Nov. 10, 1925. 1,561,240

H. H. JOHNSTON

CONTROL APPARATUS

Filed July 7, 1920

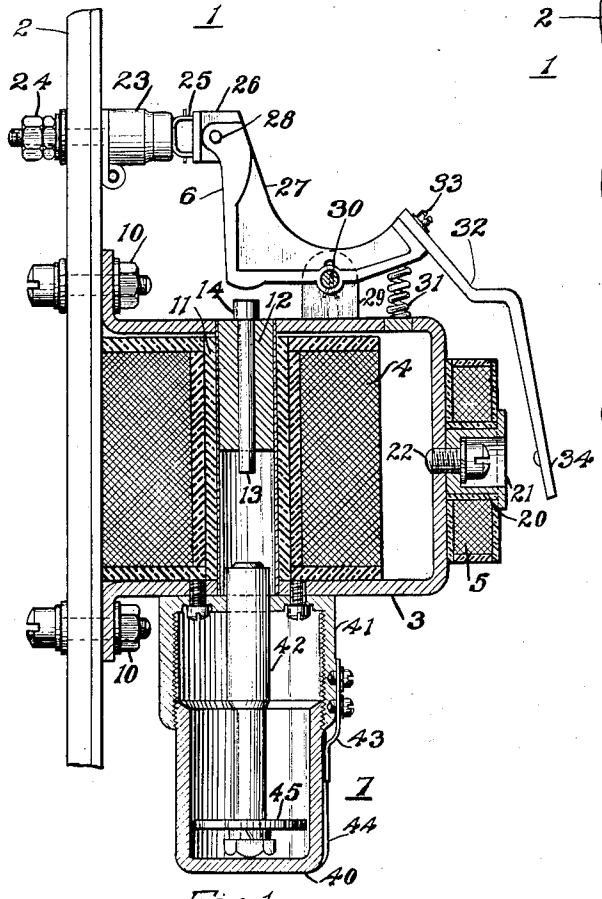


Fig. 1.

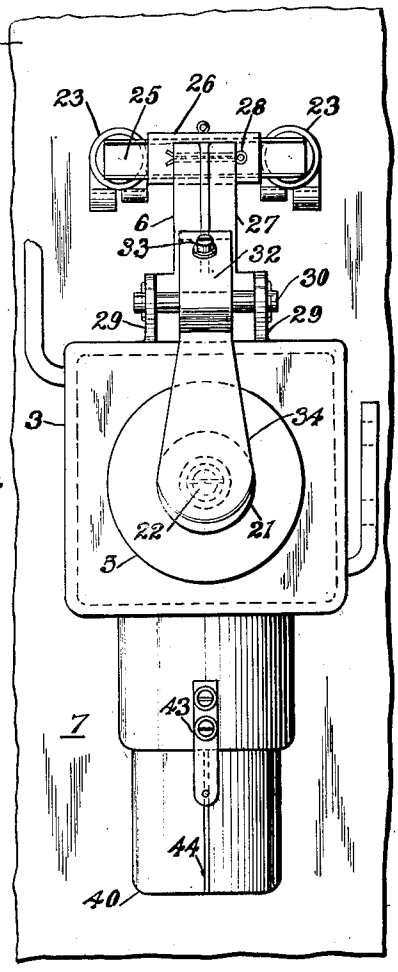


Fig. 2.

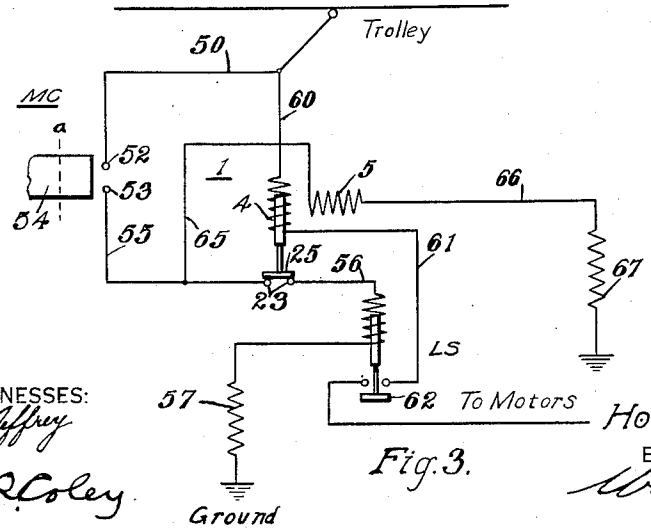


Fig. 3.

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UNITED STATES PATENT OFFICE.

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CONTROL APPARATUS.

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To all whom it may concern:

Be it known that I, HOWARD H. JOHNSTON, 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.

My invention relates to control apparatus and it has special relation to the construction and operation of an overload protective device for electric railway motors and the like.

One object of my invention is to provide a novel form of device of the above-indicated character, whereby, upon the opening of the motor circuit under overload conditions, electrical means is provided to maintain such circuit open until the master controller has been returned to the "Off" position, thus ensuring that the maximum amount of accelerating resistance is included in circuit with the main motor before power is again supplied thereto.

Another object of my invention is to provide a novel type of overload relay device wherein a plurality of coils, at right angles one to the other, are respectively adapted for initial overload actuation and holding functions.

Another object of my invention is to provide a device of the character set forth wherein the holding coil is permanently energized during all periods when the master controller occupies an operative position, whereby the holding circuit is held in instant readiness for the desired purpose.

Another object of my invention is to provide a relatively simple and compact relay device wherein mechanical latching features of the prior art are entirely eliminated.

Other objects of my invention will become evident from the following detailed description, taken in conjunction with the accompanying drawing, wherein

Figure 1 is a view, chiefly in longitudinal section and partially in side elevation, of a relay device constructed in accordance with my present invention;

Fig. 2 is a view, in front elevation, of the relay device; and

Fig. 3 is a simplified diagrammatic view of the control circuits connected with, and governed by, my novel relay device.

Referring to Fig. 1 and Fig. 2, the relay device 1 here shown comprises a suitable supporting base or mounting slab 2 to which is secured a U-shaped bracket or encasing member 3 for respectively containing and supporting actuating coils 4 and 5, a set of contact members and associated devices 6 and a tripping apparatus 7.

The bracket or encasing member 3 may be of any suitable form for suitably enclosing and protecting the coil 4 and may be attached to the base 2 by means of a plurality of bolts 10 that extend through the flanged ends of the bracket.

The main or overload actuating coil 4 is wound around an insulating spool or tube 11 along a vertical axis, a stationary core member 12 being located within the upper portion of the spool 11 and being suitably secured in position by the upper face of the bracket member 3. A movable pin or rod 13 extends through and beyond both ends of the stationary core 12, the lower end being adapted to be struck by the tripping apparatus 7 and the upset or enlarged head 14 at the upper end being adapted for separating the contact devices 6, as subsequently set forth in detail.

The auxiliary or holding coil 5 is formed of relatively light wire and may also be relatively small in dimensions by reason of the light duty imposed upon it. The coil 5 is wound around a short spool or insulating tube 20 along a horizontal axis and is supported upon the outer end of the encasing member 3 in proximity to one side of the main coil member 4.

A cap or shell member 21 is secured, by means of a screw 22, to a central point of the vertical face of the bracket member 3, and the coil 5 is wound around this cap member. The coil and the cap member may thus be readily assembled as a unit upon the encasing member 3. Furthermore, the cap member 21 thereby acts as a magnetic pole or core member, for a purpose to be subsequently set forth.

The co-operating contact devices 6 comprise a pair of stationary contact studs or terminals 23, which are secured to the slab 2 by means of bolts and nuts 24, a movable bridging contact member 25 for engaging both stationary contact members 23 in the closed position of the relay, as illustrated, a

supporting bracket arm 26 for the movable contact member 25, which is rigidly mounted upon a bell-crank lever or arm 27, as indicated by the reference character 28. The bell-crank lever 27 is a pivotally mounted between a pair of upwardly-extending lugs or taps 29 on the upper face of the bracket 3, the pivotal axis being denoted by the reference character 30. A short helical spring 31 is adapted to act between the right-hand end or heel of the bell-crank lever 27 and an adjacent portion of the bracket member 3, whereby the bell-crank lever 27 is biased to the illustrated closed-circuit position.

An auxiliary apparatus that acts in conjunction with the holding coil 5 comprises a bar or armature 32 which is secured to the heel of the bell-crank lever 27 by means of a screw 33 and the enlarged or fan-shaped lower end 34 of which is normally located opposite the magnetic pole or cap member 21 beyond the range of magnetic attraction thereof. The armature or bar 34 is suitably bent to provide the desired first-class lever action when the lower end 34 of the armature 22 is attracted into contact with the cap 21, whereby the bell-crank lever 27 may be held in its open position in opposition to the action of the biasing spring 31.

The tripping apparatus 7 comprises a cup-shaped member 40 that is screwed into a cap member 41 which, in turn, is bolted, or otherwise appropriately attached, to the lower horizontal face of the bracket member 3. A plunger or tripping rod 42, having a guiding collar 45, reposes within the receptacle formed by the members 40 and 41 and normally is located a predetermined distance below the lower end of the tripping pin 13.

The tripping apparatus 7 is assembled by first attaching the cap member 41 to the bracket 3, placing the plunger 42 in position and then screwing the cup member 40 into the desired location corresponding to a certain current setting of the overload relay device. The tripping plunger 42 may be reliably maintained in this position by means of a spring clip or finger 43, one end of which is attached to the cap member 41 and the lower or free end of which rests within a vertical groove 44 in the outer surface of the cup member 40. In this way, the desired current setting of the overload relay device may be provided by moving the tripping plunger 42 towards or away from the lower end of the tripping pin 13.

The mechanical operation of my relay device may be set forth as follows. Upon the occurrence of an overload current corresponding to the setting of the relay device, which current traverses the main coil 4, the plunger 42 is actuated upwardly to strike the lower end of the tripping pin 13. The head 14 of the pin 13, in turn, strikes the lower corner of the bell-crank lever 27 to cause immediate separation of the movable contact member 25 from the stationary contact terminals 23. Such movement of the bell-crank lever 27 causes a corresponding rotative movement of the lower end 34 of the armature 32 towards the magnetic pole or core member 21. If the holding coil 5 is already energized, the armature 34 is further actuated into direct contact with the cap 21 and is held in that position by magnetic attraction. Consequently, the main contact members 23 and 25 are held separated, after once being actuated by the action of the tripping plunger 42, as long as the holding coil 5 is energized. As soon as the holding coil 5 is de-energized, the spring 31 returns the bell-crank lever 27 to the illustrated closed-circuit position. The plunger 42, of course, is returned by gravity to its illustrated lower position as soon as the current traversing the main coil 4 is interrupted by the opening of the motor circuit.

Referring to the circuit connections shown in Fig. 3, the system here illustrated comprises suitable supply-circuit conductors Trolley and Ground, a line switch LS for connecting the propelling motor or motors to the supply circuit, my relay device 1 and a portion of a controller or primary governing device MC.

Assuming that it is desired to effect acceleration of the driving motor or motors, the master controller MC is actuated to its initial operative position *a*, whereby a circuit is established from the Trolley through conductor 50, control fingers 52 and 53, which are bridged by contact segment 54 of the master controller, conductors 55, cooperating stationary and movable contact members 23 and 25, respectively, of my relay device, in its normal or circuit-closing position, conductor 56, the actuating coil of the line switch LS and voltage-reducing resistor 57 to Ground.

The line switch is thus closed to complete a main circuit from the Trolley through conductor 60, the main actuating coil 4 of my relay device, conductor 61, contact disk 62 of the line switch LS in its closed position and thence to the driving motor or motors, as indicated by the legend "To motors."

Another circuit is established, whenever the master controller occupies an operative position, from the contact segment 54 thereof through conductors 55 and 65, holding coil 5 of my relay device, conductor 66 and voltage-reducing resistor 67 to Ground. However, no movement of the relay device parts is caused by such permanent energization of the holding coil 5, which becomes active in this sense only under overload conditions of the system.

Assuming that a predetermined heavy current, corresponding to the setting or critical value of the overload relay device 1, traverses the motor circuit, the main actuating coil 4 is sufficiently energized to lift the tripping plunger 42, as previously set forth, and separate the contact members 23 and 25, thus opening the circuit of the actuating coil for the line switch LS. Consequently, the main-motor circuit is immediately interrupted and the current traversing main actuating coil 4 ceases. The plunger 42, therefore, returns to its illustrated normal position, but the return of the movable contact member 25 is prevented by the action of the permanently energized holding coil 5. This coil, as previously set forth, attracts and holds its armature 34 in such position that the movable contact member 25 is maintained in its open-circuit position. It will be noted that the holding coil 5 is always in readiness to perform this function, by reason of the fact that it is permanently energized whenever the master controller occupies any operative position.

To effect a resetting or reclosure of the relay device to permit further operation of the motors, the master controller MC must be returned to its "Off" position to cause de-energization of the holding coil 5. Under such conditions, the biasing spring 31 of my relay device again becomes active to force the bell-crank lever 27 to the illustrated closed-circuit position.

Consequently, the motor circuit cannot again be closed until the master controller has first been returned to its "Off" position corresponding to the insertion of the entire accelerating resistor in circuit. In this way, the motors are fully protected both upon and after the occurrence of an overload condition.

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

I claim as my invention:

1. Control apparatus comprising, in combination, a movable contact member, resilient means disposed to bias the contact member to its closed position, a plurality of coils adapted to be energized, means disposed for operation by one of the coils to move the contact arm to its open position and means carried by the contact member cooperative with the other coil to retain the contact member in its open position.

2. Control apparatus comprising a plurality of coils, a single member for respectively enclosing and carrying said coils, a contact member, means governed by one of said coils for opening said contact member, and means carried by said contact member and magnetically held by another coil after such opening movement.

3. Control apparatus comprising a plurality of coils disposed at right angles, a single member for respectively enclosing and carrying said coils, a contact member, means governed by one coil and acting through one face of said single member for opening said contact member, and means governed by another coil and operative through another face at right angles to the first-named face for magnetically holding the contact member after such opening movement.

4. Control apparatus comprising a plurality of coils, a single member for respectively enclosing and carrying said coils, a contact member, a plunger governed by one coil and acting through an aperture in one face of said single member for opening said contact member, and a core member governed by another coil and located on another face of said single member for attracting and holding the contact member after such opening movement.

5. Control apparatus comprising a current and a voltage coil, a single member for respectively enclosing and carrying said coils, a contact member biased to the closed position, a plunger governed by said current coil and acting through an aperture in one face of said single member for temporarily opening said contact member, and a core member energized by the voltage coil and located on another face of said single member for magnetically holding the contact member after such opening movement.

6. Control apparatus comprising a current and a voltage coil located at right angles, a single member for respectively enclosing and carrying said coils, a contact member mounted on one face thereof, a tripping plunger mounted on the opposite face and governed by the current coil for opening said contact member, and a core member mounted on an intermediate face of said single member and energized by said voltage coil for magnetically holding said contact member after such opening movement.

7. Control apparatus comprising a current and a voltage coil located at right angles, a single member for respectively enclosing and carrying said coils, a contact member mounted on one face thereof, a tripping plunger mounted on the opposite face and governed by the current coil for opening said contact member, a magnetizable armature secured to said contact member and extending near an intermediate face of said single member, and a core member mounted on said intermediate face and energized by said voltage coil for holding said armature after such opening movement.

8. Control apparatus comprising, in com-

bination, a movable contact member, resilient means disposed to bias the contact member to its closed position, a plurality of coils adapted to be energized, means disposed for operation by one of the coils to move the contact arm to its open position and means independent of said contact-member operating means cooperative with the other coil to retain the contact member in its open position.

In testimony whereof, I have hereunto subscribed my name this 1st day of July 1920.

HOWARD H. JOHNSTON.