H. F. BICKEL.

AIR BRAKE APPARATUS.

APPLICATION FILED JUNE 18, 1912.

1,076,543.

Patented Oct. 21, 1913.

4 SHEETS—SHEET 1.

Fig. 1.

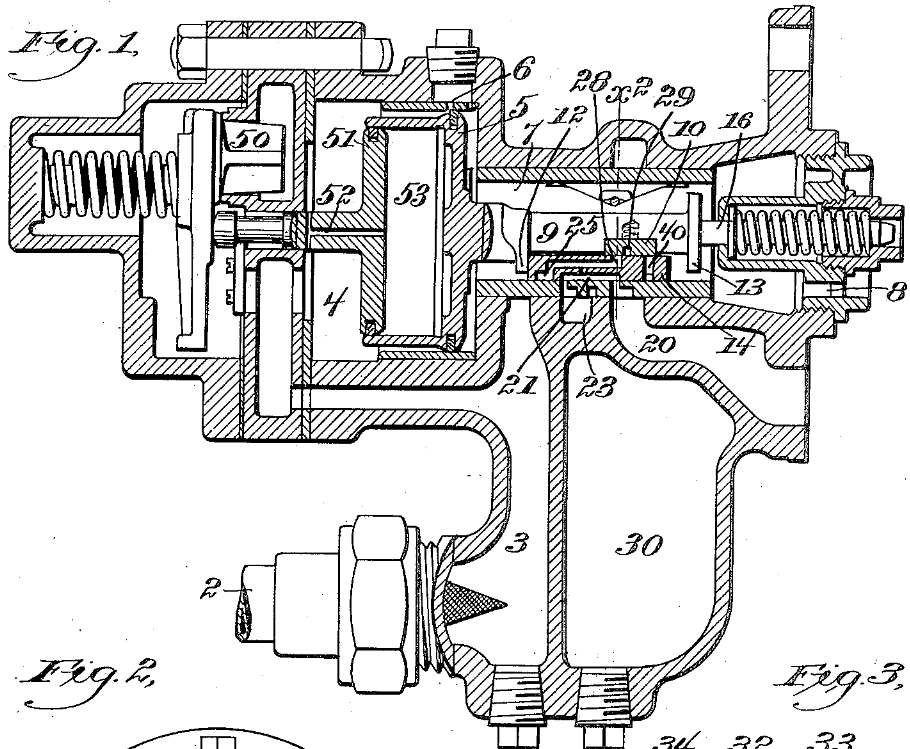


Fig. 2.

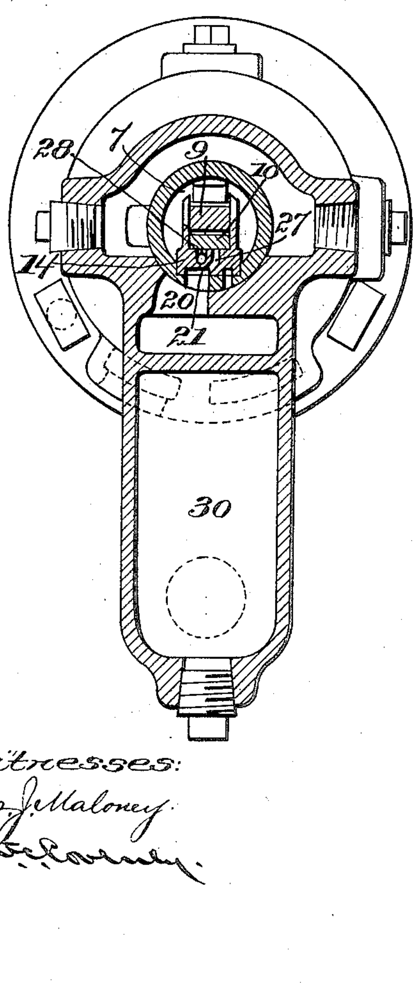


Fig. 3.

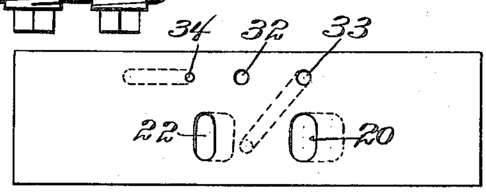


Fig. 4.

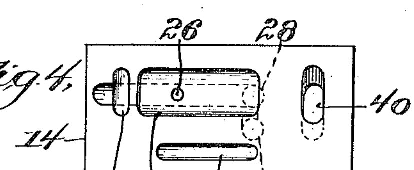


Fig. 5.

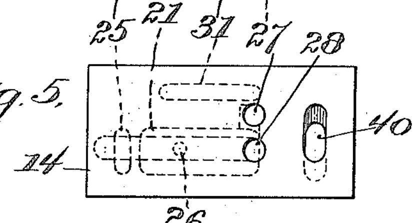
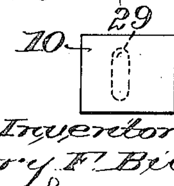


Fig. 6.



Witnesses:

Jas. J. Maloney

[signature]

Inventor:

Henry F. Bickel

by H. J. Livermore, Att'y

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4 SHEETS—SHEET 2.

Fig. 7.

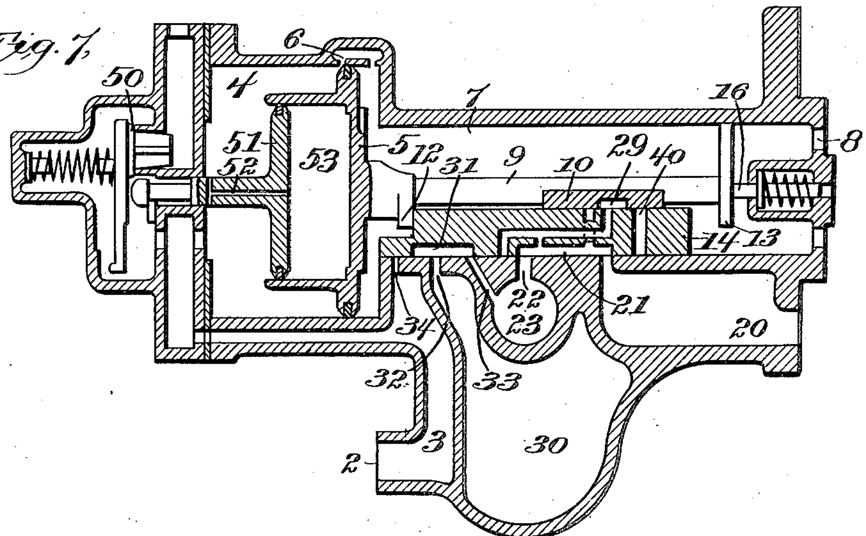


Fig. 8.

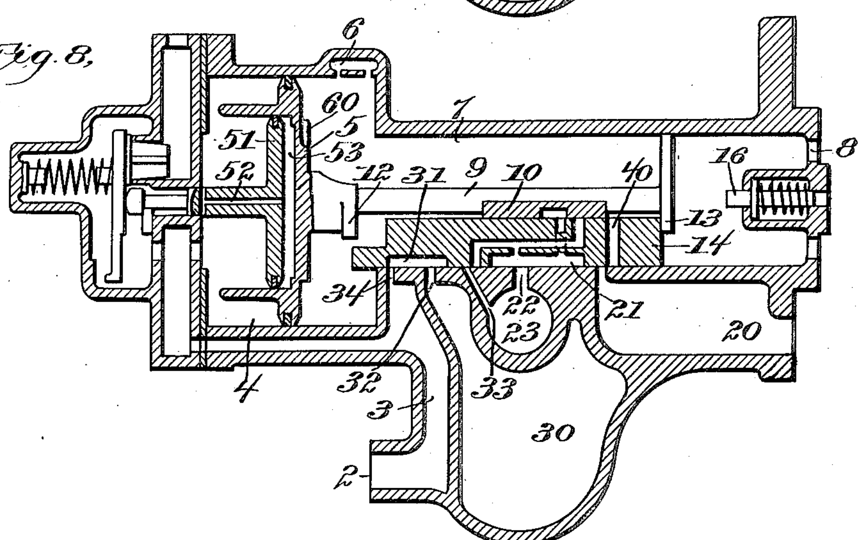
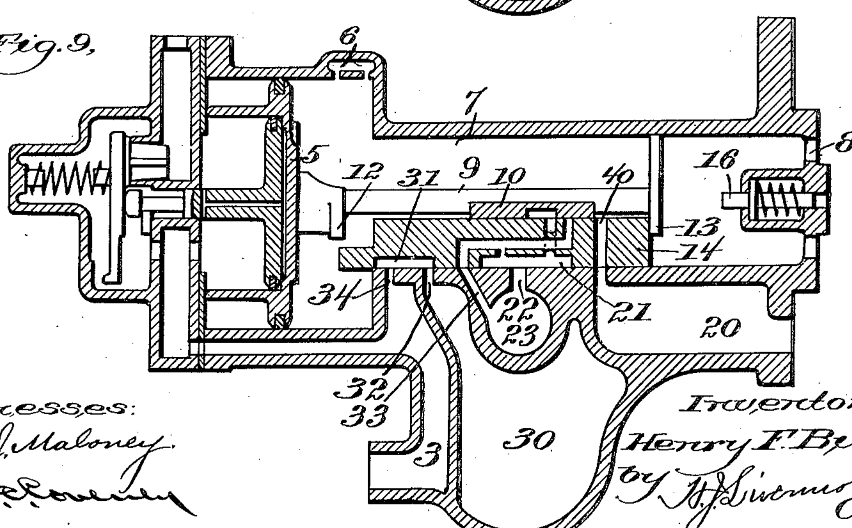


Fig. 9.



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Inventor

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by [signature] Atty.

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4 SHEETS—SHEET 3.

Fig. 10.

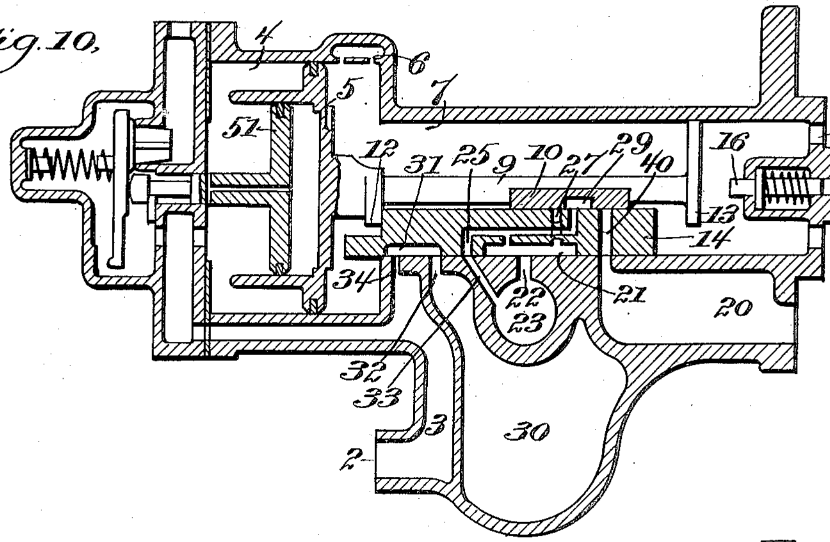


Fig. 11.

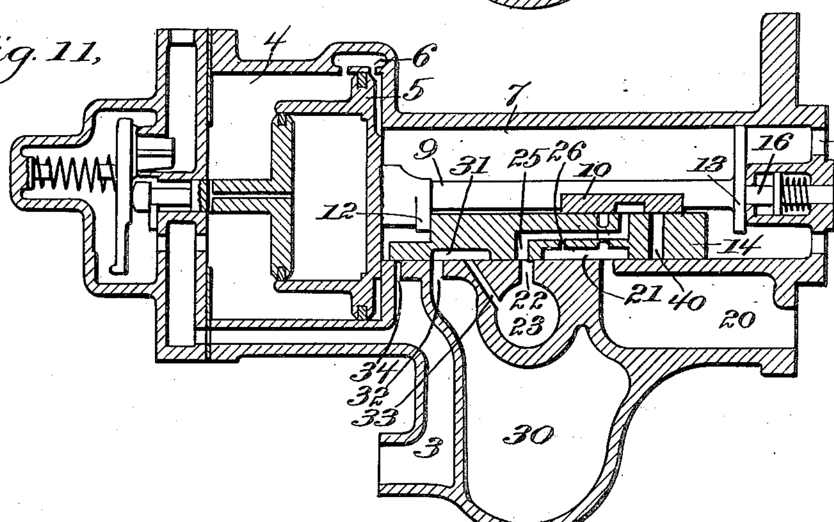
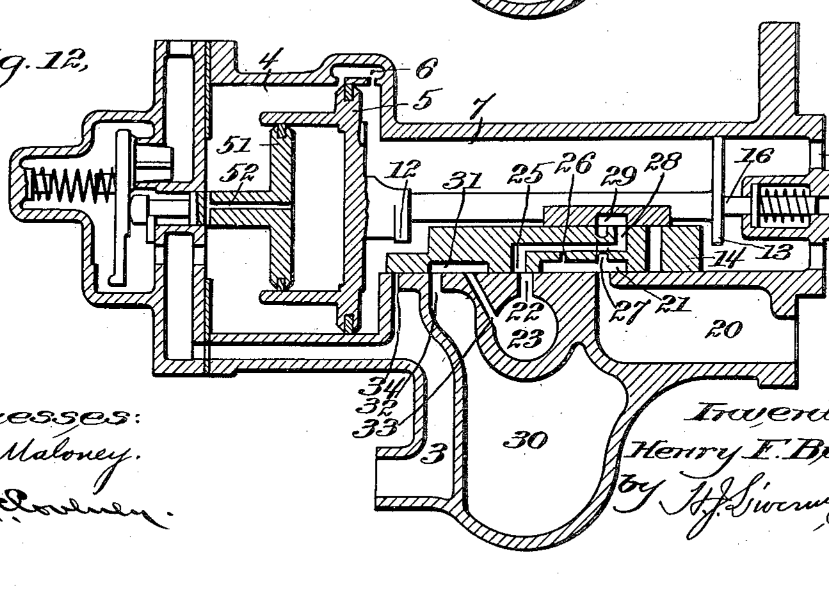


Fig. 12.



Witnesses:

Jas. J. Maloney.

[signature]

Inventor:

Henry F. Bickel

by H. J. Livermore, Atty.

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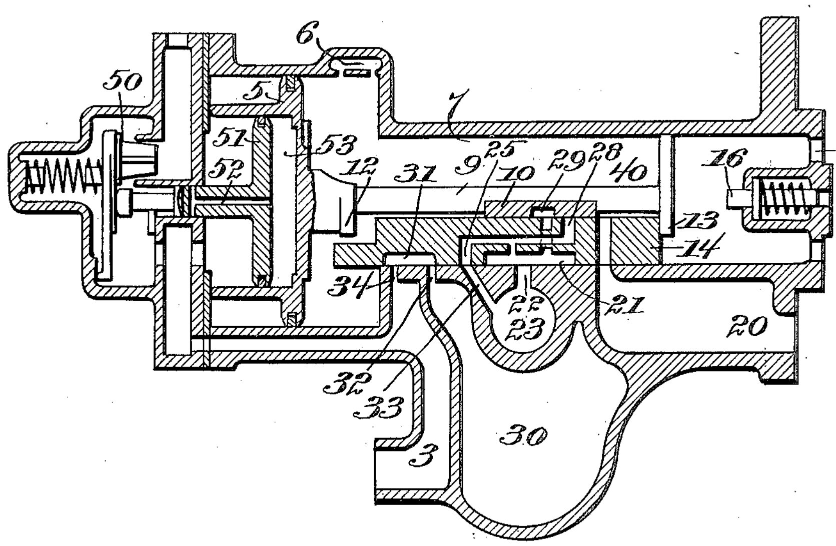
4 SHEETS—SHEET 4.

Fig. 13.



Witnesses:
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[signature]

Inventor
Henry F. Bickel.
by H. J. Livermore Atty.

UNITED STATES PATENT OFFICE.

HENRY F. BICKEL, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO NEW YORK AIR BRAKE COMPANY, A CORPORATION OF NEW JERSEY.

AIR-BRAKE APPARATUS.

1,076,543. Specification of Letters Patent. Patented Oct. 21, 1913.

Application filed June 18, 1912. Serial No. 704,285.

To all whom it may concern:

Be it known that I, HENRY F. BICKEL, a citizen of the United States, residing in Plainfield, in the county of Union and State of New Jersey, have invented an Improvement in Air-Brake Apparatus, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

The present invention relates to air brake apparatus and especially to the triple valve of an automatic air brake apparatus.

The object of the invention is to improve the action of the brakes, especially on long trains, by producing a more uniform application of the braking force throughout the length of the train than is commonly attainable.

With the standard air brake apparatus such as has been generally used on steam railways up to recent years, difficulty is experienced, especially on long trains, in obtaining an approximately uniform application of the brakes, since, by reason of the great length of the train pipe, the train pipe pressure falls more rapidly at the head of the train than toward the rear end, and thus causes the brakes to be applied with some considerable force on the cars at the head of the train before they are applied at the rear end, which unequal application causes severe shocks to the running gear of the train.

In recent years, the so-called "quick service" triple valve has been introduced which is characterized by having provision for locally venting the train pipe air in making service applications of the brakes, the purpose being to have the reduction in train pipe pressure thus propagated more rapidly toward the rear end of the train, so that the brakes at the rear end will be applied more promptly than when such local venting is not provided for. It is difficult to obtain satisfactory operation by this plan, since if the train pipe reduction by local venting is small, it is not very effective, and, if too large, the local vents are likely to discharge the train pipe pressure completely and cause an emergency application or a service application with full braking force to be produced, when only a moderate application is desired. Furthermore, the venting of train pipe air into the brake cylinder, as has been commonly practised with this type of triple valve, tends to increase the severity of the application at the head of the train in advance of that at the rear, and thus to increase the shocks on the running gear.

In accordance with the present invention, there is provided, in connection with the triple valve, a supplemental train pipe chamber and communications between said chamber and the train pipe and the atmosphere, respectively, controlled by the triple valve, said chamber being in communication with the atmosphere when the triple valve is in normal or release position, but being cut off from communication with the atmosphere and placed in communication with the train pipe when the triple valve is moved to service position in response to the reduction in train pipe pressure, this communication between the train pipe and the supplemental train pipe chamber being established before the service port establishes communication from the auxiliary reservoir to the brake cylinder. Thus the movement of the triple valve in response to a reduction in train pipe pressure produced by the engineer for applying the brakes in the usual manner, causes the supplemental chamber to be placed in communication with the train pipe and thus to increase the capacity of the train pipe a certain definite amount, so that the pressure of the train pipe air is reduced by reason of its increase in volume when the triple valve moves in response to the train pipe pressure reduction produced by the engineer. This takes place before the service port from the auxiliary reservoir to the brake cylinder has been opened so as to diminish the preponderance of auxiliary reservoir pressure tending to move the valve fully to service position. The reduction in train pipe pressure thus resulting from the response of the first triple valves to be affected, hastens the action of the triple valves more remote from the engineer's valve, and they in turn hasten the action of those still farther away, and so on, the reduction in train pipe pressure thus being propagated rapidly throughout the length of the train, and thus causing the triple valves all to respond promptly and without any considerable loss of auxiliary reservoir pressure by back flow through the feed grooves into the train pipe as takes place when train pipe pressure falls more slowly. After the initial reduction in train pipe pressure has thus been made by enlarging the train pipe air space, all further change in train pipe pressure is effected in the usual way under control of the engineer, who is thus enabled to produce graduated applications of the brakes with substantially as complete control of the braking pressure upon long trains as is attainable upon short trains.

Other features of construction and mode of operation different from those commonly exhibited in the standard triple valves heretofore used will be explained in connection with the drawings representing a concrete embodiment of the present invention, in which drawings:

Figure 1 is a longitudinal section, and Fig. 2 a transverse section on line x^2 of Fig. 1, of a triple valve embodying this invention; Fig. 3 is a plan view of the seat of the main slide valve of the triple valve; Fig. 4 is a plan view of the bottom or seating face of the main slide valve; Fig. 5 is a plan view showing the top of the main slide valve which constitutes the seat for the auxiliary or graduating valve; Fig. 6 is a plan view of the graduating valve; and Figs. 7 to 13, inclusive, are diagram views illustrating the operative relations of the passages in different positions of the parts assumed in the operation, Fig. 7 showing the parts in the normal or release position; Fig. 8 showing the parts in the position occupied in their movement from release to service position; Fig. 9 service position; Fig. 10 service lap position; Fig. 11 restricted release position; Fig. 12 normal position after restricted release; and Fig. 13 emergency position.

Referring to Figs. 1 to 6, inclusive, the main structural components may be of usual construction, or similar to those of the triple valves now in general use, and, broadly considered, they perform the usual functions in response to changes in train pipe pressure, the brakes being released and the auxiliary reservoirs charged when pressure is admitted to or increased in the train pipe, and the brakes being applied when the train pipe pressure is reduced, and the train pipe pressure being under the control of the engineer by a suitable engineer's valve, whereby the pressure may be admitted to the train pipe from the main reservoir on the locomtive, or may be reduced in the train pipe by permitting air to escape therefrom through a suitable vent or discharge passage controlled by the engineer's valve.

In the construction of triple valve represented, air is admitted from the train pipe, indicated at 2, and enters a train pipe air chamber 3 in the main shell or body of the triple valve, and thence passes to the cylinder 4 in which the triple valve piston 5 operates. The feed passage 6, of comparatively small capacity, affords a passage for the air from the train pipe past the piston 5, when in release position (to which it is moved by the train pipe pressure when greater than that in the auxiliary reservoir) said train pipe air entering the valve chamber 7 which communicates at 8 with the auxiliary reservoir of the same car equipment, so that normally the auxiliary reservoir becomes charged with air to the same pressure as that in the train pipe. The stem 9 of the triple valve piston engages the supplementary or graduating valve 10 and gives it the same movement as that of the triple valve piston, and said stem is also provided with projections 12 and 13 which engage the main slide valve 14, and cause the same to accompany the triple valve piston in a portion of its movement, but which are so located as to admit of a predetermined amount of movement of the triple valve piston and graduating valve 10 relative to the said main valve 14, in which movement the graduating valve is shifted on the main valve and controls certain ports or passages thereof, as will be explained.

For convenience in description, the terms "right" and "left" and "top" and "bottom", and the like, will be used with reference to the parts as represented in the drawings, and it will be recognized that when train pipe pressure is greater than auxiliary reservoir pressure, it acts upon the left hand side of the triple valve piston 5, tending to move it toward the right in its cylinder, while, if auxiliary reservoir pressure is greater than train pipe pressure, it acts upon the right hand side of the piston 5 and tends to move it toward the left, and said piston, in its movements in either direction, will produce a like movement of the graduating valve 10, and a movement of the main valve 14 when the shoulder 12 or 13 arrives at and engages the said main valve. The movement of the triple valve piston and valves toward the left, from the position shown in Fig. 1, causes the brakes to be applied and the return movement toward the right causes the brakes to be released, as will be explained more fully in connection with the diagrams. A yielding stop 16, shown as a spring-pressed rod, is provided to coöperate with the triple valve piston at the end of its movement toward the right in releasing the brakes, the said stop arresting the movement in the position shown in Fig. 1, if the train pipe pressure is only moderately in excess of the auxiliary reservoir pressure, and the said stop yielding and permitting a slight further movement toward the right (to the position shown in Fig. 11) when train pipe pressure is considerably greater than auxiliary reservoir pressure, said stop 16 controlling certain effects in the release operation which will be explained later.

A characteristic feature of the present invention is the supplementary train pipe chamber 30, shown in this instance as formed within the main body or shell of the triple valve, although its precise form or location is not essential. This supplementary chamber 30 is normally out of communication with the train pipe, that is, when the parts are in release position in which they remain in intervals between successive applications of the brakes, and said chamber contains only atmospheric pressure. If, therefore, the said chamber 30 should be placed in communication with the train pipe or train pipe chamber 3 in the triple valve, it would increase the capacity of the train pipe, and thus allow the train pipe air to assume a larger volume, and thereby have its pressure reduced correspondingly, the percentage of reduction depending upon the relation of the capacity of the chamber 30 to the proportional part of the train pipe pertaining to the same car equipment. Thus, if all of the equipments on the train were of this construction, and the chamber 30 had a capacity of three per cent., for example, of the capacity of the train pipe space pertaining to the same car equipment, the throwing of the chamber 30 into communication with the train pipe would cause a fall in the latter of approximately three per cent. This, with the pressures commonly carried, would produce a drop of approximately two or three pounds in train pipe pressure, resulting in a corresponding preponderance of auxiliary reservoir pressure which should be sufficient to overcome the frictional and other resistances to the movement of the valve parts, and thus cause the triple valve piston to be moved from release toward service or application position.

The remaining features will be best understood in connection with the diagrammatic representations, Figs. 7 to 13, which show the various communications in the different positions assumed in the operation of the valve. It is to be understood that the diagrams do not show the actual construction and proportions of the parts, but that the ports have been represented mainly as if located in a single plane, instead of being in different planes, as in the actual construction shown in Figs. 1 to 6.

Referring to Fig. 7, the parts are presented in normal or release position, such as is assumed when the train pipe pressure is increased, and moves the piston 5 toward the right, but has not sufficient preponderance to overcome the yielding stop 16. In this position, the graduating valve 10 is in the right hand position relative to the main valve 14, but has no effect upon the flow or distribution of the air, and the main valve 14 comes to rest with its main exhaust cavity 21 connecting the passage 20 that leads from the valve seat to the brake cylinder, with the port 22 which leads to the exhaust passage 23 communicating with the atmosphere, so that the air is exhausted from the brake cylinder through passages 20, 21, 22, 23 and the brakes are released. At the same time, air from the train pipe passes through the feed passage 6 into the valve chamber 7, and passage 8 into the auxiliary reservoir which thus becomes charged with the same pressure as that in the train pipe. In this position, the main valve 14 connects, by its cavity 31, the port 32 leading from the supplementary train pipe chamber 30 to the valve seat, with the port 33 leading to the exhaust passage 23, so that said chamber 30 is placed in communication with the atmosphere and any pressure above atmospheric which may have been produced therein when the valve was moved to service position is exhausted.

In making a service application of the brakes, the train pipe pressure is reduced by permitting air to escape from the train pipe at the engineer's valve, so as to reduce the pressure at a moderate rate. On long trains, by reason of the retardation of flow of air through the train pipe, the pressure will drop two or three pounds at the head of the train before it is materially reduced toward the rear end. The first effect of the drop in train pipe pressure on the triple valves near the head of the train is to produce movement from the position of the parts shown in Fig. 7 toward that shown in Fig. 8, because the drop in train pipe pressure leaves the auxiliary reservoir pressure in preponderance, which causes the triple valve piston 5 to move toward the left. When the train pipe pressure has fallen only slightly, the preponderance of auxiliary reservoir pressure is sufficient to start the piston 5 and graduating valve 10, and cause the latter to move on the main valve 14 until the shoulder 13 on the piston stem 9 engages the main valve 14, and when a little further fall in train pipe pressure takes place, the preponderance of auxiliary reservoir pressure will be sufficient to move the main valve to service position shown in Fig. 9, Fig. 8 being introduced merely to show the sequence of operations that take place in this movement.

The movement of the triple valve piston and the main valve may not in all cases be fully to the position shown in Fig. 9, but may stop at some point between positions shown in Figs. 8 and 9, with the service port 40 in the main valve not fully in coincidence with the brake cylinder port, that is, with the service port partially open. The movement of the graduating valve 10 from the position shown in Fig. 7 first uncovers the port 40 in the main valve 14, but, at this time, produces no effect on the flow of air as the said port 40 is still closed on the main valve seat. This movement, which takes place before the shoulder 13 engages the main valve is, however, sufficient to carry the piston 5 past the feed passage 6, so that there is no further back flow of air from the auxiliary reservoir into the train pipe such as takes place if train pipe pressure falls very slowly and does not promptly give sufficient preponderance of auxiliary reservoir pressure to move the piston and graduating valve. Directly after the main valve 14 begins its movement toward the left, the exhaust cavity 21 is moved so as to disconnect the brake cylinder and exhaust passages 20, 23, and the cavity 31 disconnects the passages 32, 33 by which the supplemental train pipe chamber 30 was maintained in communication with the atmosphere or exhausted while the brakes were at release position. A slight further movement of the main valve 14 beyond the point at which the brake cylinder and chamber 30 are cut off from the exhaust, causes the cavity 31 in the main valve to connect the port 34 in the valve seat with the port 32, and thus to establish communication from the train pipe chamber 3 to the supplemental train pipe chamber 30, the capacity of which is thus added to the train pipe space, so that the train pipe air is correspondingly increased in volume with corresponding diminution in pressure. The pressure in the train pipe and the supplemental chamber 30 very quickly equalize, and as chamber 30 is of a definite capacity the amount of train pipe reduction per car is definite in amount and uniform throughout the train. As indicated in Fig. 8, this enlargement of the train pipe capacity takes place before the service port 40 in the main valve comes into communication with the brake cylinder port 20 to admit air from the auxiliary reservoir into the brake cylinder, and thus to diminish the preponderance of auxiliary reservoir pressure which has been produced by the reduction in train pipe pressure. This is important because it insures the maintenance of the communication between the train pipe and supplementary train pipe chamber until the pressures have equalized therein. If the service port should establish communication from the auxiliary reservoir to the brake cylinder before the train pipe is put into communication with the supplemental chamber, the reduction in auxiliary reservoir pressure might cause the movement of the main valve to be checked before the communication from the train pipe to the supplementary chamber has been established, and thus prevent the hastening of the action of the other triple valves in the system. This would be especially likely to occur on long trains where the drop in train pipe pressure is relatively slow, and, consequently, where the acceleration of the reduction in train pipe pressure is most needed. If there were only the single car equipment and train pipe length to be considered, this connection of the supplemental chamber 30 with the train pipe would produce an immediate drop in train pipe pressure at this point, corresponding to the increase in train pipe volume, but, inasmuch as there is the entire length of train pipe to draw from, the effect will be not so much to produce a drop in train pipe pressure at the point where the triple valve has connected the supplemental chamber 30 therewith as to render the fall in pressure in the train pipe beyond this point more rapid than it would be if reduced only by venting the train pipe air at the locomotive. The triple valve or valves near the head of the train that first respond to the drop in train pipe pressure produced by the engineer and are moved from the position shown in Fig. 7 to that shown in Fig. 8, will, therefore, hasten the action of the triple valves immediately to the rear, and they in turn will hasten the action of those at the rear of them. The effect of this prompt serial movement of the triple valves is to cause a prompt equalization of train pipe pressure at a reduced pressure, which is sufficiently lower than auxiliary reservoir pressure, to cause the latter to produce the movement of the valves to service position, with the result that the valves at the rear end of the train are operated promptly and cut off the feed passages 6 before there is any appreciable reduction in auxiliary reservoir pressure by back flow into the train pipe.

As before stated, while the connection of the supplementary train pipe chamber with the train pipe is made before the service port from the auxiliary reservoir to the brake cylinder is opened, the movement of the main valve will ordinarily be continuous to approximately the position shown in Fig. 9, and by the time that the train pipe pressure is equalized and lowered by the increased capacity of the train pipe, as has just been explained, the service port 40 in the main valve will have been brought into communication with the brake cylinder passage 20, so that the air will flow from the auxiliary reservoir into the brake cylinder to apply the brakes, this taking place, as usual, until auxiliary reservoir pressure becomes slightly less than train pipe pressure when preponderance of the latter will move the triple valve piston 5 toward the right, bringing the parts to the position shown in Fig. 10 and commonly known as the service lap position. In the service lap position shown in Fig. 10, the parts are in the same position as in Fig. 9, except that the graduating valve 10 has been moved so as to cover the service port 40 in the main valve, and thus to prevent further delivery of air from the auxiliary reservoir to the brake cylinder until some further reduction in train pipe pressure has been made.

Comparatively small preponderance of pressure on either side of the triple valve piston is sufficient to move the said piston and the graduating valve 10, and by the above described construction a very slight application of the brakes may be made with approximate uniformity throughout the entire length of the train, thus avoiding the objectionable shocks which arise when, by reason of the variation in pressure throughout the length of the train pipe, the brakes are applied quite severely at the forward part of the train and very lightly, or not at all, at the rear end. The capacity of being able to produce light and approximately uniform applications of the brakes on long trains thus afforded is of great advantage in the handling of such trains.

After an initial application has been made, as has been explained, the braking force may be increased merely by making a further reduction in train pipe pressure, the operation then being precisely the same as with the standard triple valves heretofore used which have no provision for hastening the action toward the rear of long trains in making service applications. As there is no venting or discharge of train pipe air, except that effected under the control of the engineer by the brake valve, there is no danger of increasing the braking pressure beyond that desired by the engineer, as is the case where the triple valves are provided with means for controlling local train pipe vents which may operate to reduce the train pipe pressure beyond the desired amount in case of defective or sluggish action of some of the triple valves.

With the present construction, the failure or defective action of any of the triple valves would produce no effect upon the others. The port 34, which affords the communication between the train pipe and the supplementary train pipe chamber, is shown as of small capacity in order that the equalization of pressure may not take place too promptly, as this might cause an objectionably sudden drop in train pipe pressure on a short train in which the triple valve pistons on all the equipments would operate substantially simultaneously to establish the communication between the supplementary chamber and train pipe.

The release of the brakes is brought about by increasing train pipe pressure, as usual, which causes the triple valve piston to move toward the right. In this operation, the pressure being admitted at the head of the train, the pressure rises more rapidly in the forward part of the train pipe than at the rear of a long train, and thus causes the brakes to be released at the head before they are at the rear, unless there is some provision for preventing such action. If this release should be effected in the common manner while the train is still running, the freeing of the forward cars while the rear ones are still retarded might cause severe shocks to the draw bars, and provision is made in the construction herein shown for causing the release of the brakes to take place more slowly toward the front than toward the rear of the train.

The operation of effecting the slow release is indicated in Fig. 11. When the train pipe pressure is very much in excess of auxiliary reservoir pressure, as may be the case near the head of the train, when air is first admitted to the train pipe on a long train, the preponderance of train pipe pressure is sufficient to overcome the yielding stop 16, and thus to move the main valve 14 to the position shown in Fig. 11 which is slightly beyond the normal release position shown in Figs. 1 and 7. In this position, (Fig. 11) the main exhaust cavity 21 has passed beyond the exhaust port 22, so that the latter is not connected directly with the brake cylinder port 20, but a supplemental or secondary exhaust port 25 in the main valve communicates with the exhaust port 22, and also communicates with the main exhaust cavity 21 by a relatively small passage 26, which forms a part of the secondary exhaust passage, through which the air can escape from the brake cylinder to the atmosphere, but only at a slow rate, so that the braking pressure is reduced slowly in the equipments toward the head of the train in which the triple valve pistons have been moved far enough to overcome the yielding stop 16. Toward the rear of the train, however, where the preponderance of train pipe pressure over auxiliary reservoir pressure is less, the yielding stop 16 will not be overcome, and the parts will come to normal release position, shown in Fig. 7, so that the braking pressure will be released promptly from the brakes, and the cars toward the rear end of the train will thus be freed, while those at the forward part of the train are not yet fully released by reason of the slow discharge through the secondary exhaust passage 25, including the small or restricted part 26, and there will be a tendency for the rear part of the train to run forward and to bunch the cars together, rather than to hang back and put the couplings under tension. As soon, however, as the auxiliary reservoirs toward the head of the train become charged approximately to train pipe pressure, the springs of the yielding stops

16 will act and move the triple valve pistons and graduating valves 10 toward the left relative to the main valve, and bring the parts to the position shown in Fig. 12, or to what is the normal position after a restricted release of the brakes has been made. This movement of the graduating valve 10 relative to the main valve will cause the cavity 29 in the graduating valve to connect the port 27 leading from the main exhaust cavity 21 with a port opening 28 in the top of the main valve from the secondary exhaust port 25, thus affording a relatively large exhaust passage from the brake cylinder to the atmosphere, whereby the remainder of the pressure in the brake cylinder, if there be any which has not yet been discharged through the small passage 26, will be promptly exhausted and the brakes throughout the train will then have been completely released.

The features of construction thus far described do not depend upon the specific character of the device which is employed in making emergency applications of the brakes, but the valve which is represented as exemplifying the invention is shown as provided with appliances for effecting emergency operations, substantially such as are shown in patent to Milton H. Neff, No. 745,735, dated Dec. 1, 1903, to which reference may be had. The emergency operation is represented in the diagram, Fig. 13, and the appliances concerned therein comprise a vent valve 50 through which, when opened, air is permitted to escape from the train pipe, so as to hasten the reduction in train pipe pressure and the consequent application of the brakes, said vent valve 50 being operated by a piston 51 working in a cylindrical chamber in the triple valve piston 5.

Normally and when only moderate reductions in train pipe pressure are made, as in service applications, the pressure at both sides of the emergency piston 51 is equalized through a small passage 52, shown as made in the stem of said piston. Air at substantially train pipe pressure is thus normally maintained in the chamber 53 between the pistons 5 and 51, and, consequently, the piston 51 is not moved during the operations of the valve illustrated in Figs. 7 to 12. In case, however, of a sudden reduction of train pipe pressure, the pressure in the chamber 53 does not fall so rapidly as the train pipe pressure, and when the triple valve piston 5 is moved to the left, the pressure in the chamber 53 being greater than the train pipe pressure at the other side of the piston 51, causes said piston 51 to be moved to the left and to open the vent valve 50, thereby increasing the reduction of train pipe pressure and tending to produce similar prompt action in the other triple valves.

The invention embodied in the features above described is not limited to the specific construction shown, in all its details, nor to a structure having the specific form of appliances illustrated for operating in emergency applications of the brakes.

What I claim is:

1. A triple valve for automatic air brake apparatus, comprising a piston subject to the opposing pressures of air in the train pipe, and in the auxiliary reservoir; and main and graduating valves operated by said piston, combined with a supplementary train pipe chamber, and ports governed by said main valve whereby said chamber is cut off from communication with the train pipe and put into communication with the atmosphere when said main valve is in normal or release position, and whereby said chamber is cut off from communication with the atmosphere and placed in communication with the train pipe when said main valve is moved to position for causing the brakes to be applied, said communication being established before communication is established from the auxiliary reservoir to the brake cylinder, and whereby the auxiliary reservoir is placed in communication with the brake cylinder after communication has been established between the train pipe and said supplemental train pipe chamber.

2. The combination with the triple valve cylinder and piston, and main and graduating valves operated thereby; of a yielding stop which overcomes a predetermined preponderance of train pipe pressure on the triple valve piston, but is overcome by a larger preponderance, said main valve having a main exhaust cavity which establishes communication from the brake cylinder to the atmosphere when the piston is arrested by the yielding stop, and a secondary exhaust passage of relatively small capacity which connects the brake cylinder with the atmosphere when the piston has moved to overcome the said yielding stop, and a communication between said main and secondary exhaust cavities controlled by the graduating valve, substantially as and for the purpose described.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses.

HENRY F. BICKEL.

Witnesses:
E. M. Garrah,
Margaret G. Hogan.