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DELAYED ACTION SWITCH MECHANISM

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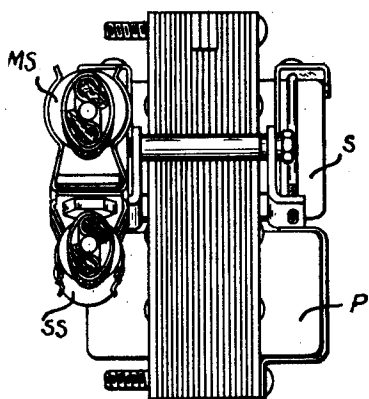


Fig. 1

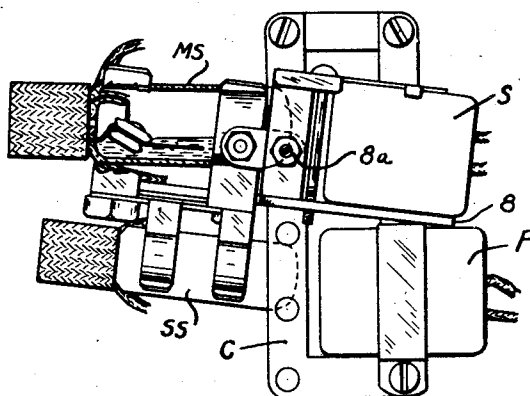


Fig. 2

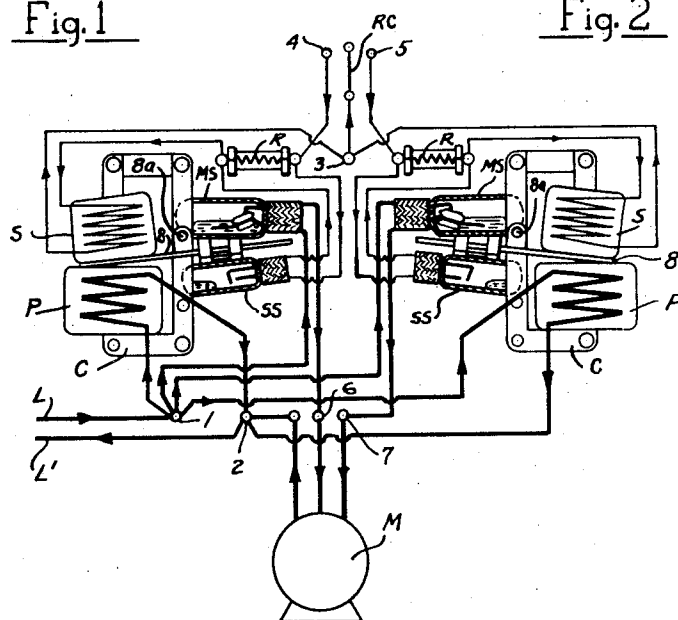


Fig 3

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## UNITED STATES PATENT OFFICE

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## DELAYED ACTION SWITCH MECHANISM

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12 Claims. (Cl. 172-179)

This invention relates to improvements in electric switches and more particularly to delayed action switch mechanism for the control of reversing motors such as employed for the opening and closing of doors, valves and the like.

To avoid damage, or unnecessary abuse to reversing motors, or equipment operated thereby it is often necessary or desirable to provide a delay between the opening of the running circuit and the closing of the reversing circuit and vice versa. The control of such motors is usually accomplished through remote control switches which open and close the motor circuits and additional mechanism is required to provide the delay necessary between the closing of the motor circuit and the operation of the motor.

It is an object of this invention to provide a switch operating mechanism for use in connection with such remote control switches. The mechanism is interposed between the source of current and the motor and caused to function upon the opening and closing of the remote control switch to immediately open the circuit to the motor and thereafter allow a period for the slowing up or stopping of the motor before closing the reversing circuit. It is a further object of this invention to always provide a positive delay in the breaking of one motor circuit and making the reversing circuit, following the operation of the remote control switch, regardless of how rapidly the control switch is caused to operate.

This invention contemplates in the delay switch operating mechanism the use of a repulsion relay such as disclosed in this applicant's co-pending application, Serial No. 508,185, filed January 12, 1931, which is adaptable for use with either alternating or direct current or the relay disclosed in this applicant's co-pending application, Serial No. 500,747, filed December 8, 1930, which may be of the transformer type permitting the use of low voltage remote control equipment.

This invention contemplates the employment in connection with the relays of an electrical resistor in the control circuit. The resistor contemplated may be any of the resistance elements, which offers great resistance to the passage of electric current therethrough when cold, but as its temperature increases, due to the passage of current therethrough its resistance decreases until a large amount of current is passable. Such elements are known in the art and one known as Durhy, an electric furnace product having as its base silicon carbide with a very high dissoci-

ation temperature, is manufactured by the Globar Corporation of Niagara Falls, New York.

With these and other objects in view reference is made to the accompanying sheets of drawings which illustrate preferred embodiments of this invention with the understanding that minor detail changes may be made without departing from the scope thereof.

In the drawings:

Figure 1 is a view in end elevation of one of the relays and switches operated thereby employed in this delay action mechanism.

Figure 2 is a view in front elevation of Figure 1.

Figure 3 is a schematic wiring diagram of the delayed action such mechanism including two of the relays illustrated in Figures 1 and 2.

Figure 4 is a view in front elevation of a modified form of switch operating mechanism in which the resistor or delay element is connected in series with the electro-magnet coil.

Figure 5 is a schematic wiring diagram operating in the same manner as that shown in Figure 3 and in which only one primary coil is employed and in which the resistor is preferably carried in the shunt switch.

Figure 6 is a view in longitudinal vertical central section through a shunt switch mounting the resistor therein, shown in the open position, with parts shown in side elevation.

Figure 7 is a view in horizontal section taken on the line 7-7 of Figure 6 looking in the direction of the arrows, with parts shown in top plan view.

Figure 8 is a view in side elevation showing the switch in closed position.

The embodiment of this invention as illustrated in the schematic diagram in Figure 3 includes an electric motor M and two relays, such as illustrated in Figures 1 and 2, each of which preferably comprises a rectangular core C with lower stationary primary windings P about one leg of the core which are connected through binding posts 1 and 2 to the commercial circuit LL'. Each relay mounts about the same leg with the primary coil a movable secondary coil S with one terminal of each secondary coil connected to the binding post 3 which, in turn, is connected to the remote control switch RC which switch is adapted to assume a position free of the contacts 4 and 5 or to engage one or the other of the contacts 4 and 5. Each of these contacts are connected through a resistor element R to the other terminal of the respective secondary coils S. The resistor element is preferably of the

material known as Durhy as hereinabove described.

The remote control switches as shown are provided with a neutral position so that having operated the motor the desired period the circuit can be broken thereto. However, reversing motors are obtainable which incorporate switch mechanisms adapted to switch the motor circuit to the open side after a predetermined time of motor operation. With these motors a two-way switch may be used.

Each secondary coil is adapted to operate a motor switch MS, the motor switch on the left in Figure 3 being connected with binding post 1 and binding post 6, so that when the motor switch is closed, the line current will pass through it and the motor M and by the way of binding post 2 to the return line to operate the motor in its forward direction. The motor switch MS on the right hand side of Figure 3 is connected through binding post 1 to binding post 7 and from thence through the motor and binding post 2 to the return line to operate the motor in the reverse direction. The motor switches are each carried on one end of operating arms 8 each pivotally mounted at 8a upon the uncovered leg of their respective cores C. The opposite ends of the arms 8 are each secured by clips to the bottom of the respective movable secondary coils S and the motor switches MS are each mounted in the clips upon the arms 8, so that when the secondary coils are in their lowermost position, that is resting upon the top of the respective primary coils, the switches MS will be open and the circuit therethrough to the motor broken. Each arm 8 also supports a shunt switch SS, preferably of the mercury tube type, which is connected on each side of the resistor R in the secondary circuit of the movable coil S. This switch SS is mounted upon the arm 8, so that when the secondary circuit is open and the coil S is in its lowermost position, this switch SS will also be in the open position.

The operation of the device shown in Figure 3 is as follows: When the remote control switch RC is moved to engage the contact 4 the secondary circuit through the coil S is closed through the resistor R and, as the resistor is cold and its conductivity increases with its increase in temperature, sufficient current will not pass therethrough at first to energize the relay to repel the secondary coil S. By proportioning the resistor and the number of turns in the windings of the secondary coil the time required after the closing of the secondary circuit, before the conductivity of the resistor R increases to allow a sufficient current to pass therethrough to repel the secondary coil, may be determined. When the secondary coil is repelled the motor switch MS is tilted to close the circuit to the motor, so that it will operate in a forward direction. At the same time the shunt switch SS is closed which shunts out the resistor R. When it is desired to reverse the motor the remote control switch RC is shifted out of engagement with contact 4 and into engagement with contact 5; thereby opening the circuit through contact 4 in the secondary coil S, whereupon it drops and opens the circuit to the motor and closes the circuit through the secondary coil S upon the right hand side through contact 5 and resistor R. The motor cannot operate until the conductivity of the resistor R in this circuit allows sufficient current to pass to repel the coil S in that circuit to tilt

the motor switch MS to close the circuit through the motor to reverse its operation.

In this manner a positive delay is occasioned every time the remote control is operated in either direction for with each operation a circuit is established through a cooled resistor and when the motor switch is finally closed the resistor is shunted and begins to cool. As a time interval will always be established by the required period of motor operation and the cooling of the resistor is very rapid the necessary delay will be provided in reversing the motor even though the remote control is operated at frequent intervals.

The form shown in Figure 4 includes an electro-magnet E which may be substituted for each of the relays shown in the schematic wiring diagram in Figure 3, only the remote control would be placed in one line from the source of current supply. This form is all high voltage controlled. In this form an electro-magnet E is mounted on the lower arm of a U-shape core 9 having an armature A pivotally mounted at A' upon the upper arm of the bracket 9. The armature is preferably in the form of a bell crank lever pivotally mounted at its apex. The arm A2 extending to the right of its pivotal point supports a motor switch, preferably of the mercury tube type, as shown in Figures 2 and 3. The weight of the motor switch so mounted normally rotates the armature out of contact with the core of the magnet when de-energized. It is preferable to mount a binding post carrying plate B, to the right of the magnet as shown, which mounts binding posts 10, 11, 12, 13 and 13a. The remote control switch RC is adapted to close the commercial circuit from the source to binding post 10.

The binding post 10 is connected to one end of the windings of the electro-magnet E, the other end of which is connected to the binding post 12 which in turn is connected through resistor R' to binding post 11 which latter post is connected to the return commercial line. The closing of this circuit actuates the armature A to close the motor switch MS. Binding post 13 is connected to the source of commercial current and to one terminal of the motor switch MS, the other terminal of which is connected to binding post 13a which in turn is connected to the motor to operate it in the forward direction.

As two of these magnetically operated switches are employed the motor switch in one is connected with the motor to operate it in the forward direction and the motor switch in the other is connected with the motor to operate it in the reverse direction, and the remote control switch in the commercial line is adapted to close the circuit to one or the other electro-magnets as desired.

In electro-magnets of this type operating with alternating currents more current is necessary to attract the armature to close the motor switch than is needed thereafter to maintain the motor switch in the closed position. When the remote control switch is closed the circuit is established through the resistor R' to the electro-magnet E to close the motor switch. As the resistor is cold there will be delay until its temperature increases and its resistance decreases sufficiently to energize the magnet to attract its armature to close the motor switch. Thereafter as less current is required to maintain the motor switch closed the impedance of the magnet will reduce

the flow of current through the resistor R' and allow the same to cool.

This type is more or less limited to those applications in which the reversing of the motor is only required at long intervals. Since some current is always passing through the resistor during the period of motor operation considerable more time is required to lower the temperature of the element where it will provide sufficient resistance to delay the reenergization of the magnet should the circuit thereto be broken and then again made in rapid succession. When rapid reversing of the motor is desired the use of the shunt shown in the other forms of this invention provides the delay most satisfactorily.

In the form shown in the schematic wiring diagram in Figure 5 but one rectangular core C' is employed with a stationary primary coil P' secured to the center of the upper leg thereof. The movable primary coils S' are mounted upon the same leg on either side of the stationary primary coil P'. The switch carrying arms 8b are pivotally mounted at 8c to the lower leg of the core C' and are each secured at their upper ends to their respective secondary coils. The arms 8b are extended downward on opposite sides of the lower leg to which they are pivoted and the lower ends of each arm support a motor switch MS and a shunt switch SS, as shown, so that the weight of said switches normally maintains the coils S' in contact with the coil P'.

The binding post 14 is connected to one side of the source of commercial current and also to one winding of the primary coil P', the other wire of which is connected through the binding post 15 to the return line commercial current. The binding post 14 is connected through the motor switch operated by the left hand coil S' to binding post 16 and thence through the motor to operate it in the forward direction to the binding post 15. The binding post 14 is also connected through the motor switch MS on the right hand side to the binding post 17 and thence through the motor to operate it in reverse direction to binding post 15. In this form one end of the windings of each of the secondary coils S' are connected through their respective shunt switches SS to binding post 18 and from thence to the remote control switch RC'. The contact 19 adapted to be engaged by the remote control switch is connected to the other end of the winding of the secondary coil upon the right of the primary coil and the contact 20 adapted to be engaged by the remote control switch is connected to the other end of the secondary coil upon the left of the primary coil.

In this form the shunt switches SS are identical and each one is a mercury tube switch especially constructed to act as both a resistance element and as a shunt switch, as shown in Figures 6 and 7. As shown in Figures 6 and 7, the lower terminal 21 is provided with an offset adapted to engage one end of the resistor element R2 and the upper terminal 22 is brought down to contact the other end of the resistor R2 and hold the same firmly in position between the two terminals at the bottom of the mercury tube switch. By this construction when the remote control switch opens the circuit through a secondary coil, the weight of the switches carried thereby returns it to contact with the primary coil and opens both of said switches, so that when the remote control switch re-establishes the circuit through that secondary coil, the current passes through the resistor in the open shunt switch causing a delay in the movement of the secondary coil until the

resistor has increased sufficiently in temperature to allow sufficient current to pass therethrough to repel said secondary coil, whereupon the motor switch and shunt switches are closed. The closing action of the shunt switch causes the mercury 23 therein to contact the terminals 21 and 22 to maintain the secondary coil repelled and the mercury itself not only shunts out the resistor R2 but as it submerges the resistor R2 also has a cooling effect and accelerates the reduction in 10 temperature of the resistor.

What I claim is:

1. A motor control including a source of electricity, a motor, means for establishing a circuit from the source through the motor, a normally open switch in the motor circuit, electrically operated means for closing said switch, a remote control switch, means actuated by closing the control switch to establish a circuit through said operating means to close the motor switch, and means to delay the closing of the motor switch after the closing of the control switch including a variable electrical resistor in the control circuit increasing in conductivity as its temperature increases, and means to maintain the motor switch closed and the resistor ineffective as long as the control switch remains closed.

2. A delayed action switch mechanism for reversing motors including a source of electricity, a reversing motor, means for establishing independent circuits from the source to operate the motor in opposite directions, a normally open motor switch in each independent circuit, electrically operated means for selectively closing a motor switch, a selective remote control switch, means actuated by closing the control switch to establish a circuit through the selected operating means to close the selected motor switch, and means to delay the action of the motor switch operating means upon the closing of the circuit therethrough, whereby after each operation of the selective control switch the motor switches remain open for a period allowing the speed of the motor to decrease before its operation is reversed including an electrical resistor increasing in conductivity upon increasing temperature interposed in the circuit between the control switch and operating means, and means actuated upon the closing of the motor switch to shunt out the resistor.

3. The structure of claim 2 in which the delay means is interposed in each circuit between the control switch and the selective motor switch operating means, and means actuated upon the closing of the selected motor switch to shunt out the resistor in the selected circuit.

4. The structure of claim 2 wherein the means for selectively closing a motor switch includes a relay having its windings in the circuit established by the closing of the control switch and having a pivoted armature mounting a normally open motor switch and upon closing the circuit there-through the movement of the armature closes the motor switch in the selected motor circuit, and the delay means is interposed in the circuit between the relay and source, whereby upon the closing of the control switch the conductivity of the resistor is insufficient to operate the relay to close the motor switch until the resistance in the circuit is decreased by the increasing temperature of the resistor and thereafter as long as the relay remains energized the resistance of its windings limits the current passing through the resistor sufficiently to reduce its temperature.

5. A delayed action switch mechanism for reversing motors including a source of electricity, a reversing motor, means for establishing independent circuits from the source to operate the motor in opposite directions, a normally open motor switch in each independent circuit, electrically operated means for selectively closing a motor switch including a repulsion relay having a stationary core, a primary coil in circuit with the source fixed thereon, a movable secondary coil, an arm intermediately pivoted upon the core attached at one end to the movable coil and mounting a motor switch on its free end, a selective remote control switch, means actuated upon the closing of the control switch to establish a circuit through the selected secondary coil to repel the coil to close the selected motor switch, and a normally open shunt switch carried upon the free end of the relay arm having a contained variable electrical resistor connected in the secondary circuit and having a contained conducting fluid adapted to shunt out the resistor upon the closing of the motor switch.

6. The structure of claim 1 wherein the delay means is interposed in the circuit between the control switch and operating means, and means actuated upon the closing of the motor switch to shunt out the resistor including a normally open mercury tube switch having its terminals connected in said circuit to the control switch with said variable resistor connected between said terminals upon the interior of the tube, said mercury tube switch closing simultaneously with the motor switch causing the mercury to bridge the resistor and connect the inner terminals to shunt out the resistor.

7. A motor control including a source of electricity, a motor, means for establishing a circuit from the source through the motor, a normally open switch in the motor circuit, electrically operated means for closing said switch, a remote control switch, means actuated by closing the control switch to establish a circuit through said operating means to close the motor switch, and means to delay the closing of the motor switch after the closing of the control switch including an electrical resistor increasing in conductivity upon increasing temperature interposed in the circuit between the control switch and operating means, and means actuated upon the closing of the motor switch to shunt out the resistor.

8. A delayed action switch mechanism for reversing motors including a source of electricity, a reversing motor, means for establishing independent circuits from the source to operate the motor in opposite directions, a normally open motor switch in each independent circuit, electrically operated means for selectively closing a motor switch, a selective remote control switch, means actuated by closing the control switch to establish a circuit through the selected operating means to close the selected motor switch, and means to delay the action of the motor switch operating means upon the closing of the circuit therethrough, whereby after each operation of the selective control switch the motor switches remain open for a period allowing the speed of the motor to decrease before its operation is reversed wherein the means for selectively closing a motor circuit includes a repulsion relay having a stationary core, a primary coil, in circuit with the source, fixed thereon and a secondary coil movable thereon, an arm intermediately pivoted upon said core having one end attached to the mov-

able coil and the other end mounting a motor switch, and wherein the control switch controls the circuit of the secondary coil.

9. A delayed action switch mechanism for reversing motors including a source of electricity, a reversing motor, means for establishing independent circuits from the source to operate the motor in opposite directions, a normally open motor switch in each independent circuit, electrically operated means for selectively closing a motor switch, a selective remote control switch, means actuated by closing the control switch to establish a circuit through the selected operating means to close the selected motor switch, and means to delay the action of the motor switch operating means upon the closing of the circuit therethrough, whereby after each operation of the selective control switch the motor switches remain open for a period allowing the speed of the motor to decrease before its operation is reversed wherein the means for selectively closing a motor circuit includes a repulsion relay having a stationary core, a primary coil in circuit with the source fixed thereon and a movable secondary coil in circuit with the control switch, an intermediately pivoted arm mounted on the core having one end attached to the movable core with the other end mounting a motor switch, and in which the delay means includes a variable electrical resistor interposed in the secondary circuit.

10. A delayed action switch mechanism for reversing motors including a source of electricity, a reversing motor, means for establishing independent circuits from the source to operate the motor in opposite directions, a normally open motor switch in each independent circuit, electrically operated means for selectively closing a motor switch, a selective remote control switch, means actuated by closing the control switch to establish a circuit through the selected operating means to close the selected motor switch, and means to delay the action of the motor switch operating means upon the closing of the circuit therethrough, whereby after each operation of the selective control switch the motor switches remain open for a period allowing the speed of the motor to decrease before its operation is reversed wherein the means for selectively closing a motor circuit includes a repulsion relay having a stationary core, a primary coil in circuit with the source fixed thereon, a movable secondary coil in circuit with the control switch, an intermediately pivoted arm mounted on the core having one end attached to the movable coil with the other end mounting a motor switch, and wherein the delay means includes a variable electrical resistor increasing in conductivity upon increasing temperature interposed in the secondary circuit, and wherein a normally open shunt switch is mounted on the relay arm adjacent the motor switch and means upon closing of the shunt switch to establish a shunt circuit about the resistor.

11. A delayed action switch mechanism for reversing motors including a source of electricity, a reversing motor, means for establishing independent circuits from the source to operate the motor in opposite directions, a normally open motor switch in each independent circuit, electrically operated means for selectively closing a motor switch, a selective remote control switch, means actuated by closing the control switch to establish a circuit through the selected operating means to close the selected motor switch, and means to delay the action of the motor switch op-

erating means upon the closing of the circuit therethrough, whereby after each operation of the selective control switch the motor switches remain open for a period allowing the speed of the motor to decrease before its operation is reversed wherein the means for selectively closing a motor switch includes a repulsion relay having a stationary core, a primary coil in circuit with the source fixed thereon and a movable secondary coil mounted on the core on each side of the stationary primary coil, an arm pivoted to the core on each side of the primary coil, one end of each arm attached to the adjacent movable secondary coil with the respective free ends mounting a normally open motor switch in the respective independent motor circuits and wherein the control switch controls the respective secondary circuits.

12. A delayed action switch mechanism for reversing motors including a source of electricity, a reversing motor, means for establishing inde-

pendent circuits from the source to operate the motor in opposite directions, a normally open motor switch in each independent circuit, electrically operated means for selectively closing a motor switch, a selective remote control switch, means actuated by closing the control switch to establish a circuit through the selected operating means to close the selected motor switch, and means to delay the action of the motor switch operating means upon the closing of the circuit therethrough, whereby after each operation of the selective control switch the motor switches remain open for a period allowing the speed of the motor to decrease before its operation is reversed said delay means including a variable electrical resistor increasing in conductivity upon increasing temperature, and means to maintain the selected motor switch closed and the resistor ineffective as long as the control switch closes the said selected circuit.

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