No. 692,779. Patented Feb. 4, 1902.

F. F. BRUSH.

CONTROLLING APPARATUS FOR ELECTRIC MOTORS.

(Application filed Apr. 27, 1901.)

(No Model.) 2 Sheets—Sheet 1.

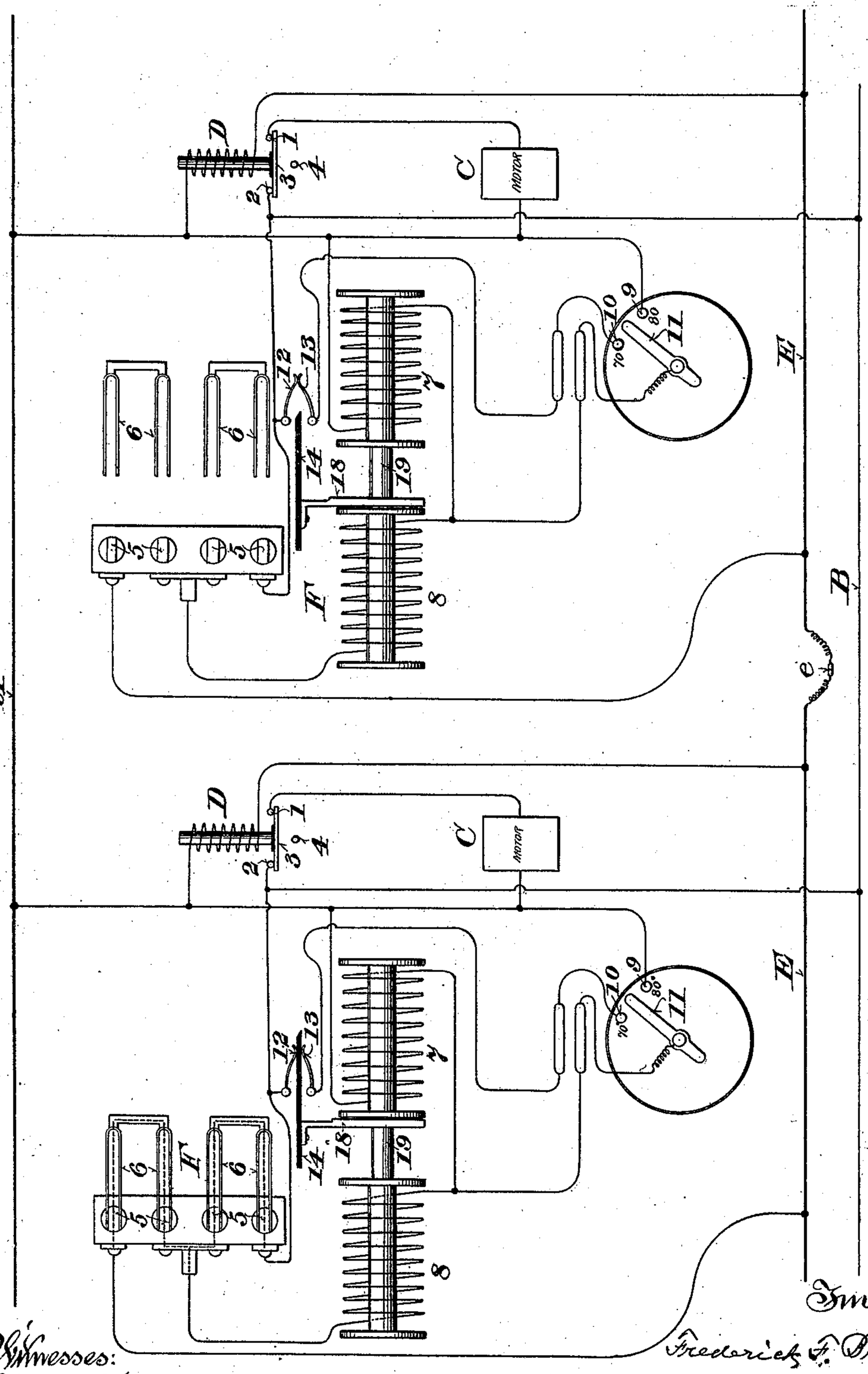

Fig. 1.

Witnesses:
Geo. W. Young.
Chas. L. Goss.

Inventor:
Frederick F. Brush,
By Winkler, Flanders, Smith, Bottum & Vilas,
Attorneys.

No. 692,779. Patented Feb. 4, 1902.

F. F. BRUSH.

CONTROLLING APPARATUS FOR ELECTRIC MOTORS.

(Application filed Apr. 27, 1901.)

(No Model.) 2 Sheets—Sheet 2.

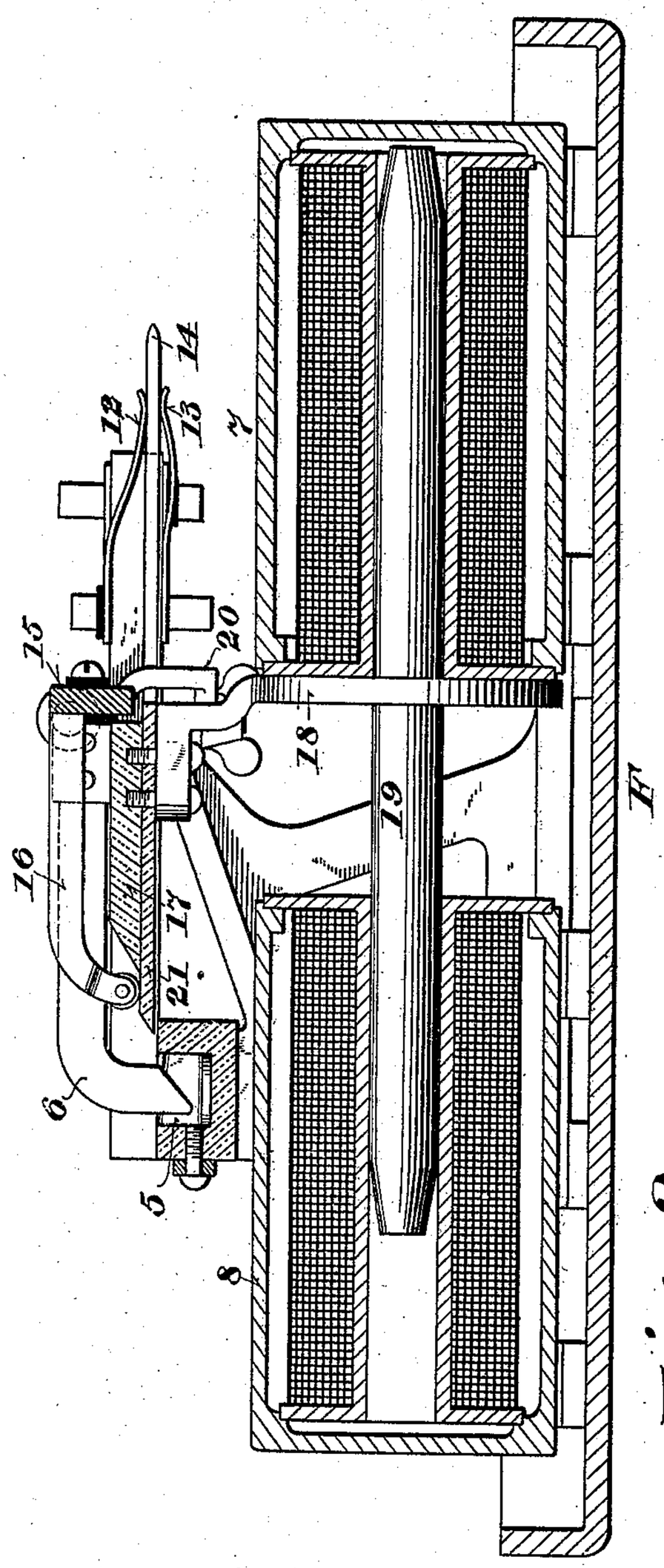

Fig. 2.

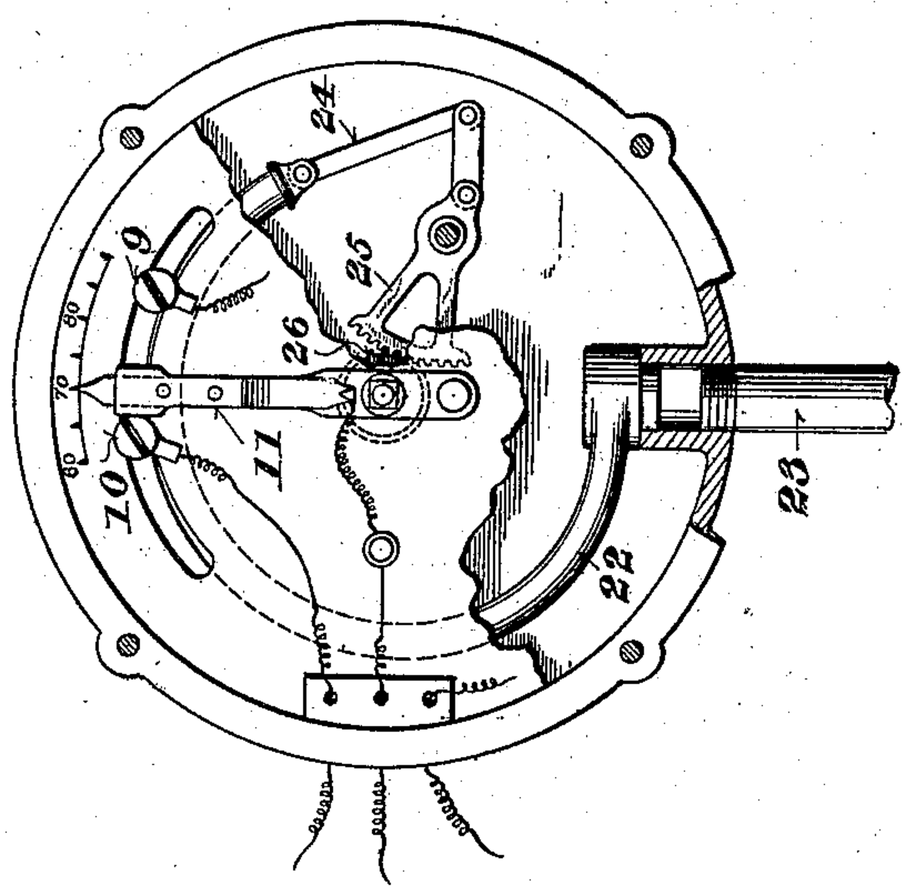

Fig. 3.

Witnesses:
Geo. W. Young.
Chas. L. Goss.

Inventor:
Frederick F. Brush,
By Winkler, Flanders, Smith, Bottum & Vilas,
Attorneys.

UNITED STATES PATENT OFFICE.

FREDERICK FARNSWORTH BRUSH, OF NEW YORK, N. Y., ASSIGNOR TO NIELS A. CHRISTENSEN, OF MILWAUKEE, WISCONSIN.

CONTROLLING APPARATUS FOR ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 692,779, dated February 4, 1902.

Application filed April 27, 1901. Serial No. 57,661. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK FARNSWORTH BRUSH, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Controlling Apparatus for Electric Motors, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates particularly to a multiple-unit system of electric motors.

The main objects of the invention are to stop and start the several motors in such a system indirectly by electromagnetic switches the operation of which is governed by a single automatic controller or by any one of a series of such controllers, according to variations in fluid-pressure, to avoid the danger and objections incident to running conductors together in the same cable or in proximity with each other for controlling the operation of independent electromagnetic devices, particularly when they are employed in electric-railway service, and generally to improve the construction and operation of apparatus of this class.

It consists in a certain novel construction and arrangement of parts, as hereinafter particularly described, and pointed out in the claims.

For the purpose of illustration I have shown and described apparatus specially designed for air-brake service on electric railways; but the invention is applicable to other uses.

In the installation of my controlling apparatus for electric-railway service the equalizing-wire is usually placed in a cable with other conductors used in connection with the reversers and with the relays controlling pilot-motors which operate the controllers for stopping and starting the propelling-motors of the cars. As heretofore connected and arranged in a multiple-unit system, this equalizing-wire may under certain contingencies impart sufficient current to operate the controlling devices of the propelling-motors, and thus occasion accidents. This objection is overcome by the construction and arrangement of apparatus in accordance with my invention, as hereinafter explained.

In the accompanying drawings like characters designate the same parts in the several figures.

Figure 1 is a diagram illustrating so much of the equipment of two cars as is essential to a clear understanding of the controlling apparatus for multiple-unit service. Fig. 2 is a longitudinal section, on a greatly enlarged scale, of the switch and operating magnets of one of the automatic controllers or relays; and Fig. 3 is a detail view, on an enlarged scale, of one of the fluid-pressure-operated devices for controlling the circuits of the controller or relay magnets.

Referring to Fig. 1, A and B designate the main conductors by which current is supplied to both the propelling-motors (not shown) and to the compressor-motors, A being the trolley or supply conductor and B the ground or return conductor.

C C are the compressor-motors, which are connected on one side with the supply-conductor A and on the other side with contact-pieces 1 of electromagnetic switches D D. Other contact-pieces 2 of said switches are connected with the return-conductor B. One terminal of each main-switch magnet is connected with the supply-conductor A and the other terminal with an equalizing or balancing conductor E, which runs through the entire train and is provided between the cars with couplings *e*.

Switches of any suitable form and construction may be employed for directly controlling the supply of current to the compressor-motors, and these switches may be operated by electromagnets of any suitable form. I have shown for the purpose in a general way in Fig. 1 solenoid-magnets the cores of which are provided with contact-plates 3, which when the magnets are energized are drawn upwardly into engagement with the fixed contact-pieces 1 and 2, so as to close the circuit through the compressor-motors, which are arranged in parallel between the main conductors A and B. When said magnets are deprived of current, the contact-plates 3 drop against stops 4, and thereby open the circuit through the associated motors.

F F are automatic controllers adapted to

be operated by variations of pressure to open and close switches or contacts by which the passage of current through the main-switch magnets D D is governed. These controllers, as well as the main electromagnetic switches, may be of any well-known form and construction suitable for the purpose. Controllers like those shown in the drawings as adapted for the purpose comprise, as generally shown in Fig. 1, a switch or circuit-breaker having fixed contact-pieces 5 and movable contact-pieces 6, two solenoid-magnets 7 and 8, which are arranged to operate the movable contact-pieces of said switch, maximum and minimum pressure contact-pieces 9 and 10, a pivoted contact-arm 11, movable between said contact-pieces 9 and 10 and adapted to be actuated by variations in fluid-pressure, and an auxiliary circuit-breaker controlling the passage of current through one of said magnets and consisting of two contact-springs 12 and 13, adapted to be separated by an insulating-strip 14, carried by the armature or core of the magnets 7 and 8. The magnets 7 and 8 and the switch or circuit-breaker which they operate constitute, in effect, a "relay," and for convenience they may be so designated, and the arm 11, with the contact-pieces 9 and 10, forms a switch which may be called the "primary" switch.

One terminal of the magnet 7 is connected with the supply-conductor A and the other terminal with the pivoted contact-arm 11. One terminal of the other magnet 8 is connected with fixed contact-pieces 5 of the relay-switch and the other terminal with the contact-arm 11. Another contact-piece 5 of said switch is connected with the ground or return conductor B, and still another contact-piece 5 is connected with the equalizing-wire E. The contact-spring 12 of the auxiliary circuit-breaker is connected with the ground or return conductor B, and the contact-spring 13 is connected with the minimum-pressure contact-piece 10. The maximum-pressure contact-piece 9 is connected with the supply-conductor A.

The connections of the various parts of the apparatus with the main conductors A and B may be reversed without change in results.

Referring to Fig. 2, which shows the relay-magnets and switch and the auxiliary circuit-breaker in detail, the movable contact-pieces 6, made in the form of spring-arms, are attached at one end to a rocking bar 15, which is provided with an arm 16, carrying a roller at its free end in the path of an incline 17. The incline 17 is attached to a plate 18, mounted on the movable core 19, between the magnets 7 and 8, so that when said plate and core are moved to the left by the magnet 8 the incline 17 will lift the arm 16 and disengage the contact-arms 6 from the contact-pieces 5. The bar 15 is also provided with a depending arm 20, with which the plate 18 engages when it is moved to the right by the magnet 7, thereby turning the contact-arms 6 down into engagement with the contact-pieces 5. The plate 18, besides the insulating-strip 14, carries an insulating-strip 21, which is thrust between the contact-pieces 5 and 6 when they are separated, thereby extinguishing arcs that may be formed between them. The strip 14, the incline 17, and the arm 20 are so constructed and arranged that when the contact-pieces 5 and 6 are in engagement with each other the contact-springs 12 and 13 will be separated, as shown in Fig. 2, and vice versa.

Referring to Fig. 3, which illustrates in detail, on a larger scale, the primary switch, 22 is a curved spring-tube which is connected at one end by a pipe 23 with a reservoir (not shown) supplied with compressed air from the compressors for the operation of the brakes. The free end of the spring-tube is connected by a link 24 and a segment-gear 25 with a pinion 26 on the pivot-pin of the contact-arm 11. The contact-pieces 9 and 10 are made adjustable, so as to vary the maximum and minimum limits of the pressure to be maintained.

Each car is provided according to my invention with an air-compressor, a reservoir connected with the discharge of the compressor, an electric motor for operating the compressor, a main switch for controlling the supply of current to said motor, an automatic controller for opening and closing the circuit through the main-switch magnet according to variations in the pressure produced by the compressor, and an equalizing-conductor for connecting the main-switch magnet with corresponding magnets on other cars, so that a single automatic controller on any car will govern the operation of all the main switches on several cars coupled in a train, and the several main switches will in turn control the operation of the associated compressor-motors each independently of the others.

The apparatus hereinbefore described operates as follows: When the fixed contact-pieces 5 of a relay-switch are connected by the contact-arms 6, as shown at the left in Fig. 1, circuits will be closed from the conductor A through all of the main-switch magnets D, the equalizing-conductor E, and the relay-switch to the return-conductor B. A circuit will also be closed from the supply-conductor A through the magnets 7 and 8 in series and a part of the associated relay-switch to the return-conductor B. The magnets D being energized close the main switches through the contact-pieces 1 2 and plates 3, thereby connecting the compressor-motors C with both the main conductors A and B. In this condition of the apparatus the compressors will be operated by the motors and supply compressed air to the reservoirs on the several cars. As the pressure in the reservoirs rises the contact-arms 11 of all the controllers will be turned to the right, and when the contact-arm 11 of the controller at the left (which is assumed to have control of the entire system) engages with the maximum-pressure contact-

piece 9 it will short-circuit and deënergize magnet 7, leaving the magnet 8 in circuit and energized, current passing from the supply-conductor A through contact-piece 9, arm 11, magnet 8, and relay-switch to the return-conductor B. The magnet 8 will thereupon move the armature and core 18 and 19 to the left, separate the contact-pieces 5 and 6, and withdraw the insulating-strip 14 from the contact-springs 12 and 13, allowing them to come together. This breaks the connection between the return-conductor B and the equalizing-conductor E, opening the circuits through the several main-switch magnets D, which will thereupon release the contact-plates 3 and allow them to drop away from the contact-pieces 1 and 2. The circuits of the several compressor-motors are thereby opened and the compressors are simultaneously stopped. As the pressure falls in the reservoirs the contact-arms 11 will gradually turn to the left away from the maximum-pressure contact-pieces 9. No arc will be formed by the separation of these contacts, since the ground connection of the contact-arm 11 through magnet 8 is broken by the associated relay-switch. When the movable contact-arm 11 of the automatic controller which governs the main-switch magnets D on the several connected cars engages the minimum-pressure contact-piece 10, current will pass from the supply-conductor A through the coil of magnet 7, contact-arm 11, contact-piece 10, and the contact-springs 13 and 12 of the auxiliary circuit-breaker to the return-conductor B. Magnet 7 being thus energized, while the opposing magnet 8 remains inert, will move the armature and core 18 and 19 back to the right, as shown at the left in Fig. 1, and turn the arms 6 of the associated switch into engagement with the contact-pieces 5, thereby closing the connection between the return-conductor B and the equalizing-conductor E. This closes the circuits of the several main-switch magnets D, which are thus energized and caused to close the circuits of the associated compressor-motors through the contact-pieces 1 2 and plates 3. At the same time the circuit is closed through the magnets 7 and 8 of the dominating controller at the left, and the insulating-strip 14 is thrust between and separates the associated contact-springs 12 and 13, thereby breaking the connection between the minimum-pressure contact-piece 10 and the return-conductor B. The compressors being started by the closing of the main switches, as above explained, deliver compressed air to the reservoirs and raise the pressure therein, causing the contact-arms 11 to turn back again toward the maximum-pressure contact-pieces 9. In this way all the electromagnetic switches D are operated, and the compressor-motors are started and stopped simultaneously by one of the several automatic controllers. The separation of the contact-arms 11 from the contact-pieces 10 will not produce arcs, because when such separation takes place the connections between said contact-pieces 10 and the ground or return conductor B are all broken by the associated auxiliary circuit-breakers. That controller which is adjusted to close the circuit at the highest minimum pressure will be brought into service and will operate all the main-switch magnets D and control all the compressor-motors on the several cars, as long as it is in working condition, in preference to other controllers which are adjusted to close the circuit at a lower pressure.

The coils of the main-switch magnets D are made of high resistance, so that in case of a cross between the equalizing-wire or its branches and any of the other wires contained with it in the same cable or branches of such wires the current that could pass by way of the equalizer or its branches through the controlling devices of the propelling-motors would be insufficient to operate them.

Pumps operated by motors controlled according to my system may be employed to produce and maintain a vacuum, and variations in the vacuum may be utilized to open and close the circuits of the relay-magnets.

The number and arrangement of the contact-pieces through which the circuits of the relay-magnets are opened and closed, either by variations in absolute pressure or in vacuum, may be changed—as, for example, the maximum and minimum pressure contact-pieces may be movable while the other contact is fixed.

Various changes in the details of construction and arrangement of parts may be made within the spirit and intended scope of my invention without affecting the principle or mode of operation of the apparatus.

I claim—

1. In controlling apparatus, the combination with main conductors and an electric motor, of a main switch controlling the motor-circuit, a magnet for operating said switch, a relay-switch in the circuit of the main-switch magnet, a magnet for operating the relay-switch, and a primary switch controlling the circuit of said relay-magnet and adapted to be operated by variations in fluid-pressure, substantially as described.

2. In controlling apparatus, the combination with main conductors and a number of electric motors arranged in parallel, switches controlling the supply of current to the several motors, magnets for operating said switches, and an automatic controller comprising a switch in the circuit of said several magnets and means adapted to be operated by variations in fluid-pressure for automatically opening and closing the controller-switch, substantially as described.

3. In controlling apparatus, the combination with main supply and return conductors and an electric motor, of a switch controlling the supply of current to said motor, a magnet for operating said switch, an equalizing-con-

ductor for connecting said magnet with other switch-operating magnets, and an automatic controller adapted to open and close a connection between said equalizing-conductor and one of the main conductors according to variations in fluid-pressure, substantially as described.

4. In controlling apparatus, the combination with main supply and return conductors and an electric motor, of a switch controlling the connection of said motor with one of said conductors, a magnet for operating said switch, having one terminal connected with the supply-conductor, an equalizing-conductor for connecting the other terminal of said magnet with the corresponding terminals of other similar switch-operating magnets, and an automatic controller adapted to be actuated by variations of fluid-pressure and to electrically connect and disconnect said equalizing and return conductors, substantially as described.

5. In controlling apparatus, the combination with main conductors and an electric motor, of a main switch controlling the supply of current to said motor, a magnet for operating said switch, a magnetic relay comprising a switch controlling the passage of current through the main-switch magnet and two magnets for operating the relay-switch, a primary switch having maximum and minimum pressure contact-pieces and adapted to be operated by variations of fluid-pressure and to control the supply of current to the relay-magnets, and an auxiliary switch controlling a connection between one of the contacts of the primary switch and the return conductor and adapted to be operated by said relay-magnets, substantially as described.

6. In controlling apparatus, the combination with an electric motor and main conductors, of a switch controlling the supply of current to said motor, a magnet for operating said switch, an equalizing-conductor for connecting said magnet with other similar switch-operating magnets, an automatic controller comprising a relay-switch governing the passage of current through said equalizing-conductor and the main-switch-operating magnets connected thereby, a primary switch having maximum and minimum pressure contact-pieces and a movable contact-piece adapted to be actuated by variations of fluid-pressure, two magnets for operating the relay-switch, one terminal of each of said relay-magnets being connected with the movable contact-piece of the primary switch, the remaining terminal of one magnet with one of the main conductors and the remaining terminal of the other magnet with a contact of the relay-switch, the maximum-pressure contact-piece of the primary switch being connected with one of the main conductors and the minimum-pressure contact-piece being connected through an auxiliary circuit-breaker operated by the relay-magnets, with the other main conductor, substantially as described.

In witness whereof I hereto affix my signature in presence of two witnesses.

FREDERICK FARNSWORTH BRUSH.

Witnesses:

JEAN DE TRAZ,

EDWARD P. MACLEAN.