May 23, 1933. F. J. SUPER 1,910,936

AIR BRAKE

Filed Sept. 23, 1930 2 Sheets-Sheet 1

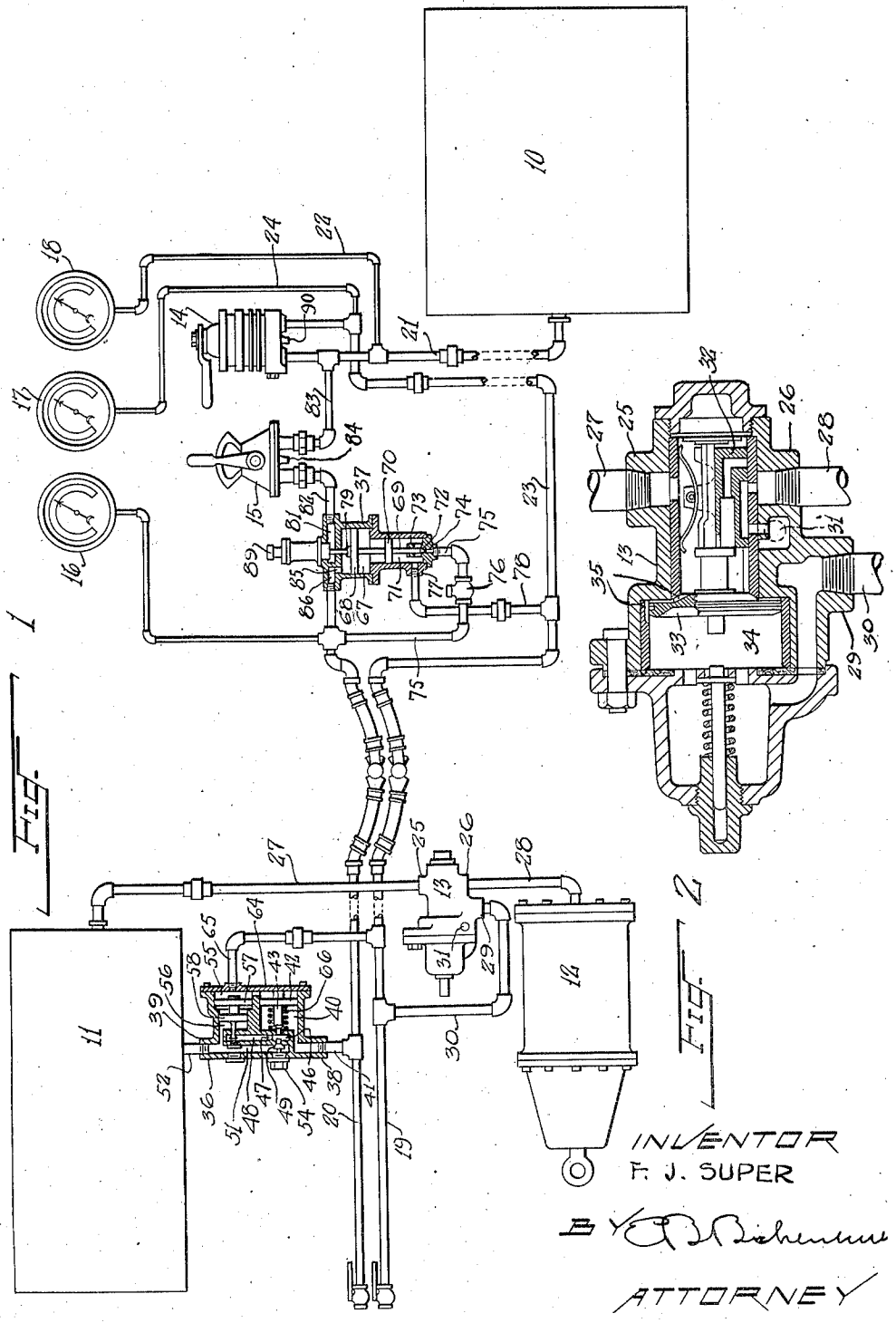


FIG. 1

FIG. 2

INVENTOR
F. J. SUPER
BY
ATTORNEY

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AIR BRAKE

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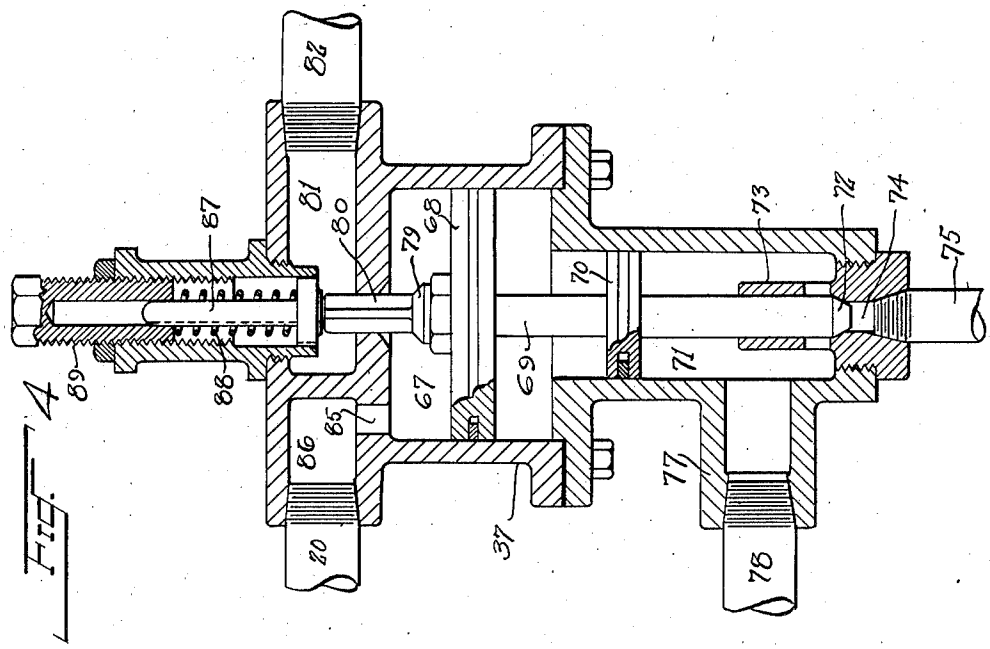


Fig. 4

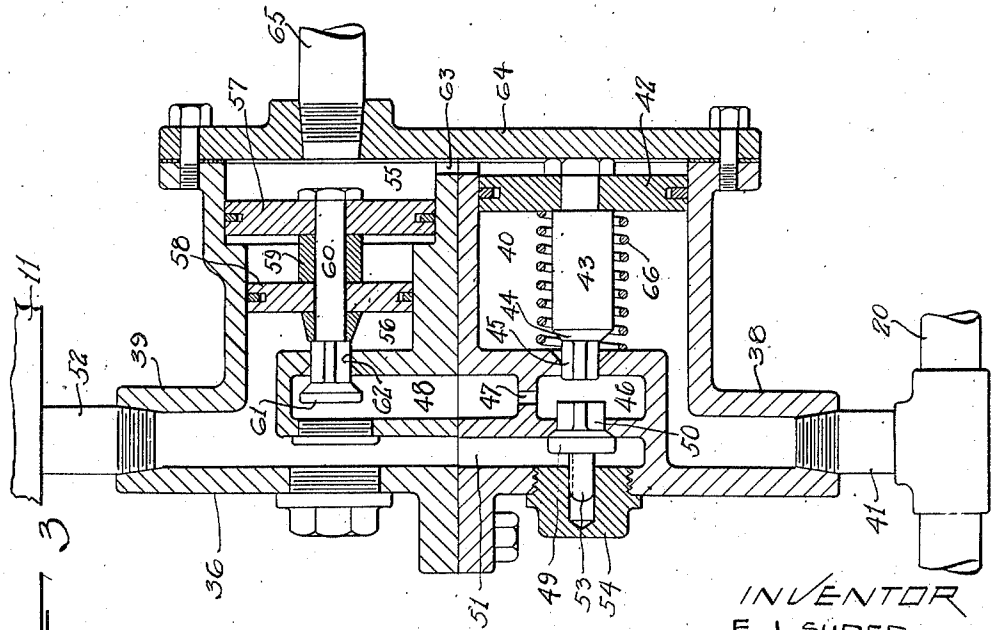


Fig. 3

INVENTOR
F. J. SUPER
BY C. B. Richmond
ATTORNEY

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UNITED STATES PATENT OFFICE

FRANK J. SUPER, OF PORTLAND, OREGON

AIR BRAKE

Application filed September 23, 1930. Serial No. 483,792.

This invention relates to air brake systems suitable for use where heavy trains must descend long grades, and it has for its principal object the provision of a system giving maximum safety with a minimum of added equipment.

A further object of the invention is to devise a system which will preserve the usual train line with its triple valves and in the paralleling of this line by a simple straight air line using only two new and entirely automatic valves with a well known manually controlled valve, to make it possible to gain new and important advantages such as the ability continually to charge the auxiliary reservoirs while the brakes are applied, to apply or release the brakes by means of the straight air line without movement of the engineer's brake valve, to increase the brake pressure without releasing the brakes, etc., all without sacrificing a single advantage flowing from the use of the customary train line which remains substantially unaltered.

With the equipment now in general use the engineer has perfect control over his train under practically all conditions where the road is either level or with relatively short grades. Where however, the grades are long and it is necessary to increase the length of the train many problems are presented which are met by the present systems only with difficulty for example, when a long grade is to be descended the brakeman must adjust retainers on the triple valves of each car this in order to retard the release of the brakes each time the auxiliary reservoir is to be recharged, furthermore there is always danger with such long grades and the equipment is severely taxed and it happens altogether too frequently that a train will break in two causing at very least a serious delay.

By means of the additional equipment here provided, which adds only a very trifling expense and weight, it is possible to eliminate the retainers and yet retard the descent of a train down a long grade with the greatest of ease and entirely without danger or even material strain upon the equipment.

In the drawings:—

Figure 1 is a diagrammatic view of the system showing the new valves in section.

Figure 2 is a section thru a triple valve of well known construction.

Figure 3 is a section thru the straight air control valve.

Figure 4 is a section thru the automatic application valve.

Before taking up the new straight air line a brief description will be given of that portion of the present system which is prior art, a very simple form having been chosen in order to shorten the description. Having particular reference to Figure 1 the equipment to the right is all located on the engine and the equipment to the left of the coupling pipes is located on each of the cars. The pressure in the main air reservoir 10 is kept between chosen limits by well known mechanism and this reservoir charges a plurality of auxiliary reservoirs 11 which in turn build up a pressure in the brake cylinders 12 whenever the triple valves 13 are in position to establish thru communications, such position being taken whenever pressure in the train line is lowered, either intentionally as by the engineer moving his brake valve 14, or by loss of air in the train line due to an accident.

Referring particularly to Figure 2 the triple valve 13 represents well known practice, pipe 27 leading from the auxiliary reservoir 11 and the lower pipe 28 substantially in alinement with it leading directly to the brake cylinder 12, communication between these two pipes being prevented, while the valve is in the normal position shown, by the blocking of the port leading to the pipe 28 by the D-valve 32 which, as illustrated, is establishing communication between the brake cylinder and the atmosphere thru the exhaust port 31 which is indicated by a dotted circle. The train line 19 thru a branch 30 communicates with the bottom of the triple valve substantially centrally, leading to a bore in communication with the chamber 34, pressure in the train line forcing the

piston 33 to the right carrying with it the D-valve 32. When the piston 33 is at the right of the chamber 34 the groove 35 establishes communication between the train line 19 and the auxiliary reservoir 11 in order to restore the pressure in the auxiliary reservoir 11 whenever the triple valve is moved to normal position, that is, whenever the brakes are released, the air passing from train line 19 thru branch 30 into the bottom of the triple valve, the chamber 34, groove 35, the chamber in which the D-valve is located, and thence thru pipe 27 direct to the auxiliary reservoir which therefore is normally at the same pressure as the train line.

Upon decrease in pressure in the train line 19, and therefore in the pipe 30 and chamber 34, the now greater pressure in the auxiliary reservoir and pipe 27 moves the piston 33 and valve 32 to the left closing the exhaust port 31 and permitting air to flow thru the D-valve 32 from pipe 27 to pipe 28, that is, from the auxiliary reservoir, to the brake cylinder. It is possible to recharge the auxiliary reservoir only by opening the brake cylinder to atmosphere thru port 31 as only in this position of the D-valve can the grooves 35 establish communication between the main and auxiliary reservoirs.

The engineer's brake valve 14, which is connected to the main reservoir by pipe 21 and to the main reservoir gage 18 by branch pipe 22, has five different positions, namely: full release, in which air can pass straight thru the valve to the train line; running position, which establishes communication between the main reservoir and the train line thru a reducing valve; lap position, in which the valve is closed so that no air can pass thru the valve in either direction; service position, for applying the brakes, in which case the pipe 23 which leads to the train line 19 is connected to atmosphere thru the port 90; and emergency position, which is the same as the service position except that the air is more rapidly exhausted. The train line gage 17 is positioned adjacent the reservoir gage 18 and is connected by a branch line 24 to the pipe 23 which leads from the outlet end of the engineer's brake valve.

The straight air valve 15 will now be described, this being a well known piece of mechanism altho novel in its combination in the present system. This valve, which is commonly used on switch engines, has four positions, namely: lap, which in the present case is normal running position, no air passing thru the valve in either direction; service position, in which air passes thru the valve from the main to the auxiliary reservoir, that is, from pipe 83 to pipe 82; emergency position, which is also a straight thru position but affording a more rapid flow of air; and release position, in which the pipe 83 leading to the main reservoir is closed and the pipe 82 leading to the auxiliary reservoir 11 is open to atmosphere by way of the exhaust port 84.

The new equipment includes a straight air pipe 20 which runs thru the entire train and parallels the train line 19, being fed from the main reservoir 10 thru pipe 82 from the straight air valve 15, its pressure being indicated on the straight air gage 16 which will also indicate auxiliary reservoir pressure whenever the straight air valve 15 is in normal or lap position, this being a change from ordinary practice in which it is the train line gage 17 which gives the auxiliary reservoir pressure, this change being due to the fact that the straight air line 20 is in free communication with the auxiliary reservoir 11 thru a straight air control valve 36 which breaks the communication between the auxiliary reservoir and the straight air line only under emergency conditions. Under normal conditions both gages read the same, as the train line and straight air line pressures equalize in a short time thru the groove 35 in the triple valve.

The location of the straight air control valve 36 is shown at the left of Figure 1 but the details of this valve can best be understood from the larger size drawing of Figure 3, its principal function being to hold the air in the auxiliary reservoir 11 in case of breakage of the straight air line 20, while ordinarily permitting free passage of air thru the valve in either direction between the straight air pipe and the auxiliary reservoir. For convenience of illustration the valve 36 is shown turned thru 90°, the plug 54 actually being at the top and the pipe 65 at the bottom, the action being exactly the same however and the turning of the valve facilitating the description of the device.

The straight air control valve 36 has a lower outlet 38 and an upper outlet 39 leading, respectively, to the train line 20 below thru nipple 41 and to the auxiliary air reservoir 11 above thru nipple 52. The lower portion of the body of this valve 36 has formed therein a cylindrical chamber 40 which communicates with the lower outlet 38 and houses a piston 42 carrying a stem 43 terminating in a valve plug 44 guided by and controlling an outlet 45 into a small intermediate chamber 46, which in turn communicates by means of a small opening 47 with a chamber 48 above. A check valve 49 having a stem 53 guided in a plug 54 normally closes a port 50 between the chambers 46 and 51, but opens when the pressure within the intermediate chamber 46 exceeds that within the chamber 51 which, as will be noted, is a passageway freely open at all times to the auxiliary reservoir 11.

In the upper portion of the body of the straight air control valve 36 is formed a pair

of coaxial cylindrical chambers 55 and 56, the latter having a somewhat smaller diameter than the former and receiving a piston 58 which is spaced from a piston 57 in chamber 56 by means of a sleeve 59 on stem 60 which latter projects thru an opening 62 between chambers 56 and 48 and has at its free end a valve plug 61 which can close the opening 62 but which is normally in the open position illustrated. The entire right hand side of the straight air control valve 36 is closed by a bolted head 64 sealing the piston chambers 40 and 55 except for a short passageway 63 which equalizes the pressures behind pistons 42 and 57 keeping both at train line pressure.

Ordinary fluctuations in such pressure do not affect either piston for spring 66 exerts a differential pressure against piston 42 to keep the outlet 45 open when the pressures on both sides of the piston 42 are approximately equal, and the piston 57 is for this very purpose made sufficiently larger than piston 58, which is always open to full auxiliary reservoir pressure, as to insure against movement of the two connected pistons under any ordinary reduction of train line pressure up to full brake application, while always closing the outlet 62 upon an emergency application whether caused intentionally or by a breaking of either the train line or the straight air line or both. Such a movement of valve plug 61 to close outlet 62 is caused by the total pressure on the smaller piston 58 being greater than that against the larger piston 57 and the function of the movement is to hold the pressure in auxiliary reservoir in case of emergency, by preventing loss of air pressure thru outlet 62 as would otherwise occur should the break occur in straight air pipe 20.

Referring now particularly to Figure 4 in which is illustrated the new automatic application valve 37 it will be seen that the central piston chamber 67 is of fairly large diameter housing a piston 68 from which projects downwardly a stem 69 on which is secured a second much smaller piston 70 sliding in piston chamber 71 which communicates at the left thru boss 77 and nipple 78 with the train line 19. The stem 69 is guided near its bottom by a ported sleeve 73 which forms a valve plug for the port 74 which communicates with the straight air line 20 by means of a pipe 75, an optional check valve 76 in this pipe permitting flow of air from the train line 19 to the straight air line 20 but preventing flow in the opposite direction in case the valve plug 72, which is the end of the stem 69, should be away from its seat.

Coaxial with the stem 69 but on the opposite side of the piston 68 is a valve plug which may be omitted if desired but which is adapted under emergency conditions to close the opening 80 leading from the chamber 81 which latter thru pipe 82, straight air valve 15, pipe 83, and pipe 21 may be placed in communication with the main reservoir. As previously stated however, the handle of the straight air valve 15 is normally vertical, that is, it is in lap position but the passage 81 is nevertheless at straight air line pressure, the valve plug 79 being held open not only by the straight air line pressure but in addition by the urge of the spring 88 pressing a resilient plunger 87 against the valve plug 79, holding the unbalanced valve assembly in position to close the port 74 at the bottom of the valve 37. The tension of the spring 88, the main function of which is to prevent fluttering of the two connected pistons, is controlled by means of a hollow screw 89.

The principal object of this automatic application valve 37 is to reduce the pressure in the train line 19 in case the straight air pipe 20 should break, the ultimate purpose being to apply the brakes and also to prevent a loss of pressure in the auxiliary reservoir 11 by closing the valve plug 61 which if open would exhaust the auxiliary reservoir thru the break in the straight air pipe 20. This purpose is accomplished because the pressure in the small chamber 86 in the upper left hand corner of Figure 4 is reduced for this small chamber is in direct communication with the break and this lowers the pressure in the opening 85 leading from the chamber 86 to the main piston chamber 67 just beneath.

Whether the straight air valve 15 be in lap position or in release position, the pistons 68 and 70 would move upwardly closing the opening 80 because the train line pressure in the chamber 71 would be sufficiently greater than the pressure to which the chamber 81 had been reduced, whether it was open to atmosphere thru exhaust port 84 or thru the break, or both, as to cause this travel of the connected pistons 68 and 70, this movement simultaneously opening train line 19 thru pipe 78 in the lower left hand corner of Figure 4 to the break in the straight air line 20 thru the pipe 75, the check valve 76 permitting this flow of air because the pressure in the lower chamber 71 would at this time be greater than the pressure remaining in the straight air pipe 20 after the break. This sharp reduction in train line pressure would cause an emergency operation of the brakes and also a closing of the valve plug 61 by a movement to the left of the pistons 57 and 58 in the upper chamber of the straight air control valve 36.

The object in having the piston 68 so much larger than the piston 70 is to permit a rather considerable range of pressure within the main chamber 67 above the piston 68.

Should the piston 68 be more nearly the same diameter as the smaller piston 70 a rather sharp application of the brakes by means of the straight air line 20 might readily cause a lifting of the piston 68 and a consequent opening of the port 74 at the bottom of the application valve 37. It is desired, however, that when there is a severe reduction of pressure above the piston 68 the much smaller piston 70 will be moved upwardly thus applying the brakes because of the reduction of pressure in the train line caused by the upward movement of the valve plug 72.

The operation of the device will now be briefly given. Under ordinary conditions the engineer may and doubtless will use the older equipment alone, applying and releasing the brakes solely by movement of the handle of the engineer's brake valve 14, this operation being in no wise changed by the additional safety features added here since the connection 65 from the train line to the straight air control valve 36 never transmits air but only pressure and the branch line 78 from the train line to the automatic application valve 37 transmits pressure only except in case of an emergency reduction in the pressure above the piston 68. The only effect of the new equipment is to allow a small quantity of air to pass from the straight air pipe 20 to the auxiliary reservoir 11 thru the small opening 47 to equalize the pressure in these two members.

In descending a steep grade the engineer will doubtless use the straight air valve 15 alone because of the advantages heretofore pointed out. The brakes are applied by moving the straight air valve 15 to service position this allowing air to pass thru the valve from the main auxiliary reservoir, building a pressure appreciably above the normal train line pressure, following this course—main reservoir 10, upward thru pipe 21, pipe 83 to the valve 15, pipe 82, entrance chamber 81, down past the open valve 79 into chamber 67 above the piston 68, upwardly thru outlet 85 to exit chamber 86, straight air pipe 20 to nipple 41 at the bottom of the straight air control valve 36, thence into the lower pison chamber 40, past the valve 44 which is held open by spring 66 even tho the pressure behind the piston 42 should be as great as the pressure in chamber 40 as would usually be the case, into the lower intermediate chamber 46, to vertical passageway 51 past check valve 49, thru port 50, also by-passing upwardly thru the small opening 47 into the upper intermediate chamber 48, thru the open valve 62, this valve being open because of the greater size of piston 57 as compared with piston 58, the combined air streams now passing thru upper outlet 39 and nipple 52 to the auxiliary reservoir 11 and from there down thru the pipe 27 to the triple valve 13.

At this point two separate opposed actions will take place. The air will, of course, leak thru the groove 35 tending to build up an equal pressure in the train line but a building up of pressure at a much greater rate will occur in the D-valve chamber of the triple valve, because the groove 35 is purposely restricted in size. The considerable increase in pressure to the right of the triple valve piston 33 will cause the D-valve assembly 32 to move to the left against the normal train line pressure thus establishing communication from the auxiliary reservoir 11 to the brake cylinder 12 thru the pipe 28 and the interior of the D-valve 32.

The application of brakes in this manner has no effect whatsoever upon the train line 19 except for a rather slight increase in pressure due to the temporary leakage thru the groove 35 at the beginning of the stroke of the triple valve piston; specifically, the increase in straight air line pressure can not move the double piston assembly 57—58 in the upper chamber of the straight air control valve 36 because the difference in pressure on the two sides of this assembly is not sufficiently great to overbalance the differential caused by the increased size of the piston 57 which is illustrated in its normal position and the increase in pressure on the straight air side can have no effect on the piston 42 in the lower chamber 40 of the straight air control valve because this valve is already at the right hand limit of its travel. The increase in straight air pressure can have no effect on automatic application valve 37 because the increase in pressure merely seats more firmly the valve plug 72 at the bottom of this valve and in so doing maintains the directly connected valve plug 79 at the other end of stem 69 in open position.

To increase the pressure on the brakes the engineer merely moves the straight air valve 15 again to service position applying further air from the main to the auxiliary reservoir. To release the brakes in full or in part the engineer merely moves his straight air valve 15 to release position, this opening the new straight air line 20 to atmosphere thru the port 84 in the straight air valve and lowering the straight air pressure below the train line pressure so as to move the D-valve 32 to the right. Train line pressure does not equalize thru the groove 35 during this action as this groove is not uncovered until the D-valve is practically at the right hand limit of its travel. The path of the air in reducing the pressure to the right of triple valve piston 33 is as follows: Exhaust port 84 of straight air valve 15, pipe 82, entrance chamber 81, piston chamber 67 above piston 68, port 85, exit chamber 86, straight air line 20, nipple 41, piston chamber 40, open port 45, lower intermediate chamber 46, small opening 47, upper intermediate chamber 48,

open port 62, chamber 56, nipple 52, auxiliary reservoir 11, pipe 27, boss 25, D-valve chamber. As before this operation of the straight air valve 15 to release the brakes has no effect whatsoever on the new valves for a decrease in straight air line pressure can not move the valve assembly 57—58 in the upper chamber of the straight air control valve because this assembly is already at the left of its travel, and it can not move the valve plug 44 in lower chamber 40 because the spring 66 is sufficiently strong to prevent such movement altho yielding should there be an emergency decrease in the straight air pressure. Any ordinary decrease in straight air pressure will not operate to raise the valve assembly 68—70 in the automatic application valve 37 because such movement is resisted not only by the spring 88 but also because of the fact that the total pressure above the larger piston 68 under reduced straight air line pressure will still be greater than the total pressure on the piston 70 because of the small size of the latter.

In case the train line 19 should become broken the brakes would be applied exactly the same as if the new equipment were not present. There would be no other action because the branch pipe 65 leading from the train line to the straight air control valve 36 never transmits air but only pressure and the failure of the pressure would move the valve assembly 57—58 sharply to the right closing the port 62 by means of the valve plug 61, while leaving the auxiliary reservoir in free communication with the brake cylinder and also in one-way communication with the straight air line for the port 50 will be opened by the check valve 49 whenever the pressure in the auxiliary reservoir is materially lower than that in the straight air line 20. Total failure of the train line pressure would have no effect on the automatic application valve 37.

Should the straight air line 20 break and not the train line 19, the brakes would be applied because the new equipment insures that the train line pressure shall be sharply decreased upon any breakage of the straight air line. The first effect of the breakage would be to close the valve plug 44 for the spring 66 is not strong enough to overbalance the full train line pressure so the piston 42 would move sharply to the left closing the port 45 and temporarily preventing loss of air pressure from the auxiliary reservoir. The break would then exhaust the straight air line 20 back to the corner chamber 86 in the automatic application valve 37. This would lower the pressure in the piston chamber 67 above the piston 68 to such an extent that the total pressure on the smaller piston 70 would overbalance the severely lowered pressure on the much greater area of the piston 68 and would move the valve assembly 68—70 against the spring 88 and would close the port 80 leading from the straight air valve 15 and would simultaneously admit train line pressure thru the branch line 78, boss 77, thru the ported sleeve 73, the port 74, pipe 75, past the check valve 76 to the point of breakage and this reduction of train line pressure would apply the valves and at the same time exhaust the chamber 55 located between the piston 57 and the head 64, this preventing loss of air pressure from the auxiliary reservoir, for the spring 66 would now reopen the valve plug 44 because of the greatly reduced pressure behind the piston 42, to the break.

Should both lines break, as would always be the case when the train parts, the combined action would take place, the breakage of the train line closing the valve plug 61 as before and directly applying the brakes. Under such circumstances the piston assembly 68—70 in automatic application valve 37 would not move and if by any change the straight air valve 15 should be in service position the engineers would close it manually upon noticing the simultaneous drops in the gages. The piston 42 would not move as the spring 66 would prevent this while the pressures on both sides were falling at substantially equal rates.

In the initial charging of the system when the train is first made up the valve 15 is in normal or lap position and the engineer's brake valve 14 is moved to fill the entire system in the usual way building up a pressure in the auxiliary reservoir thru the groove 35 in the triple valve. The valve assembly 57—58 would move almost from the beginning of the charging because this assembly is unbalanced. There would be a tendency of the valve 43 to move but the spring 66 is amply strong to prevent this while the slightly filled auxiliary reservoir 11 was discharging thru the now open port 62 into the intermediate chambers 48 and 46 and thru the still open port 45 into the piston chamber 40. The pressure in this piston chamber 40 would therefore build up sufficiently to prevent movement of the piston 42 because the spring 66 takes care of the time element, that is, this spring prevents movement during such time as the pressure behind the piston 42 is only slightly greater than that on the spring side. During the making up of a train there would also be a tendency for the valve assembly 68—70 to raise but the valve spring 88 prevents this and entirely eliminates the fluttering that might otherwise be caused by a transfer of train line pressure thru the port 74 and pipe 75 to the upper corner chamber 86. Since the straight air pressure is increasing at very nearly the same rate as the train line pres-

sure, there would actually be no movement whatsoever of the piston assembly 68—70.

What I claim is:

1. The combination with an air brake system including a main reservoir, an auxiliary reservoir, a brake cylinder, a train line, a triple valve for supplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, and means for causing said triple valve to supply air to the brake cylinder when the pressure in said straight air line falls below a predetermined amount.

2. The combination with an air brake system including a main reservoir, an auxiliary reservoir, a brake cylinder, a train line, a triple valve for supplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line, of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, and means for placing the auxiliary reservoir in free communication with the straight air line under all normal pressures in the train line and for closing such communication upon emergency decrease in train line pressure.

3. The combination with an air brake system including a main reservoir, an auxiliary reservoir, a brake cylinder, a train line, a triple valve for supplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line, of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, a normally closed valved passage connecting the straight air line with the train line, and means to cause said valve to open said passage upon emergency decrease of pressure in the straight air line.

4. The combination with an air brake system including a main reservoir, an auxiliary reservoir, a brake cylinder, a train line, a triple valve for supplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line, of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, means for placing the auxiliary reservoir in free communication with the straight air line under all normal pressures in the train line and for closing such communication upon emergency decrease in train line pressure, a normally closed valve passage connecting the straight air line with the train line, and means to cause said valve to open said passage upon emergency decrease of pressure in the straight air line.

5. The combination with an air brake system including a main reservoir, an auxiliary reservoir, a brake cylinder, a train line, a triple valve for suplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line, of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, means for placing the auxiliary reservoir in free communication with the straight air line under all normal pressures in the train line and for closing such communication upon emergency decrease in train line pressure, a normally closed valved passage connecting the straight air line with the train line, and means to cause said valve to open said passage upon emergency decrease of pressure in the straight air line, said means including an unbalanced piston assembly controlling the opening and closing of a normally open port in said free communication, the larger piston being exposed to the train line pressure and the smaller piston being exposed to the pressure of the auxiliary reservoir.

6. The combination with an air brake system including a main reservoir, an auxiliary reservoir, a brake cylinder, a train line, a triple valve for supplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line, of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, means for placing the auxiliary reservoir in free communication with the straight air line under all normal pressures in the train line and for closing such communication upon emergency decrease in train line pressure, a normally closed valved passage connecting the straight air line with the train line, means to cause said valve to open said passage upon emergency decrease of pressure in the straight air line, said means including a spring pressed piston controlling the opening and closing of a normally open port in said free communication, said piston being exposed on one side to the train line pressure to urge the piston to close said port and being exposed to straight air line pressure on the spring side to hold the port open, said spring exerting such differential pressure as to prevent the closing of said port except under emergency decrease in straight air pressure below train line pressure.

7. The combination with an air brake system including a main reservoir, an auxiliary

reservoir, a brake cylinder, a train line, a triple valve for supplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line, of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, a normally closed valved passage connecting the straight air line with the train line, and means to cause said valve to open said passage upon emergency decrease of pressure in the straight air line, said means including a spring pressed piston controlling the opening and closing of a normally open port in said free communication, said piston being exposed on one side to the train line pressure to urge the piston to close said port and being exposed to straight air line pressure on the spring side to hold the port open, said spring exerting such differential pressure as to prevent the closing of said port except under emergency decrease in straight air pressure below said train line pressure.

8. An automatic valve for use in an air brake system employing a train line and a straight air line, said valve consisting of a housing having a port open to the train line and having a port open to the straight air line, a valve plug adapted to move to close the straight air port, a piston movable with said valve plug and exposed to train line pressure, said train line pressure normally urging the piston to unseat the valve plug and establish communication between the train line port and the straight air line port, and means varying with changes in the straight air line pressure to overcome the tendency of the train line pressure to unseat the valve plug and causing said valve plug to seat under normal conditions so as to prevent exchange of train line and straight air line pressure thru said valve.

9. The device of claim 8 in which the second means includes a second piston movable with the first piston, said second piston being exposed to straight air line pressure and being of larger diameter than the first mentioned piston.

10. An automatic application valve for an air brake system employing a train line and a straight air line, said valve comprising a housing having two coaxial cylinders of different diameters, the smaller cylinder having a port leading to the train line and a second port leading to the straight air line, a straight air line inlet port opening to the larger chamber and a straight air line exit port leading from the larger chamber and a valve assembly movable as a unit in said valve housing and comprising a piston in each chamber, a valve plug in the smaller chamber adapted normally to break communication between the train line port and the straight air line port, a valve plug in the larger chamber adapted to close the straight air inlet port when the assembly has moved to open communication between the train line port and the straight air line port in the smaller chamber.

11. In an air brake system, a main reservoir, an auxiliary reservoir, a straight air line connecting said reservoirs, a manually operated valve (15) in said line, a check valve (44) in said line, a brake cylinder, a brake line (27—28) leading from said auxiliary reservoir to said brake cylinder, a triple valve in said brake line, and yielding means acting in opposition to the pressure in the straight air line and in the brake line for urging the triple valve to release position and urging the check valve to position to close communication between the auxiliary reservoir and the straight air line.

12. The combination in an air brake system in which the brakes are applied by a reduction of pressure in the train line, of a straight air line having a control valve through which the straight air line can discharge into the auxiliary reservoir of the system and in which said straight air line the pressure is constantly maintained, a straight air valve through which air can be admitted from the source of supply to said straight air line or released therefrom, an automatic application valve in said straight air line, an unbalanced piston therein, a valve plug in said automatic application valve having a connection to the straight air line, said connection including a check valve permitting air to flow from said application valve to said straight air line, said application valve having a connection between said train line and the smaller side of its unbalanced valve, said application valve having a connection between said straight air line and the larger side of said unbalanced valve whereby a subnormal pressure on the larger side of said unbalanced valve will permit air to flow into said straight air line from said straight air valve and from the train line.

13. An air brake system having in combination a train line including a source of air together with valve means for admitting or releasing air to and from said train line, an auxiliary reservoir connected to said brake cylinder, a triple control valve in said connection operated by a drop of pressure in said train line, a constant pressure straight air line forming an auxiliary feed for said auxiliary reservoir, a control valve between said straight air line and auxiliary reservoir through which air normally passes freely into said auxiliary cylinder but which is closed by a break in either or both said train line or said straight air line.

14. An air brake system having in combination a train line including a source of air together with valve means for admitting or releasing air to and from said train line, an auxiliary storage cylinder connected to said

brake cylinder, a triple control valve in said connection operated by a drop in pressure in said train line, a constant pressure straight air line forming an auxiliary feed for said auxiliary reservoir, a control valve between said straight air line and auxiliary reservoir through which air normally passes freely into said auxiliary cylinder but which is closed by a break in either or both said train line or said straight air line, an automatic application valve between said train line and straight air line whereby the entire system may be charged simultaneously or application of air may be made to said brake cylinder when the pressure in said straight air line falls below a predetermined pressure, and an auxiliary engineer's control valve for controlling the flow of air to and from said straight air line.

15. A control valve for air brake systems consisting of a body having an inlet chamber, a piston controlled valve in the outlet of said chamber, and having a second chamber communicating by means of said outlet with said inlet chamber, and having a third chamber communicating with said second chamber, a check valve between said second and third chambers permitting air to flow into said third chamber, a fourth chamber communicating with said second chamber by means of a reduced port, a differential piston controlled valve occupying a recess in said third chamber adapted to permit a flow of air from said third chamber to said fourth chamber.

16. A control valve having a body and having a pair of chambers formed therein communicating by means of a reduced opening, one of said chambers being smaller than the other, said body having an inlet port communicating with the small chamber by means of an opening, a valve for controlling said opening, a piston mounted in said body for operating said valve, a valve in the larger chamber having a pair of unequal pistons mounted in said body for operating same, a head over both sets of pistons, means for supplying air to the space in the body between the head and the pistons whereby a given reduction in air pressure will close the valve operated by said unequal pistons and prevent the flow of air through said reduced opening, and a check valve controlling a passage between the two chambers.

17. An application valve consisting of a cylindrical body having a head formed on one end thereof and having a piston mounted therein, said head having a valve therein controlled by said piston, an inlet port communicating with the outlet portion of said head, an outlet port communicating with the interior of said body through a separate port, a cylindrical extension for said body having a piston therein of reduced diameter as compared with said first mentioned piston, a stem on which both of said pistons are mounted, the end of said stem constituting a valve plug at one end of said cylindrical extension, and an air inlet at the side of said cylindrical extension.

18. The combination with an air brake system including a main reservoir, an auxiliary reservoir, a brake cylinder, a train line, a triple valve for supplying air from said auxiliary reservoir to said brake cylinder under a change of pressure in said train line, and a brake valve for admitting air to or releasing air from said train line, of a straight air line for charging said auxiliary reservoir from said main reservoir while the brakes are applied, a normally closed valve passage connecting the straight air line with the train line, and means to cause said valve to open said passage upon emergency decrease of pressure in the straight air line, said means including a spring pressed piston, said piston being exposed on one side to the train line pressure to urge the piston to open said passage and being exposed to straight air line pressure on the spring side to close the passage, said spring exerting such differential pressure as to prevent the opening of said passage except under emergency decrease in straight air pressure below said train line pressure.

FRANK J. SUPER.