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ANTI-ARCING ELECTRIC MOTOR CONTROL APPARATUS

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FIG. 1

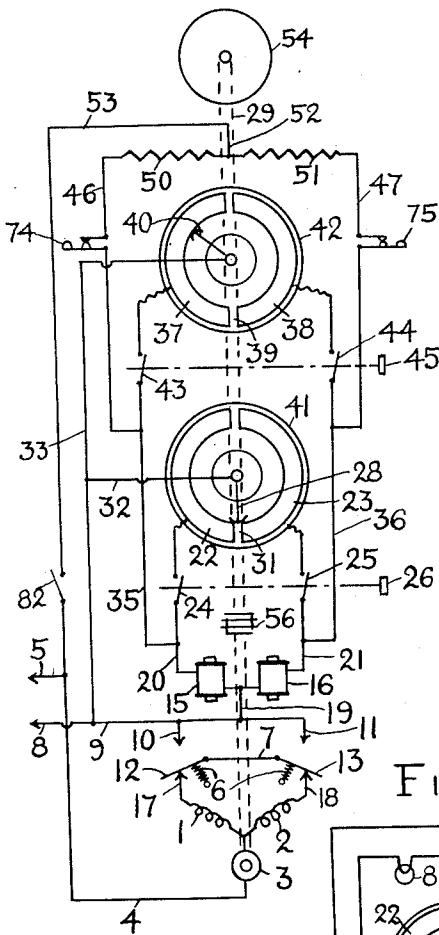


FIG. 2

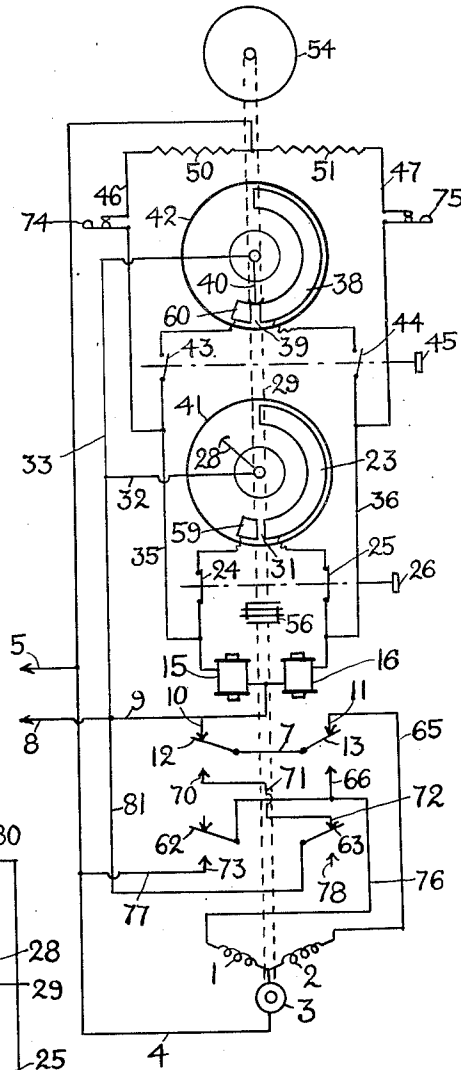
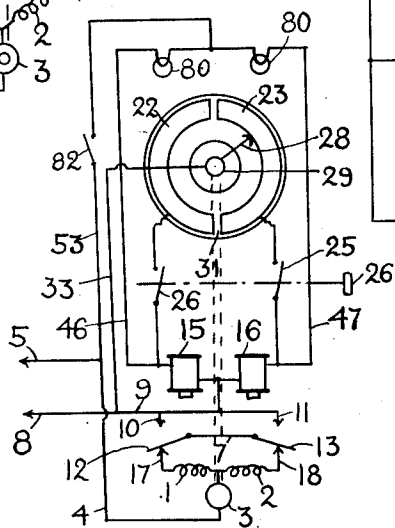


FIG. 3



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ANTIARCING ELECTRIC MOTOR CONTROL APPARATUS

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3 Claims. (Cl. 172—239)

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My invention relates to electric control systems or apparatus and has particular reference to systems or apparatus for controlling positions of a movable object.

My invention has for its object to provide a control system or apparatus in which sparking or arcing at current interrupting points of control elements connected with relays is substantially suppressed by avoiding complete circuit interruption. Relays, especially when they must operate two or more contact arms, or where their contact arms must be sufficiently large to carry heavy currents, consume an appreciable amount of power so that strong sparking or arcing may occur at the points which control connections of the relay coils with a source of current, such sparking or arcing being harmful to these points and to the operation of the system.

Another object of my invention is to render the operation of the relays more rapid by avoiding circuit interruption.

Another object of my invention is to include impedance elements such as resistors in the circuits to avoid an excessive current flow when the relay coils are short circuited. Electric lamps or similar means may also be used as impedances. The lamps will serve as signal means by burning brightly when the coils are short circuited and by glowing dimly when the coils are energized.

My control system is applicable to various control devices preferably such in which movable elements establish certain circuits thereby controlling the movements of a movable object as to its direction, rate of speed, etc.

My invention is more fully described hereinafter and in the accompanying drawing in which:

Fig. 1 is a diagrammatic view of a typical control system or apparatus according to my invention.

Fig. 2 is a diagrammatic view of a modification of my control system or apparatus; and

Fig. 3 is a fractional diagrammatic view of still another modification of my invention.

My control system or apparatus in one of its embodiments is shown in Fig. 1. In this system or apparatus, a reversible motor is employed with windings 1, 2, connected in series with one terminal of an armature 3. The other terminal of the armature is connected by a lead 4 with a terminal 5 of a source of current. The other terminal 8 of the source of current is connected by a lead 9 with contact points 10, 11 which are engaged by arms 12, 13 when coils 15, 16 of two relays are energized. However, any other number of relays can be used in connection with a sys-

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tem according to the invention. When the coils are deenergized, arms 12, 13 engage contact points 17, 18, at the ends of the windings 1, 2, by the action of springs 6.

The coils 15, 16 are connected together at their ends and the common point is connected by a lead 19 with the lead 9 and terminal 8. The other ends of the coils are connected by leads 20, 21 with segments 22, 23 through switches 24, 25 operated by a common handle 26. These segments are slidably engaged by a contact arm 28 mounted on a shaft 29 rotated by the motor armature 3. The arm has a contact point which can engage or bridge a neutral point such as a gap 31 between the segments 22, 23 and is connected by leads 32 and 33, with terminal 8.

The relay coils are also connected by leads 35, 36 with a second pair of conducting segments 37, 38 separated by a gap 39 and slidably engaged by a contact arm 40, also mounted on the shaft 29 and connected by lead 33 with the terminal 8 through switches 43, 44 having a handle 45. The segments 22, 23 are mounted on an insulation disc 41 and the segments 37, 38 on an insulation disc 42, concentrically with the shaft 29 and suitably supported on a fixed, preferably adjustable position.

Two sets of control units are shown in Fig. 1 for clarity but any desired number of such units may be employed.

The relay coils are also connected by leads 20, 35, 46, and 21, 36, 47 with resistors or other suitable impedance elements 50, 51, respectively, the resistors being connected together at 52 and connected by a lead 53 with the terminal 5.

A suitable useful load 54 may be connected to the shaft 29.

Switches 74, 75 may be included in leads 46, 47 for manual control. These switches are normally closed, leaving both relay coils energized through the resistors 50, 51, thereby leaving the motor inoperative. By depressing one of the switches, the corresponding relay coil is disconnected releasing its contact arm, thereby establishing a circuit through the motor and one of the field windings. The manual control permits a rapid positioning of the load by the motor.

The operation of the system is as follows:

When switches 82, 74, 75 are closed and the terminals 5, 8 are connected to the source of current, relay coils 15, 16 will be continuously energized through the resistors 50, 51, current passing from the terminal 5 through the leads 53, 52, resistor 50, leads 46, 35, 20, coil 15, leads 19, 9, to the terminal 8 and through leads 53, 52, re-

resistor 51, leads 47, 38, 31, coil 15 and leads 19, 3 to the terminal 8. Both arms 12, 13, will be attracted, disconnecting the armature 3 and windings 1, 2 of the motor.

If one of the switches, for instance, switch 45 is closed, current will also flow from the terminal 8 through lead 33, contact arm 40, segment 37, switch contact 43, lead 35, switch 74, lead 48, resistor 50, lead 53 and switch 82 to the terminal 5. Hence relay coil 15 is short circuited without interrupting the circuit. As a result, coil 15 releases arm 12. The motor will be energized, current flowing from the terminal 8 through the lead 8, point 11, arm 13, connecting lead 7, arm 12, point 17, winding 1, armature 3 and lead 4 to the terminal 5. The motor will turn, moving the arm 40 toward the gap 39. As soon as the gap is reached or bridged by the arm 40, relay coil 16 is also short circuited through resistor 51. Hence both relay coils will be short circuited causing both arms 12 and 13 to drop into their lower positions as shown in Fig. 1.

To prevent hunting or oscillations of the motor when the gap is reached, suitable methods may be employed such as disclosed in my copending applications Serial No. 357,660, filed September 20, 1940, now Patent No. 2,342,717, Serial No. 477,469, filed February 27, 1943, and Serial No. 490,767, filed June 14, 1943. Provisions for suppressing hunting or oscillations may also include one or more frictional overrunning clutches 56 as described in my application No. 490,767, also means to retain yieldably the contact arm in the gap as disclosed for example, in my application No. 490,767.

My relays can be used with any control system for controlling rotation of a motor, or more generally, for controlling the operation of a drive means, or movable member by using control elements.

Another control system or apparatus according to my invention is shown in Fig. 2 in which the control elements include long segments 23, 38 and short segments 59, 60, the latter may be in the form of small contact points. The segments are connected with the relays in the same manner as in Fig. 1 but the relays are provided with two contact arms each, relay coil 15 operating arms 12, 62 and the relay coil 16 operating arms 13, 63. When both relays are energized, as for instance, if the switches 24, 25 are closed and the arm 28 engages the insulation disc 41 itself and none of the segments, current will flow from the terminal 8 through lead 9, point 10, attracted arm 12, lead 7, attracted arm 13, point 11, lead 65, winding 2, armature 3, and lead 4 to the terminal 5. The motor will be energized and will move the arm 28 toward the gap 31.

As soon as the arm 28 engages the short segment 59, relay coil 15 will be short circuited through arm 28 and lead 32 and deenergized, releasing the previous attracted arms 12 and 62. The arm 12 will then engage the point 70 connected by a lead 71 with a point 72, and the arm 62 will engage a point 73 connected by a lead 77 with the lead 4. Current will flow from the terminal 8 through a lead 81, arm 63, point 72, lead 71, point 70, arm 12, lead 7, arm 13, point 11, lead 65, winding 2, armature 3 and lead 4 to the terminal 5. Hence winding 2 remains energized. The direction of rotation of the motor will also remain the same, but its speed will be considerably reduced since the second winding 1 of the motor will be also energized and in the same direction as the winding 2. 75

Current will flow from the winding 2 through the winding 1, lead 76, arm 62, point 73 and leads 77 and 4 to the terminal 5, in parallel with the armature 3. When the gap 31 is bridged, both relays will be short circuited and deenergized, releasing all four contact arms which will return into their lower positions, engaging points 70, 66, 73 and a blind point 78. Terminal 8 will be then disconnected at point 12 and the motor is inoperative.

If the arm 28 engages the long segment 23, relay 15 will be energized and relay 16 will be short circuited, releasing its arms. Arm 13 will engage point 66, permitting the current from the terminal 8 to flow through lead 66, the winding 1, armature 3 and lead 4, energizing the motor for rotation in the opposite direction.

Resistors 50, 51 can be replaced by electric lamps 80 as shown in Fig. 3. The lamps will not only serve as resistors, but will also form visual signals to indicate when the device is operating and a gap is bridged. The lamps will glow dimly when both relays are energized and will be brightly lighted when both relays are short circuited, or one lamp will be bright and the other dim when one relay is short circuited.

My control system materially lengthens the life of the contact points at the gaps by suppressing, arcing or sparking at these contacts, since the current is never entirely interrupted.

It will be understood that various features and principles of each of the embodiments of the invention above described or referred to may be utilized or substituted in the other embodiments.

While the invention has been described in detail with respect to certain particular preferred examples, it will be understood by those skilled in the art after understanding the invention, that various changes and further modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. In apparatus for moving a load to a desired position, in combination, a motor having a pair of reversing field windings for moving the load, a pair of relatively movable members, one of the members being provided with conducting elements having a gap and the other member having a contact element engageable therewith, a pair of relays each having an armature and a pair of contacts, said armatures being connected, circuit means having two parallel branches with individual resistance elements for supplying current to the respective relays to maintain both relays in energized condition, and second circuit means including the said contact element and respective ones of the said conducting elements for by-passing a respective one of the said relays through its said resistance element, to render a selected one of the relays ineffective when its said by-passed circuit is completed by engagement of its contact element with a selected one of its associated conducting elements, by-passing of both relays when the said contact element is at the said gap to engage both said conducting elements causing the de-energization of both relays, the contacts of said relays being connected to one of the supply terminals and to the terminal ends of respective ones of the associated field windings, whereby in both the said energized and de-energized conditions of the relays the motor is de-energized, said by-passing of a particular

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relay causing the de-energization thereof, the other relay remaining energized, whereby one of the said two reversing field windings is energized to rotate the motor in the desired direction.

2. In apparatus for moving a load to a desired position, in combination, a motor having a pair of reversing field windings for moving the load, a pair of relatively movable members, one of the members being provided with conducting elements having a gap and the other member having a contact element engageable therewith, a pair of relays each having an armature and a pair of contacts, said armatures being connected, circuit means having two parallel branches with individual resistance elements for supplying current to the respective relays to maintain both relays in energized condition, and second circuit means including the said contact element and respective ones of the said conducting elements for by-passing a respective one of the said relays through its said resistance element, to render a selected one of the relays ineffective when its said by-passed circuit is completed by engagement of its contact element with a selected one of its associated conducting elements, the contacts of said relays being connected to one of the supply terminals and to the terminal ends of respective ones of the associated field windings, whereby in both the said energized and de-energized conditions of the relays the motor is de-energized, said by-passing of a particular relay causing the de-energization thereof, the other relay remaining energized, whereby one of the said two reversing

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field windings is energized to rotate the motor in the desired direction.

3. The combination according to claim 2, wherein each of the said two branches of the first said circuit means is provided with a manually operated switch, whereby the operation of a selected one of the said switches will open the circuit in one of the said two branches to de-energize the respective relay and thereby cause motor rotation in the desired direction.

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