H. R. MEYER.

CONTROL APPARATUS.

APPLICATION FILED JUNE 9, 1920.

1,416,047. Patented May 16, 1922.

Fig. 1.

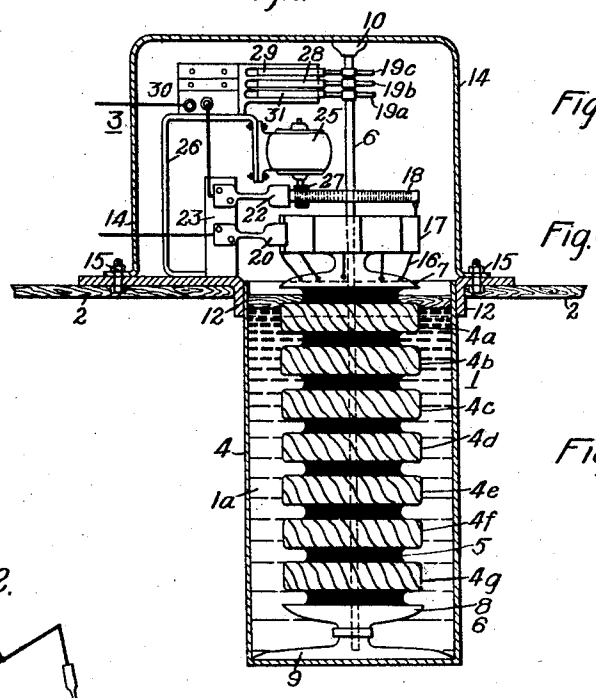


Fig. 5.

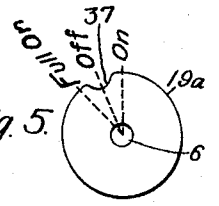


Fig. 6.

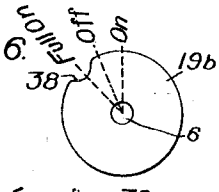


Fig. 7.

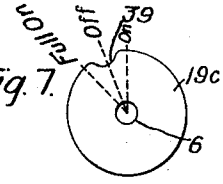


Fig. 2.

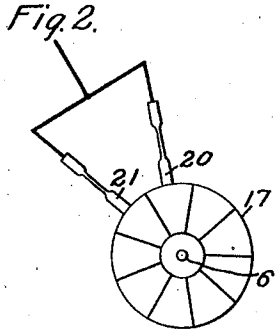


Fig. 3.

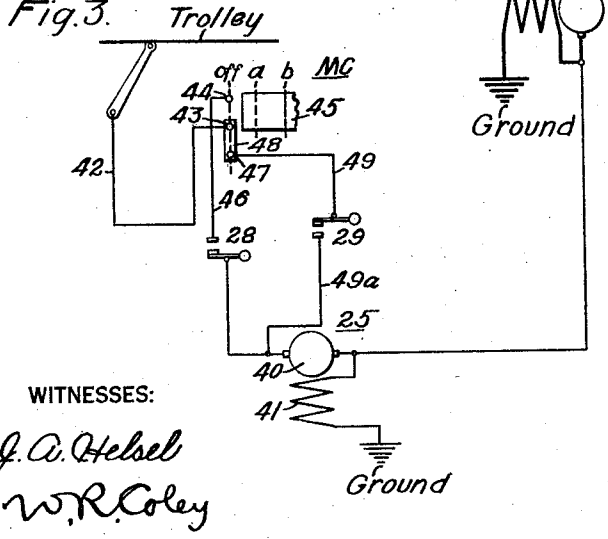
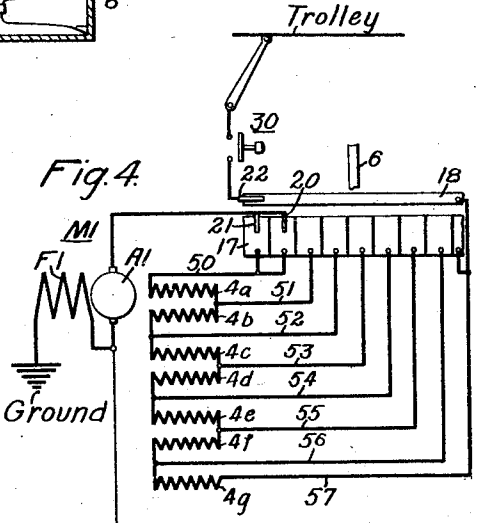


Fig. 4.



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CONTROL APPARATUS.

1,416,047. Specification of Letters Patent. Patented May 16, 1922.

Application filed June 9, 1920. Serial No. 387,592.

To all whom it may concern:

Be it known that I, HARRY R. MEYER, a citizen of the United States, and a resident of Wilkinsburg, 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 power-operated control devices for electric railway motors and the like.

The object of my invention is to provide a control apparatus of the above-indicated character wherein a minimum number of working parts, occupying a minimum amount of space, are enclosed in a single encasing structure, which may be conveniently located partially above and partially below the car floor or platform.

More specifically stated, it is the object of my invention to provide a cell-type resistor; that is, a plurality of spaced resistance coils, that are mounted directly upon an operating shaft which is further provided with current-collecting means, the shaft being driven by a pilot motor and, in turn, controlling the circuits thereof and also the main circuit for the car-propelling motor or motors.

My invention may best be understood by reference to the accompanying drawing, wherein—

Figure 1 is a view, in front elevation, of a control device constructed in accordance with my present invention, the encasing member being shown in section for the sake of clearness;

Fig. 2 is a fragmentary view illustrating the commutator finger connections that are preferably employed in the apparatus of Fig. 1;

Fig. 3 is a diagrammatic view of the auxiliary or pilot-motor circuits of the apparatus;

Fig. 4 is a diagrammatic view of the main motor circuits that are governed by my control apparatus; and

Figs. 5 to 7, inclusive, are enlarged detail views of certain portions of the apparatus shown in Fig. 1.

Referring to Figs. 1 and 2 of the drawing, the structure here shown comprises a cell-type resistor apparatus 1 which is preferably located beneath the car floor or platform 2, and a power-operated device, together with the necessary switching equipment, designated by the general reference character 3, which is preferably mounted above the car floor or platform 2.

The cell-type resistor device 1 comprises an encasing cylinder or tank 4 which contains a body of oil or the like 1*a* in which are immersed a plurality of resistors 4*a* to 4*g*, inclusive, of the familiar pancake-coil type, for example, the coils being suitably spaced for insulating and cooling purposes by means of a plurality of insulating collars or spacers 5. The entire set of resistors, which is thus of a general cylindrical shape, is mounted between a pair of suitable end-plates 7 and 8 upon an operating shaft or rod 6, being suitably insulated therefrom. A bottom bearing member 9 for the shaft 6, located at the bottom of the tank 4, and a top bearing member or journal 10, located on the upper face of the encasing member 14 for the apparatus 3, are also provided.

A plate or slab 12 is provided with a flanged internal opening, whereby the tank 4 may be suitably supported, the two members 4 and 12 being either welded or bolted together. The cover or encasing member 14 is open at the bottom only, and the flanged side walls thereof are detachably secured to the plate or slab 12 by means of a plurality of bolts 15.

The necessary leads or conductors 16 from the several resistors 4*a* to 4*g*, inclusive, extend upwardly through or around the top assembly plate 7 to the several segments of a commutator 17, the complete connections being shown in the developed view of Fig. 4. The commutator 17 is rigidly secured to and suitably insulated from the shaft 6.

A combined slip-ring and internal gear-wheel 18 is also rigidly and insulatedly mounted upon the operating shaft 6 just above the commutator 17. An operating cam 19*a*, shown in plan in Fig. 5, for controlling the main motor circuit, and a plurality of auxiliary cams 19*b* and 19*c*, shown in plan in Figs. 6 and 7, respectively, are also mounted rigidly upon the operating shaft 6.

Consequently, the rotatable member 6 carries with it the several resistors 4*a* to 4*g*, inclusive, the commutator 17, the slip-ring and gear-wheel 18 and the three cams 19*a*, 19*b* and 19*c*.

For the purpose of conveying current to

the commutator 17, a pair of parallel-connected control fingers or brushes 20 and 21, best shown in Fig. 2, are provided. The reason for the provision of two fingers, adapted to bear on adjacent segments, is to prevent any possibility of an open circuit during rotative movement of the commutator, as will be understood. A third control finger or brush 22 bears upon the outer surface of the slip-ring and gear-wheel 18. The three fingers or brushes 20, 21 and 22 may be suitably supported, as by a finger-board 23, which may be secured to the base plate 12.

A power-operated device, such as a pilot motor 25, is mounted, with its rotor axis vertical, a short distance above the slip-ring and gear member 18. The base of the motor is bolted or otherwise suitably secured to a vertical arm of a bent metal strap or bracket 26, the lower end of which is welded or otherwise fastened to the base plate 12. The position of the motor 25 is such as to effect proper meshing between a pinion 27 on the motor shaft and the teeth of the internal gear-wheel 18.

A line switch device 30 is mounted on its side upon an intermediate horizontally-extending portion of the bracket 26, the movable contact member 31 being located opposite the main cam member 19*a* on the operating shaft 6. Since any well-known type of cam-operated switch may be employed, it is not deemed necessary to further illustrate or describe the construction thereof.

The remaining cam members 19*b* and 19*c* are adapted to co-operate with similar but smaller-capacity switches 28 and 29 for purposes to be set forth.

The main cam 19*a* is provided with a switch-opening notch 37 in the "off" position of the apparatus and the auxiliary cam 19*c* is provided with a similarly located notch 39. The other cam 19*b* has a notch 38 in the "full on" position. The purposes of these switch-opening notches will be set forth later.

The various circuits will be described during the description of Figs. 3 and 4 and, consequently, will not be set forth in connection with Fig. 1.

Referring to the auxiliary circuits shown in Fig. 3, the illustrated type of control system comprises suitable supply-circuit conductors Trolley and Ground; the pilot motor 25, the cam-operated switches 28 and 29; and a primary controlling device, such as a master controller MC.

Assuming that it is desired to operate the pilot motor 25, the master controller MC may be moved to its first operative position *a*, whereby a circuit is established from the Trolley through conductor 42, control fingers 43 and 44, which are bridged by contact segment 45 of the master controller, conductor 46, cam switch 28, which is closed in all positions except the final or "full on" position, as indicated by the notch 38 in the corresponding portion of cam 19*b* (Fig. 6), whence circuit is completed through the armature 40 and the field winding 41 of the pilot motor 25 to Ground.

In this way, the pilot motor is started into operation to effect rotative movement of the operating shaft 6 through the agency of the pinion 27 and the gear-wheel 18. Such movement gradually effects exclusion of resistors 4*a* to 4*g*, inclusive, from circuit, as subsequently described in detail, until the "full on" position of the operating shaft 6 is reached, corresponding to the position to the left of the notch 37 in the main cam 19*a*, as indicated in Fig. 5.

If desired, the pilot motor 25 may be designed to possess such operating characteristics that a suitably slow speed thereof, corresponding to a gradual exclusion or time-element control of the various resistor sections from the circuit of the main motor, may be obtained. However, I prefer to make the speed of the pilot motor dependent upon the load of the main motor or motors, whereby the rate of exclusion of the resistors is decreased whenever the load becomes relatively heavy and increased when the load becomes relatively light. To accomplish this object, the field winding 41 of the pilot motor 25 is connected in parallel relation with the field winding F1 of the main propelling motor M1. In this way, the speed of the pilot motor 25, which is dependent upon its field strength, is directly governed by the load current traversing the series field winding of the main motor. However, this particular arrangement is not of my present invention but is fully set forth and claimed in a copending application of Bascum O. Austin, Serial No. 328,847, filed June 6, 1919, and assigned to the Westinghouse Electric & Manufacturing Company.

It is, of course, necessary to arrest the movement of the operating shaft at the "full on" position, since full running conditions of the main propelling motor or motors have been attained. This action is accomplished through the agency of the notch 38 in the cam 19*b*, whereby the cam switch 28 is automatically opened as soon as the "full on" position is reached. The pilot motor 25 is thus de-energized and quickly comes to rest in the desired position.

To return the operating shaft 6 to its normal or "off" position, the master controller is merely actuated to its "off" position, whereupon a new circuit is established from the conductor 42 through control fingers 43 and 47, which are bridged by contact segment 48 in the "off" position of the controller, conductor 49 and cam switch 29, which is closed in all positions except the

"off" position of the shaft 6, as is indicated by the location of the notch 39 in the cam 19*c*. Circuit is continued from the cam switch 29 through conductor 49*a* and the pilot motor 25 to Ground.

In this way, the pilot motor 25 is operated in the same direction as before until the "off" position of the operating shaft 6 is reached, whereupon the cam shaft 29 is automatically opened by reason of its encounter with the notch 39 in the cam 19*c*. Consequently, the pilot motor is automatically brought to rest when the operating shaft reaches its normal or "off" position, in readiness for the next accelerating operation, by merely returning the master controller to its "off" position.

Referring to the main circuits, Fig. 4 shows the supply-circuit conductors Trolley and Ground, a main or car-propelling motor M1 having a commutator-type armature A1 and a series field winding F1, together with the various resistors 4*a* to 4*g*, inclusive, the commutator 17, the slip-ring 18 and the line-switch device 30.

For the purpose of obtaining successive exclusion or short-circuit of the resistor sections 4*a* to 4*g*, inclusive, as the commutator 17 is rotated, the following permanent connections are made. The left-hand end of the resistor 4*a* is connected through conductor 50 to two adjacent commutator segments upon which the commutator brushes 20 and 21 also initially bear. A point intermediate the adjacent ends of the resistors 4*a* and 4*b* is connected through the conductor 51 to the next commutator segment, and similar conditions, with regard to the remaining adjacent pairs of resistor elements, obtain through the medium of conductors 52 to 56, inclusive, which are respectively connected to the successive commutator segments. The right-hand end of the last resistor 4*g* is connected through conductor 57 to the next commutator segment and also to the slip-ring 18.

When the operating shaft 6 is initially actuated, as previously described, by throwing the master controller to its position *a*, the line switch 30 is closed in a familiar manner to complete a main circuit from the Trolley through the line switch 30, brush 22, slip-ring 18, conductor 57, all of the resistors 4*g* to 4*a*, inclusive, in series relation, and conductor 50, to those segments of the commutator 17 upon which the brushes 20 and 21 bear. Circuit is completed from the commutator brushes through the armature A1 and the field winding F1 of the car-propelling motor to Ground. The main motor is thus started into operation with all of the accelerating resistors in circuit therewith.

As the operating shaft 6 is actuated by the pilot motor 25, it will be observed that the resistors 4*a* to 4*g*, inclusive, are successively short-circuited and then entirely disconnected from circuit by reason of the successive locations of the commutator brushes 20 and 21 upon the commutator segments. In this way, the resistors are gradually excluded from circuit to permit the impression of a gradually increasing voltage upon the car-propelling motor M1. In the "full on" position of the operating shaft 6, the pilot motor 25 is automatically stopped, as previously set forth, and, in that case, all of the resistor sections are excluded from circuit, and the slip-ring 18 is directly connected to the commutator brushes 20 and 21.

It will be understood that the principles of my invention may be readily adapted to systems of control other than that herein illustrated. For example, series-parallel control of a plurality of motors may be readily obtained by the use of additional main-circuit cam switches or other contact members, operating in accordance with a predetermined sequence. Furthermore, various modifications in the structural details and arrangement of parts may be made without departing from 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 a rotatable member, a plurality of resistors rotatable therewith, power-operated means for actuating said member and a switch governed by said member for controlling the circuit of said resistors.

2. Control apparatus comprising a rotatable shaft, a plurality of resistors mounted thereon, a motor for actuating said shaft, and a cam switch operated by said shaft for controlling the circuit of said resistors.

3. Control apparatus comprising a rotatable member, a plurality of resistors rotatable therewith, a commutator having a plurality of segments connected to said resistors, power-operated means for actuating said member, and a switch governed by said member for controlling the circuit of said resistors.

4. Control apparatus comprising a rotatable shaft, a plurality of resistors mounted on said shaft, a commutator having a plurality of segments connected to said resistors, a motor for actuating said shaft, and a cam switch operated by said shaft for governing the circuit of said resistors.

5. Control apparatus comprising a rotatable shaft, a plurality of resistors mounted on said shaft, a commutator having a plurality of segments connected to said resistors for constituting one terminal of the resistor circuit, a slip-ring for constituting the other terminal of that circuit, and a motor for actuating said shaft.

6. Control apparatus comprising a rotatable shaft, a plurality of resistors mounted on said shaft, a commutator having a plurality of segments connected to said resistors for constituting one terminal of the resistor circuit, a slip-ring for constituting the other terminal of that circuit, and a switch governed by said shaft for controlling the circuit of said resistors.

7. Control apparatus comprising a rotatable shaft, a plurality of resistors mounted on said shaft, a commutator having a plurality of segments connected to said resistors for constituting one terminal of the resistor circuit, a slip-ring for constituting the other terminal of that circuit, and a motor mechanically connected to said slip-ring.

8. Control apparatus comprising a rotatable shaft, a plurality of resistors mounted on said shaft, a commutator having a plurality of segments connected to said resistors for constituting one terminal of the resistor circuit, a slip-ring for constituting the other terminal of that circuit, a motor internally geared to said slip-ring, and a switch governed by said shaft for controlling the circuit of said resistors.

9. Vehicle-control apparatus comprising a rotatable shaft, a plurality of spaced resistors mounted on said shaft, a tank of oil located beneath the vehicle floor for immersing said resistors, a commutator having a plurality of segments connected to said resistors for constituting one terminal of the resistor circuit, a slip-ring for constituting the other terminal of that circuit, a motor internally geared to said slip-ring, and a cam switch operated by said shaft for controlling the circuit of said resistors.

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

HARRY R. MEYER.