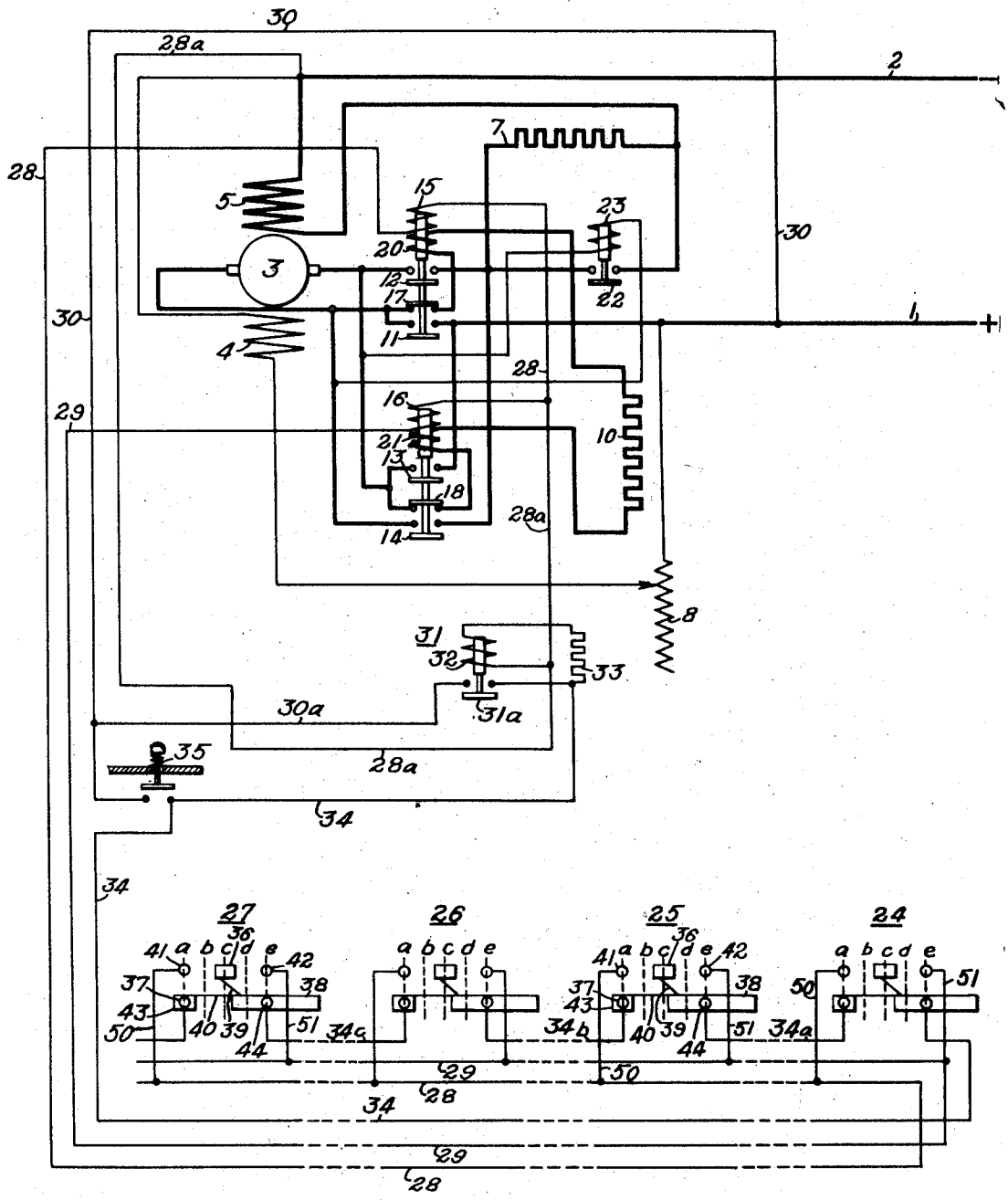
A. L. HARVEY.

MOTOR CONTROL SYSTEM.

APPLICATION FILED JULY 7, 1920.

1,414,409. Patented May 2, 1922.



WITNESSES:

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MOTOR-CONTROL SYSTEM.

1,414,409. Specification of Letters Patent. Patented May 2, 1922.

Application filed July 7, 1920. Serial No. 394,438.

To all whom it may concern:

Be it known that I, ALBERT L. HARVEY, 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 Motor-Control Systems, of which the following is a specification.

My invention relates to motor-control systems and it has particular relation to such systems as are employed in connection with the operation of a motor by a plurality of controllers or switching devices that are separated from each other by relatively great distances.

My invention has for its object to provide a relatively simple and convenient means of control for a motor-operated gun lathe of relatively great length having a plurality of carriages each of which has a master controller mounted thereon; the master controllers being arranged in such order or sequence that the operation of each controller is dependent upon the electrical connections established by other controllers that are located prior in the order or sequence and independent of the controllers subsequent to it in the sequence.

Briefly speaking, my invention consists in providing a plurality of master controllers that may be selectively adapted for operating a motor, each controller being mounted upon a separate carriage. All but one of the controllers are made subject to the operation of other master controllers that are placed on the other carriages. One or more carriages may be used at one time for turning a gun, as hereinafter more fully set forth. However, the most skilled workman determines whether the motor shall operate and, if so, in which direction. If he leaves the first controller, which is preferably placed on the carriage nearest the head stock of the lathe, in an "off" position, the next workman may control the operation of the lathe and, likewise, other workmen, in a predetermined order, may also control its operation.

For a better understanding of my invention, reference may be made to the accompanying drawing, which is a diagrammatic view of a control system embodying my invention.

Line conductors 1 and 2, which may be connected to any suitable source of energy supply current to an electric motor having an armature 3, a shunt field-magnet winding 4 and a series field-magnet winding 5. A starting resistor 7 is connected in the armature circuit of the motor during the starting period thereof. An adjustable resistor 8 is connected in circuit with the shunt field-magnet winding 4. A dynamic-braking resistor 10 is connected in circuit with the motor armature 3 when the operating circuit of the motor is open.

The armature circuits of the motor are controlled by two pairs of mechanically interlocked directional or reversing contactors 11 and 12, and 13 and 14, in accordance with a familiar practice. The respective pairs of reversing contactors are provided with actuating coils 15 and 16. The dynamic-braking circuit of the motor is completed by contactors 17 and 18, which are mechanically connected to the respective pairs of directional switches and are maintained in their respective closed positions by series holding coils 20 and 21.

The starting resistor 7 may be shunted by a contactor 22 having an actuating coil 23 that is connected across the terminals of the armature 3, or that may be energized in accordance with any other suitable method of acceleration.

When the armature 3 reaches a certain speed, the coil 23 is sufficiently energized by the counter-electromotive force thereof to close the contactor 22, which short-circuits the starting resistor, thus connecting the armature directly to the supply circuit.

A plurality of master controllers 24, 25, 26 and 27 are mounted upon carriages (not shown) which are spaced relatively great distances apart, and the controllers are connected to energize coils 15 and 16 by means of conductors 28 and 29, respectively. The master controller 24 may be assumed to be upon the carriage that is nearest the head stock of the lathe. The controllers are supplied with electrical energy by a conductor 30, the energization of which is controlled by a low-voltage relay 31 having an actuating coil 32. A resistor 33 and a push-button switch 35 are electrically connected to the actuating coil 32.

Each of the controllers 24, 25, 26 and 27, has a forward position *a*, a central or "off" position *c*, a reverse position *e* and intermediate positions *b* and *d*.

In each of the master controllers 24 to 27, inclusive, contact segments 36 and 37 are electrically connected to a relatively long segment 38 by connectors 39 and 40, respectively. Each controller is provided with a plurality of suitably arranged contact fingers 41, 42, 43 and 44. The contact fingers 43 and 44 are electrically connected only when the contact segments 37 and 38 are in the normal or "off" position shown in the drawing.

It may be assumed that the various master switches 24 to 27, inclusive, initially occupy their respective illustrated "off" positions and that line conductors 1 and 2 and the shunt field-magnet winding 4 are electrically energized. By closing push-button switch 35, an electrical circuit is established from positively energized conductors 30, through the movable contact member of the push-button 35, conductor 34, resistor 33, actuating coil 32 and conductor 28^a to the negative supply conductor 2. The closing of the relay 31 completes a holding circuit comprising conductors 30 and 30^a, movable contact member 31^a of the relay, resistor 33, actuating coil 32 and negative conductor 28^a. The relay 31 will thus remain closed after the push-button switch 35 is opened, until the line conductors 1 and 2 are de-energized.

By the above-described operation, the electrical circuit to the master controllers 24, 25, 26 and 27 are completed. The workman at controller 24 may operate the motor in a forward direction by moving the controller handle from the "off" position *c* to the forward position *a*. This movement completes an electrical circuit from the conductor 34 through controller 24 and conductor 50 to the conductor 28, thereby electrically energizing the actuating coil 15, which closes the forward directional contactors 11 and 12 and opens the dynamic-braking contactor 17. The closing of the forward directional contactors 11 and 12 completes the electrical circuit for the forward operation of the motor which comprises line conductor 1, contactor 11, armature 3, contactor switch 12, starting resistor 7, series field-magnet winding 5 and the line conductor 2.

The movement of the controller 24 to position *b*, *c* or *d*, the remaining controllers being in their respective normal or "off" positions, breaks the electrical connection between the conductors 28 and 34 and de-energizes the actuating coil 15, thereby opening directional contactors 11 and 12 and closing dynamic-braking contactor 17.

By actuating the controller 24 to the reverse position *e*, conductors 34 and 29 are electrically connected through the contact segments of the controller and conductor 51, whereby the actuating coil 16 is energized. In this way, the reverse directional contactors 13 and 14 are closed and dynamic-braking contactor 18 is opened. The closing of directional contactors 13 and 14 completes an electrical circuit for the reverse operation of the motor comprising line conductor 1, contactor 13, armature 3, contactor 14, starting resistor 7, series field-magnet winding 5 and line conductor 2.

Reverse movement of the controller 24 from the position *e* breaks the electrical circuit from the conductor 34 to the conductor 29, thus de-energizing the actuating coil 16, and opening reverse directional contactors 13 and 14 and closing the dynamic-braking contactor 18.

The operation of any one of the master controllers 25, 26 and 27 is similar to that described for the controller 24. It is apparent that, unless each of the prior controllers is in its normal or "off" postion, the circuit through the various continuations 34^a, 34^b, 34^c, etc., of the conductor 34 is interrupted; therefore, the movement of any subsequent controller to either a forward or a reverse position will not connect either the conductor 28 or 29 with the conductor 34. In this way, the operation of the gun lathe by any workman is subject to the electrical condition of the prior controllers under the direction of other workmen.

If the motor be operated by any one of the master controllers 25. 26 or 27, its operation may be stopped by bringing the master controller 24 or any prior controller into either of the intermediate positions *b* or *d*, thereby breaking the circuit through the conductor 34. The continued movement of the controller 24 or any prior controller to either the forward position *a* or the reverse position *e* will cause the motor to operate in accordance with the position thereof regardless of the position of any subsequent controller.

It is apparent that, so long as the master controllers 24, 25, 26 and 27 are arranged in the same relation with respect to the electrical conductors 28, 29 and 34, they will operate as described, regardless of whether their relative side-by-side locations correspond to those shown in the drawing.

While I have shown my invention in a preferred form, I do not wish to be restricted to the specific circuit connections, structural details, 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 as are indicated in the appended claims.

I claim as my invention:

1. The combination with a dynamo-electric machine, and means for effecting two different types of operation thereof, of a plurality of controlling devices in predetermined electrical arrangement and each having a plurality of positions adapted for re-

mote control of said machine, and means associated with each of said controlling devices whereby any subsequent device is operative only during the period that a prior device occupies a predetermined position.

2. The combination with a dynamo-electric machine, and means for effecting two different types of operation thereof, of a plurality of controlling devices in predetermined electrical arrangement and adapted for remote control of said machine, and means governed by said devices whereby the operation of each device is respectively dependent upon certain conditions of different numbers of the other devices prior thereto in said arrangement.

3. The combination with a dynamo-electric machine, and means for effecting two different types of operation thereof, of a plurality of controlling devices connected in predetermined sequence and adapted for remote control of said machine, each having an inoperative position and a plurality of operative positions and means governed by each of said devices for rendering all subsequent devices inoperative upon one of said devices prior thereto occupying a predetermined position.

4. The combination with a dynamo-electric machine, and means for effecting two different types of operation thereof, of a plurality of controlling devices connected in a predetermined sequence and adapted for remote control of said machine, each device having an inoperative position and a forward and a reverse operative position and means for rendering each device operative only during the period that the other devices prior thereto in said sequence are in their respective inoperative positions.

5. The combination with a dynamo-electric machine, and means for effecting two different types of operation thereof, of a plurality of plural-position controlling devices in predetermined electrical arrangement and adapted for remote control of said machine, and means governed by one of said controlling devices for rendering a subsequent device operative only during the period said prior device is inoperative.

6. The combination with a dynamo-electric machine, and means for effecting two different types of operation thereof, of a plurality of controlling devices having a plurality of positions and adapted for remote control of said machine, and means comprising a plurality of contact devices governed by said controlling devices for energizing said controlling devices by connecting them in series relation when all prior devices occupy inoperative positions.

7. The combination with an electric motor and means for effecting two different types of operation thereof, of a plurality of master controllers adapted for remote control of said motor, each of said controllers having an inoperative position and a plurality of operative positions, and means whereby the operation of said controllers is respectively dependent upon certain numbers of the other controllers being in inoperative positions.

8. The combination with an electric motor and directional contactors having actuating coils for controlling the operation of said motor, of a plurality of controllers having a plurality of positions adapted for governing the energization of said coils, said controllers being in predetermined electrical arrangement, and means associated with each controller for preventing the energization of said coils by any subsequent controller when any prior controller occupies an operative position.

9. The combination with a dynamo-electric machine, and means for effecting two different types of operation thereof, of a plurality of master controllers arranged in a predetermined sequence for controlling said machine, and means whereby the operation of each controller is dependent upon the position of the prior controllers and independent of the subsequent controllers in said sequence.

10. The combination with an electric motor, a pair of interlocking contactors corresponding to forward operation of said motor, another pair of contactors corresponding to reverse operation of said motor, and a plurality of coils for actuating said contactors, of a plurality of master controllers arranged in predetermined sequence for controlling the energization of said coils, means comprising a supply circuit for energizing said coils, and means associated with each controller for disconnecting all subsequent controllers from said circuit upon a prior controller being out of its off position.

11. The combination with an electric motor, directional contactors controlling the forward and the reverse operations of said motor, of a plurality of master controllers for controlling said contactors, each controller having a central "off" position, operative positions at each side of said "off" position corresponding to the direction of operation of said motor and an intermediate position between each of said operative positions and said "off" position, the operation of said controllers being dependent upon certain other controllers being in an "off" position.

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

ALBERT L. HARVEY.