 holding the valve seat may be varied. A cap 92 incloses the spring 91 and its adjusting means, and said cap is open to the atmosphere through pipe 93. It is manifest that a downward movement of the abutment 63 will result in opening valve 87 and venting the emergency train pipe chamber 39^a to atmosphere.

The abutment 63 is formed with a central upwardly extending post 94 which extends into the quick-action chamber 81. In said chamber and pivotally connected to the post 94 is a lever 95, said lever being pivoted at one end at 96 on a suitable post within said chamber 81, and connected to the post 94 at a point intermediate its ends. The free end of said lever fits loosely in a slot 97 in a vertical valve rod 98 which carries near its upper end two oppositely facing valves 99 and 100. The upper end of the valve rod 98 is arranged to reciprocate in a valve casing 101, said casing being formed with a chamber 102 at the upper end of which is formed a valve seat 103; a vertically adjustable sleeve 104 forming the lower end of said chamber, said sleeve being beveled at its upper end to form the valve seat 105. The valve 99 is adapted to engage the seat 105, and the valve 100 is adapted to engage the seat 103, said seats being spaced apart sufficiently to permit one valve to be opened when the other is closed. The chamber 102 is connected directly to the train pipe reservoir E through pipe 106. The upper end of the valve sleeve 101 is provided with a downwardly seating check valve 107, said valve being held to its seat by a spring 108. The sleeve 101 opens at its lower end, past valve 99 and through the sleeve 104, into the quick-action chamber 81; and at its upper end, past valve 107, into a chamber 109, this latter chamber being in communication with the emergency brake cylinder chamber 41 through passage 110. It is manifest that when the abutment 63 is raised by an in-

crease of brake pipe pressure, lever 95 will lift valve rod 98 thereby closing the valve 100 and opening the valve 99 to permit air to pass from the quick-action chamber 81 past valve 99 into the train pipe reservoir E. When the abutment 63 is depressed the lever 95 will move downwardly and seat valve 99 and unseat valve 100, thereby placing the train pipe reservoir in communication with the emergency brake cylinder chamber 41 through sleeve 101, chamber 109 and passage 110. The pressure of the air from the train pipe reservoir will unseat valve 107, but said valve will be seated by a superior pressure in chamber 41 to prevent emergency reservoir air passing to the train pipe reservoir upon an emergency application of the brakes, as will be more fully hereinafter described.

The lower end of the valve rod 98 is loosely connected to the upper end of a downwardly seating valve 111, said valve controlling communication between the quick-action chamber 81 and the pipe 59 which leads to the service section of the triple and communicates with the supplemental train pipe chamber 40^a through passage 58, chamber 51 and the passage controlled by the valve 55. Valve 111 is provided with a leak port 112 which permits the air in quick-action chamber 81 and quick-action reservoir F to leak down to train pipe pressure when said pressure is less than the quick-action reservoir pressure. This is necessary in order that a release of the brakes may be secured after an emergency application of the brakes. It is manifest that when the abutment 63 is depressed valve 111 will be seated, together with valve 99, and that valve 100 will be opened. This action will close communication between the quick-action chamber 81 and the pipe 59 except for the small leak port through the valve 112. It will also close communication between the quick-action chamber 81 and the train pipe reservoir, opening communication between the train pipe reservoir and chamber 41 as hereinbefore described.

Extending into the emergency brake cylinder chamber 41 is a rigid arm 113, and in said arm is arranged a vertically adjustable hollow plug 114, on the upper end of which is formed a valve seat. The interior of said plug, below the valve seat, is in communication with the vent port 61 formed in the arm 113, said port being open to atmosphere through the chamber 115. In the chamber 41 and connected at its lower end to the emergency abutment 39 is a yoke 116, said yoke surrounding the inner end of the arm 113. In a slot in the upper arm of the yoke 116 is mounted a valve stem 117 which carries at its lower end a valve 51 which is adapted to seat on the upper end of the plug 114 to thereby close communication between the chamber 41 and the vent port 61. Connected to the upper end of the yoke 116 by means of the valve stem 117, is a cross bar 118. This bar is connected at one end to an emergency reservoir valve 60, and at its other end to a brake cylinder valve 60^a. These valves are arranged to seat upwardly against the lower ends of vertically adjustable valve sleeves 119 arranged in the upper wall of the chamber 41. Valve 60 controls communication between chamber 41 and a small chamber 120 which is connected, by means of pipe 121, to the auxiliary reservoir through pipe 68. As shown in Fig. 1 of the drawings, pipe 68 is connected to emergency reservoir chamber 4 through passage 76. Valve 60^a controls communication between chamber 41 and a small chamber 122 which is in communication with chamber 25 of the section A of the triple valve, through pipe 123. Each of the valves 60 and 60^a is provided with an upwardly extending stem, and surrounding this stem is a light spring which is maintained under tenison by means of a cap plate and nut screwed on the end of the valve stem. The purpose of this spring is to accurately seat the valves and yieldingly hold them in closed position.

Valves 51, 60 and 60^a are so connected together that when the diaphragm or abutment 39 is moved downwardly valve 51 will be closed and valves 60 and 60^a opened. When the diaphragm or abutment 39 is moved upwardly valves 60 and 60^a are closed and valve 51 opened. The abutment 39 is formed with a central depending stem 128 within quick-action chamber 81, axially in line with post 94.

Section B of the triple valve may be quite accurately designated as the "emergency change-over section", for the reason that it contains the parts which control emergency applications of the brakes and also the valves and parts which place the train pipe reservoir in communication with the train pipe for service applications of the brakes, and with the brake cylinder for emergency applications of the brakes.

The auxiliary brake cylinder D^1 is connected directly to chamber 41 by means of a pipe 124, and in said pipe is a valve 125 by means of which communication between said chamber 41 and the auxiliary brake cylinder may be controlled. The auxiliary brake cylinder D^1 is connected to the service brake cylinder D by means of pipe 126 in which is arranged a valve 127. By providing the auxiliary brake cylinder D^1 and the pipe connections and valves described, it is manifest that the said auxiliary cylinder may be used, together with brake cylinder D, for service braking and emergency braking, by opening valve 127 and closing valve 125. By closing valve 127 and opening valve 125 the auxiliary brake cylinder may be used

for emergency braking only. By closing valves 125 and 127 the auxiliary brake cylinder will be entirely disconnected from the braking apparatus. This is desirable where only light braking is necessary. It is clear, therefore, that by means of the auxiliary brake cylinder the apparatus is adapted for light braking suitable for empty or unloaded cars, but may be quickly changed to adapt it for heavy braking for use on loaded cars. It is also well adapted for use in passenger service where it is desirable to have heavy braking for emergency occasions and light braking for ordinary service stops.

The operation of the emergency change-over section of the apparatus will be clear from the foregoing, but may be briefly restated as follows:

In originally charging the apparatus brake pipe air flows through pipe 59 past valve 111, into chamber 81, past valve 99 which is then open, into train pipe reservoir E. From chamber 81 air passes into the quick-action reservoir F. Brake pipe air will flow through branch pipe 1^a into the emergency train pipe chamber 39^a and will raise abutment 63. This operation will close valve 100 and open valves 99 and 111.

Upon a sudden reduction of brake pipe pressure for the purpose of securing an emergency application of the brakes, pressure in chamber 39^a is correspondingly reduced and the superior pressure in quick-action chamber 81 will immediately move abutment 63 downwardly. The valve movements will be as follows: The lever 95 moves downwardly thereby permitting valve 99 to move downwardly to its seat, and as valve 111 is carried by valve rod 98 this latter valve will also move downwardly to its seat. Valves 99 and 111 will seat practically simultaneously, it being desirable that valve 111 shall seat slightly ahead of valve 99. As valve rod 98 moves downwardly it is manifest that valve 100 will also move downwardly, thereby opening a passage from the train pipe reservoir through passage 110 to chamber 41. After valves 99 and 111 have seated lever 85 will have taken up the lost motion between it and the valve head 88, whereupon the valve 87 will be opened to vent the train pipe chamber 39^a and the train pipe to atmosphere. Train pipe reservoir air entering chamber 41 will depress diaphragm 39, thereby closing vent port 61 and opening valves 60 and 60^a. Emergency reservoir air will then flow through pipe 121, chamber 120, past valve 60 into chamber 41, and from said chamber past valve 60^a into pipe 123 to chamber 25 and thence to the brake cylinder. The check valve 107 prevents brake cylinder pressure passing from the chamber 41 back to the train pipe reservoir when said pressure exceeds the pressure in the train pipe reservoir. The said valve, however, permits train pipe reservoir air to pass to chamber 41 and thence to the brake cylinder when said train pipe reservoir pressure exceeds the brake cylinder pressure upon an emergency application of the brakes.

Air in the quick-action chamber 81 and from the quick-action reservoir will flow through the leak port 112 to pipe 59 and thence to train pipe until there is an equalization of pressures in the train pipe and said chamber 81. At this time valve 55 in the service section of the triple serves merely as a check valve which is held lightly to its seat by the spring 56 so that air may pass by it into the chamber 40^a and thence to the train pipe. The lost motion between the arm 65 of lever 62 and the head of valve 55, is provided for in order that valve 55 may serve merely as a check valve and be free to move independently of said lever. When this equalization of pressures has taken place a release of the brakes may be obtained by an increase of train pipe pressure. The rapidity of this equalization will depend upon the size of the leak port 112, and said port may be proportioned to bring about the said equalization within the desired period of time.

After an emergency application and after the equalization of pressures in chambers 81 and 39^a, valve 87 will be seated by spring 91, and diaphragm 63 will be raised to cause stem 94 to engage stem 128. The superior brake cylinder pressure in chamber 41 will prevent further upward movement of the diaphragm 63. Upon an increase of brake pipe pressure pressures in chambers 39^a and 81 will be increased, the pressures in said two chambers being substantially equal. When valve 87 is closed further exhaust from chamber 39^a is prevented. A continued increase in train pipe pressure will operate the parts in the service section of the triple to open valve 35 and release brake cylinder pressure, thereby reducing the brake cylinder pressure in chamber 41. When the pressure in said chamber has been sufficiently reduced diaphragm 63 will continue its upward movement, and diaphragm 39 will also move upwardly, opening valve 51 and closing valves 60 and 60^a. The continued upward movement of the diaphragm 63 will open valves 111 and 99 and close valve 100, thereby permitting the recharging of the quick-action chamber 81, the quick-action reservoir and the train pipe reservoir.

It is to be noted that there is lost motion between the lever 85 and the valve head 88, and between the lever 95 and the valve rod 98, said lost motions being so proportioned as to secure the proper sequence of operations of the various valves controlled and operated by said levers. Diaphragm 39 preferably has approximately one-half the

movement of diaphragm 63. This excess movement of diaphragm 63 permits said diaphragm to be partly raised to close valve 87 without moving the diaphragm 39. In the downward movement of the diaphragm 63 stem 94 is moved away from stem 128, as shown clearly in Fig. 4.

It is to be noted that valves 99, 100 and 111 control the charging of the quick-action reservoir and the train pipe reservoir and the connection between the service reservoir and the emergency brake cylinder chamber, during emergency applications of the brakes, and between said reservoir and the train pipe through the quick-action chamber 81, during all service applications of the brakes.

Upon all emergency applications of the brakes air will pass from chamber 41 through pipe 124 to the auxiliary brake cylinder D^1 when it is desired that said brake cylinder shall be used during emergency applications of the brakes. It is also manifest that the auxiliary brake cylinder may be used in all service and emergency applications of the brakes if desired, or only in emergency applications, by the proper positioning of the valves 125 and 127.

Pressure in chamber 81 rises and falls with slow changes in train pipe pressure and with the pressure in chamber 39^a, so that upon slow reductions of train pipe pressure for service applications of the brakes the diaphragms in the emergency section of the triple will not be operated, these diaphragms responding only to a sudden reduction in train pipe pressure designed to secure an emergency application of the brakes.

During all service applications of the brakes the train pipe capacity is augmented by the train pipe reservoir. For emergency applications of the brakes the train pipe capacity is reduced by the sealing of the train pipe reservoir from the train pipe and connecting said reservoir to the brake cylinder. This is of great advantage as it prevents the depletion of the train pipe reservoirs when the train pipe is vented to atmosphere to secure the emergency application of the brakes.

What I claim is:

1. A triple valve, comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, an emergency reservoir chamber, a quick-release diaphragm, and means operated by said diaphragm upon an increase of train pipe pressure for a release of the brakes to open communication between the emergency reservoir chamber and the train pipe.

2. A triple valve, comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, an emergency reservoir chamber, and means operated by an increase of train pipe pressure for a release of the brakes to open communication between the emergency reservoir chamber and the train pipe.

3. A triple valve, comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, an emergency reservoir chamber, a quick-release diaphragm, means for admitting train pipe pressure on one side of said diaphragm, and means operated by an increase of train pipe pressure on the opposite side of said diaphragm for a release of the brakes to open communication between the emergency reservoir and the train pipe.

4. An air brake apparatus, comprising a triple valve, an emergency reservoir, a train pipe reservoir, means in the triple valve operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, a quick-release diaphragm in said triple valve, and means operated by said diaphragm upon an increase of train pipe pressure for a release of the brakes to open communication between the emergency reservoir, the train pipe reservoir and the train pipe.

5. An air brake apparatus, comprising a triple valve, an emergency reservoir, a train pipe reservoir, means in the triple valve operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, a quick-release diaphragm in said triple valve, means for admitting train pipe reservoir air to one side of said diaphragm, means for admitting train pipe air to the other side of said diaphragm, and means operated by said diaphragm upon an increase of train pipe pressure in opposition to train pipe reservoir pressure to open communication between the emergency reservoir, train pipe reservoir, and the train pipe.

6. An air brake apparatus, comprising a valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe air alone, a quick-release diaphragm, a pair of valves controlling communication between the emergency reservoir, train pipe, and train pipe reservoir, and means operated by the said diaphragm by an increase of train pipe pressure to open said valve to permit emergency reservoir air to flow to the train pipe and to the train pipe reservoir.

7. An air brake apparatus, comprising a

valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe air alone, a quick-release diaphragm, a pair of valves controlling communication between the emergency reservoir, train pipe and train pipe reservoir, and a quick-release lever connected to said diaphragm and to said valves and operating upon an increase of train pipe pressure for a release of the brakes to open said valves to permit emergency reservoir air to flow to the train pipe and to the train pipe reservoir.

8. An air brake apparatus, comprising a valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe air alone, a quick-release diaphragm, a pair of valves controlling communication between the emergency reservoir, train pipe and train pipe reservoir, a quick-release lever connected to said diaphragm and to said valves and operating upon an increase of train pipe pressure for a release of the brakes to open said valves to permit emergency reservoir air to flow to the train pipe and to the train pipe reservoir, and means for adjusting the valve seats toward and from said lever.

9. An air brake apparatus, comprising a valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe air alone, a quick-release diaphragm, a pair of valves controlling communication between the emergency reservoir, train pipe and train pipe reservoir, a quick-release lever connected to said diaphragm and to said valves and operating upon an increase of train pipe pressure for a release of the brakes to open said valves to permit emergency reservoir air to flow to the train pipe and to the train pipe reservoir, and adjustable means for limiting the movement of the quick-release diaphragm in both directions.

10. An air brake apparatus comprising a valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe air alone, a quick-release diaphragm, a pair of valves controlling communication between the emergency reservoir, train pipe and train pipe reservoir, a quick-release lever connected to said diaphragm and to said valves and operating upon an increase of train pipe pressure for a release of the brakes to open said valves to permit emergency reservoir air to flow to the train pipe and to the train pipe reservoir, and a stop adapted to be engaged by the diaphragm and to limit its movement in one direction.

11. An air brake apparatus comprising a valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe air alone, a quick-release diaphragm, a pair of valves controlling communication between the emergency reservoir, train pipe and train pipe reservoir, a quick-release lever connected to said diaphragm and to said valve and operating upon an increase of train pipe pressure for a release of the brakes to open said valves to permit emergency reservoir air to flow to the train pipe and to the train-pipe reservoir, and a stop adapted to be engaged by the diaphragm and to limit its movement in one direction.

12. A triple valve comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, an emergency reservoir chamber, a quick-release diaphragm, yieldable means operating on one side of said diaphragm, means for admitting train pipe pressure on the opposite side of said diaphragm, and means operated by said diaphragm on an increase of train pipe pressure to open communication between the emergency reservoir and the train pipe.

13. A triple valve, comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, an emergency reservoir chamber, a quick-release diaphragm, a spring operating on one side of said diaphragm, means for admitting train pipe pressure on the opposite side of said diaphragm, and means operated by said diaphragm on an increase of train pipe pressure to open communication between the emergency reservoir and the train pipe.

14. An air brake apparatus comprising an emergency reservoir, a brake cylinder, a brake pipe reservoir, a brake pipe and a valve device operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, a diaphragm in said valve device subject to train pipe pressure, a valve controlled by said diaphragm, a spring tending to move said valve to closed position whereby an increase of train pipe pressure will move said valve to open posi-

tion in opposition to said spring, and means whereby the emergency reservoir will be discharged into the brake pipe when said diaphragm and valve are moved by an increase of train pipe pressure.

15. An air brake apparatus, comprising a triple valve, means therein operating upon a reduction of train pipe pressure to admit air to the brake cylinder for a service application of the brakes, a train pipe reservoir, a quick-release means in said triple valve subject to train pipe reservoir pressure and train pipe pressure and operating upon an increase of train pipe pressure for a release of the brakes to place the emergency reservoir in communication with the train pipe to increase the train pipe pressure.

16. A triple valve provided with a main train pipe chamber, an equalizing chamber adapted to be placed in direct communication with a brake cylinder, an emergency reservoir chamber adapted to be placed in direct communication with an emergency reservoir, a supplemental train pipe chamber in open communication with the main train pipe chamber, an emergency reservoir, a train pipe reservoir, valves controlling communication between said reservoirs and the supplemental train pipe chamber, a quick-release diaphragm subject to pressure in said supplemental train pipe chamber, means admitting train pipe reservoir air to one side of the said quick-release diaphragm, means connecting said diaphragm to said valves whereby upon an increase of train pipe pressure said diaphragm will be moved to open the said valves to place the emergency reservoir and train pipe reservoir in communication with the supplemental train pipe chamber.

17. An air brake apparatus comprising two independent valve casings, means in one of said casings to control train pipe air for service applications of the brakes and the release of the brakes, means to control emergency reservoir air for a quick-release of the brakes, and means in the other casing to control emergency reservoir air for emergency applications.

18. A triple valve comprising two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and the release of the brakes, means to control emergency reservoir air for a quick-release of the brakes, and means in the other casing to control auxiliary reservoir air and train pipe reservoir air for emergency applications.

19. A triple valve comprising two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and the release of the brakes, and also means operated by an an increase of train pipe pressure to place emergency reservoir air in the train pipe for a quick-release of the brakes, and means in the other casing operating upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake cylinder for an emergency application of the brakes.

20. A triple valve comprising two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and the release of the brakes, means operated by an increase of train pipe pressure to place emergency reservoir air in the train pipe for a quick-release of the brakes, and means in the other casing operating upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake cylinder for an emergency application of the brakes and to vent the train pipe to atmosphere.

21. A triple valve comprising two independent casings, means in one of said casings operating upon a reduction in train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, and operating upon an increase of train pipe pressure to vent the brake cylinder to atmosphere, and means in the other casing operating upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake cylinder and to seal the train pipe reservoir from the train pipe and place it in communication with the brake cylinder.

22. A triple valve comprising two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and for the release of the brakes, and means in the other casing to control emergency reservoir air and train pipe reservoir air for emergency applications of the brakes.

23. A triple valve comprising two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and for the release of the brakes, and means in the other casing to control emergency reservoir air and train pipe reservoir air for emergency applications of the brakes and to vent the train pipe to atmosphere.

24. A triple valve comprising two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and for the release of the brakes and to control emergency reservoir air for the quick-release of the brakes, and means in the other casing to control emergency reservoir and train pipe reservoir air for emergency applications of the brakes, and to vent the train pipe to atmosphere.

25. An air brake apparatus comprising an emergency reservoir, a service reservoir, a triple valve comprising two independent

casings, means in one of said casings to control train pipe air for service applications of the brakes and the release of the brakes and to control emergency reservoir air for the quick-release of the brakes, and means in the other casing to control emergency reservoir and train pipe reservoir air for emergency applications of the brakes and to vent the train pipe to atmosphere.

26. An air brake apparatus comprising an emergency reservoir, a train pipe reservoir, a train pipe, a triple valve comprising two independent casings, means in one of said casings to control train pipe air and train pipe reservoir air for service applications of the brakes and emergency reservoir air for the quick-release of the brakes, and means in the other casing to control emergency reservoir air and train pipe reservoir air for emergency applications of the brakes and to vent the train pipe to atmosphere.

27. A triple valve comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, an emergency train pipe chamber, a movable abutment forming one wall of said chamber, an exhaust valve adapted to be operated by said abutment upon a sudden reduction of train pipe pressure, an emergency brake cylinder chamber, and means therein operating upon a sudden reduction of train pipe pressure to open communication between the emergency reservoir and the brake cylinder for an emergency application of the brakes.

28. A triple valve for air brakes comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, an emergency train pipe chamber, an emergency brake cylinder chamber, movable abutments between said chambers, and valves controlling communication from the emergency reservoir to the emergency brake cylinder chamber and from said chamber to the brake cylinder and from the emergency train pipe chamber to atmosphere, all of said valves being operated by the movable abutments upon a sudden reduction in train pipe pressure.

29. A triple valve comprising means operating upon a slow reduction of train pipe pressure to admit air to the brake cylinder for a service application of the brakes, an emergency train pipe chamber, an emergency brake cylinder chamber, movable abutments between said chambers, and means operated by a sudden reduction of train pipe pressure to vent the emergency train pipe chamber to atmosphere and to place the emergency reservoir in communication with the brake cylinder through the emergency brake cylinder chamber.

30. An air brake apparatus comprising an emergency reservoir, a train pipe reservoir, a train pipe, a triple valve comprising two independent casings, means in one of said casings operable by a reduction in train pipe pressure to admit air to the brake cylinder for a service application of the brakes, and by an increase of train pipe pressure to vent the brake cylinder to atmosphere, and means in the other casing operable by a sudden reduction of train pipe pressure to vent the train pipe to atmosphere and open communication between the emergency reservoir and brake cylinder.

31. An air brake apparatus comprising an emergency reservoir, a train pipe reservoir, a train pipe, a triple valve comprising two independent casings, means in one of said casings operable by a reduction in train pipe pressure to admit air to the brake cylinder for a service application of the brakes, and by an increase of train pipe pressure to vent the brake cylinder to atmosphere and connect the emergency reservoir to the train pipe to increase train pipe pressure, and means in the other casing operable by a sudden reduction of train pipe pressure to vent the train pipe to atmosphere and open communication between the emergency reservoir and brake cylinder.

32. A triple valve comprising means operating upon a slow reduction of train pipe pressure to admit air to the brake cylinder for a service application of the brakes, an emergency train pipe chamber, an emergency brake cylinder chamber, movable abutments between said chambers formed of two independent diaphragms having a quick-action chamber between them, one of said diaphragms forming one wall of the emergency train pipe chamber and the other forming one wall of the emergency brake cylinder chamber, a quick-action reservoir connected to the quick-action chamber, a train pipe reservoir connection normally in communication with the quick-action chamber, means operated by one of the movable abutments to open communication between the emergency reservoir and the brake cylinder upon a sudden reduction in train pipe pressure, means operable by the abutment forming one wall of the emergency train pipe chamber for venting the said emergency train pipe chamber to atmosphere, and means whereby upon a sudden reduction of train pipe pressure the train pipe reservoir connection will be sealed from the quick-action chamber and placed in communication with the emergency brake cylinder chamber.

33. In an air brake apparatus, a valve device comprising two independently movable diaphragms having a quick-action chamber between them, means operable by one of said diaphragms upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake

cylinder, and means whereby the pressure in the quick-action chamber between said diaphragms will move one of them to vent the train pipe to atmosphere.

34. In an air brake apparatus, a valve device comprising two independently movable diaphragms having a quick-action chamber between them, means operable by one of said diaphragms upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake cylinder, means whereby the pressure in the quick-action chamber between said diaphragms will move one of them to vent the train pipe to atmosphere, a quick-action reservoir connected to said quick-action chamber, and means whereby the pressure in the quick-action chamber will slowly equalize with the reduced train pipe pressure.

35. An air brake apparatus comprising a valve device formed with an emergency train pipe chamber, an emergency brake cylinder chamber, two independently movable diaphragms between said chambers and having a quick-action chamber between them, a quick-action reservoir connected to the quick-action chamber, a train pipe reservoir connected to the quick-action chamber, means operable by one of the movable diaphragms upon a sudden reduction of train pipe pressure to place the emergency reservoir in communication with the brake cylinder and to seal the train pipe reservoir from the quick-action chamber and place it in communication with the emergency brake cylinder chamber, means whereby the pressure in the quick-action chamber will move one of said diaphragms independently of the other to vent the emergency train pipe chamber to atmosphere, and means permitting a slow equalization of pressures in the quick-action chamber and the train pipe after a reduction in the train pipe pressure.

36. A triple valve emergency section formed with an emergency train pipe chamber, an emergency brake cylinder chamber, two independently movable diaphragms between said chambers and having a quick-action chamber between them, an emergency reservoir valve, a brake cylinder valve, means connecting said valves to one of the movable diaphragms, an emergency train pipe chamber exhaust valve, and a lever adapted to be operated by one of the diaphragms to open said exhaust valve upon a sudden reduction in train pipe pressure.

37. An air brake apparatus, comprising an emergency reservoir, a train pipe reservoir, a train pipe and a triple valve formed of two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and the release of the brakes, and also means operated by an increase of train pipe pressure to connect the emergency reservoir to the train pipe for a quick-release of the brakes, means in the other casing operating upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake cylinder for an emergency application of the brakes, means in both of said casings for connecting the train pipe reservoir to the train pipe, and means in one of said casings to connect the train pipe reservoir to the brake cylinder for an emergency application of the brakes.

38. An air brake apparatus, comprising a train pipe, an emergency reservoir, a train pipe reservoir, a triple valve formed of two independent casings, means in one of said casings to connect the train pipe reservoir to the train pipe for service applications of the brakes, and means in the other casing to connect the said train pipe reservoir to the brake cylinder in emergency applications of the brakes.

39. A triple valve, comprising two independent casings, means in one of said casings to control train pipe air for service applications of the brakes and the release of the brakes, a pair of diaphragms in the other casing independently movable and spaced apart to form a quick-action chamber, a train pipe exhaust valve adapted to be operated by one of said diaphragms, and means operated by the other diaphragm to open communication between the emergency reservoir and the brake cylinder.

40. A triple valve, comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, a pair of diaphragms independently movable and spaced apart to form a quick-action chamber, a train pipe exhaust valve adapted to be operated by one of said diaphragms, and means operated by the other diaphragm to open communication between the emergency reservoir and the brake cylinder.

41. A valve device, comprising two independently movable diaphragms having a quick-action chamber between them, means operable by one of said diaphragms upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake cylinder, and means whereby the pressure in the quick-action chamber between said diaphragms will move one of them to vent the train pipe to atmosphere.

42. A triple valve comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, a pair of diaphragms independently movable and spaced apart to form a quick-action chamber, an emergency brake cylinder chamber

above one of said diaphragms, a train pipe exhaust valve adapted to be operated by one of said diaphragms upon a sudden reduction in train pipe pressure, a lever connected to said diaphragm and arranged in the quick-action chamber, a train pipe reservoir, valves connected to said lever and arranged to control communication between the quick-action chamber and the said reservoir and between said reservoir and the emergency brake cylinder chamber, and means operated by the other diaphragm to open communication between the emergency reservoir emergency brake cylinder chamber and the brake cylinder.

43. In an air brake apparatus a triple valve comprising an emergency section, a pair of diaphragms therein and independently movable and spaced apart to form a quick-action chamber, an emergency train pipe chamber below one of said diaphragms, an emergency brake cylinder chamber above the other of said diaphragms, a lever in the emergency train pipe chamber, a train pipe exhaust valve connected to one end of said lever the other end thereof being connected to the diaphragm, a lever in the quick-action chamber and connected to the diaphragm forming a portion of the walls of the emergency train pipe chamber, a pair of valves connected to said lever and controlling communication between the quick-action chamber and the train pipe reservoir and between the train pipe reservoir and the emergency brake cylinder chamber, and means connected to the diaphragm forming a portion of the walls of the emergency brake cylinder chamber for opening communication between the emergency reservoir and said chamber and between the said chamber and the brake cylinder.

44. In an air brake apparatus a triple valve comprising an emergency section, a pair of diaphragms therein and spaced apart to form a quick-action chamber, a train pipe exhaust valve operated by one of said diaphragms upon a sudden reduction of train pipe pressure, and means operated by said diaphragm upon a sudden reduction of train pipe pressure to close communication between the quick-action chamber and the train pipe reservoir and to open communication between the train pipe reservoir and the brake cylinder, and means operated by the other diaphragm to open communication between the emergency reservoir and the brake cylinder.

45. In an air brake apparatus a triple valve comprising an emergency section, a pair of diaphragms therein, means operated by one of said diaphragms upon a sudden reduction of train pipe pressure to open the train pipe to atmosphere to open communication between the train pipe reservoir and the brake cylinder, and means operated by the other diaphragm to open communication between the emergency reservoir and the brake cylinder.

46. In an air brake apparatus, a train pipe, an emergency reservoir, a train pipe reservoir, a triple valve comprising an emergency section and means therein operating upon a sudden reduction in train pipe pressure to open the train pipe to atmosphere and to open communication between the train pipe reservoir and the brake cylinder and also to open communication between the emergency reservoir and the brake cylinder.

47. An air brake apparatus comprising an emergency reservoir, a brake cylinder, a train pipe reservoir, a quick-action reservoir, a triple valve containing means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure alone, and also containing means operating upon a sudden reduction of train pipe pressure for an emergency application of the brakes to open the train pipe to atmosphere to seal the quick-action reservoir from the train pipe reservoir and from the train pipe except for a small leak port, to open communication between the train pipe reservoir and the brake cylinder and to open communication from the emergency reservoir to the brake cylinder.

48. An air brake apparatus comprising an emergency reservoir, a brake cylinder, a train pipe reservoir, a quick-action reservoir, a triple valve formed of a service section and an emergency section, the service section containing means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, and means operating upon an increase of train pipe pressure to open communication between the emergency reservoir and the train pipe for a quick release of the brakes, the emergency section containing means operating upon a sudden reduction in train pipe pressure to open the train pipe to atmosphere to seal the quick-action reservoir from the train pipe except for a small leak port and to seal said reservoir from the train pipe reservoir and to open the train pipe reservoir to the brake cylinder, and also containing means to open communication between the emergency reservoir and the brake cylinder.

49. An air brake apparatus comprising an emergency reservoir, a brake cylinder, a train pipe reservoir, a quick-action reservoir, a triple valve formed of a service section and an emergency section, the service section containing a movable abutment controlling the admission of train pipe air to the brake cylinder for a service application of the brakes and the release of said brake cylinder air for a release of the brakes, and also con-

taining an abutment operating upon an increase of train pipe pressure to open communication between the emergency reservoir and the train pipe for a quick release of the brakes, the emergency section containing a pair of movable diaphragms or abutments one of said diaphragms upon a sudden reduction in train pipe pressure venting the train pipe to atmosphere, sealing the quick-action reservoir from the train pipe reservoir and opening communication between the train pipe reservoir and the brake cylinder, the other of said diaphragms opening communication between the auxiliary reservoir and the brake cylinder.

50. An air brake apparatus comprising an emergency reservoir, a train pipe, a brake cylinder, a triple valve comprising means operating upon a reduction of train pipe pressure to admit air to the brake cylinder for a service application of the brakes, and upon an increase of train pipe pressure to open communication between the emergency reservoir and the train pipe to permit the emergency reservoir air to discharge into the train pipe for a release of the brakes.

51. An air brake apparatus comprising an emergency reservoir, a brake cylinder, a train pipe reservoir, a triple valve comprising means operating upon a slow reduction of train pipe pressure to admit train pipe and train pipe reservoir air to the brake cylinder for a service application of the brakes, and means operating upon an increase of train pipe pressure above the reduced train pipe reservoir pressure to open communication between the emergency reservoir and the train pipe to permit emergency reservoir air to discharge into the train pipe for a quick release of the brakes.

52. An air brake apparatus comprising an emergency reservoir, a train pipe, a brake cylinder, a triple valve comprising means operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, and upon an increase of train pipe pressure to open communication between the emergency reservoir and the train pipe to permit the emergency reservoir air to discharge into the train pipe for a release of the brakes.

53. An air brake apparatus comprising a triple valve, an emergency reservoir, a train pipe reservoir, means in the triple valve operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, a quick-release diaphragm in said triple valve, means for admitting train pipe reservoir air to one side of said diaphragm, means for admitting train pipe air to the other side of said diaphragm, and means operated by said diaphragm upon an increase of train pipe pressure in opposition to train pipe reservoir pressure to first open communication between the emergency reservoir and the train pipe and to then open communication between the train pipe reservoir and the train pipe.

54. An air brake apparatus comprising a valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, a quick-release diaphragm, a valve controlling communication between the emergency reservoir and train pipe, a valve controlling communication between the train pipe reservoir and the train pipe, and means operated by the said quick-release diaphragm upon an increase of train pipe pressure to first open the valve to admit emergency reservoir air to the train pipe and to then open the valve controlling communication between the train pipe reservoir and the train pipe, whereby the emergency reservoir air will be discharged into the train pipe before communication is opened between the train pipe and the train pipe reservoir.

55. A triple valve for an air brake apparatus comprising means operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes, a quick-release diaphragm in said triple valve, means for admitting train pipe reservoir air to one side of said diaphragm, means for admitting train pipe air to the other side of said diaphragm, and means operated by said diaphragm upon an increase of train pipe pressure in opposition to train pipe reservoir pressure to first open a valve controlling communication between an emergency reservoir and the train pipe, and to then open a valve controlling communication between the train pipe and a train pipe reservoir.

56. A triple valve for air brake apparatus comprising means operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe pressure, a quick-release diaphragm in said triple valve, a quick-release valve in said triple valve and controlling communication between an emergency reservoir and the train pipe, a check valve in said triple controlling communication between the train pipe and a train pipe reservoir, and means operated by said diaphragm upon an increase of train pipe pressure to first open the quick-release valve and to then open the said check valve.

57. An air brake apparatus, comprising a triple valve, an emergency reservoir, a train pipe reservoir, means in the triple valve operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the

brakes by train pipe pressure alone, a quick-release diaphragm in said triple valve, means for admitting train pipe reservoir air to one side of said diaphragm, means for admitting train pipe air to the other side of said diaphragm, means operated by said diaphragm upon an increase of train pipe pressure in opposition to train pipe reservoir pressure to open communication between the emergency reservoir, train pipe reservoir and the train pipe, a spring tending to move said quick-release diaphragm, and means for varying the pressure of said spring on said diaphragm.

58. An air brake apparatus, comprising a valve device, an emergency reservoir, a train pipe reservoir, means in the valve device operating upon a reduction of train pipe pressure to admit train pipe air to the brake cylinder for a service application of the brakes by train pipe air alone, a quick-release diaphragm, a pair of valves controlling communication between the emergency reservoir, train pipe and train pipe reservoir, a quick-release lever connected to said diaphragm and to said valves and operating upon an increase of train pipe pressure for a release of the brakes to open said valves to permit emergency reservoir air to flow to the train pipe and to the train pipe reservoir, spring means tending to move said lever to permit the valves to close, and means for varying the pressure of said spring means on said lever.

59. An air brake apparatus comprising a train pipe, an emergency reservoir, a brake cylinder and a valve device, means in said valve device operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for an application of the brakes, and a quick-release means in said valve device operating upon a predetermined increase in train pipe pressure without regard to the rate of rise of train pipe pressure to discharge the emergency reservoir into the train pipe for a quick release of the brakes.

60. An air brake apparatus comprising a train pipe, an emergency reservoir, a brake cylinder and a valve device, means in said valve device operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for an application of the brakes, a quick-release means in said valve device operating upon a predetermined increase in train pipe pressure without regard to the rate of rise of train pipe pressure to discharge the emergency reservoir into the train pipe for a quick release of the brakes, and means in said valve device operating upon a sudden reduction in train pipe pressure to discharge the emergency reservoir into the brake cylinder for an emergency application of the brakes.

61. An air brake apparatus comprising a train pipe, an emergency reservoir, a brake cylinder and a valve device, means in said valve device operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for an application of the brakes, a quick-release means in said valve device operating upon an increase in train pipe pressure to discharge the emergency reservoir into the train pipe for a quick release of the brakes, and means in said valve device operating upon a sudden reduction in train pipe pressure to discharge the emergency reservoir into the brake cylinder for an emergency application of the brakes.

62. An air brake apparatus comprising a train pipe, an emergency reservoir, a brake cylinder and a valve device, means in said valve device operating upon a slow reduction of train pipe pressure to admit train pipe air to the brake cylinder for an application of the brakes, a quick-release means in said valve device operating upon an increase in train pipe pressure without regard to the rate of rise in train pipe pressure to discharge the emergency reservoir into the train pipe for a quick release of the brakes, and means in said valve device operating upon a sudden reduction in train pipe pressure to discharge the emergency reservoir into the brake cylinder for an emergency application of the brakes.

63. A triple valve for that type of air brake apparatus in which train pipe air is admitted to the brake cylinder for all service applications of the brakes and the emergency reservoir air is admitted to the brake cylinder for emergency applications of the brakes and to the train pipe for a quick release of the brakes, and comprising means operating upon a slow reduction of train pipe pressure to place the train pipe in communication with the brake cylinder for a service application of the brakes, and means operating upon an increase of train pipe pressure to place the emergency reservoir in communication with the train pipe for a quick release of the brakes, and with means operating upon a sudden reduction in train pipe pressure to place the emergency reservoir in communication with the brake cylinder for an emergency application of the brakes, said means also operating to vent the train pipe to atmosphere through the triple valve.

64. A triple valve in accordance with claim 63, and wherein the means for placing the emergency reservoir in communication with the train pipe for a quick release of the brakes will operate upon a predetermined rise in train pipe pressure without regard to the rate of rise.

65. A triple valve in accordance with

claim 63, and wherein the means for placing the emergency reservoir in communication with the train pipe for a quick release of the brakes will operate upon an increase of train pipe pressure without regard to the rate of rise.

66. An air brake apparatus comprising a train pipe, a brake cylinder, an emergency reservoir, a triple valve, means for augmenting the train pipe capacity, means in the triple valve operating upon a slow reduction of train pipe pressure to place the train pipe in communication with the brake cylinder for a service application of the brakes by train pipe pressure alone, means in the triple valve operating upon a sudden reduction in train pipe pressure to cut off a portion of the train pipe capacity from the train pipe and to connect said cut-off portion to the brake cylinder, said means also operating to place the emergency reservoir in communication with the brake cylinder for an emergency application of the brakes.

67. An air brake apparatus, comprising a train pipe, a brake cylinder, an emergency reservoir, a triple valve, means for augmenting the train pipe capacity, means in the triple valve operating upon a slow reduction of train pipe pressure to place the train pipe in communication with the brake cylinder for a service application of the brakes by train pipe pressure alone, and means in the triple valve operating upon a sudden reduction in train pipe pressure to cut off a portion of the train pipe capacity from the train pipe, said means also operating to place the emergency reservoir in communication with the brake cylinder for an emergency application of the brakes.

In testimony whereof I hereunto affix my signature.

SPENCER G. NEAL.