H. L. TOOKER.

ELECTRICALLY OPERATED AIR BRAKE.

APPLICATION FILED JUNE 29, 1911. RENEWED OCT. 11, 1913.

1,084,506.

Patented Jan. 13, 1914.

4 SHEETS—SHEET 1.

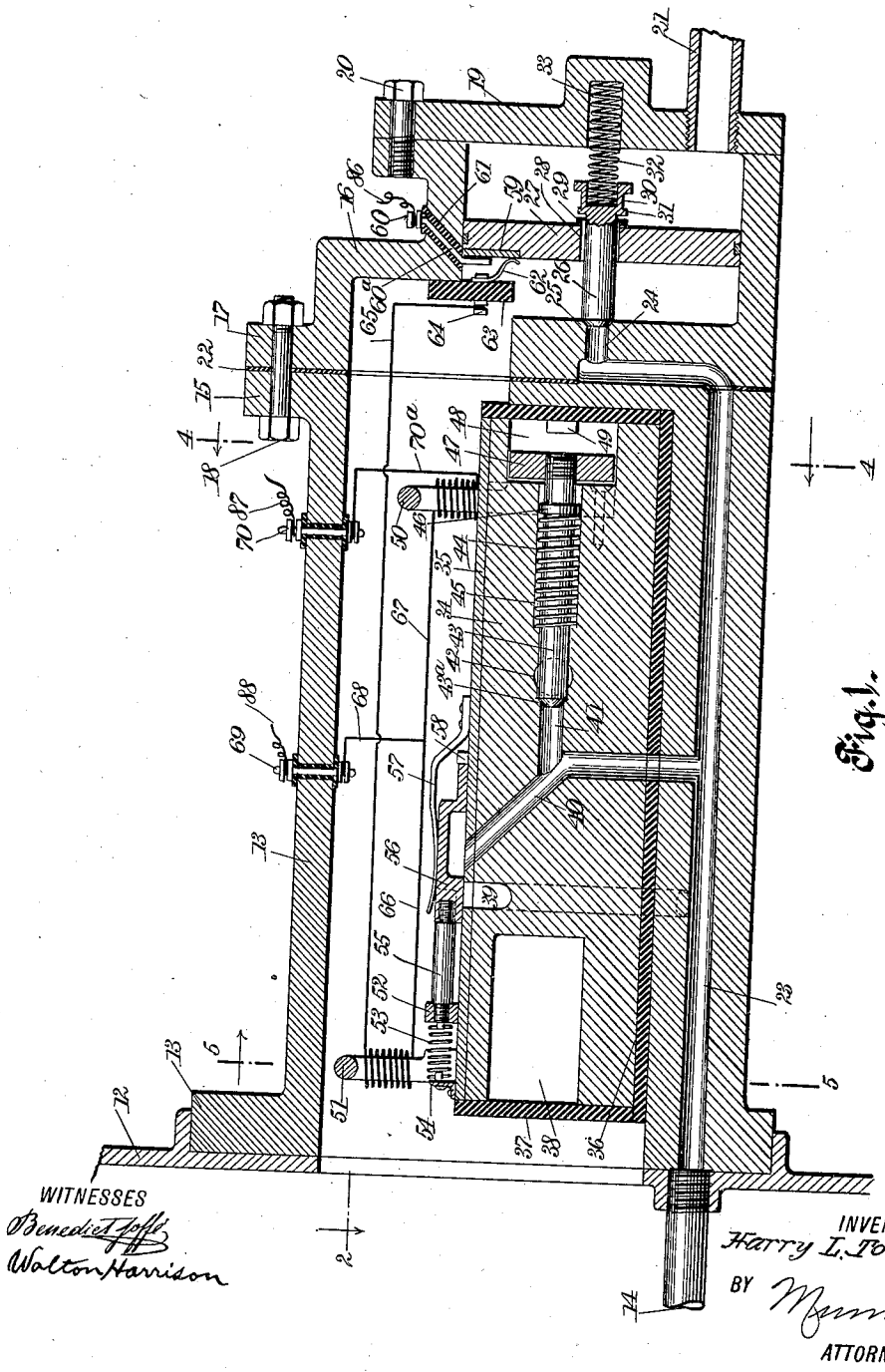

Fig. 1.

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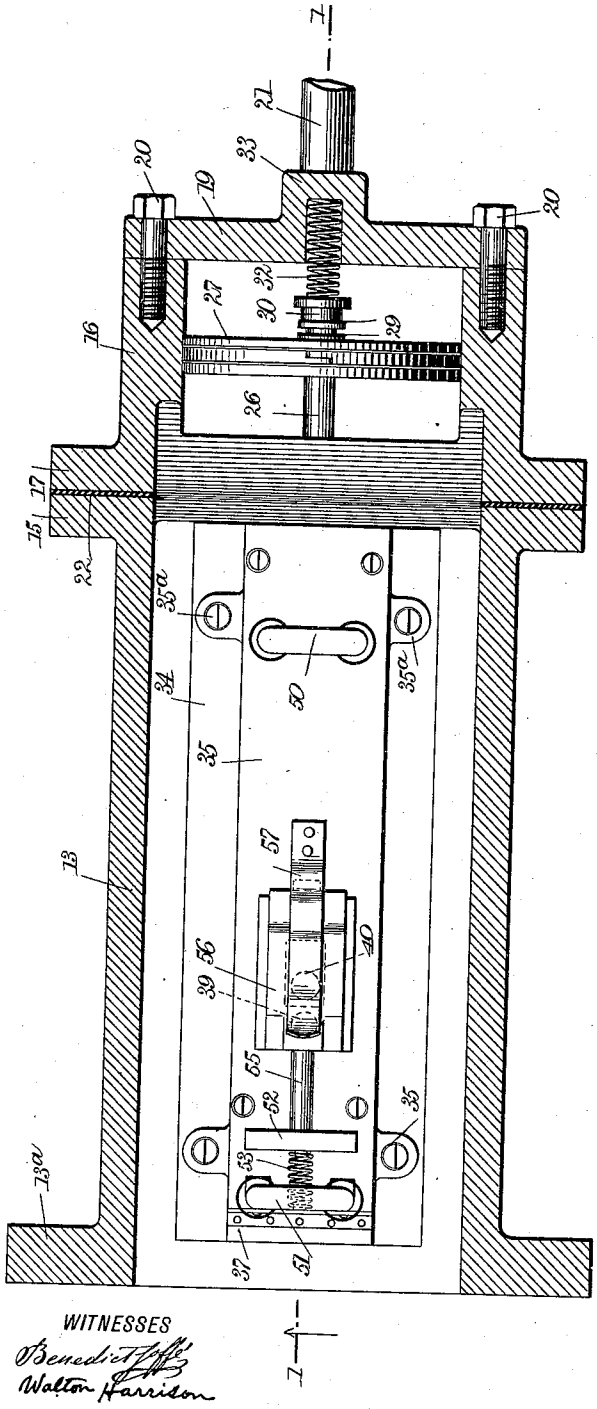

Fig. 2.

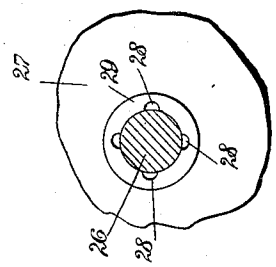

Fig. 3.

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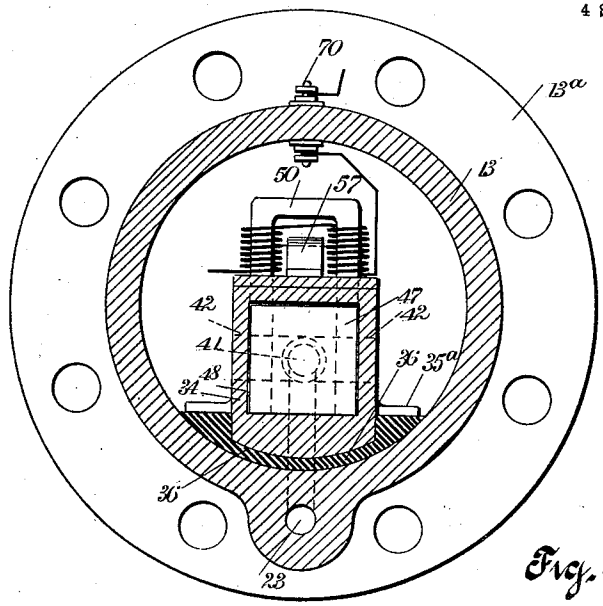

Fig. 4.

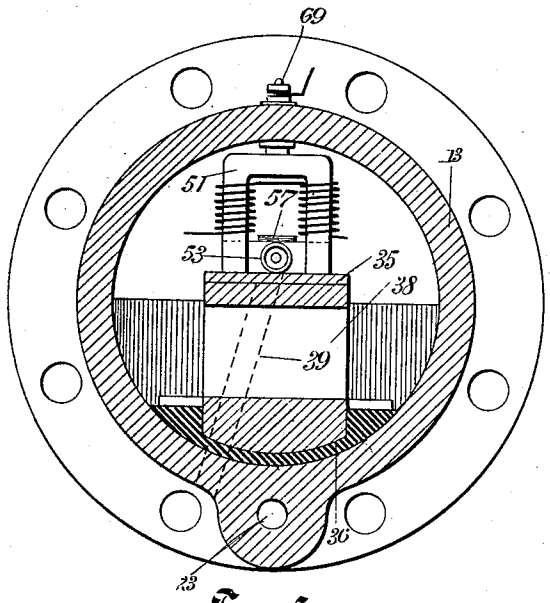

Fig. 5.

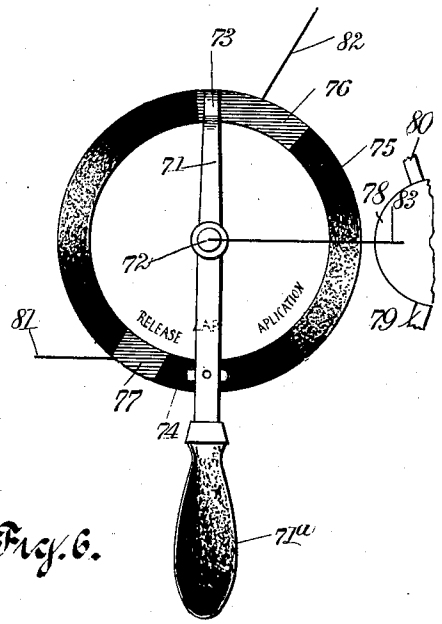

Fig. 6.

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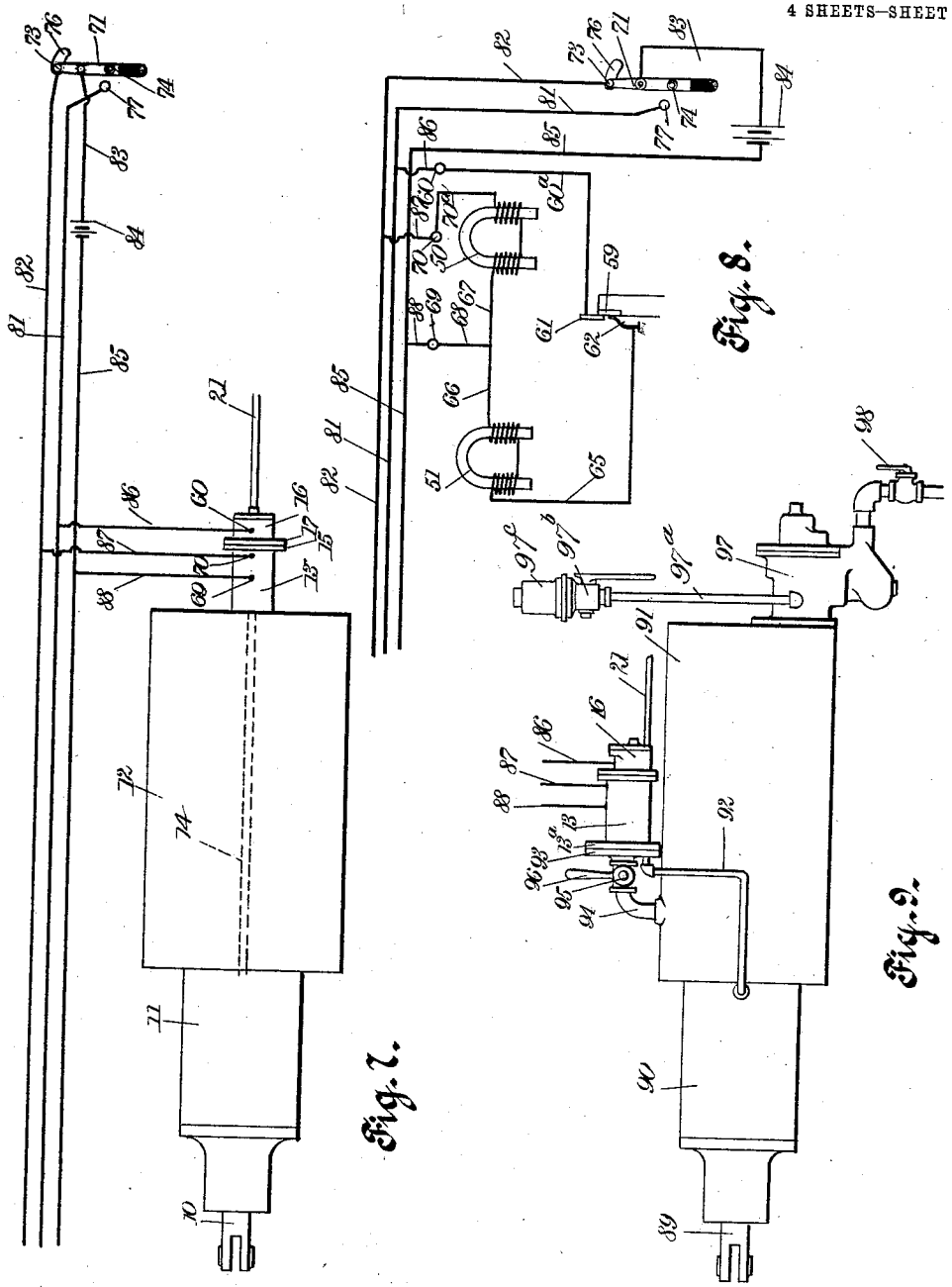

Fig. 7.

Fig. 8.

Fig. 9.

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UNITED STATES PATENT OFFICE.

HARRY L. TOOKER, OF WINSLOW, ARIZONA.

ELECTRICALLY-OPERATED AIR-BRAKE.

1,084,506. Specification of Letters Patent. Patented Jan. 13, 1914.

Application filed June 29, 1911, Serial No. 635,937. Renewed October 11, 1913. Serial No. 794,750.

To all whom it may concern:

Be it known that I, HARRY L. TOOKER, a citizen of the United States, and a resident of Winslow, in the county of Navajo and State of Arizona, have invented a new and Improved Electrically-Operated Air-Brake, of which the following is a full, clear, and exact description.

My invention relates to electrically-operated air brakes, my more particular purpose being to provide an electrical control, analogous to the triple valve commonly used for handling the pneumatic elements of the brake mechanism.

More particularly stated, my invention comprehends a system whereby the enginemen, by manipulating a hand lever, can operate the electro-pneumatic control independently of the usual air-controlled mechanism.

My invention also comprehends the addition of an electrical control through the pneumatic elements of the air brake mechanism as they now stand, the arrangement being such that the triple valve now commonly used may be discarded altogether, or used only when desired, the brake mechanism being handled by aid of the electric mechanism.

By aid of my invention all of the separate air brakes distributed throughout the entire length of the train are applied simultaneously and released simultaneously, notwithstanding the fact that the number of cars and the lineal measurement of the train may be very great.

Reference is to be had to the accompanying drawings forming part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a substantially central vertical section through one of the air cylinders, of the kind carried by each car; Fig. 2 is a section on the line 2—2 of Fig. 1, looking in the direction of the arrow; Fig. 3 is a detail showing a section through the application valve and means for equalizing air pressure upon opposite sides of the piston associated with said valve; and Fig. 4 is a section on the line 4—4 of Fig. 1, looking in the direction of the arrow, and showing a magnet by aid whereof the brake 5 is applied; Fig. 5 is a section on the line 5—5 of Fig. 1, looking in the direction of the arrow, and showing a magnet by aid whereof the brake is released; Fig. 6 is a detail showing a hand switch that is mounted upon the locomotive for enabling the engineer to apply and release the brakes throughout the train, and also showing a releasing valve for venting the air brakes; Fig. 7 is a diagram of the wiring from the controlling switch in the engineer's cab to the air brake mechanism in any one of the cars; Fig. 8 is a diagram showing more particularly the wiring inside of one of the air cylinders; and Fig. 9 is a side elevation of the air cylinder and parts associated with it and provided with my improved mechanism to be used independently of the triple valve.

The piston rod of an air brake is shown at 10, the brake cylinder at 11, the auxiliary reservoir at 12, and the air cylinder or casing containing the valve mechanism at 13. The air cylinder 13 is mounted directly upon the auxiliary air reservoir 12 by aid of a flange 13^a, as indicated in Fig. 1. A pipe 14 (see lower left-hand corner of Fig. 1) leads from the air cylinder 13 to the brake cylinder 11. The air cylinder 13 is provided with a flange 15 and with a cap 16 having a mating flange 17, these two flanges being secured together by aid of bolts 18. The cap 16 is provided with a head 19 secured to it by aid of bolts 20. A pipe 21 extends through the head 19 and is at all times in open communication with the train pipe. A packing 22 is disposed between the flanges 15, 17, and serves to prevent the escape of air. The cylinder 13 is provided with a core passage 23 which communicates with the pipe 14. This core passage extends upwardly according to Fig. 1 and merged into a port 24 leading to a valve seat 25 in the cap 16. A check valve 26 engages the valve seat 25 and is used for controlling the flow of air from the air cylinder 13 and auxiliary air reservoir connected therewith, to the brake cylinder. A piston 27 is provided centrally with an opening through which the valve 26 extends and is further provided with air grooves 28 extending longitudinally of the valve 26 for the purpose of equalizing the air pressure upon opposite sides of the piston. An annular packing 29 encircles the air grooves 28 and the valve 26. This valve carries a spring cup 30 and an annular bead 31, these parts being so arranged that when the piston 27 is forced to the right, according to Fig. 1, the annular packing 29 engages the annular bead 31 and closes the adjacent ends of the

air grooves 28, thus destroying pneumatic communication between the opposite sides of the piston. A spring 32 extends into the valve cup 30 and also extends into a pocket 33 forming part of the head 19; this spring 32, by its pressure against the valve 26, tends to force this valve against its seat 25.

Mounted within the cylinder 13 is a block 34 and a plate 35 is secured upon the block by aid of fastenings 35ª. The block 34 is separated from the air cylinder 13 by a packing 36 and is cored out to form a passage 38 which is covered by a plate 37 of insulating material. The block 34 and plate 35 are together provided with an exhaust passage 39 leading out into the open air. The block 34 and plate 35 are further provided with a passage 40 communicating with the passage 23. Another passage 41 communicates with the passage 40 and leads to a pair of cross passages 42 which are simply holes drilled through the block 34 and crossing the passage 41. A valve 43 provided with a valve seat 43ª is adapted to open and close the passage 41, which passage merges into a larger passage 45 which contains a spiral spring 44. This spring engages an annular bead 46 carried by the valve 43, and mounted upon one end of the valve 43 is an armature 47 of soft iron. This armature is disposed within a recess 48 in the block 34 and mounted within this recess is a lug 49 serving as a limiting stop for preventing excessive travel of the armature 47 and valve 43 in one direction. The spring 44 tends to force the valve 43 to the right according to Fig. 1, thus keeping this valve off its seat 43ª. An electro-magnet 50 is supported by the block 34 and is provided with holes disposed adjacent to the armature 47 for the purpose of attracting and releasing the latter. Another electro-magnet 51 is mounted upon the opposite end of the block 34. An armature 52 of soft iron is provided for this magnet. A spring 53 engages the armature 52 and rests against the stop plate 54. Secured to the armature 52 is a rod 55 and connected with the latter is a slide valve 56. A leaf spring 57 is mounted upon the plate 35 and engages the slide valve 56. A lug 58 secured rigidly upon the plate 35 serves as a limiting stop for the slide valve 56. When the magnet 51 is energized it attracts the armature 52, thus moving the rod 55 and the slide valve 56 to the left according to Fig. 1, so that the slide valve established communication from the upper end of the passage 40 to the upper end of the exhaust pipe 39. When, however, the magnet 51 is deënergized the spring 53 forces the armature 52 to the right, thereby moving the slide valve 56 into the position indicated and destroying communication between the passages 39, 40. When the magnet 50 is energized it attracts the armature 47 and forces the valve 43 against its seat 43ª, so that there is no communication from the cross passages 42 to the passages 41, 23. When, however, the magnet 50 is deënergized, the pressure of the spring 44 forces the armature 47 to the right according to Fig. 1 and establishes communication from the cross passages 42 to the passages 41, 23, and pipe 14.

The piston 27 carries a contact plate 59. A binding post 60 is connected with a conductor 60ª which extends obliquely downward and is provided with a portion normally engaged by the contact plate 59—that is, when the piston 27 occupies its normal position as indicated in Fig. 1. The conductor 60ª is encircled by a tube 61 of insulating material. A leaf spring 62 is mounted upon a plate 63 of insulating material, this plate being mounted within the cap 16 and provided with a binding post 64 which is in metallic communication with the spring 62. A wire 65 leads from the binding post 64 to the magnet 51, and another wire 66 from this magnet to a wire 67, the latter leading to the magnet 50. A wire 68 is connected with the wires 66, 67, and leads to a binding post 69, the latter being insulated from the cylinder 13. Another binding post 70 is carried by the cylinder 13 and insulated from the same. A wire 70ª leads from this binding post to the magnet 50.

Mounted upon the locomotive is a hand lever 71 provided with a handle 71ª of insulating material. Mounted upon this hand lever is a binding post 72. The hand lever is provided with a spring portion 73 serving as a contact member and is further provided with a contact spring 74. An annular plate 75 of insulating material is disposed parallel with the hand lever 71 and is provided with two contact sectors 76, 77 of conducting material, preferably metal or carbon. The hand operated pneumatic valve 78, which may be of the usual or any desired construction, is associated with the hand switch shown in Fig. 6, but is entirely independent of said hand switch and is preferably placed along side of the same, as indicated in said figure. A pipe 79 is connected with the train pipe, and a discharge pipe is shown at 80. Connected with the contact sector 77 is a wire 81. A wire 82 is connected with the contact sector 76 and a wire 83 is secured to the binding post 72 and thus permanently connected with the hand lever 71. The wire 83 leads to a battery 84 carried upon the locomotive and from this battery a wire 85, together with the two wires 81, 82, leads back the entire length of the train. These three wires 81, 82, and 85 are, by aid of wires 86, 87, 88 branching therefrom in each car, brought into metallic communication with the binding posts 60, 70, 69 carried by the air cylinder 13.

The operation of the device above de-

scribed is as follows: The battery 84 being in action and the hand lever 71, being in its normal position, as indicated in Fig. 6, the following circuit is completed: battery 84, wire 83, hand lever 71, contact sector 76, wire 82, wire 87, binding post 70, wire 70ª, magnet 50, wires 67, 68, binding post 69, wires 88, 85, back to battery 84. This energizes the magnet 50 and the latter remains energized while the train is running at normal speed. The armature 47 (see Fig. 1) being attracted by the magnet 50 is thus forced to the left and the valve 43 is normally forced against the seat 43ª. The passage 41 is therefore normally closed. The magnet 51 is normally deënergized for the reason that no circuit from the battery 84 is completed through it.

The mechanism contained within the cap 16 normally performs a single function only, to wit, allowing free access of air from the train line to the auxiliary cylinder and the air cylinder 13, as will be understood more particularly by reference to Fig. 1. In case of emergency, such as the accidental bursting of a hose, the mechanism contained within the cap 16 automatically causes the application of the air brakes which it does by opening the valve 26. In this event the application of the brakes is entirely independent of the electrical control of the brakes. The escape of air, due to the bursting of the hose, or to the separation of the cars, causes the piston 27 to move to the right, according to Fig. 1, and by this moving away from the contact 62, the circuit containing the magnet 51 is deënergized and the release of the air brakes through the instrumentality of the said magnet 51 is thereby prevented. Such being the case, there is no danger of the brakes being released while the train line remains without air pressure. It is desirable that the brakes be controlled only by the operation of valves which are under direct control of the magnets 50 and 51.

Suppose, now, that the operator desires to apply the brakes. Grasping the handle 71ª, he moves it abruptly to the right until the hand lever 71 coincides with the position indicated by the legend "Application." This movement of the lever 71 disengages its spring portion 73 from the contact sector 72. This opens the circuit through the magnet 50, said circuit being above traced. The magnet 50 is thus deënergized and the armature 47 now being free is forced to the right, together with the valve 43 by tension of the spring 44. It will be seen, therefore, that the valve 43 is moved some little distance from its seat 43ª. The compressed air, contained within the air cylinder 13 and auxiliary reservoir 12 connected therewith, now escapes freely through the cross passages 42, and passages 41 and 23, and the pipe 14, to the brake cylinder, thus applying the brakes. This movement takes place in each car throughout the entire length of the train, and as the magnets 50 are all deenergized at the same instant, the cars are all affected simultaneously yet independently. The time required for the stoppage of the train is therefore reduced to a minimum. This being done, as soon as enough air enters the brake cylinder from the train line and the auxiliary cylinder, the handle 7ª is returned to its so-called "lap" position. If now more braking power is required, the magnet 50 is again deënergized in the manner above described, thus allowing more air to flow into the brake cylinder. This step may be repeated as often as desired, so as to render the action of the air brakes as vigorous as desired. If too much pressure develops in the brake cylinder, the magnet 51 is energized, the valve under its control thus allowing a greater or lesser quantity of air to escape into the atmosphere. The exhaust of the air from the brakes is independent of the application of the air to the brakes. Neither the exhaust valves nor the application valves are operation by the equalization of air pressure or by variation thereof, and are not affected by such equalization or variation. It should be borne in mind that there is a constant recharge of the train pipe, that is to say, air is continually flowing from the main reservoir into the train pipe and auxiliary cylinders, regardless of the operation of the brake. No retainer valves are necessary in connection with the brake cylinders for the reason that the desired pressure in the brake cylinders is maintained by the engineer. If it happens that the train pipe is broken, or for any reason the electric current fails to work, both of the magnets 50 and 51 are deenergized and the brakes are in consequence applied automatically, that is, without either the will or the knowledge of the engineer. When the engineer desires to release the brakes, he turns the lever 71 to the left, or into the position coinciding with the word "Release" in Fig. 6. In doing this the contact spring 74 is brought into engagement with the contact sector 77, and the spring portion 73 of the hand lever 71 remains in communication with the contact sector 76. The circuit through the magnet 50, being controllable by the engagement of the contact spring 73 with the sector 76, therefore, remains unbroken. The engagement of the contact spring 74 with the contact sector 77, however, completes the following circuit: battery 84, wire 83, contact lever 71, contact spring 74, contact sector 77, wire 81 (extending the entire length of the train), thence continuing in each car as follows: wire 86, binding post 60, wire 60ª, contact plate 59, contact spring 62, wire 65, magnet 51, wires 66, 68, binding

post 69, wires 88, 85, back to battery 84. This energizes the magnet 51 and by causing it to attract its armature 52 causes the slide valve 56 to move to the left according to Fig. 1. This movement of the slide valve brings the passages 39, 40 into communication with each other, and the air contained in the brake cylinder now makes its escape to the atmosphere through the pipe 14, passage 40, and passage 39. All of the brakes of the train being released in the manner just described, the train is ready to proceed, and before starting the operator moves the hand lever 71 into its normal position as indicated in Fig. 6.

My brake cylinder may, if desired, be used as indicated in Fig. 9 in connection with a triple valve, and so arranged that either my improved air cylinder or the triple valve which it supplants may be cut out. This equipment is used principally in instances where the triple valve is already installed and it is not considered desirable to remove it, my improved apparatus being somewhat in the nature of an attachment. Again, my improved air cylinder is sometimes used in connection with the triple valve where it is desired to have two alternative devices for controlling the brakes.

There is no danger of releasing the compressed air from the brake cylinder except when the piston 27 is in its extreme position to the left, as indicated in Fig. 1. This is because the position in question is the only one the piston can occupy if the air pressure upon its opposite sides are in equilibrium. Hence, the air in the brake cylinder cannot be released except when the valve 26 is closed. There is therefore no possibility of venting the train pipe directly through the exhaust and there is no danger of air discharging from the air cylinder unless it passes out at the exhaust. The escape of air from the air cylinder is therefore unable to disturb any part controllable by air pressure.

If a train happens to be standing upon a grade, it may be securely braked while air is being pumped directly into the train pipe. After air has been supplied to the brake cylinder and "lapped," a slight reduction in the pressure of the train pipe due, for instance, to a leak, will not have the effect of further applying the brakes. The engineer is thus given a more efficient and accurate control over the brakes than is usual where the brakes are operated pneumatically. While the train is moving at any speed, the air brakes can be released, or partially released, and again applied indefinitely without straining the couplings.

The body portion of the brake cylinder 13, including the cap 16, has the same form in Fig. 9 as in the other figures. The piston rod of the brake is shown at 89, the brake cylinder at 90, and the auxiliary air reservoir at 91. A pipe 92 is connected to the brake cylinder 90 and to a head 93 which is secured to the flange 13^a. A pipe 94 is provided with a valve 95 having a handle 96, the pipe extending from the head 93 to the auxiliary reservoir 91. The triple valve is shown at 97 and adjacent thereto is provided a valve 98, these parts being of ordinary construction and operated in the manner well known in this art. The valve 95 is, by aid of the handle 96, used to cut out my improved mechanism whenever desired by the operator in order that the triple valve may be employed instead.

The operation of the device shown in Fig. 9 is not materially different from that above described with reference to the other figures. In fact, a car equipped with the mechanism shown in Fig. 9 may form part of a train in which other cars equipped with apparatus of the kind described in the other figures are present. When the brake is released air escapes from the brake cylinder 90 through the pipe 92 (corresponding to the pipe 14 in Fig. 1) and escapes through passages 23, 40 and slide valve 56 to the exhaust passage 39. Instead, however, of having the air cylinder 13 connected with the auxiliary reservoir 91 in the manner indicated in Figs. 1 and 2, the communication is established by aid of the pipe 94 and valve 95, the latter being controllable by its handle 96. The release of air through the triple valve 97 and its retainer pipe 97^a may be accomplished when the three way valve 97^b in the retainer pipe is in one of its three positions. This valve 97^b which may also register the retainer pipe with the usual retainer valve 97^c, may be further moved to a position where it is entirely closed and thus prevent air from escaping to the atmosphere from the brake cylinder. Otherwise the function of the triple valve 97 is not materially different from that which it ordinarily performs. In the instance now under discussion, the valve 97 performs generally the office of the valves located in the cap 16, to wit, the valve 97 acts automatically in order to apply the brakes in the event of a broken train pipe. The cap 16 has here, for the time being, no function whatever, and may, if desired, be detached. In this case the release of air from the brake cylinder is controlled altogether by the magnet 51 as in all other instances where the electric control is used. During electrically controlled braking, valve 97^b is turned so as to close the triple valve exhaust to atmosphere and during pneumatically controlled braking, the circuit of solenoid 51 is broken so as to permit spring 53 to move valve 56 to close the communication through passages 40 and 39 to atmosphere. The air under pressure flows through the triple

valve 97 to the auxiliary reservoir and thence to the electrically operated valve. When air is drawn from the auxiliary reservoir through the mechanism shown in Fig. 1, this does not affect the triple valve 97 except that air from the train pipe flows through the latter to the auxiliary reservoir. In this case, the pipe 21 is not connected and so has no function.

As may be seen from the foregoing description, my invention may be used in more than one way. It may be applied in the first instance upon cars which are being equipped with air brakes. For cars which have already been equipped and which are provided with triple valves of ordinary construction, my improved apparatus may be added, as an attachment, and used or not, as desired, the only thing necessary to "convert" a car being to open or close an ordinary hand valve.

There can be no considerable delay in either applying or releasing the brakes, no matter how great may be the length of the train or the number of cars employed, for the reason that the electric circuit acts instantly from one end of the train to the other so that the flow of air from the auxiliary reservoirs to the brake cylinders, or from the brake cylinders to the atmosphere, is instantaneous and the brakes are in consequence quickly applied or released.

I do not limit myself to the precise construction above described and shown in the accompanying drawings, as various forms of apparatus may be employed for the same purpose without departing from the spirit of my invention—the scope of my invention being commensurate with my claims.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. An electrically operated air brake, comprising a brake cylinder, a valve for admitting air thereinto, said valve being normally closed, a piston slidable relatively to said valve, a contact controllable by movements of said piston, an electric circuit including said contact, said electric circuit being closed when said piston occupies a predetermined normal position, an electro-magnet included in said circuit and controllable thereby, a slide valve controllable by said electro-magnet, and mechanism co-acting with said slide valve and including passages for discharging compressed air from said brake cylinder whenever said electro-magnet is energized.

2. In an electrically operated air brake, the combination of a brake cylinder, a valve for admitting air thereinto, said valve being normally closed, a piston slidable relatively to said valve, a contact controllable by movements of said piston, an electric circuit including said contact, said electric circuit being closed when said piston occupies a predetermined normal position, an electro-magnet included in said circuit and controllable thereby, and a valve controlling the exhaust of air from said brake cylinder and actuated by the electro-magnet, when said electro-magnet is energized.

3. An electrically operated air brake, comprising a brake cylinder, an air cylinder, a piston slidably mounted in said air cylinder and provided with an opening and with air grooves merging into said opening, a valve for admitting air into said brake cylinder and extending through said opening and provided with a flange, a packing disposed adjacent to said air grooves and adapted to be engaged by said flange for the purpose of temporarily closing said air grooves, spring mechanism for normally forcing said valve in a direction to bring said flange against said packing, a valve seat to be engaged by said valve, a brake cylinder exhaust valve, a contact controllable by movements of said piston, an electric circuit including said contact and being closed when said piston occupies a predetermined normal position, an electro-magnet included in said circuit and controlling said exhaust valve so as to permit the exhaust of air from the brake cylinder whenever the electro-magnet is energized.

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

H. L. TOOKER.

Witnesses:
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WM. H. DAGG.