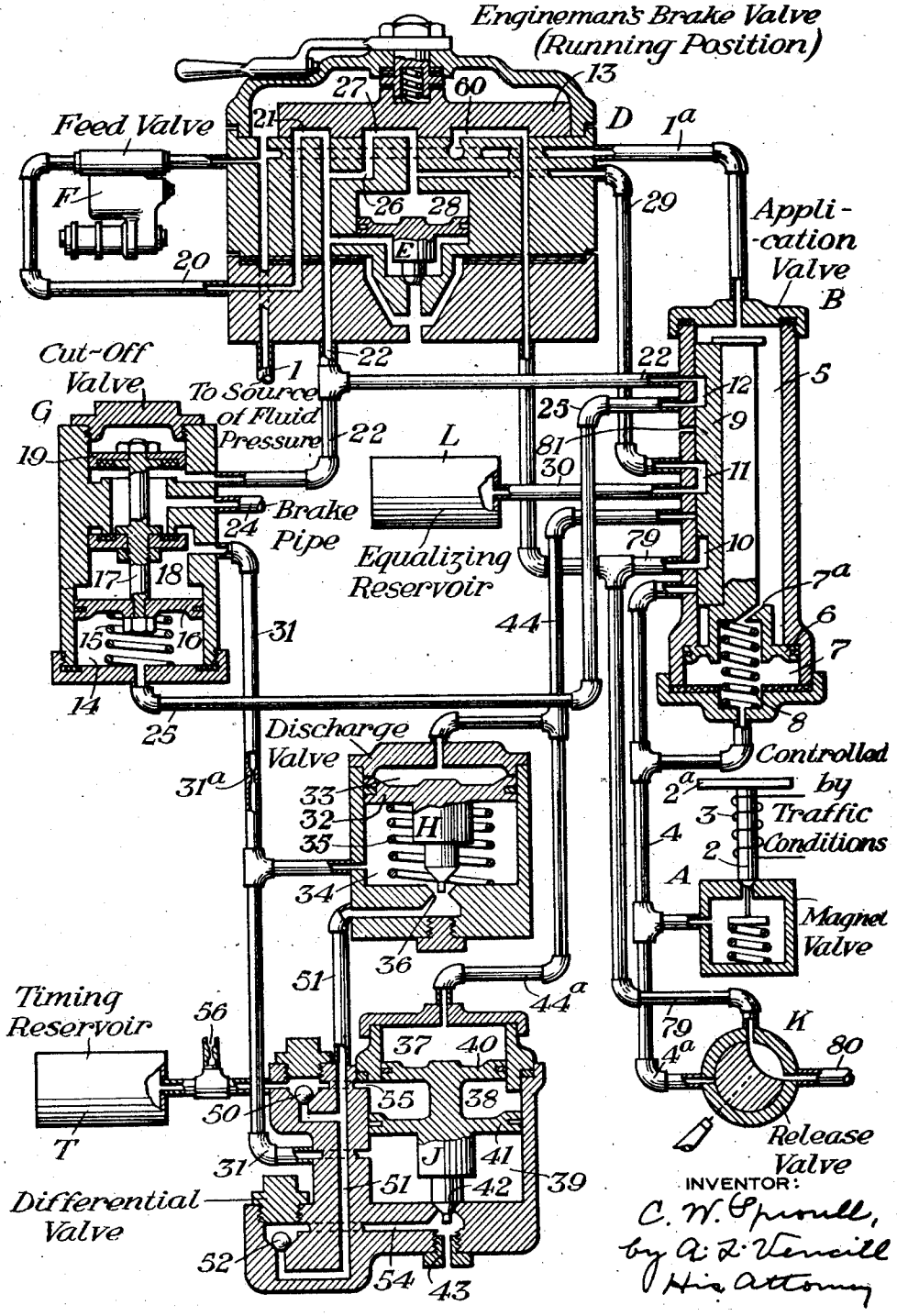
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RAILWAY TRAFFIC CONTROLLING APPARATUS

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RAILWAY-TRAFFIC-CONTROLLING APPARATUS.

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My invention relates to railway traffic controlling apparatus, and particularly to apparatus for controlling the automatic brake applying mechanism on a train in accordance with traffic conditions.

In at least one form of railway traffic controlling apparatus of the type described, the train is provided with apparatus for causing an automatic application of the brakes under unsafe traffic conditions and for preventing such application under safe traffic conditions. When the brakes upon a train are automatically applied with sufficient force to produce the deceleration which safety requires, damage may result from shifting of the lading or from shocks to the rolling stock. For this and other reasons it is sometimes desirable to make the application in two parts, that is, to cause a preliminary brake application to run in the "slack" of the train and then, after a time interval, to cause a second application to bring the train to the desired low speed. Brake applications which are accomplished in the manner just described are usually called "split" applications and one object of my present invention is the provision of means for automatically causing a split application on board a train.

I will describe one form of apparatus embodying my invention, and will then point out the novel features thereof in claims.

The accompanying drawing is a view, partly diagrammatic and partly in cross-section, illustrating one form of apparatus embodying my invention.

Referring to the drawing, the reference character A designates a magnet valve comprising a valve stem 2 provided with an armature 2^a and a winding 3. The supply of current to winding 3 is controlled in accordance with traffiic conditions by means forming no part of my present invention and omitted from the drawing for the sake of simplicity. For present purposes it is sufficient to state that when traffic conditions are safe, winding 3 is energized and stem 2 is then drawn downwardly into the position in which it is shown in the drawing to blank pipe 4. Under unsafe traffic conditions winding 3 becomes de-energized, allowing stem 2 to rise and connecting the pipe 4 with atmosphere.

Pipe 4 controls a brake application valve designated by the reference character B and comprising two chambers 5 and 7, separated by a reciprocable piston 6. When valve A is closed, fluid pressure, usually air, flows from a suitable source not shown in the drawing, through pipes 1 and 1^a to chamber 5 of valve B, and thence through a restricted orifice 7^a in piston 6 to chamber 7. Pipe 4 is connected with chamber 7 but with valve A closed, this pipe is blanked so that the pressures on the two sides of piston 6 are equal, and spring 8 therefore moves piston 6 to its upper or normal position. The piston 6 controls a slide valve 9 containing a number of ports, the functions of which will be described in detail hereinafter.

The reference character D designates the usual engineman's brake valve, here illustrated in the running position and containing an equalizing valve E. The usual brake applying mechanism on the train, not shown in the drawing, is controlled by means of a pipe 24 which may conveniently be the brake pipe and which is normally supplied with fluid pressure from pipe 1, through the usual feed valve F, pipe 20, port 21 of the rotary valve 13 of the engineman's brake valve, pipe 22 and cut-off valve G to the brake pipe 24. When the pressure in the brake pipe 24 is reduced an automatic application of the brakes results, the severity of the brake application depending upon the magnitude of the brake pipe pressure reduction.

The cut-off valve G comprises a chamber 14 containing a piston 16 which operates a stem 17 controlling two valves 18 and 19. With the brake valve D and the application valve B in the positions in which they are shown in the drawing, pressure from the pipe 22 flows through port 12 of the application valve and pipe 25 to chamber 14 beneath the piston 16. The combined force exerted by this pressure and the spring 15 moves the piston 16 and the stem 17 carried thereby to an upper or normal position in which valve 18 is closed and valve 19 is open. Under these conditions, pipe 24 is connected with pipe 22 to permit fluid pressure to flow into the brake pipe as described hereinbefore to maintain the pressure in this pipe. When the application valve B is reversed, port 12 connects pipe 25 with atmosphere through port 81 thereby venting chamber 14 of valve G to atmosphere and allowing the pressure above

valve 18 to open this valve, thereby admitting pressure to the upper side of piston 16 and moving the piston to its lower or reverse position against the bias of spring 15. When valve G is reversed, pipe 22 is disconnected from brake pipe 24 and the brake pipe is connected with pipe 31.

With the application valve B in its normal position and with valve G in its normal position, the brake pipe 24 is connected through valve G, pipes 22 and 26, and port 27 of valve D with the chamber 28 above the usual equalizing valve E, and through pipe 29, port 11 in valve B and pipe 30 with the usual equalizing reservoir L. Under normal conditions, therefore, the equalizing reservoir L is charged to the same pressure as the brake pipe 24.

The apparatus comprises also a discharge valve H and a differential valve J. The valve H comprises two chambers 33 and 34 separated by a reciprocable piston 32, biased to an upper position by a spring 35. When the piston is in its lower position port 36 is closed, but when the piston is in its upper position port 36 is open and connects the chamber 34 with atmosphere through pipe 51, check valve 52, port 54 and a restricted orifice 43.

The differential valve J comprises a chamber 37 containing a comparatively small piston 40 and a second chamber 39 containing a comparatively large piston 41. The pistons 40 and 41 are operatively connected together and are spaced axially so that the valve comprises a chamber 38 intermediate the two pistons. When valve J occupies its lower position port 42 is closed, but when valve J rises, port 42 connects chamber 39 with port 54, and hence with atmosphere through orifice 43. Chamber 38 is constantly connected with a timing reservoir T through pipe 55 which communicates with atmosphere through a restricted orifice 56. The pipe 55 connecting the reservoir T with chamber 38 is connected with pipe 51 through a check valve 50.

As shown in the drawing, valve A is energized so that pipe 4 is blanked and the application valve B occupies its normal position. The engineman's brake valve D is illustrated in its running position and valve G is normal. The brake pipe 24 is therefore charged with fluid pressure to prevent a brake application, and the equalizing valve is connected with this pipe and is also charged with the same fluid pressure. Under these conditions, no pressure is supplied to any of the chambers of valves H or J and the timing reservoir T is subjected to atmospheric pressure. Piston 32 of valve H is therefore raised by spring 35, and gravity holds valve J in its lower position.

In explaining the operation of the apparatus, I will first assume that winding 3 of valve A becomes de-energized, as by a change from safe to unsafe traffic conditions. Pipe 4 is therefore connected with atmosphere so that chamber 7 of application valve B is vented. The pressure in chamber 5 therefore moves piston 6 of valve B downwardly against the force exerted by spring 8 to reverse valve B. Port 10 then connects chamber 7 with pipe 79 which communicates with atmosphere at port 80 of a release valve K. This valve is preferably located at some point of the locomotive where it will be inaccessible to the engineman except when the train is at rest. Pipe 79 also normally communicates with atmosphere through a port 60 in the engineman's brake valve which is closed only when the valve D is in the lap position. The brake application valve B having once been moved to its reverse position remains in the reverse position even though valve A subsequently closes. When the application valve moves to its reverse position, chamber 14 of valve G is vented to atmosphere through port 12 of valve B and port 81 as described hereinbefore. The cut-off valve G therefore moves to its reverse position, disconnecting pipe 24 from pipe 22 and connecting pipe 24 with pipe 31. Pipe 31 is constantly connected with chamber 34 of valve H and with chamber 39 of valve J. These chambers and the pipe connected therewith may have a considerable volume and I therefore interpose a restriction 31^a in the pipe 31 so that the sudden connection of the brake pipe 24 with pipe 31 when the valve G reverses will not cause a sufficiently rapid reduction in the brake pipe pressure to cause an emergency application of the brakes. It should be noted that valve G remains in its reverse position as long as the application valve B is reversed due to the connection of pipe 25 with port 81. The movements of the brake application valve B to its reverse position also disconnected the equalizing reservoir L from pipe 29 and connected this reservoir with pipe 44 through port 11 of valve B. The equalizing reservoir is therefore connected with chamber 33 of valve H and with chamber 37 of valve J. The chambers 33 and 37 and pipe 44 should preferably have small volumes so that the connection of reservoir L with these volumes will cause substantially no reduction in the pressure to which this reservoir was initially charged. The combined force of brake pipe pressure and spring 35 is now applied to the under side of piston 32 of valve H and equalizing reservoir pressure is applied to the upper side of this piston. The piston therefore remains in its upper position, so that port 36 is open to vent the brake pipe to atmosphere through pipe 51, valve 52, port 54 and orifice 43. At the same time the equalizing reservoir pressure in chamber 37

above piston 40 of valve J is over-balanced by the brake pipe pressure in chamber 39 under piston 41 of this valve, so that valve J rises, opening port 42 and connecting pipe 31 with orifice 43. Valves J and H are both now in their upper positions and the brake pipe is vented through ports 36 and 42 to the orifice 43. During this operation a considerable back pressure is formed in pipe 51 due to the discharge from port 36 of valve H through the restricted orifice 43. This back pressure flows through the check valve 50 into the timing reservoir T, charging this reservoir with fluid pressure. The pressure in the reservoir T enters chamber 38 through pipe 55 and combines with the force exerted on the top of piston 40 to move the valve J to its lower position, closing port 42 and interrupting the venting of the brake pipe through port 42. After an interval of time the brake pipe pressure will be so reduced that the equalizing reservoir pressure in chamber 33 of valve H will over-balance the combined forces exerted by the brake pipe pressure in chamber 34 and the spring 35. When this happens valve H returns to its lower position, closing port 36 and preventing further bleeding of the brake pipe. The parts are so proportioned that this preliminary reduction in brake pipe pressure is sufficient to give the desired "bunching" application. In actual practice it has been found desirable to make the preliminary brake pipe reduction amount to about seven pounds per square inch.

When the preliminary reduction is completed as above described both valves H and J closed, and the timing reservoir T is discharging through the restricted orifice 56. The rate at which the pressure in the timing reservoir T is reduced depends upon the combined volume of the reservoir, pipes, ports and other volumes to which it is connected, the character of fluid, and the effective area of discharge orifice 56. When the pressure in the timing reservoir has reduced to a certain value, which will be a definite proportion of the then existing pressure in chamber 39, valve J will move to its upward position thus opening port 42 and permitting fluid to flow to atmosphere from the brake pipe through pipe 31, chamber 39, port 42 and orifice 43. On account of this flow of fluid from the brake pipe, the pressure below piston 41 is gradually reduced. At the same time the pressure in the timing reservoir T and above piston 41 is gradually reducing. It is, therefore, evident that if the rate of pressure reduction in chamber 39 becomes greater than the rate of pressure reduction in chamber 38, the resultant forces controlling valve J will operate to close port 42 to terminate the second and final automatic brake pipe pressure reduction, and thus prevent the rate of pressure reduction in chamber 39 from exceeding the rate of pressure reduction in the timing reservoir T. It is, therefore, evident that valve J may be made to operate in such a way as to govern the rate at which the fluid pressure of the brake pipe will be reduced during the progress of the second and final brake pipe pressure reduction.

In the practical operation of trains it has been found that the shock to which the train is subjected during a brake application is very largely dependent upon the rate at which the pressure in the brake pipe is reduced. Furthermore, the brake pipe of a train is, in most cases, in a leaky condition and since the leakage rate affects the rate of pressure reduction in the brake pipe, it is of prime practical importance that the automatic applications be made in such manner that the absolute rate of brake pipe reduction will be automatically governed regardless of the rate at which the brake pipe leaks to atmosphere.

By properly proportioning the areas of pistons 40 and 41 the final gauge pressure of the brake pipe after the second reduction may be made to equal any predetermined proportion of the original gauge pressure of the equalizing reservoir. In actual practice I have discovered that if the area of piston 41 is substantially 46 per cent greater than the area of piston 40 a satisfactory reduction of brake pipe pressure will be obtained for normal operating conditions with standard automatic air brake apparatus.

It will be noted that when valve G reverses, the brake pipe is disconnected from pipe 22 through which it receives its fluid pressure from pipe 1 and it is therefore impossible to recharge the brake pipe until valve G is restored to its normal position.

The purpose of the ball check valve 52 is to prevent pressure from pipe 54 from flowing back through pipe 51 into the timing reservoir T during the second brake pipe reduction when pressure flows from chamber 39 of valve J through port 42. The purpose of check valve 50 is to prevent pressure from the timing reservoir from flowing through pipe 51 out through port 43 during the time interval after the preliminary reduction and before valve J opens to give a second brake pipe reduction.

I will now assume that valve A again becomes closed, as upon a change from unsafe to safe traffic conditions. Pipe 4 is therefore blanked at valve A, but the application valve remains in its reverse position because when valve B is reversed to connect pipe 4 with pipe 79 at port 10, chamber 7 is connected with atmosphere at port 60 of valve D and also through the release valve K. The engineman must therefore bring the train to a full stop, move his brake valve D to the lap position, and

operate valve K to blank pipe 79. This operation of the valve K also connects pipe 79 with a branch 4ª of pipe 4. Pressure flowing from chamber 5 of valve B through port 7ª into chamber 7 and pipes 4 and 79, builds up until the pressures on the two sides of piston 6 are equal, whereupon valve B returns to its normal position. Pipes 4 and 79 are now disconnected at port 10 of valve B, but these pipes are connected through valve K. If however, the engineman restores the valve K to its normal position after valve B has moved to its normal position, branch pipe 4ª will be blanked, and the application valve will remain in its normal position. The engineman may now move his brake valve away from the lap position to charge chamber 14 of valve G through pipes 25 and 22. Valve G therefore returns to its normal position, disconnecting the brake pipe from pipe 31, and connecting the brake pipe with pipe 22. The brake pipe may then be recharged with fluid pressure through the feed valve or may be charged directly from pipe 1 by manipulation of the engineman's brake valve to the release position as will be readily understood by one skilled in the art.

I have described in detail the operation of only that part of the apparatus which is involved in an automatic application of the brakes. It will be clear from the drawing, however, that the engineman's brake valve may be operated as usual to control the brake pipe pressure manually through the medium of the equalizing valve E in accordance with standard practice, except when valves B and G are in their reverse positions. It will therefore be seen that in apparatus embodying my invention when an application of the brakes is to be made automatically, the operation of valve H first causes a preliminary reduction of the brake pipe pressure by a predetermined amount and at the same time charges the timing reservoir T. After the preliminary reduction is completed a time interval of predetermined duration elapses during which the reservoir T discharges to asmosphere through the port 56. Upon the expiration of this interval valve J operates to further reduce the brake pipe pressure to a predetermined proportion of its original value.

Although I have herein shown and described only one form of railway traffic controlling apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, a discharge valve comprising a cylinder divided into a lower chamber and an upper chamber by a reciprocable piston the lower chamber communicating with atmosphere when the piston occupies an upper position, a spring for urging the piston to an upper position, and means for at times connecting said pipe with the lower chamber, and for supplying the upper chamber with the pressure to which the pipe was initially charged.

2. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, a cylinder containing a reciprocable piston, a spring constantly bearing against one side of the piston, means for at times exposing one side of the piston to the pressure in the pipe and for exposing the other side of the piston to the pressure to which the pipe was initially charged, and a valve controlled by said piston for reducing the pressure in the pipe until the combined force exerted on one side of the piston by the spring and the pressure in the pipe is less than the force exerted on the other side of the piston by said initial pressure.

3. In combination with the automatic brake applying mechanism on a train, a magnet valve controlled by traffic conditions, an application valve controlled by the magnet valve, and a discharge valve and a differential valve controlled by said application valve and arranged when the application valve is reversed to cause successive operations of the brake applying mechanism.

4. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an application valve controlled by traffic conditions, a cut-off valve controlled by the application valve, a discharge valve controlled by the application valve and by the cut-off valve, and a differential valve controlled in part by the discharge valve, said discharge and differential valves operating at times to cause successive measured reductions in the pressure in said pipe.

5. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe, an application valve controlled by traffic conditions for disconnecting the reservoir from the pipe when the application valve is reversed, and means effective when the appli-

cation valve is reversed to automatically reduce the pressure in the pipe by a predetermined amount below the pressure in the reservoir.

6. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe, an application valve controlled by traffic conditions for disconnecting the reservoir from the pipe when the application valve is reversed, and means effective when the application valve is reversed to automatically reduce the pressure in the pipe by a predetermined amount below the pressure in the reservoir, and means for subsequently further reducing the pressure in the pipe to a predetermined proportion of the pressure in said reservoir.

7. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe, an application valve controlled by traffic conditions for disconnecting the reservoir from the pipe when the application valve is reversed, and means operating upon the expiration of a time interval following the reversal of the application valve to reduce the pressure in said pipe to a predetermined proportion of the pressure in the reservoir.

8. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe, an application valve controlled by traffic conditions for disconnecting the reservoir from the pipe when the application valve is reversed, means operating when the application valve is reversed to cause a preliminary reduction in the pressure in said pipe, and other means effective upon the expiration of a time interval after such preliminary reduction to further reduce the pressure in the pipe to a predetermined proportion of the pressure in said reservoir.

9. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equaliing reservoir normally connected with said pipe, an application valve controlled by traffic conditions for disconnecting the reservoir from the pipe when the application valve is reversed, a timing reservoir connected with atmosphere through a restricted orifice, means operating when the application valve is reversed to cause a preliminary reduction in the pressure in said pipe and to charge said timing reservoir, and means responsive to the pressure in said timing reservoir for further reducing the pressure in said pipe to a predetermined proportion of the pressure in the equalizing reservoir.

10. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, a timing reservoir constantly connected with atmosphere through a restricted orifice, a discharge valve for at times causing a preliminary reduction in the pressure in said pipe, and for simultaneously charging said reservoir, and means responsive to the pressure in said reservoir for causing a further reduction in the pressure in said pipe.

11. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, a timing reservoir constantly connected with atmosphere through a restricted orifice, a discharge valve for at times causing a preliminary reduction in the pressure in said pipe and for simultaneously charging said reservoir, and means effective when the pressure in the reservoir has been reduced by leakage through the orifice to cause a further reduction in the pressure in said pipe.

12. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe, a discharge valve comprising a cylinder divided into a first chamber and a second chamber by a reciprocable piston, a port connecting the second chamber with atmosphere and closed when the piston occupies one extreme position, a spring constantly urging the piston away from such extreme position, and means for at times disconnecting the reservoir from said pipe and connecting the reservoir with the first chamber and for connecting the pipe with the second chamber.

13. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe, a differential valve comprising two pistons of different areas, means for at times disconnecting the reservoir from said pipe and for exposing one piston to the pressure in the reservoir, and for exposing the other piston to the pressure in the pipe, and means responsive to the relative values of the forces acting upon the two pistons for controlling the pressure in said pipe.

14. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe, a differential valve comprising two chambers containing pistons of different areas operatively connected together, means for disconnecting the equalizing reservoir from said pipe and connecting the reservoir with the chamber containing the smaller piston and for connecting the pipe with the other chamber, and a port in said other chamber communicating with atmosphere and arranged to be closed when the force exerted upon the smaller piston exceeds the force exerted upon the larger piston.

15. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe; a differential valve comprising a cylinder containing two pistons of different areas operatively connected together and dividing the cylinder into a first chamber containing the smaller piston, a second chamber containing the larger piston and a third chamber between the two pistons; a timing reservoir constantly connected with said third chamber and communicating with atmosphere through a restricted orifice, means for at times disconnecting the equalizing reservoir from said pipe and for connecting such reservoir with said first chamber, a discharge valve responsive to the pressure in said equalizing reservoir for causing a preliminary reduction in the pressure in said pipe and for simultaneously charging said timing reservoir, and means for connecting said pipe with said second chamber.

16. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe; a differential valve comprising a cylinder containing two pistons of different areas operatively connected together and dividing the cylinder into a first chamber containing the smaller piston, a second chamber containing the larger piston and a third chamber between the two pistons; a timing reservoir constantly connected with said third chamber and communicating with atmosphere through a restricted orifice, means for at times disconnecting the equalizing reservoir from said pipe and for connecting such reservoir with said first chamber, means for at times charging the timing reservoir, and means for connecting said pipe with the second chamber, the differential valve being responsive to the relative values of the pressures in the three chambers to vent the second chamber at a predetermined rate.

17. Automatic brake applying apparatus on a train comprising a brake pipe initially charged with fluid pressure and arranged to apply the brakes when the pressure in such pipe is reduced, an equalizing reservoir normally connected with said pipe; a differential valve comprising a cylinder containing two pistons of different areas operatively connected together and dividing the cylinder into a first chamber containing the smaller piston, a second chamber containing the larger piston and a third chamber between the two pistons; a timing reservoir constantly connected with said third chamber and communicating with atmosphere through a restricted orifice, means for at times disconnecting the equalizing reservoir from said pipe and for connecting such reservoir with said first chamber, means for at times charging the timing reservoir, and means for connecting said pipe with the second chamber, the differential valve operating at times to vent the second chamber at a rate dependent upon the pressure in the timing reservoir.

In testimony whereof I affix my signature.

CLARENCE W. SPROULL.