J. R. SNYDER.

TRIPLE VALVE.

APPLICATION FILED FEB. 13, 1914.

1,212,828. Patented Jan. 16, 1917.

3 SHEETS—SHEET 1.

FIG. 2

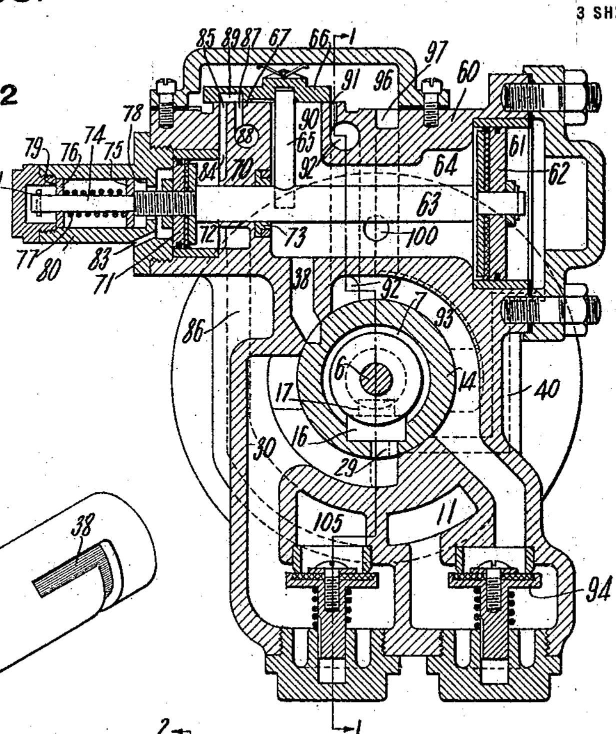
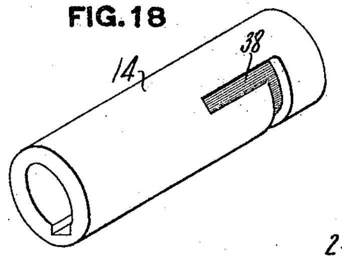


FIG. 18



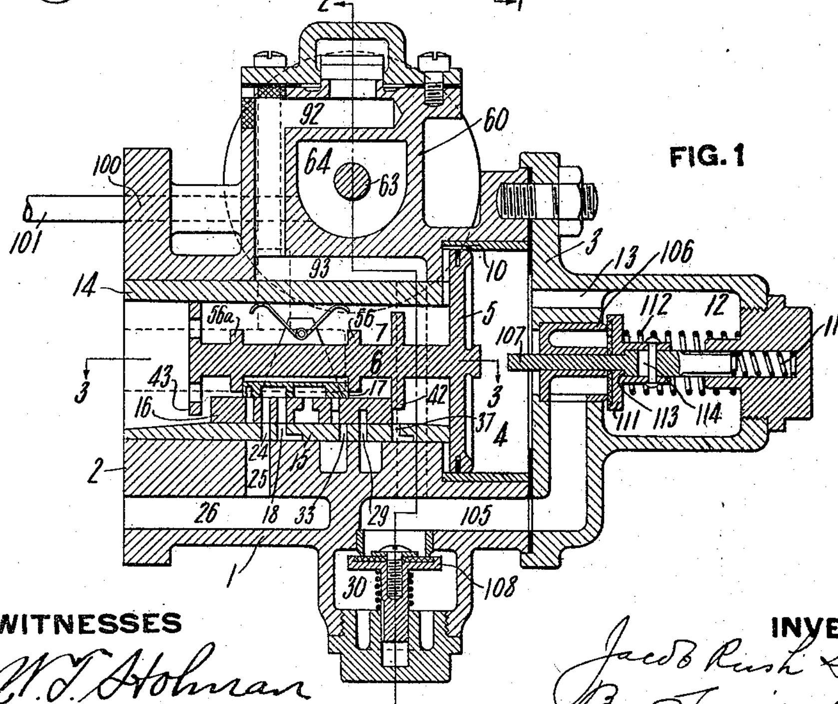


FIG. 1

WITNESSES

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3 SHEETS—SHEET 2.

FIG. 3

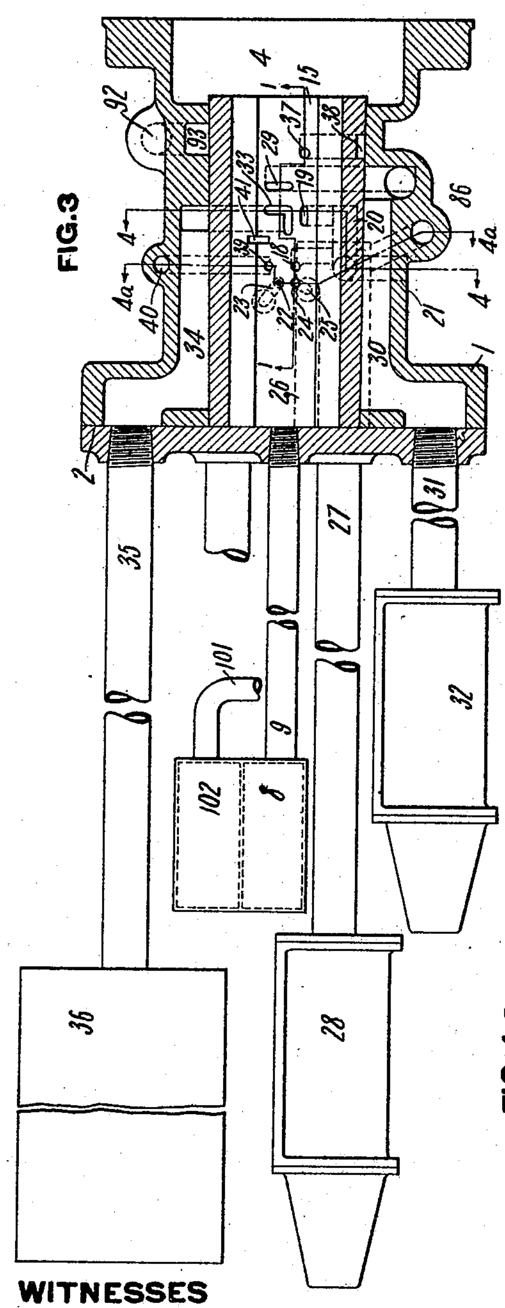


FIG. 5

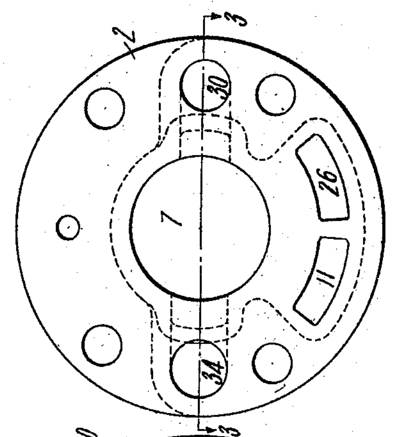


FIG. 4

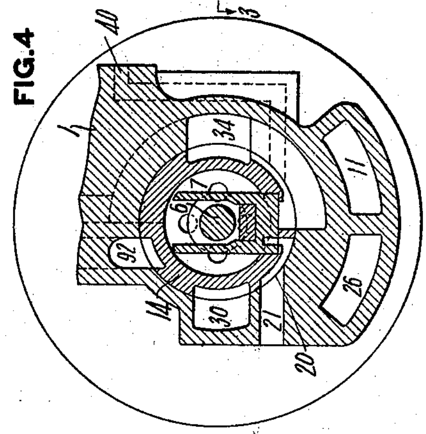
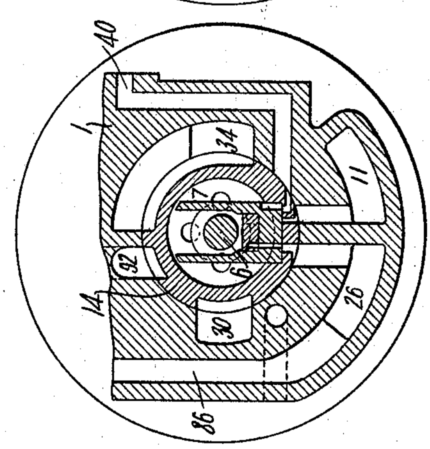


FIG. 4 A



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3 SHEETS—SHEET 3.

FIG. 6

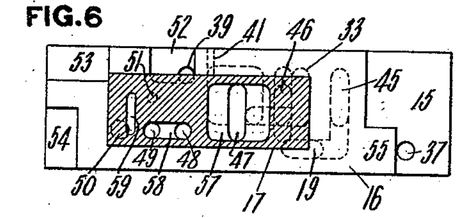


FIG. 10

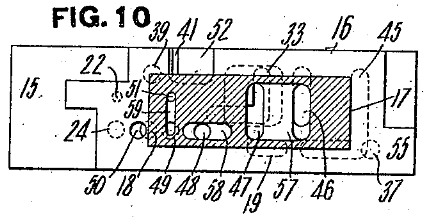


FIG. 7

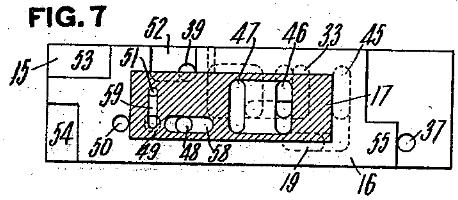


FIG. 11

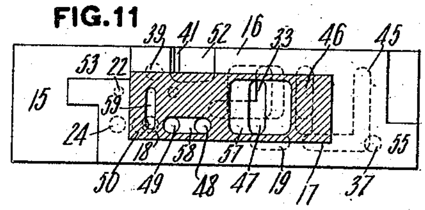


FIG. 8

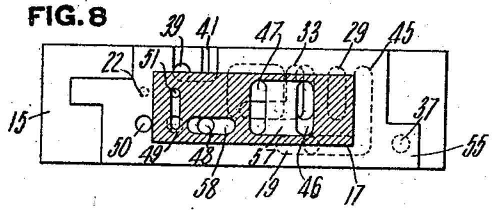


FIG. 12

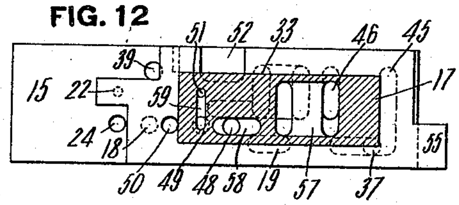


FIG. 9

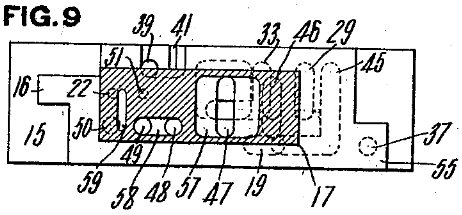


FIG. 13

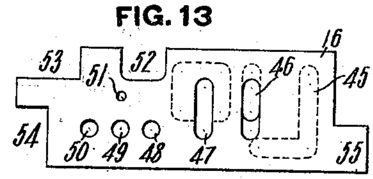


FIG. 15

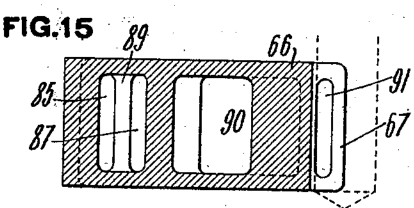


FIG. 16

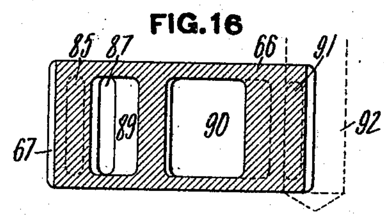


FIG. 17

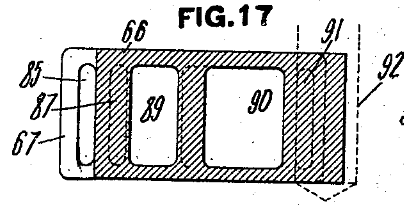
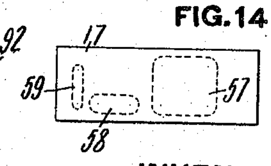


FIG. 14



WITNESSES

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UNITED STATES PATENT OFFICE.

JACOB RUSH SNYDER, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO PITTSBURGH AIR BRAKE COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

TRIPLE VALVE.

1,212,828. Specification of Letters Patent. Patented Jan. 16, 1917.

Application filed February 13, 1914. Serial No. 818,567.

To all whom it may concern:

Be it known that I, JACOB RUSH SNYDER, a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Triple Valves, of which the following is a specification.

This invention relates to triple valves for air brake systems, and more particularly for freight car service.

The principal object of the invention is to provide triple valve mechanism whereby after full service application of the brakes, such as produced by equilization between the auxiliary reservoir, train pipe and the usual brake cylinder, additional braking power can be secured so as to hold the car when loaded on steep grades without the use of hand-brakes. To this end the triple valve mechanism is so arranged that after full service application, by further reduction of train pipe pressure, fluid pressure can be graduated into a supplementary or high pressure brake cylinder at the will of the engineer and to any desired degree practically to complete depletion of train pipe pressure, but without destroying the other functions of the triple valve mechanism or disturbing the braking effect of the other triple valves in the train. As a consequence the braking power can be so proportioned that the ordinary full service application provides sufficient power to hold the car when empty, and by means of the additional or high pressure application, the braking power can be increased so as to hold the car on steep grades when loaded.

Further objects of the invention are to provide a triple valve having all of the usual functions of triple valves and in addition being so arranged as to produce a quick release of the brakes throughout the train, provide for a quick serial action of the brakes throughout the train in service application as well as in emergency application, and, further, to supply the service brake cylinder with pressure in proportion to train pipe reduction and irrespective of variations in piston travel, and to maintain said brake cylinder pressure against leakage in service as well as in high pressure applications; and which valve performs these various functions by much simpler and less complicated construction than prior valves capable of effecting only a part of these results and functions.

The invention comprises the construction and arrangement of a triple valve hereinafter described and claimed.

In the accompanying drawings Figure 1 is a vertical longitudinal section through a triple valve embodying the invention and showing the same in full release and running position, and being taken on the line 1—1, Fig. 2; Fig. 2 is a vertical transverse section on the line 2—2, Fig. 1; Fig. 3 is a horizontal section on the line 3—3, Figs. 1 and 5, with the piston stem and slide valves removed, and showing the connections to the supplemental and auxiliary reservoirs, the pressure chamber and the service and high pressure brake cylinders; Fig. 4 is a cross section through the valve taken on the line 4—4, Fig. 3, looking in the direction of the arrows; Fig. 4_a is a cross section on the line 4_a—4_a Fig. 3, looking in the direction of the arrows; Fig. 5 is an end view of the valve casing, parts of the valve being omitted; Figs. 6, 7, 8, 9, 10, 11 and 12 are diagrammatic views showing the main valve seat and main slide valve in plan view and the graduating valve in horizontal section and showing different positions of the valve; Fig. 6 showing the same in full and quick release position, Fig. 7 in quick service position, Fig. 8 in full service position, Fig. 9 in service lap position, Fig. 10 in high pressure application position, Fig. 11 in high pressure lap position, and Fig. 12 in emergency application position; Fig. 13 is a plan view of the main slide valve; Fig. 14 is a similar view of the graduating slide valve; Figs. 15, 16 and 17 are diagrammatic views of the supplementary valve seat in plan and the supplementary slide valve in horizontal section and showing the different positions of this valve; Fig. 15 showing the same in release position; Fig. 16 in lap and running position; Fig. 17 in application position, and Fig. 18 in a detail perspective view of the main valve bushing.

The triple valve in its general form, construction and arrangement follows the standard type of Westinghouse and similar valves. It comprises a main body or casing 1 provided at one end with a flat face 2 for the usual connection to the auxiliary reservoir and brake cylinders, when desired, and is closed at its opposite end by the head or cap 3. In this casing is the usual chamber 4 in which works the main piston 5 which is provided with a stem 6 extending into the chamber or bore 7 and actuating the slide valves. The auxiliary reservoir 8 is connected by pipe 9 with the end of chamber or bore 7 and is normally charged through the feed groove 10 in the bushing forming the wall of chamber 4, which feed groove is open when the main piston is in full release position.

The train pipe is connected to the passage 11 which extends longitudinally through the bottom portion of the casing on one side of its center line and communicates with the chamber 12 in the head or cap 3, from which chamber communication is had with piston chamber 4 through port 13.

The lower part of the bushing 14 in chamber or bore 7 provides a seat 15 for the main slide valve 16 which, together with the supplementary or graduating valve 17, which rests upon the top of the main slide valve 16, is actuated by the piston stem 6. The valve seat 15 is provided with the ports and passages shown in Fig. 3, to-wit:—two exhaust ports, marked 18 and 19 respectively and which communicate with a cored out passage 20 communicating with the atmosphere through the passage 21; a port 22 near one end of the valve seat and which communicates through a passage 23 with the train pipe passage 11; a port 24 located substantially transversely of port 22 and communicating through passage 25 with a longitudinal passage 26 from which a pipe 27 leads to the service brake cylinder 28; an oblong transverse port 29 located near the opposite end of the valve seat and communicating through passage 30 and pipe 31 with the high pressure brake cylinder 32; an L-shaped port 33 located longitudinally adjacent to the high pressure brake cylinder port 29 and transversely adjacent to the exhaust port 19 and communicating through passage 34 and pipe 35 with the supplementary reservoir 36; a circular port 37 located adjacent one end of the valve seat and communicating through passage 38 with the pressure chamber of the supplemental valve hereinafter described; and a port 39 connected by passage 40 with the opposite side of the pressure chamber piston as hereinafter described. The valve seat is also provided with a groove or slot 41 extending inwardly from one side edge and serving in full release position of the valve to form a portion of a connection from the chamber 7 to the supplementary reservoir for charging the latter, as will hereinafter more fully appear.

The main slide valve 16 has a slight lost motion between collars 42 and 43 on the main piston stem 6, and is provided with the ports and cavities shown in Fig. 13, to-wit, an L-shaped cavity 45 adjacent to one end; an oblong transverse port 46 extending through the valve and being offset transversely of the valve on the lower face of the latter; another transversely arranged oblong port 47 which on the lower face of the valve is enlarged to substantially square-shape; three circular ports 48, 49 and 50 substantially in line with each other longitudinally of the valve, and a smaller circular port 51 transversely in line with port 49. One edge of this valve is also cut away as at 52, and both inner corners are cut away, one corner being cut away for a considerable distance longitudinally of the valve, as at 53, and the other corner being cut away transversely of the valve, as at 54. The outer end of the valve is provided with a projection 55.

The upper face of the main slide valve forms the seat for the graduating valve 17 which is held without lost motion between collars 56 and 56_a on the main piston stem 6. This graduating valve is provided in its lower face with three cavities, shown in Fig. 14, to-wit, a substantially rectangular cavity 57 near the outer end of the slide valve, a narrow longitudinally arranged oblong cavity 58 located entirely on one side of the center line of the valve, and a transversely arranged oblong cavity 59 adjacent to the inner end of the valve.

On the upper side of the main casing 1 is provided a casing 60 for a supplementary valve mechanism, in this casing is a chamber 61 in which works a piston 62 provided with a stem 63 projecting into the pressure chamber 64 and carrying an arm or projection 65 which actuates the supplementary slide valve 66 working on the valve seat 67. The piston stem 63 extends through a partition or wall 70 and beyond said partition or wall carries a smaller piston 71 working in a chamber 72. A stuffing-box 73 surrounds the piston stem 63 and prevents air from leaking from pressure chamber 64 to the chamber 72. The piston stem extends beyond the piston 71, and has a reduced portion 74 which is loosely surrounded by two collars marked 75 and 76 respectively, between which is a compression spring 77. The collar 75 is adapted to seat against a shoulder 78 and the collar 76 is adapted to seat against a shoulder 79 formed in the extension 80 of the casing, and the outer end of the piston stem is provided with a suitable shoulder, shown as a transverse pin 81, adapted to contact with collar 76 when the piston stem moves inwardly.

The outer face of piston 71 is open to the atmosphere through port 83, and the chamber 72 on the inner face thereof communicates by passage 84 with port 85 in the valve seat 67, and also communicates through passage 86 with the passage 26 leading to the service brake cylinder.

The valve seat 67 is provided adjacent to the port 85 with a port 87 leading to an exhaust passage 88, and the slide valve 66 is provided on its lower face with a cavity 89 arranged in release position, as shown in Fig. 15, to connect ports 85 and 87 and therefore exhaust chamber 72 to the atmosphere. The valve seat 67 is also provided with a large port 90 through which the stem 65 projects, and near its opposite end with a small port 91 communicating through passage 92 with a cored-out passage 93 around the bushing 14 and thence leading to the train pipe passage 11. A check valve 94, spring-seated away from the train pipe passage 11, controls this communication, so that air can flow into the train pipe passage 11 past this check valve, but not in the reverse direction. The chamber 96 in which slide valve 66 operates is connected by passage 97 with the supplementary reservoir connection 34. Consequently, when the valve 66 is in release position pressure flows from the supplementary reservoir connection 34 through passage 97 into chamber 96 and thence through port 91 and passages 92 and 93 past the check valve 94 to the train pipe connection 11.

The chamber 64 is connected through passage 100 and pipe 101 to the pressure chamber 102. The chamber 61 on the opposite face of the supplementary piston 62 is open to the auxiliary reservoir through port 39 and passage 40, except in high pressure application and high pressure lap positions of the main valve.

The high pressure brake cylinder passage 30 communicates with a passage 105 leading to the cap 3 through a valve seat 106 surrounding the graduating stem 107. In this connection is a check valve 108 spring-seated away from the high pressure brake cylinder, so that fluid pressure can pass said valve toward the high pressure brake cylinder, but not in the reverse direction. The graduating stem 107 is normally projected into main piston chamber 4 by the graduating spring 110. Slidably surrounding said stem is a valve 111 seating on valve seat 106 and normally held against said seat by compression spring 112. A shoulder 113 on the graduating stem also assists in holding the valve 111 on its seat. The graduating stem, however, has a pin and slot connection 114 with said valve, so that the graduating stem can be pushed backwardly somewhat without unseating valve 111. These parts are so arranged that under ordinary service and high pressure application reductions the graduating stem 107 is not pushed outwardly so far as to unseat valve 111, but upon emergency reductions of train pipe pressure the graduating stem is pushed backwardly so far that it unseats valve 111 and thereby permits train pipe pressure to flow from the chamber 12 in the cap 3 through passage 105 past the check valve 108 and thence to the high pressure brake cylinder.

The auxiliary reservoir 8 is of small capacity. While a certain amount of the air from this reservoir at times passes to the service brake cylinder, this is so limited that it is not the main braking medium. The principal purpose of the auxiliary reservoir is to serve as a source of pressure for effecting certain movements of the main and supplemental valves. The valve mechanism described has seven different functional positions as follows:—

1. Full and quick release and running position. (Shown in Figs. 1, 2, 6 and 15.)— In this position the main piston 5 is at its extreme forward or inward stroke and uncovers the feed groove 10 to permit train pipe pressure to flow to the auxiliary reservoir and charge the same. The main slide valve 16 is in such position that the enlarged lower end of its port 47 laps over the inner end of the groove 41 and one end of the L-shaped port 33, so that air flows from the chamber 7 to the supplementary reservoir, charging the same to the same pressure as the auxiliary reservoir. In this position cavity 58 in the graduating valve 17 connects ports 48 and 49 of the main valve, 16, and which ports in turn register with exhaust port 18 and service brake cylinder port 24 respectively, while the L-shaped cavity 45 in the main slide valve connects exhaust port 19 with high pressure brake cylinder port 29. Consequently, both brake cylinders are being exhausted to the atmosphere. The cut-away portion 52 of the main slide valve has uncovered port 39 so that auxiliary reservoir pressure also flows to the chamber 61 of the supplementary valve mechanism, on the outer face of the supplementary piston 62; and said main slide valve has also uncovered port 37, whence auxiliary reservoir air also flows to the pressure chamber 64 in the supplementary valve mechanism. As a consequence the pressures in the auxiliary reservoir, supplementary reservoir, pressure chamber 64 and chamber 61 on the outer face of supplemental piston 62, all equalize. Upon the release of the brakes, that is, by increase of brake pipe pressure, the pressures in chambers 61 and 64 immediately equalize with auxiliary reservoir pressure. Consequently, the brake cylinder pressure in chamber 72 drives the supplementary valve mechanism to the extreme left to the position shown in Figs. 2 and 15, which results in opening the exhaust port 87 to serve as an auxiliary exhaust for the service brake cylinder. This also results in carrying the collar 75 away from shoulder 78 and compressing spring 77. As soon as the brake cylinder pressure is substantially exhausted it relieves pressure in chamber 72 to such an extent that the spring 77 moves the supplementary valve mechanism to the right, until the collar 75 contacts with shoulder 78, leaving the supplementary valve in lap position, shown in Fig. 16. This position is maintained during running. In this position the ports 85, 87 and 91 in the supplementary valve seat are all closed and the remaining brake cylinder pressure is exhausted by way of ports 25, 24, 49, cavity 58 and ports 48, 18 and 21 in the main part of the valve.

2. Quick service or serial venting position. (Shown in Fig. 7.)—This position is assumed upon the first movement of the main piston upon a slight reduction of train pipe pressure and results in moving graduating valve 17 from the position shown in Fig. 6 to that shown in Fig. 7, but without moving the main slide valve 16, due to the lost motion connection between the latter valve and the main piston stem. This movement results in breaking the connection between the service brake cylinder port 24 and the exhaust port 18, and establishes communication through the cavity 59 in the graduating valve and ports 51 and 49 of the main slide valve between the train pipe port 22 and service brake cylinder port 24, thereby venting the train pipe momentarily to the service brake cylinder, which is at atmospheric pressure, and producing a drop in pressure in the train pipe at the car and securing a quicker serial action of the brakes throughout the train than would be possible if all the air had to flow forwardly and at the engineer's brake valve. The air passing to the service brake cylinder produces a light setting of the brakes. The valve remains in this position for a brief time, due to the fact that the first movement of the piston 5 moves only the slide valve 17, but as soon as the lost motion between the piston stem 6 and the slide valve 16 is taken up, the added frictional resistance encountered momentarily checks the movement of the piston 5, thereby providing an appreciable time of venting the train pipe. The reduction of train pipe pressure caused thereby produces a sufficient unbalancing of pressures on the opposite sides of the main piston to overcome the friction of both slide valves, and the valve mechanism almost immediately moves to the next position, now to be described.

3. Full service position. (Shown in Figs. 8 and 17.)—In this position the main slide valve has moved so as to break connection between the high pressure brake cylinder port 29 and exhaust port 19 and between the train pipe port 22 and service brake cylinder port 24. It has also covered the pressure chamber port 37, and broken the connection between the supplementary reservoir charging groove 41 and supplementary reservoir port 33, thereby trapping the air in both the supplementary reservoir and the pressure chamber. The port 39 leading to the auxiliary reservoir side of supplementary piston 62 is, however, still open, so that variations in auxiliary reservoir pressure are communicated to the outer face of supplementary piston 62. The port 50 in the main slide valve in this position is uncovered by the graduating valve and also communicates with the service brake cylinder port 24. Consequently, auxiliary reservoir pressure flows to the brake cylinder and produces a light setting of the brakes. On account, however, of the small capacity of the auxiliary reservoir this results in practically a negligible pressure in the service brake cylinder. It results, however, in a very material reduction in auxiliary reservoir pressure, thereby producing an equivalent reduction on the outer face of supplementary piston 62, while the trapped pressure in the pressure chamber 64 remains constant; as a consequence of which the supplementary piston 62 moves outwardly, that is, to the right in Fig. 2, carrying with it the slide valve 66, which results in uncovering the port 85, as shown in Fig. 17, whence supplementary reservoir pressure flows from chamber 96 through passage 84, chamber 72, passage 86 to service brake cylinder connection 26 and thence to the service brake cylinder, thereby applying the brakes with a pressure proportionate to the reduction in train pipe pressure. The brake cylinder pressure, it will be observed, also acts in chamber 72 on the face of the small piston 71, and as soon as this pressure plus the auxiliary reservoir pressure on the outer face of piston 61 and the tension of spring 77 exceeds the trapped pressure in the pressure chamber 64 the supplementary piston moves backwardly or to lap position, shown in Fig. 16, but without connecting port 85 with exhaust port 87. It will be noticed that the collar 76 abuts against shoulder 79 before the piston stem 63 is moved entirely to its left-hand position, as indicated in Fig. 2. Consequently as soon as the supplementary piston is relieved of the tension of spring 77 it comes to rest, without moving entirely to the left, which results in lapping the connection between the supplementary reservoir and the brake cylinder, but without opening the latter to exhaust. Should brake cylinder pressure leak off, it results in a corresponding reduction of pressure in chamber 72 and the constant pressure in chamber 64 will again move the supplementary valve mechanism to the right and again establish communication between the supplementary reservoir and service brake cylinder, until the latter is again built up so that it will push the supplementary valve mechanism to the left to lap position. As a consequence this supplementary valve mechanism serves to maintain brake cylinder pressure constant, entirely irrespective of brake cylinder leakages or variations in piston travel in the brake cylinder, giving at all times a uniform pressure in the brake cylinder proportionate to the reduction of train pipe pressure.

4. Lap position. (Shown in Fig. 9.)—The reduction of auxiliary reservoir pressure by venting to the service brake cylinder, as described in the last previous position, results in the main piston 5 moving inwardly, carrying with it the graduating valve 17, but without moving the main slide valve 16. As a consequence the graduating valve laps port 50 and service brake cylinder port 24, thereby preventing further reduction on the auxiliary reservoir side of the main piston and on the outer face of supplementary piston 62, and which condition will be maintained until the engineer further reduces train pipe pressure, which will result in the repetition of the movements described in connection with the service application position, until full service pressure is reached. While the main valve mechanism is in lap position the supplementary valve mechanism will continue to maintain brake cylinder pressure against leakage as hereinbefore described.

5. High pressure application position. (Shown in Fig. 10.)—This position is assumed after a full service application of the brakes (that is, equalization of auxiliary reservoir and service brake cylinder pressure), and in cases where the engineer desires a higher braking pressure. In moving to full service position the end of the main piston abuts against the graduating stem 107, and then stops, due to the resistance of graduating spring 110. But when the higher braking pressure is desired the engineer reduces train pipe pressure to such an extent that the piston 5 will move backwardly and compress spring 110 until the lost motion in the connection between the graduating stem and valve 111 is taken up, when the added resistance of spring 112 is encountered and this causes the valve mechanism to stop in the position shown in Fig. 10. In this position port 39 is lapped by the main slide valve so that the pressure on the outer face of supplementary piston 62 is also trapped. The port 47 of the main slide valve registers with the supplementary reservoir port 33, while the port 46 on the main slide valve registers with the high pressure brake cylinder port 29; and the cavity 57 of the graduating valve connects ports 46 and 47, thereby establishing communication from the supplementary reservoir directly to the high pressure brake cylinder. This increases the braking power by the added power of the second cylinder. To prevent overcharging the high pressure brake cylinder when the valve is in this position the port 50 of the main slide valve is uncovered by the graduating valve and is also partly in register with the exhaust port 18, as a result of which auxiliary reservoir pressure is slowly exhausted to the atmosphere, and as soon as the pressure on the auxiliary reservoir side of the main piston drops slightly below train pipe pressure the main piston is moved back by the graduating spring, thereby moving the graduating valve back to the position next to be described, in which it laps the port 50, preventing further venting on the auxiliary reservoir side of the main piston, and also breaking connection between the supplementary reservoir and high pressure brake cylinder. The connection from the supplementary reservoir to the high pressure cylinder may be established as frequently as necessary by successive reductions of train pipe pressure, until the supplementary reservoir has equalized with the high pressure brake cylinder.

6. High pressure lap position. (Shown in Fig. 11.)—This position is assumed by the lapping back of the graduating valve, due to the leaking off of auxiliary reservoir pressure through port 50 and exhaust port 18, as just described. The effect is to break the connection between the supplementary reservoir and the emergency brake cylinder. After a full service application, that is, after equalization has been established between the auxiliary reservoir and the service brake cylinder, additional pressure can be graduated into the high pressure brake cylinder at the will of the engineer, up to the maximum capacity, which is reached upon equalization of the supplementary reservoir with the high pressure brake cylinder. This high pressure application is established without destroying or reducing the sensitiveness of the valve as to release or disturbing the braking effect of the other triple valves in the train. The brake rigging can be so adjusted that the full service application of the brakes provides sufficient power to hold the car when empty, and by using the high pressure application above described, power can be added as desired to hold the car on steep grades when loaded, so that the use of hand-brakes in coming down steep grades can be entirely dispensed with. During the high pressure application the supplementary valve mechanism serves to maintain service brake cylinder pressure against leakage, in exactly the same way as it does during ordinary service applications.

7. *Emergency position.* (Shown in Fig. 12.)—This position is assumed upon a sudden reduction in train pipe pressure, which moves the main piston 5 to compress both the springs 110 and 112 and move fully outwardly, thereby dragging out both slide valves. The full movement of the piston 5 outwardly has taken up the lost motion between graduating stem 107 and valve 111, thereby unseating the latter valve and permitting train pipe pressure to rush through passage 105, past check valve 108 and through passage 30 to the high pressure brake cylinder. This not only supplies the high pressure brake cylinder with air but also produces a quick serial action of the brakes through the train. As soon as the pressure in the high pressure brake cylinder equalizes with the train pipe pressure the check valve 108 closes and prevents a backward flow of air from the brake cylinder to the train pipe as the pressure in the brake cylinder is further built up. In this position the main slide valve has uncovered service brake cylinder port 24 and also port 39 which communicates with the chamber 61 on the outer face of supplementary piston 2. As a consequence auxiliary reservoir pressure rushes to the service brake cylinder and this also depletes the pressure on the outer face of piston 62 correspondingly, so that piston 62 and slide valve 66 move fully over toward the right, establishing communication from the supplementary reservoir to the service brake cylinder by way of passage 97, chamber 96, port 85, chamber 72 and passage 86. Also, in this position port 47 in main slide valve connects supplementary reservoir port 33 with high pressure cylinder port 29. Consequently, this position results in complete equalization between supplementary reservoir, auxiliary reservoir and both brake cylinders. The pressure chamber, however, still continues to be trapped so that it holds the supplementary piston fully over to the right.

The emergency position of the valve can be secured either directly from full release position or from any of the other positions of the valve by suddenly reducing the train pipe pressure below the point of equalization of the auxiliary reservoir pressure with brake cylinder pressure.

The valve mechanism described performs all of the usual functions of freight triple valves, and in addition provides for a quick service application of the brakes, a quick release of the brakes, and for the high pressure application after full service application as above described. It is further so arranged as to secure uniform pressure in both service and high pressure applications irrespective of piston travel, and to maintain such pressure against leakage. Sufficient power can be secured in high pressure application position to hold loaded cars when going down steep grades, so as to dispense with the use of hand-brakes.

What I claim is:

1. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variation in train pipe pressure and arranged on service reduction of train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders, and upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder.

2. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged on service reduction of train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders, upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, and upon emergency reduction of train pipe pressure to connect both of said reservoirs to both of said brake cylinders.

3. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged on service reduction in train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders, upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, and upon emergency reduction of train pipe pressure to connect both of said reservoirs and a source of pressure to both brake cylinders.

4. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged on service reduction of train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders, and upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, said means including a supplementary valve device controlled by variations in reservoir pressure and arranged to maintain brake cylinder pressure against leakage.

5. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged upon service reduction in train pipe pressure to connect first one and then the other of said reservoirs with one of

said brake cylinders, and upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, said means including a supplementary valve device controlled by variations in the pressure of the other of said reservoirs and arranged to maintain brake cylinder pressure against leakage.

6. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged on service reduction in train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders, upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, and upon emergency reduction of train pipe pressure to connect both of said reservoirs to both of said brake cylinders, said means including a supplementary valve device controlled by variations in reservoir pressure and arranged to maintain brake cylinder pressure against leakage.

7. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged on service reduction of train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders, upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, and upon emergency reduction in train pipe pressure to connect both of said reservoirs and a source of pressure to both brake cylinders, said means including a supplementary valve device controlled by variations in the pressure in one of said reservoirs and arranged to maintain brake cylinder pressure against leakage.

8. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, a reservoir, a pressure chamber, valve mechanism actuated by variations in train pipe pressure and arranged upon service reduction in train pipe pressure to open communication between said reservoir and one of said brake cylinders and to trap pressure in the pressure chamber, and upon emergency reduction in train pipe pressure to establish communication between a source of pressure and the other brake cylinder, and means subject to the pressures in said pressure chamber and reservoir and arranged to maintain brake cylinder pressure against leakage.

9. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, a reservoir, a pressure chamber, valve mechanism actuated by variations in train pipe pressure and arranged upon service reduction in train pipe pressure to open communication between said reservoir and one of said brake cylinders and to trap pressure in the pressure chamber, and upon emergency reduction in train pipe pressure to establish communication between a source of pressure and the other brake cylinder, and means subject to the pressures in the same pressure chamber and reservoir and arranged upon reductions in reservoir pressure to open communication between an additional source of pressure and a brake cylinder.

10. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, an auxiliary reservoir, a supplementary reservoir, a constant pressure chamber in communication with the auxiliary reservoir in running position, means actuated by variations in train pipe pressure and arranged upon reduction in train pipe pressure to connect said auxiliary reservoir to one of said brake cylinders and to close said pressure chamber and trap pressure therein, and supplementary valve mechanism subject to the pressures in said pressure chamber and auxiliary reservoir and arranged upon service reduction in train pipe pressure to connect the supplementary reservoir to said brake cylinder.

11. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged upon service reduction in train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders and upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, said means including a supplementary valve device subject to brake cylinder pressure and to the pressure in one of said reservoirs and arranged to maintain brake cylinder pressure against leakage.

12. In a fluid pressure brake, the combination of a train pipe, a pair of brake cylinders, two reservoirs on a car, and means operative by variations in train pipe pressure and arranged upon service reduction in train pipe pressure to connect first one and then the other of said reservoirs with one of said brake cylinders, and upon reduction of train pipe pressure after full service application to connect one of said reservoirs to the other brake cylinder, said means including a supplementary valve device subject to brake cylinder pressure and to the pressure in one of said reservoirs and arranged upon variations in said pressures to control communication between the other of said reservoirs and the first named brake cylinder.

13. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, two reservoirs on a car, means operated by

variations in train pipe pressure and arranged on service reduction in train pipe pressure to connect first one and then the other of said reservoirs to one of said brake cylinders upon further reduction of train pipe pressure to connect one of said reservoirs to the other brake cylinder, and upon emergency reduction in train pipe pressure to connect both of said reservoirs to both of said cylinders, said means including a supplementary valve device subject to brake cylinder pressure and to the pressure in one of said reservoirs and a main slide valve mechanism.

14. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, two reservoirs on a car, means operative by variations in train pipe pressure and arranged on reduction in train pipe pressure to connect one of said reservoirs with the brake cylinders, a pressure chamber in communication with said reservoir in running position, and means subject to the pressures in said chamber and reservoir and arranged upon variations in the pressures therein to connect the other reservoir to one of the brake cylinders.

15. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, auxiliary reservoir, and pressure chamber, valve mechanism actuated by variations in train pipe pressure and arranged upon service reduction in train pipe pressure to open communication between the auxiliary reservoir and one brake cylinder and to trap pressure in the pressure chamber, and upon reduction in train pipe pressure after full service application to open communication between an additional source of pressure and the other brake cylinder, and means subject to brake cylinder pressure and to the pressure in said pressure chamber and auxiliary reservoir and arranged to maintain brake cylinder pressure against leakage.

16. In a fluid pressure brake, the combination of a train pipe, two brake cylinders, auxiliary reservoir, supplementary reservoir, and pressure chamber, valve mechanism actuated by variations in train pipe pressure and arranged upon service reduction in train pipe pressure to open communication between the auxiliary reservoir and one of said brake cylinders and to trap pressure in said chamber, and upon reduction in train pipe pressure after full service application to open communication between the supplementary reservoir and other brake cylinder, and means subject to brake cylinder pressure and to the pressures in the pressure chamber and auxiliary reservoir and arranged upon variations in said pressures to control communication between the supplementary reservoir and the first named brake cylinder.

In testimony whereof, I have hereunto set my hand.

JACOB RUSH SNYDER.

Witnesses:
ELBERT L. HYDE,
GLENN H. LERESCHE.