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L. A. HAWKINS.

BRAKE CONTROL SYSTEM.

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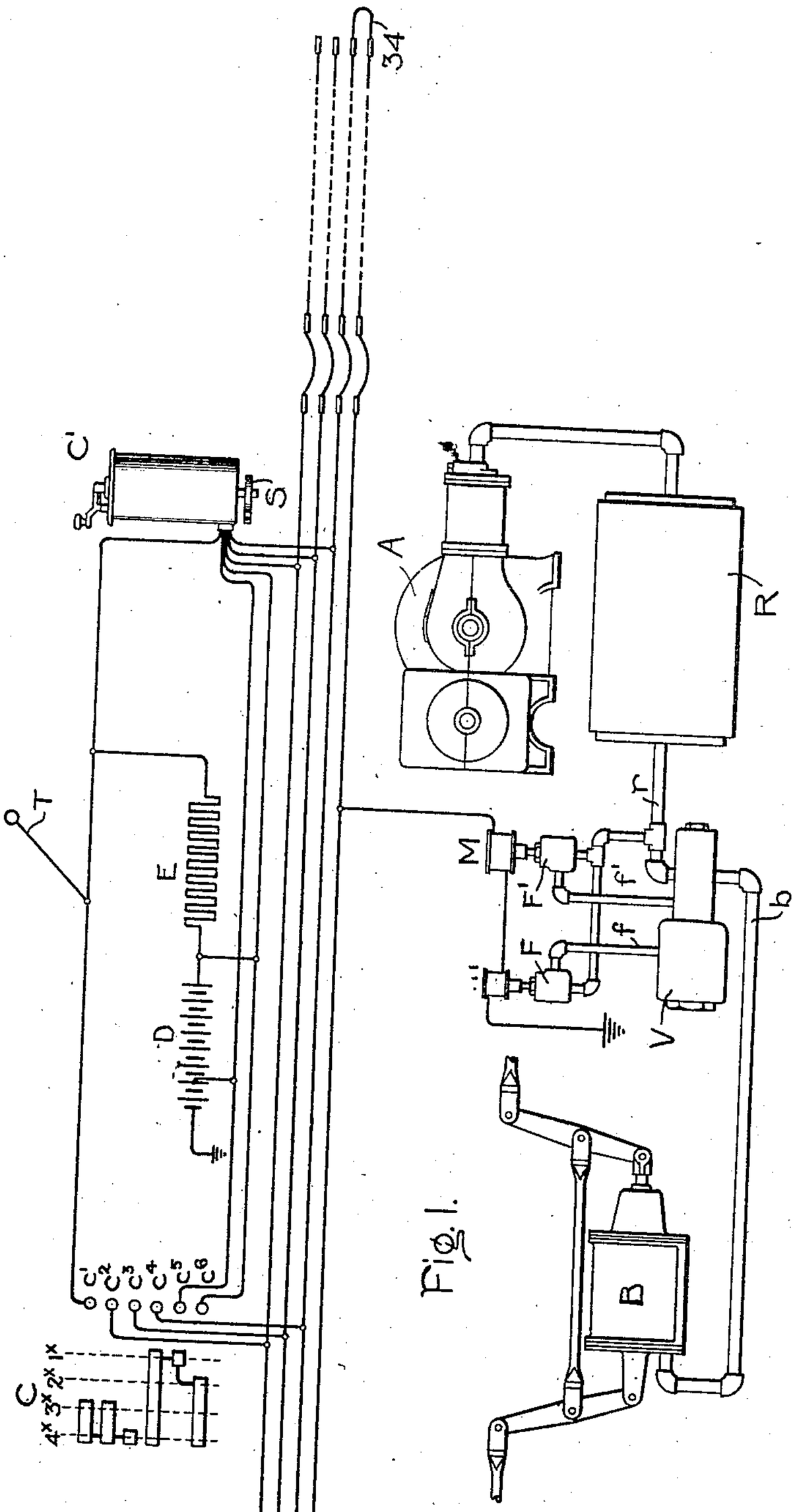

Fig. 1.

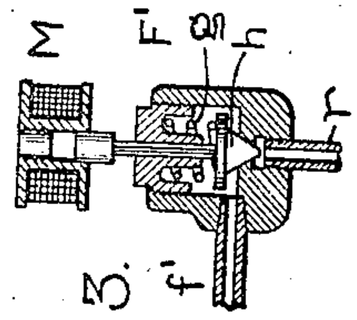

Fig. 3.

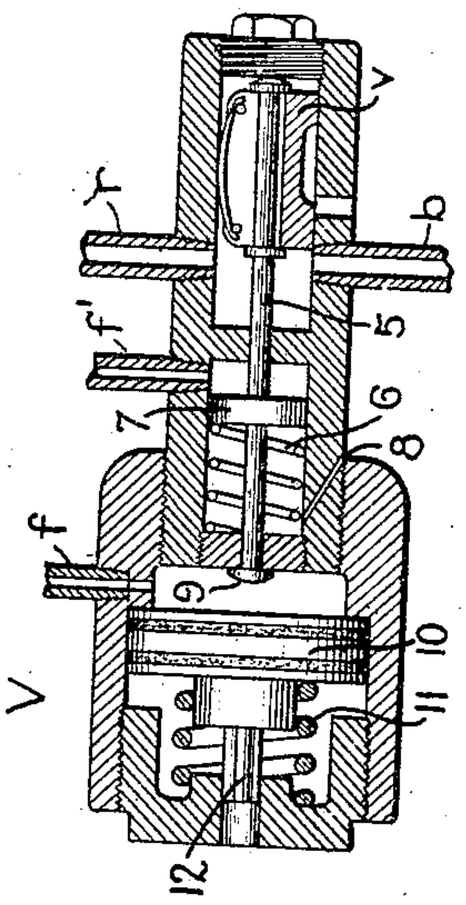

Fig. 2.

Witnesses.

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UNITED STATES PATENT OFFICE.

LAURENCE A. HAWKINS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

BRAKE-CONTROL SYSTEM.

No. 843,749. Specification of Letters Patent. Patented Feb. 12, 1907.

Application filed October 8, 1904. Serial No. 227,634.

To all whom it may concern:

Be it known that I, LAURENCE A. HAWKINS, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Brake-Control Systems, of which the following is a specification.

My invention relates to air-brakes for electrically-propelled vehicles operated in trains on the multiple-unit system.

The object of my invention is to provide a novel control system for the brakes, which enables the brakes on all the train to be operated simultaneously from a given point with gradual application and release, which gives an automatic application of the brakes on all the train, if the train breaks apart at any point, which does away with the necessity for train-pipes and pipe-couplings between the cars, which eliminates the ordinary motorman's valve and much of the car-piping, which makes the air-compressors on the several cars wholly independent, so that no synchronizing apparatus is required for the several governors, which enables the motorman to control both power and brakes by a single handle, which insures the automatic cutting off of power and application of the brakes upon an accident to the motorman, and which is readily applied to single cars with standard straight air-brake equipment, so as to adapt them for operation in a train.

In accomplishing the above results I provide a valve on each car arranged to move automatically into position to connect brake-cylinder to reservoir, so as to apply the brakes, and electrically-controlled devices for moving the valve to lap or release position. Since the control is electrical, the necessity for train-pipes and pipe-couplings between the cars is done away with, and instead two extra train-wires are employed in the train-control leads, so as to enable the brakes on all the cars to be controlled simultaneously from a single point. The electrical controlling means for the valve is so arranged that the motorman can move the automatic valve at will to any one of its three positions and hold it there, so that a gradual application or release of the brakes may be obtained. Since there is no pipe connection between the several reservoirs, no synchronizing devices or connections of any kind are required between the several governors. Since the automatic valve is arranged to move automatically into position to connect the brake-cylinder to reservoir, its electrical control means are deënergized. A breaking apart of the train at any point, which deënergizes the electric controlling devices for the automatic valve, will produce a movement of the valve to braking position and automatically apply the breaks on all the train. Since the control is wholly electrical, the usual motorman's valve may be eliminated, and the control of the brakes obtained by two or three extra contacts on the usual master-controller.

It is frequently desirable that the power should be cut off and the brakes applied in case of an accident to the motorman in the operation of the train, and to accomplish this end devices have been proposed heretofore for application to the motor-controller or to the motorman's valve, or both, which return the controller to off position or move the motorman's valve to braking position when the handle of either is released by the motorman. The objection that has been found heretofore to this arrangement is the strain which is placed on the muscles of the motorman's hand, since in operation he must maintain a grip on the handle of the controller or valve, as the case may be, throughout the operation of the train. With the master-controller arranged in accordance with my invention to control both power and brakes, this objection no longer arises, since only one hand is required at a time for operation, and the motorman may change hands and rest as often as he desires.

My invention then consists in the combination, with a train of cars each equipped with an air-brake system, of a valve for each car arranged to move automatically into position to establish braking connections and electrically-controlled means for moving the valve to lap or release positions.

More specifically considered, my invention consists in the combination, with the above-mentioned valve, of controlling means arranged to move said valve to lap or to release positions, according to the amount of voltage impressed upon the controlling means, and means under the control of the motorman for varying the voltage impressed upon the controlling means.

Still more specifically considered, my in-

vention consists in the combination, with the above valve, of two independent electroresponsive devices arranged to respond to different current strengths and to move the valve respectively to lap and to release position, with means under the control of the motorman for varying the current strength supplied to the devices.

Another feature of my invention consists in the combination, with the valve and electric controlling device above mentioned, of a master-controller for controlling the driving-motors of the train and provided with extra contacts for controlling the controlling devices for the valve.

Another feature consists in arranging the controller in the above combination so that it returns automatically to off position when released.

Other features of my invention will appear from the following specification and will be more specifically pointed out in the appended claims.

My invention will best be understood by reference to the accompanying drawings, in which—

Figure 1 shows diagrammatically a control system for air-brakes arranged in accordance with my invention. Fig. 2 shows a cross-sectional view of an automatic valve adapted for use in such a system, and Fig. 3 shows a cross-sectional view of one of the relay-valves.

In Fig. 1, 1, 2, 3, and 4 represent the usual train-wires, which are provided with couplings, as indicated. To these train-wires are connected on each car the controllers C and C′, the former of which is shown with its contacts developed on a plane surface. These contacts, as shown, consist of six stationary contact-fingers c' to c^6 and two sets of movable contacts. The three upper stationary contacts c', c^2, and c^3 and the corresponding movable contacts represent the usual portion of the controller controlling the motor-circuits, and the train-wires 1 and 2, which are connected to these contacts, represent the usual train-wires for the motor-control system. The particular arrangement of these contacts and their connections and the arrangement and connections of the motor-controlling devices form no part of the present invention, and the motor-controlling devices have been omitted from the drawings for the sake of simplicity. It will be understood that by the three upper stationary contact-fingers, their corresponding movable contacts, and the two upper train-wires is represented any suitable multiple-unit motor-control system. The only controller-contacts which are involved in the control of the brakes are the three lower contact-fingers c^4 to c^6 and their corresponding movable contacts. Similarly the train-wires 3 and 4 alone belong to the brake-controlling system.

It will be seen that the contact-finger c^6 is connected to the battery D, the other terminal of which is connected to earth. The contact c^5 is connected to an intermediate terminal of the battery, and the finger c^4 is connected to the train-wire 3. Thus it will be seen that if any devices are electrically connected at one terminal to this train-wire 3 and at the other terminal to earth and if the contact c^4 is connected to contact c^5 or c^6 a portion or the entire voltage of the battery D will be impressed upon the said devices. The battery D is shown connected to the trolley T through the charging resistance E. The battery is thus floated on the line and is maintained charged; but the connection from the battery to the trolley may be omitted, if preferred.

The electrical controlling devices for the brake system are indicated by the magnets m and M. It will be seen that these magnets are connected to train-wire 4, which is coupled to train-wire 3 at the rear end of the train, as is indicated at 34. The purpose of this extra train-wire and the rear coupling is to provide for the deënergizing of all the electric controlling devices on all the cars of the train, so that the brakes will be applied on all the cars if the train breaks apart at any point whatever.

The breaking system comprises the usual air-compressor A, the reservoir R, and brake-cylinder B. In place of the motorman's valve usually employed on single cars equipped with a straight air-brake system the brake-cylinder B is connected to the reservoir R through the automatic valve V. This automatic valve is controlled by two relay valves F and F′, which are respectively controlled by the magnets m and M. The construction and arrangement of the automatic valve V will be fully described hereinafter; but for the present it is sufficient to understand that the valve V when its electrical controlling means are deënergized establishes a connection between reservoir R and the brake-cylinder B, so as to apply the brakes, but that when valve F′ is opened valve V is moved to lap position, and when valve F is opened valve V is moved to release position connecting brake-cylinder B to atmosphere. It will be seen that the two magnets m and M are represented as of different sizes. This is to indicate that the magnet M controlling the valve F′ operates on a smaller current flow than the magnet m controlling the valve F.

The operation is then as follows: With the controller in the off position, as shown above, the motor-control and brake-control circuits are open. The power is consequently off and the brakes are applied. This is the position to which the controller returns automatically when released by the motorman. This is indicated by the spiral spring S on the shaft of controller C′. Consequently in

order to prevent the cutting off of power and application of the brakes the motorman must keep one hand or the other on the controller-handle; but since only one hand is required for operation of both brakes and power this is no objection, since he is able to rest his hands as frequently as desired. If the controller C be moved to its first position, as indicated by the dotted line $1^{\times}$, contacts c^4 and c^5 will be electrically connected and a portion of the voltage of battery D will consequently be impressed on train-wire 3. A current is thus sent through the magnets m and M, which is insufficient to operate the magnet m, but which causes the magnet M to open the valve F′ so as to move the automatic valve V to lap position in the manner that will be hereinafter explained. If the controller C is moved to its second position, as indicated by the dotted line $2^{\times}$, the total potential of the battery B will be impressed on train-wire 3 and sufficient current will flow through the magnets to operate magnet m so as to open the valve F and move the automatic valve to release position. Thus by moving the controller to off position or position $1^{\times}$ or $2^{\times}$ the valve V may be moved to braking, lap, or release position. As the controller is moved through its remaining positions in order to close the motor-controlling circuit the contacts c^4 and c^6 are maintained electrically connected and the valve V is maintained at release position. If the motorman, however, at any time releases the handle, the controller C will return to off position, cutting off the power and applying the brakes. Moreover, if at any time the train breaks apart the connection between magnets m and M on all the cars and the battery D will be broken and an automatic application of the brakes secured.

Referring now to Fig. 2, the construction of the automatic valve will be explained. The automatic valve V comprises a slide-valve v, mounted on a rod or spindle 5, which when the electrical controlling means are deënergized is held in the position shown by the compression-spring 6, which bears against the piston 7, secured to the spindle. In this position of the valve v the pipe r, leading to the reservoir, is in direct connection with the pipe b, leading to the brake-cylinder. This is the position of the valve to which it tends to return when the electrical controlling means are deënergized. Spindle 5 is limited in its movement by the head 9, as shown. The chamber on the left-hand side of piston 7 is open to atmosphere by port 8, while the right-hand side of the piston is in connection with the pipe f', the pressure in which is controlled by the valve F. The valve-casing V contains a piston 10, which is held in the position shown by the compression-spring 11 as long as the electrical controlling means are deënergized. The chamber on the left-hand side of piston 10 is open to atmosphere through channels in spindle 12, as shown. On its right-hand side the piston is connected to the pipe f, controlled by the valve F.

The construction of the valves F and F′ is shown in Fig. 3, which is a cross-sectional view of the valve F′. This valve comprises a puppet-valve h, which is normally held seated by a spring g and which disconnects the pipe f' from the connection to the reservoir. When the valve h is seated, as shown, the pipe f' is in communication with the atmosphere through channels in the spindle connecting the valve h with the core of magnet M. When the valve h is raised by the magnet M, this connection is closed and a connection is established between the pipe f' and the reservoir. Obviously instead of making the magnets m and M of different sizes so as to respond to different currents strengths the same result may be obtained by making the spring g of one valve stronger than that of the other.

The operation is then as follows: When a small amount of current is sent through the magnets m and M by moving the controller C to its first position, the valve F′ is opened, connecting the pipe f' with reservoir R. The reservoir-pressure upon the right-hand side of piston 7 moves spindle 5 toward the left, as viewed in Fig. 2, until the head 9 on the spindle strikes the piston 10. The spindle is then brought to rest, since the pressure on piston 7 is not sufficient to move piston 10 against the pressure of spring 11. In this position the slide-valve v closes the connection b to brake-cylinder, or, in other words, the valve is in lap position. If the voltage impressed upon the magnets m and M is now increased by moving the controller to its second position, magnet m will open valve F, connecting the right-hand side of piston 10 to reservoir. The pressure on the piston will then move it toward the left, allowing spindle 5 to follow under the pressure on piston 7, so as to bring valve v into position to connect the pipe b to the port a opening to atmosphere. The valve is thus brought to the release position. It maintains this position as long as the controller is maintained in its second position or is moved to close the motor-circuit; but if the controller is returned to its first position the connection between pipe f' and reservoir will be broken and pipe f will be connected to atmosphere by means of the channels on the spindle of the valve h, as has been heretofore explained, and piston 10 will be moved back to the position shown in Fig. 2, returning valve v to lap position. Similarly if the controller is moved to off position or if the circuit of the magnets m and M is broken the pipe f' will be disconnected from reservoir and connected to atmosphere so as to allow the spring 6 to return the pis-

ton 7 to the position shown in Fig. 2, thereby returning the valve *v* to braking position.

Many modifications may be made in the construction and arrangement of parts of the automatic-valve V as well as in its controlling devices. It is not essential that independent devices should be employed for moving the valve to lap and to release position. Furthermore, the arrangement and connection of the controller-contacts may be varied as desired. Accordingly I do not desire to limit myself to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In combination with a train of cars equipped with independent air-brake systems, a valve on each car adapted and arranged to move automatically into position to establish braking connections, and electrically-controlled means for each valve adapted to move it to lap and to release positions.

2. In combination with a train of cars equipped with independent air-brake systems, valve mechanism on each car adapted to connect brake-cylinder to reservoir or to atmosphere or to disconnect it from both and arranged to move automatically into position to connect it to reservoir, electrically-operated controlling means for said valve mechanism, and a control-circuit for said means extending through the train.

3. In combination with a train of cars equipped with independent air-brake systems, a valve on each car adapted and arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-controlled means adapted to move said valve to lap or to release position according to the amount of voltage impressed thereon, a control-circuit extending through the train and connected to said electrically-controlled means on each car, and means at a distant point for impressing different voltages on said control-circuit.

4. In combination with a train of cars equipped with independent air-brake systems, an automatic valve on each car adapted and arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-controlled means adapted to move said valve to lap or to release position according to the amount of voltage impressed thereon, a control-circuit extending through the train and connected to said electrically-controlled means on each car, a battery, and a manually-operated switch adapted to connect different portions of said battery to said control-circuit.

5. In combination with a train of cars equipped with independent air-brake systems, an automatic valve on each car adapted and arranged to move automatically into position to connect brake-cylinder to reservoir, two relay-valves controlling said valve and adapted when moved to move said valve respectively to lap and to release positions, two magnet-windings adapted to operate said relay-valves and to respond to different impressed voltages, a control-circuit extending through the train and connected to the several windings, and means under the control of the motorman for impressing different voltages on said circuit.

6. In combination with a train of cars equipped with independent air-brake systems, a valve on each car arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-operated controlling means therefor, two train-wires of the same polarity extending through the train and connected in series at one end of the train, one of said train-wires being connected to said electrically-operated means on each car, and a controlling-switch connected to the other train-wire.

7. In combination with a motor-operated train of cars each equipped with an independent air-brake system, a valve on each car arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-operated controlling means therefor, control-circuits for said electrically-operated means and for the driving-motors extending through the train, and a switch for controlling both circuits.

8. In combination with a motor-operated train of cars each equipped with an independent air-brake system, a valve on each car arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-operated controlling means therefor, control-circuits for said electrically-operated means and for the driving-motors extending through the train, a switch for controlling both circuits, and means for returning said switch to off position when released by the motorman.

9. In combination with a motor-operated train of cars each equipped with an independent air-brake system, an automatic valve on each car adapted and arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-operated controlling means for said valve adapted to move said valve to lap and to release position, a control-circuit for said means extending through the train, a second control-circuit for the driving-motors, and a controlling-switch adapted and arranged when moved from off position to energize the first control-circuit to move the automatic valves to lap position then to move them to release position, and then to energize the motor-control circuit.

10. In combination with a motor-operated train of cars each equipped with an independ-

ent air-brake system, an automatic valve on each car adapted and arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-operated controlling means for said valve adapted to move said valve to lap and to release position, a control-circuit for said means extending through the train, a second control-circuit for the driving-motors, a controlling-switch adapted and arranged when moved from off position to energize the first control-circuit to move the automatic valves to lap position, then to move them to release position, and then to energize the motor-control circuit, and means for returning said switch to off position when released by the motorman.

11. In combination with a motor-operated train of cars each equipped with an independent air-brake system, an automatic valve on each car adapted and arranged to move automatically into position to establish braking connections, electrically-operated means for moving said valve to lap or to release position according to the amount of voltage impressed thereon, a control-circuit for said means extending through the train, a second control-circuit for the driving-motors, a controlling-switch adapted and arranged when moved from off position to impress a definite voltage on the first control-circuit, then to increase said voltage, and then to energize the motor-control circuit, and means for returning said switch to off position when released by the motorman.

12. In combination with a train of cars equipped with independent air-brake systems, a valve on each car arranged to move automatically into position to connect brake-cylinder to reservoir, electrically-operated means for breaking said connection and connecting brake-cylinder to atmosphere, a control-circuit for said electrically-operated means extending through the train, a manually-operated switch controlling said control-circuit, and means for returning said switch to off position when released by the operator.

13. In combination with a train of cars equipped with independent air-brake systems, a brake-controlling valve on each car, electrically-operated controlling means therefor, a source of current for said controlling means, and electrical connections from said controlling means to said source, the connection from the controlling means on each car to the source passing in series through all the cars in the train.

In witness whereof I have hereunto set my hand this 5th day of October, 1904.

LAURENCE A. HAWKINS.

Witnesses:
EDWARD WILLIAMS, JR.,
FRED B. COREY.