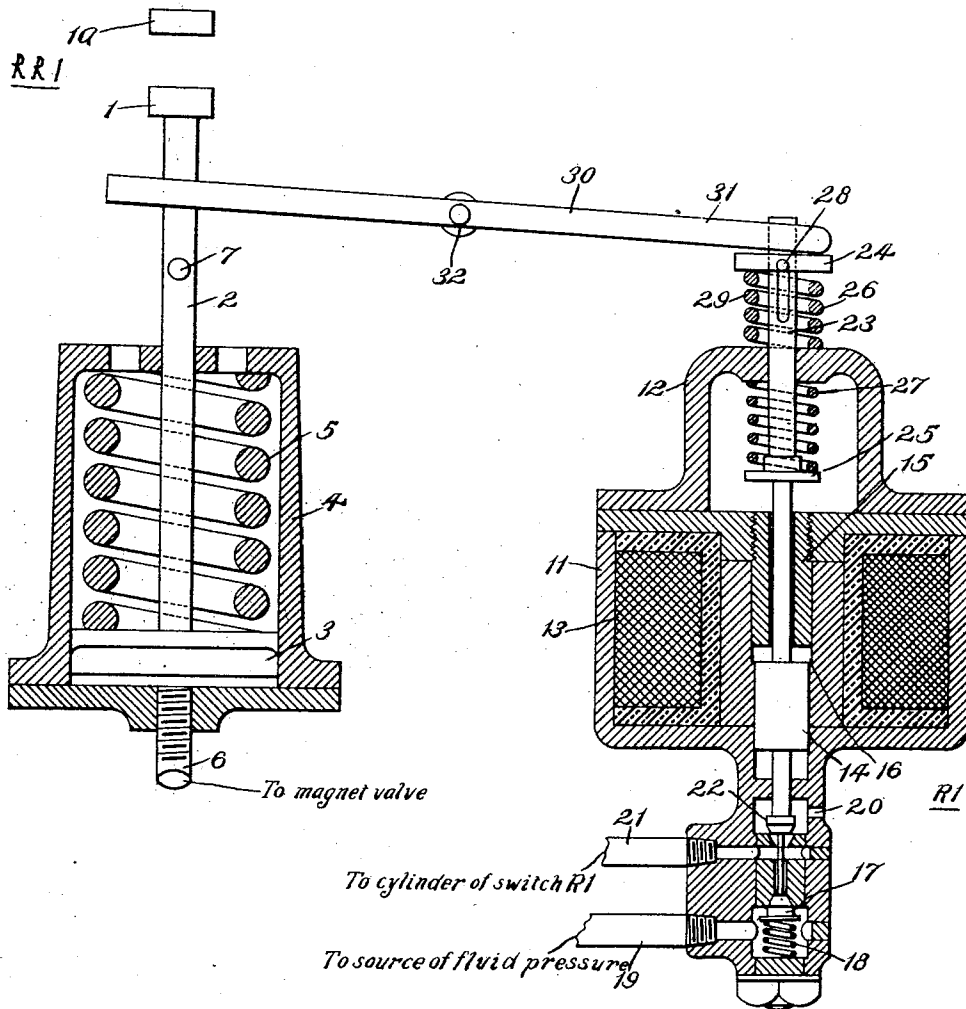


H. L. BEACH,
CONTROL APPARATUS.
APPLICATION FILED OCT. 30, 1917.

1,406,333.

Patented Feb. 14, 1922.



WITNESSES:

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CONTROL APPARATUS.

1,406,333.

Specification of Letters Patent. Patented Feb. 14, 1922.

Original application filed September 8, 1914, Serial No. 860,605, matured into Patent No. 1,244,459, dated October 30, 1917. Divided and this application filed October 30, 1917. Serial No. 199,286.

To all whom it may concern:

Be it known that I, HOWARD L. BEACH, a citizen of the United States, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Control Apparatus, of which the following is a specification, this application being a division of my copending application, which has matured into Patent No. 1,244,459, granted October 30, 1917.

My invention relates to control apparatus for electric motors, and it has special reference to control apparatus for electric motors that are adapted for use in propelling electric railway vehicles and the like.

One object of my invention is to simplify, and reduce the cost of construction and maintenance of control apparatus of the above-indicated character.

Another object of my invention is to provide a novel type of control apparatus whereby the flexibility and efficiency of operation of systems of the general type under consideration are increased.

In many types of control systems for electric railway vehicles that employ auxiliary control circuits for electrically governing a plurality of power-operated, particularly fluid-pressure operated, switches, it is customary practice to control the operation of the switches directly from the auxiliary control circuit through a suitable master controller. In the case of automatic systems, in addition to the apparatus mentioned, it is necessary to provide an accelerating relay or limit switch, which is set to operate upon the traversal therethrough of a predetermined current value, and also a multiplicity of electrical interlocking contact members that are associated with corresponding control fingers and are actuated by the respective switches to energize the magnet coils of the switches, in accordance with a predetermined sequence, to effect automatic progressive operation of the several motor-controlling switches.

Disadvantages of this type of control apparatus are the first cost and maintenance of the large number of interlocking contact members. It is, therefore, with the purpose of obviating these disadvantages that my invention is designed.

According to my invention, I reduce to a

necessary minimum the number of electrical interlocking contact members that are carried by the switches; and in particular, I provide a plurality of adjustable electromagnetic devices that are mechanically actuated by the switch that closes, just prior in the sequence, to effect fluid-pressure operation of the respective switches, as more fully set forth in my above-identified patent.

In the accompanying drawing, the single figure is a sectional detail view of a complete switching device constructed in accordance with my invention.

Referring to the figure, which illustrates the preferred form of one type of switching device that is employed in the systems shown in my above identified patent, the device shows the relation of a switch RR1 to the electromagnetic device that is associated with a switch R1. A stationary switch member 1^a is supported in position in any suitable and familiar manner (not shown), and a co-operating movable contact member 1 is suitably insulated from, and is movable with, a rod 2 to the lower end of which is secured a piston 3 which operates within a cylinder 4 in opposition to the action of a helical spring 5. A suitable inlet pipe 6 is provided to admit fluid-pressure from any suitable source (not shown). A pin 7 is secured near the free end of the rod 2, for a purpose hereinafter specified. It will be understood that any other equivalent type of fluid-pressure-operated device may be employed, if desired. The electromagnetic valve illustrated in the figure comprises a suitable encasing member 11 which is provided with a cap having a hollow raised central portion or hub 12; a coil 13 of relatively large current capacity which is disposed within the encasing member 11 and which is adapted for connection in the main motor circuits; a centrally disposed movable core 14 which co-operates with a stationary longitudinally adjustable core 15 and is separated therefrom by a suitable air gap 16; a valve member 17 which is suitably secured to the lower end of the core 14 and is biased by a spring member 18 to close an inlet passage or pipe 19 from the source of fluid-pressure; an exhaust chamber 20 which is normally in communication with a passage or pipe 21 leading to the operating cylinder of the corresponding switch; a

second valve member 22 which is adapted to close communication between the chamber 20 and the passage 21 upon actuation of the electromagnetic device; a rod 23 which is
 5 secured to the upper end of the core 14 and is movable therewith; a loose collar 24 which is disposed near the upper end of the rod 23; a second collar 25 which is rigidly
 10 secured to an intermediate point of the rod 23; a helical spring 26 which is supported upon the upper surface of the hub 12 and is adapted to bias the collar 24 and the rod
 15 23 to their upper positions, a second helical spring 27 which is disposed around the rod 23 between the inner flat surface of the hub 12 and the collar 25, and is adapted to bias
 20 the rod 23 and the associated valve member 17 to its lower position; a pin 28 which is secured to opposite sides of the collar 24 and extends through a longitudinally dis-
 25 posed slot 29 in the rod 23; and an oscillating rod or lever 30, one looped end 31 of which extends around the rod 23 and rests upon the collar 24 and is pivoted at an inter-
 30 mediate point 32 to have its free end engaged by the pin 7 of the rod 2, under pre-determined conditions.

The electromagnetic action of the coil 13 tends to maintain the valve 17 closed, and,
 30 therefore, the coil 13 and the upper spring 26 act in conjunction with each other and in common opposition to the action of the spring 27. With no current flowing, the
 35 action of the spring 26 predominates over that of the spring 27, and the valve 17 remains closed; also, the electromagnetic force exerted by the coil 13, while the motor
 40 current traversing the coil is maintained above a predetermined value, is sufficient to overcome the action of the spring 27, even
 45 though the spring 26 be temporarily rendered inoperative upon the rod 23, as hereinafter described. The current value at which the device operates may be readily
 50 varied to suit the particular conditions and to obtain the most efficient operation by adjusting the position of the stationary core 15 relative to the movable core 14.

The operation of the device just described
 50 may be set forth as follows: Upon closure of the switch RR1 by the admission of fluid-pressure to the cylinder 4, the pin 7 of the rod 2 engages the free end of the rod 30,
 55 and, consequently, depresses the other end 31 of the rod, causing the collar 24 to be actuated downwardly, a movement which is permitted by the pin and slot construction. The actuation of the spring 26 upon the
 60 rod 23 and associated valve member 17 is thus relieved. However, so long as the motor current passing through the coil 13 remains above a predetermined value, the electromagnetic action of the coil is sufficient to overcome the action of the spring
 65 27, and no further operation of the electro-

magnetic device occurs. When the current drops below the predetermined value, how-
 ever, the action of the spring 27 becomes greater than the force exerted by the coil 13, and the valve member 17 is actuated to its
 70 lower position to admit fluid-pressure to the cylinder of the switch R1, thereby closing the said switch. Thus the opening of the valve causes the piston-and-cylinder of the
 75 switch R1 to effect its working movement. The switch is then maintained in its closed position, irrespective of further variations in the motor current, by the disposal of the coil 13 in a circuit which receives only a
 80 small portion of the motor current, or by opening the circuit of the coil 13.

The opening action of the device illustrated is effected as follows: Upon the open-
 ing of the switch with which the device is mechanically associated, the pin 7 is dis-
 85 engaged from the free end of the rod 30, whereupon the spring 26 overcomes the action of the spring 27 and actuates the rod 23 and its associated valve member 17 to their upper positions to permit of the re-
 90 lease of fluid pressure from the operating cylinder of the corresponding switch through the passage 21 and the exhaust chamber 20.

I do not wish to be restricted to the specific arrangement of parts, or structural
 95 details herein set forth, as many modifications thereof may be made within the spirit and scope of my invention. I, therefore, desire that only such limitations shall be imposed as are indicated in the appended
 100 claims.

I claim as my invention:

1. The combination with a normally closed fluid-controlling valve and a device whose
 working movement is governed by the
 105 opening thereof, of electromagnetic means adapted to oppose the opening operation of the said valve and a plurality of resilient means for respectively assisting and
 110 opposing said electromagnetic means.

2. The combination with a normally closed fluid-controlling valve and a piston-and-cylinder whose working movement is gov-
 115 erned by the opening thereof, of electromagnetic means for biasing the said valve to the closed position thereof, mechanical means for rendering the valve active and a plurality
 120 of unlike resilient means for respectively assisting and opposing said electromagnetic means.

3. The combination with a normally closed fluid-controlling valve and a device whose
 working movement is governed by the open-
 125 ing thereof, of a current-carrying coil, an armature actuated by the said coil and adapted to bias the said valve to the closed position thereof, and a plurality of unlike springs for respectively assisting and oppos-
 130 ing said coil.

4. The combination with a normally-closed

fluid-controlling valve and a piston-and-cylinder whose working movement is governed by the opening thereof, of mechanical means and electromagnetic means co-operating with the said mechanical means for rendering the said valve inactive and a plurality of unequal springs for respectively assisting and opposing said electromagnetic means.

10 5. The combination with a fluid-controlling valve, of resilient means for biasing the said valve to a predetermined position, weaker resilient means for opposing the first-named means, electromagnetic means for
15 aiding the first-named means and mechanical

means for rendering the first-named means inoperative.

6. The combination with a fluid-controlling valve, of resilient means for biasing the said valve to a predetermined position, 20 weaker resilient means for opposing the first-named means, electromagnetic means for aiding the first-named means and mechanical means for rendering the first-named means temporarily inoperative. 25

In testimony whereof, I have hereunto subscribed my name this twentieth day of October, 1917.

HOWARD L. BEACH.