

April 3, 1928.

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1,664,836

VALVE

Filed Jan. 22, 1926

2 Sheets-Sheet 1

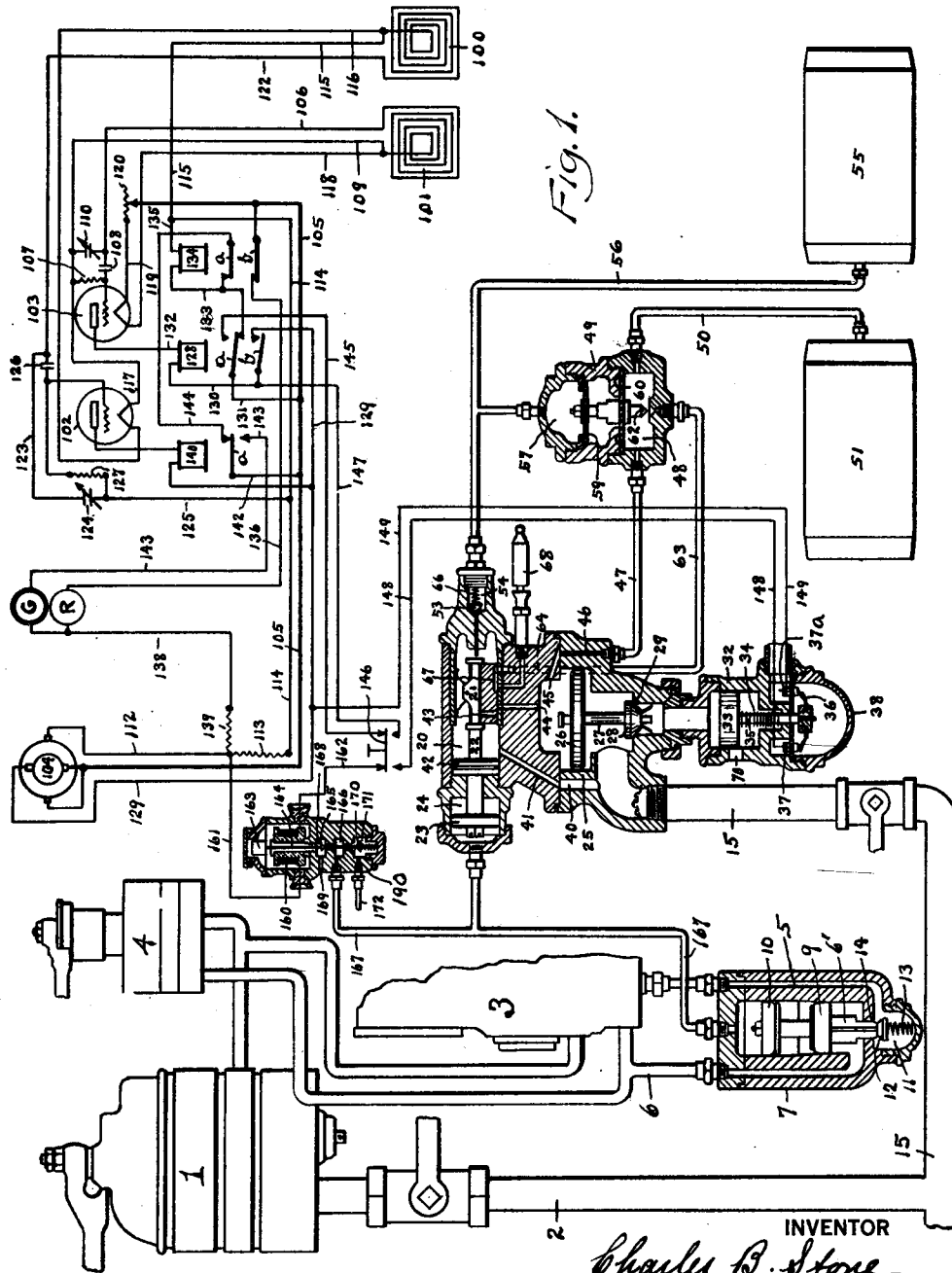


Fig. 1.

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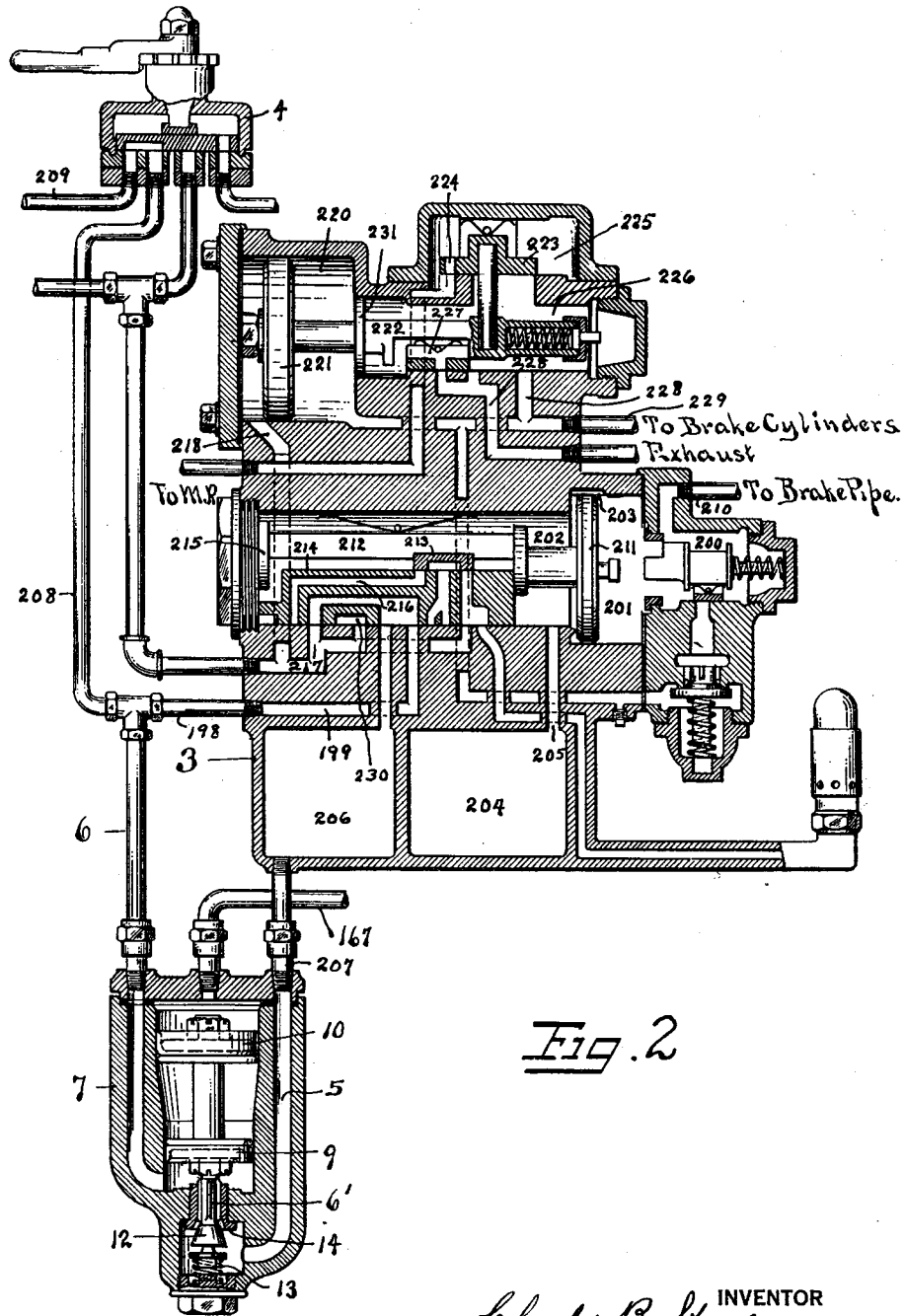


Fig. 2

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## VALVE.

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This invention relates to train control systems wherein the operation of trains is regularly controlled by the engineers' valves and is automatically controlled by means of  
 5 air-brake valves governed by electro-magnetic instrumentalities on the locomotive, which, in turn, respond to proper currents in wayside circuits which may embody the rails of the track or independent conductors  
 10 along the trackway, or a combination of such conductors, and its object is to provide an automatic air valve to close a connection between the distributor valve and the train and locomotive brake valves and thus insure  
 15 application of the locomotive brakes when the train brakes are automatically applied.

This invention consists in the construction of the automatic air valve illustrated in the accompanying drawing and particularly  
 20 pointed out in the claims.

In the accompanying drawings, Fig. 1, illustrates an air brake control mechanism which embodies the present invention. Fig. 2 is a section of a distributing valve together  
 25 with my improved air valve.

While this particular invention comprises a comparatively minor part of the locomotive installation illustrated in the drawing, it is advisable to describe the entire construction so that the operation of the various parts may be considered in connection with  
 30 this valve.

The air brake mechanism shown by the drawing as embodying the present invention is designed to be used in connection with instrumentalities on the locomotive which are controlled by electro-magnetic waves flowing in the track rails over which the locomotive is passing, and attention is called  
 35 to the Thomas E. Clark Patent Number 1,262,637, dated April 16, 1918, which shows propagating mechanism for electro-magnetic waves attached to the exit ends of the blocks into which the track is divided. Each installation is controlled by the next installation ahead and functions to propagate current of one wave length, say 8000 meters, when the conditions of the block of track pertaining to such installation are for safety or  
 40 "clear", and current of another wave length, say 6000 meters, when the conditions of such

block are for "danger". Any other desired means may be employed to propagate such currents under "clear" and "danger" conditions.  
 55

The track installations adapted to the present train control devices are of such power and wave lengths that only a limited length of track at the exit end of each block is energized by these installations sufficiently  
 60 to affect the instrumentalities on the locomotive. These instrumentalities are not affected while passing over the remainder of the blocks.

The locomotive instrumentalities embody  
 65 two collector coils 100 and 101, one for each wave length, mounted on the locomotive where they can be influenced by the lines of force of such electro-magnetic waves. These connect to two electron tubes 102 and 103  
 70 which have the usual characteristic that when negative potential accumulates in the grids, the flow of electrons from the filaments to the plates is interrupted and therefore substantially stops the flow of current  
 75 in the plate circuits. These plate circuits embody relays normally energized by the flow of the current in the plate circuits.

I prefer to use a two-voltage generator 104 which may be driven in any desired manner. The common wire to this generator for  
 80 both voltages is the heavy wire 105. When the coil 101 cuts lines of force of a current in the rails of say 6000 meters wave length, electro-magnetic current flows from this coil  
 85 over wire 106 to the grid of tube 103, the grid leak 107 connecting this wire with the return wire 109, the usual condenser 108 being connected into this circuit, which may be tuned to the desired wave length by the  
 90 adjustable condenser 110. The heating circuit for the filament of this tube is from the generator 104 over the wire 112, resistance 113, which reduces the voltage from say 32 to 12 volts, wires 114, 115 and 116, filament of tube 102, wires 117, 109 and 118, filament of tube 103, wire 119, adjustable resistance 120 to common wire 105.

The reason for passing this current over the wires 115, 116, 109 and 118 is to cut out  
 100 the current to both filaments should either of the coils 100 and 101 be broken through

accident. But otherwise, current flows to these filaments at all times that the generator is in operation.

The receiver circuit of the coil 100 comprises the wires 122 and 123, adjustable condenser 124 and wires 125, 114 and 115. The grid condenser 126 and grid leak 127 serve to impose negative potential on the grid of tube 102. When the grid of tube 102 has sufficient negative potential to obstruct the flow of the plate circuit, insufficient current flows to the relay 128 over the common wire 105, adjustable resistance 120, wire 119, filament to plate in tube 103, and wire 132 to this relay, from which current would normally flow over wire 130, armature 128<sup>b</sup> and wire 129 to the high voltage side of the generator.

But as this circuit is interrupted because of lack of sufficient current to energize this relay, its armature *a* completes the following circuits for the red lamp R: From the common wire 105, wire 131, armature 128<sup>a</sup>, wire 133, relay 134 and wires 135 and 114 to the generator. This now energized relay 134 attracts its armatures and the circuit from common wire 105, armature 134<sup>b</sup>, wire 136, lamp R and wires 138 and 112 is established, a resistance 139 being provided to protect the low voltage lamps.

Therefore, when the coil 101 picks up current, the red lamp R burns in the cab.

Should the coil 100 pick up current, then the tube 102 would pass insufficient plate current and the relay 140 would be de-energized, and a circuit consisting of the common wire 105, wire 142, armature 140<sup>a</sup>, wire 143, green lamp G, and wires 138 and 112, would be completed. The green lamp G therefore burns during only the interval that the locomotive is passing over the section of track in which the "clear" current is found. The red light, however, when it starts burning, keeps on burning until the coil 100 picks up "clear" current from an energized section at the exit end of a next block, and this results from the circuit of its relay 134 being closed through the armature 140<sup>a</sup>, wire 144, armature 134<sup>a</sup>, wire 133, relay 134, wires 135, 114 and 112. But when the relay 140 becomes de-energized by reason of the coil 100 picking up current, this circuit to relay 134 is opened and the red lamp ceases to burn. No current will pass to this red lamp until the coil 101 again picks up current.

An electro-pneumatic valve is employed to control the operation of the air brakes and consists of a body 190 having a series of superimposed chambers. A magnet 160 is mounted in the upper chamber and has lead wires 161 and 162, and this magnet, when energized, draws down the armature 163 and the stem 164, which carries the valve 165 which normally closes the passage between the chamber 166 to which the pipe 167 con-

nects, and the chamber 168 which has a relief passage 169. The second valve 170, on this stem, normally opens the passage between the chamber 166 and the chamber 171 to which the pipe 172 connects.

The pipe 172 connects to the main air reservoir and the air pressure within the chamber 171 together with the small spring beneath it are sufficient to hold the valve 170 onto its seat, unless the magnet is energized to hold down this valve and the stem. The pipe 167 connects to the brake control mechanism which is held in normal position, as will be described later on, by the pressure of air from the main reservoir, through pipes 172 and 167. But when the magnet is de-energized, the valve 170 closes the passage between these pipes and the control air escapes through the relief passage 169.

So long as relay 128 is energized, current flows to the magnet of this valve 190 over common wire 105, wire 131, armature 128<sup>a</sup>, wire 145, forestalling key 146, and wire 162, and from the valve 190 over wires 161 and 112 to the generator. But when the coil 101 picks up current and the relay 128 is de-energized, this circuit is opened and the connection between pipes 167 and 172 is closed, which will result in the setting of the air brakes unless forestalled by the depression of the key 146, which temporarily closes a circuit from the relay 128 over wires 130 and 147, depressed key 146, wire 148, a pressure controlled switch 36—37 to be explained later on, and wires 149 and 129. This switch 36—37 is normally closed and the depression of the key 146 will therefore cause the relay 128 to be reenergized, in which position its circuit will be maintained as heretofore described until the coil 101 again picks up "danger" current.

In the ordinary air brake system installed on many of the locomotives in use in this country, two manually operated brake control valves 1 and 4 and an air operated distributing valve 3 are employed. The valve 1 connects to the pipe 2, which in turn connects to the train pipe 15, and its function is to release the air in this pipe 2, which results in the application of the train brakes, to admit air to this pipe from the main pressure tank, which results in the release of the train brakes and to control the action of the distributing valve 3 whose function is to apply and release the locomotive brakes simultaneously and proportionately to the action of the train brakes.

These distributing valves are standard products of the Westinghouse Air Brake Company and are fully described in Turner Patent No. 1,130,448 of Mar. 2, 1915.

The independent valve 4 functions to admit air from the main pressure tank to the locomotive air pipe (not shown), which results in the application of the locomotive

brakes, independently of the train brakes, and to release the pressure on this air pipe releases the locomotive brakes independently of the train brakes, which may be desirable when a heavy train is on a down grade and the engineer wishes to save his locomotive brakes while still using his train brakes.

The distinction between the valves 1 and 4 is primarily that when valve 1 releases the pressure on the train pipe, the brakes are applied, but when valve 4 releases the pressure on its air pipe, the brakes are released. On the other hand, an increase of pressure on the train pipe releases the train brakes but pressure applies the locomotive brakes. As the two valves are inter-connected, it is evident that leakage of train pipe pressure at the distributor valve 3 to the valve 4 may cause application of the locomotive brakes. In order to prevent this, a manually operated cock was provided to permit escape of any such pressure in the locomotive air pipe to the valve 1 and the open air, and this cock was closed when two locomotives operated together as a "double-header", in which case the brakes of one locomotive had to be under the control of the engineer of the other. This leakage during "double-heading" would be watched and released by the second engineer.

When the valve 1 was in brake-release or running position and the cock was open, this leakage escaped through that valve, but when this valve was in brake-applying or "lap" position, the escape was prevented so that the locomotive brakes would be applied by the action of the distributor valve 3. Theoretically, such leakage should not occur, but in actual practice it is sufficient to require the cock above mentioned.

In the present system, I have substituted an air operated control valve 7 for the cock above mentioned for the reason that an application of the brakes because of the operation of the automatic train control system shown in the drawing may occur when the valve 1 is in running position, in which event no application of the locomotive brakes would result unless the by-pass provided for this leakage is closed. The open stop cock would therefore prevent the application of the locomotive brakes. The air operated control valve 7 therefore is open during normal operation of the locomotive but closed during the operation of the automatic train control system. The valve 7 may be bored to two diameters, a larger diameter for the piston 10 and a slightly smaller diameter for the guide piston 9, the stem 3' being in the form of a cross in cross section. The air under the piston 9 assists in closing and keeping closed the valve 12 to prevent the flow of air from the distributor valve 3 through the passage 5 and valve chamber 11 to the pipe 6 and the train and locomotive valves

Under normal running conditions with both valves 1 and 4 in "lap" position, train pipe pressure exists in the chamber 200, cylinder 201 and valve chamber 202 because of the small by-pass 203 which extends around the piston 211 when in its normal position. The pressure tank 204 connects to the valve chamber 202 by means of passage 205. Fig. 2 shows the distributing valve-parts in such position. Any leakage collects in the tank 206 and passes to the atmosphere through pipe 207, valve 7, pipes 6 and 208, valve 4, pipe 209 and valve 1, but such leakage might pass through passage 199 and pipe 198 to pipe 6.

When the E. P. valve becomes de-energized, pressure in train pipe 15 is suddenly reduced, it falls in pipe 210, chamber 200 and cylinder 201 connected thereto, so that the stored pressure in valve chamber 202 and tank 204 may force the control piston 211, stem 212 and valves 213 and 214 to the right, the valve 213 being connected directly to the stem and the valve 214 being moved by the disk 215. The valve 12 is closed at the same time as before explained closing the connection between tank 206 and the atmosphere.

The compressed air now fills the following chambers and passages:—pressure chamber 204, passage 205, valve chamber 202, passage 216 in valve 214, passages 217 and 218 to the left end of the application cylinder 220. The application piston 221 and its stem 222 are therefore forced to the right, carrying with them first the valve 223 whose port 224 connects the upper valve chamber 225 to the lower valve chamber 226 and then the valve 227 which closes the openings from the chamber 226 to the exhaust passage 228. The upper valve chamber 225 is normally under main reservoir pressure through the pipe 226 and passage 227. This pressure passes to chamber 226, passage 228 and pipe 229 to the brake cylinders on the locomotive.

While this mechanism provides for the application of the locomotive brakes as well as the train brakes, it is also of value as it permits the engineer of the leading locomotive of a "double-header" to apply the locomotive brakes of the second locomotive while the valves 1 and 4 of this second locomotive remain in lap position.

It is evident that the valve 7 has practically no function in the automatic application of the brakes, but it operates to release these brakes when the E. P. valve is again energized. It will be understood that this automatic brake mechanism does not function to release the brakes as this must be done by the engineer after the train pipe pressure has been reduced sufficiently to bring the train to a stop by the action of the pneumatic switch. But when the E. P.

valve is again energized and closes the passage 169, air may be delivered to the train pipe by the engineer through the operation of his valve 1 in the usual manner. This immediately causes the valve 12 to open and the pressures in chamber 206, passage 219, passage 230 in valve 214, passages 216 and 218, valve chamber 202 and cylinder 220 are released. The train pipe pressure from pipe 210 now presses piston 211 to the left to normal position and the pressure in chamber 226 acting on piston 231 presses the operating piston 221 and valve 223 to the left, cutting off the main reservoir pressure in chamber 226. At the end of this movement, the small valve 227 is moved to the position shown in Fig. 2 to connect the passages 228 and 229 to permit the pressure in the locomotive-brake cylinders to pass to the atmosphere.

The many other details of this distributing valve are brought into use in the control of the locomotive and train by the engineer and need not be explained here as they have no bearing on the present invention.

As above explained, when the coil 101 picks up "danger" current, the magnet 160 becomes de-energized and the pipe 167 is connected to the relief vent 169. The spring 13 will therefore press the valve 12 against its seat 14. As soon, however, as the magnet 160 is re-energized, air under pressure will flow from the pipe 172 past the valve 170 through pipe 167 to the space above the piston 10 and open the passage between the pipe 6 and the automatic valve 3.

The brake-control mechanism shown in cross section at the middle of the drawing embodies a valve chamber 20 with a slide valve 21 therein connected to a stem 22 which is slidable by a piston 23 in the small cylinder 24. Below this chamber 20 is a second cylinder 25 containing a piston 26 connected to a stem 27 carrying the valve 28 which normally engages a seat 29 forming part of the chamber 30. Below the chamber 30 is another cylinder 32 in which the piston 33 is slidable, being normally held up by the spring 34 on the stem 35, and this stem carries an arched electrical contact 36 normally engaging the contact blocks 37 and 37<sup>a</sup>. The wires 148 and 149 connect to the contacts 37 and 37<sup>a</sup> respectively. The cap 38 protects this switch.

The drawing shows the piston 23 and valve 21 just after the pressure in the outer end of the cylinder 24 has been reduced because of the magnet 160 being de-energized, the valve 170 closing the passage between the pipes 167 and 172 and the small valve 165 opening the passage from the pipe 167 to the vent 169. This movement of the valve 21 is caused by air flowing from train pipe 15 through passages 40 and 41 and acting on a second piston 42 on the stem 22.

While the valve 21 was in its normal position at the right end of chamber 20, air under train pipe pressure flowed from the chamber 20 through the port 43 in the valve 21, through the passage 44 to the upper end of the cylinder 25, through the passages 45 and 46 and pipe 47 to the lower chamber 48 of the valve body 49. From this chamber air flows through pipe 50 to the tank 51.

At the same time the small valve 53 was held off its seat in the small chamber 54 at the end of the main valve chamber 20 by the valve 21, the stem of the valve 53 being loose in its support and permitting a slow flow of air from this chamber 20 to the control tank 55 through pipe 56 and into the upper chamber 57 of the valve 49.

A smaller flexible diaphragm 59 and a larger flexible diaphragm 60 are mounted in the valve body 49 and support the valve 62 which normally opens the vent to the pipe 63 which connects to a passage 64 opening into the space 67 below the valve 21.

When the valve has reached the position shown, the spring 66 forces the small valve 53 onto its seat, preventing leakage from the tank 55 which retains normal train pipe pressure. The valve 21 by means of its port 67 connects the passage 64 and pipe 63 to the whistle 68, and air flows from above the piston 26 and from the tank 51 through the pipe 63 to this whistle. The reduction of air pressure above the piston 26 is rendered slow by this tank 51. When the downward air pressure on the piston 26 and stem 27 falls to less than the upward air pressure thereon, the piston and valve will rise and air from the train pipe will rush down into the chamber 32, depressing the piston 33 and escaping through the holes 70. At the same time the contacts 36 and 37 separate, opening the forestalling-key circuit.

So long, therefore, as the pressure above the piston 26 is at not less than a certain ratio to the train pipe pressure, the circuit between the forestalling key and the valve 190 may be closed and the engineer may prevent the application of the brakes thereby, the circuit to the electro-pneumatic valve 190 being established as above described.

But if the engineer delays depressing his forestalling key until the air pressure above the piston 26 is sufficiently reduced to permit the air pressure below it to raise it and the valve 28, the rush of air downward opens the switch between the wires 148 and 149 and holds this switch open until the air pressure on the train line is sufficiently reduced to cause an application of the air brakes, and also until the valve 1 is brought to "lap" or "brake application" position. Should the engineer feed air into the train pipe in an endeavor to release the brakes, such added air would assist in holding the valve 28 open, but if he assists in reducing this train

pipe pressure, the valve 28 will close earlier.

The upper diaphragm 59 of valve 49 is always under initial train pipe air pressure. When the pressure above the piston 26 and  
5 below the diaphragm 60 has fallen so that the total pressure below the diaphragm 60 is less than the total pressure above the diaphragm 59, the valve 62 closes and prevents further reduction, which results in the piston 26 forcing the valve 28 to its seat, provided, of course, the valve 1 is at "lap" position. The  
10 piston 33 is then lifted by its spring 34 and the contacts 36 and 37 engage to close the forestalling-key circuit, so that the engineer  
15 can reset the relay 128 as before described.

The details of construction of this valve mechanism, the proportions of its parts, and the pipe connections may all be changed by those skilled in the art without departing  
20 from the spirit of my invention as set forth in the following claims.

I claim:—

1. In an air brake system for railway trains comprising an engineer's train valve,  
25 a distributor valve, and an automatic electro-pneumatic valve adapted to cause the application of the brakes, a control valve between the distributor valve and the train valve adapted to be operated by air received from the electro-pneumatic valve under normal  
30 running conditions to keep open a passage between the distributor valve and the train valve and to close said passage when the electro-pneumatic valve causes the applica-  
35 tion of the brakes.

2. In an air brake system for railway

trains comprising an engineer's train valve, a distributor valve and an automatic electro-pneumatic valve adapted to cause the application of the brakes, a control valve  
40 between the distributor valve and the train valve adapted to be operated by air received from the electro-pneumatic valve under normal running conditions to keep open a passage between the distributor valve and the  
45 train valve and to close said passage when the electro-pneumatic valve causes the application of the brakes, said control valve comprising a valve and a seat for the same, a spring to press the valve to its seat, and an  
50 air cylinder and a piston therein connected to said valve and receiving pressure from the electro-pneumatic valve to overcome the force of said spring.

3. In a control valve for air brake systems  
55 for locomotives, the combination of a cylindrical body having a larger and a smaller bore, a valve chamber and a valve seat between the outer end of the smaller bore and the valve chamber, a stem, pistons on said  
60 stem within said bores and a valve at the end of the stem within the valve chamber, a spring to press the valve to its seat to close a central passage between the valve chamber and the smaller end of the cylinder, said  
65 body having a passage to admit air to the outer end of the larger cylinder to force the valve from its seat, a second passage connecting to the outer end of the smaller cylinder, and a third passage to admit air to the valve  
70 chamber.

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