April 6, 1926. 1,580,025

J. EATON

ELECTROMAGNETICALLY CONTROLLED DEVICE

Original Filed Sept. 29, 1921

Fig. 1.

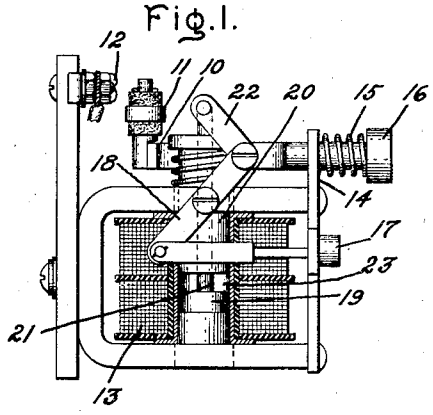


Fig. 2.

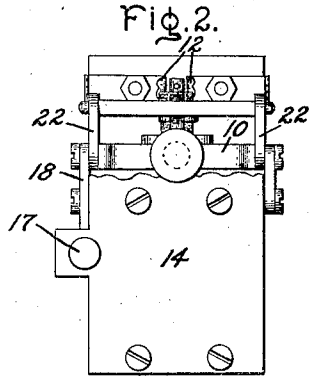


Fig. 3.

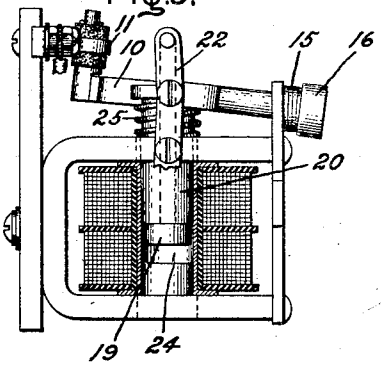


Fig. 4.

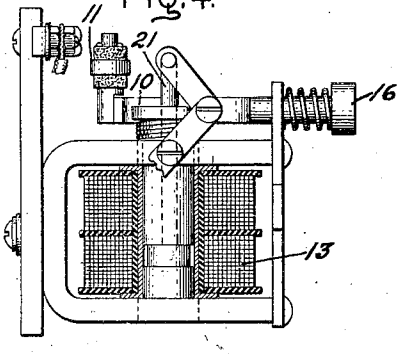


Fig. 5.

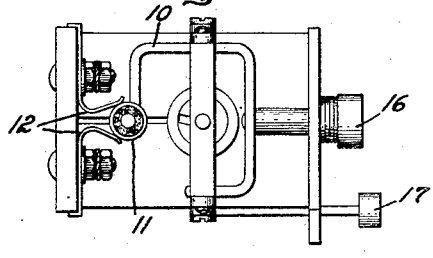
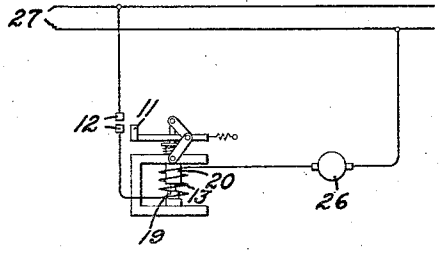


Fig. 6.



Inventor:
John Eaton,
by Albert G. Davis
His Attorney.

Patented Apr. 6, 1926. 1,580,025

UNITED STATES PATENT OFFICE.

JOHN EATON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTROMAGNETICALLY-CONTROLLED DEVICE.

Application filed September 29, 1921, Serial No. 504,052. Renewed March 19, 1925.

To all whom it may concern:

Be it known that I, JOHN EATON, a subject of Great Britain, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Electromagnetically-Controlled Devices, of which the following is a specification.

One of the objects of the invention is to provide an improved electromagnetically controlled device in which a controlled member biased to one position is magnetically held in a second position when the energization of an electromagnet is above a predetermined minimum value, and arranged so that when the energization of the electromagnet is above a predetermined maximum value, the controlled member is directly operated away from the second position.

A further object of the invention is to provide an electromagnetically controlled device having a controlled member which is under the control of two relatively movable magnetic members, and the arrangement such that the controlled member is moved to and magnetically held in a second position while the energization of the electromagnet is above a predetermined minimum value by a movement of one of the magnetic members independently of the other magnetic member, and the controlled member is operated away from the second position by a substantially simultaneous movement of the magnetic members when the energization of the electromagnet is in excess of a predetermined value.

A further object of the invention is to provide an electromagnetically controlled switch in which a switch member is magnetically held in the closed position against its bias to the open position when the current in the winding of the electromagnet is above a predetermined value and which is magnetically and directly operated to the open position when the current in the winding of the electromagnet is above a predetermined maximum value.

A still further object of the invention is to provide an improved circuit controller which combines the feature of manual control and also the feature of automatic control to protect the controlled circuit from abnormal conditions such, for example, as an overload or a failure of voltage, although in certain of its aspects the invention is not necessarily limited to a manually controlled switch.

The present invention is a modified form of the electromagnetically controlled device, for which I filed an application for patent on September 29, 1921, Serial No. 504,051. The electromagnetically controlled device of the present application is broadly covered in my said copending application, Serial 504,051, filed Sept. 29, 1921.

In carrying the invention into effect in one form as applied to an electromagnetic circuit controller, means is provided for closing and opening the controlled circuit at the will of the operator or in response to any predetermined condition. The said means may take the form of open and close or start and stop push buttons, although the invention is not limited to a push button switch, nor are certain features of the invention limited to their use in a manually operated switch. A switch member is under the control of the said means and also under the control of an electromagnet which may have a single winding energized responsively to the current through the switch. The electromagnet is provided with a magnetic movable member which is under the control of the magnet winding or windings, and the arrangement is such that the switch member is magnetically held thereby in an operative position as long as the conditions in the controlled circuit are normal, or until said manual means is operated to return the switch to its original position. In case an abnormal circuit condition occurs, such, for example, as a failure of voltage, the magnetic holding effect on the said magnetic movable member is released and the switch member is returned from the closed circuit position to the open circuit position in accordance with its bias; or in case there is an overload in the controlled circuit, the magnetic movable member is automatically operated to open the switch and to permit the switch member to return to the open position in accordance with its bias. In the present form of the invention, which has certain advantageous features of construction and arrangement which will be pointed out particularly hereinafter, the magnetic movable means comprises two magnetic members which are movable independently of each other, and these two members cooperate to control the switch member. In the

particular form of the invention which I have selected for purposes of illustration, the two magnetic members are in the form of plungers operating within the magnetic circuit of the controlling electromagnet of the switch, although the invention is not necessarily limited to an arrangement in which the elements are in the form of plungers. The one plunger is movable independently of the other to close the switch, and the switch is magnetically held closed thereby while the current in the switch winding is above a predetermined minimum value. In case the current through the magnet winding should rise above a predetermined maximum value, the two plungers move simultaneously to open the switch. The first plunger is separated from the second by an air gap which is open when the switch is open and which is closed when the switch is closed. When the switch is closed, the two plungers are attracted and moved as a unit to close a second air gap in the magnetic circuit of the controlling electromagnet, and a resilient connection is provided between the two plungers so that when the switch is thus automatically opened the various parts of the switch will return to their normally open positions.

For a better understanding of the invention, reference is had to the accompanying drawings, in which I have shown an embodiment of my invention. Referring to the drawings, Fig. 1 is a side view of my improved switch in the open position; Fig. 2 is an end view of the same with one of the parts broken away; Fig. 3 is a view showing the relative positions of the parts of the switch when the switch is closed; Fig. 4 is a view showing the relative positions of the parts of the switch when the switch is manually opened; Fig. 5 is a top view of the switch in the closed position as shown in Fig. 3; Fig. 6 is a very simplified diagram of a motor starting arrangement embodying the invention.

Referring to the drawings, the switch member 10 carries at its end a rotatable contact 11 which is adapted to make engagement with the set of resilient contacts 12 to close the switch and thereby complete the electric circuit controlled by the switch and also to energize the coil 13 of the electromagnet for the switch. The switch member 10 is mounted in the end piece 14 so as to be movable with respect thereto, and the switch member is biased to the position shown in Fig. 1 by means of the spring 15. The right hand end of the switch member 10 is connected to the close or start push button 16, and the stop or open push button 17 is also connected to the right hand end of the switch member 10 through the lever 18.

The controlling electromagnet for the switch is provided with magnetic movable means which in the present form of the invention takes the form of two relatively movable plungers 19 and 20. The plunger 19 has connected thereto a pin 21 which is connected to the right hand end of the switch member 10 through the link 22 so that when the start push button 16 is depressed to elevate the switch contact 11 into engagement with the stationary contacts 12, the plunger 19 moves independently of the plunger 20 to close the air gap 23 so that the switch will be magnetically held closed by the magnetic attraction between the two plungers while the current in the magnet winding 13 is above a predetermined minimum value. The parts of the switch will be in their relative positions as shown in Fig. 3, and it will be observed that when the switch is closed, a second air gap 24 is open. In case the current through the magnet winding of the switch should rise above a predetermined maximum value, the two plungers will move as a unit simultaneously to close the air gap 24 and thereby cause the contact 11 to break engagement with the stationary contacts 12. The circuit through the switch is thereby opened and the controlling electromagnet deenergized, so that the switch will be automatically returned to its initial position shown in Fig. 1. The spring 25 is provided for biasing the plunger 20 to the position shown in Figs. 1 and 3, and this spring in cooperation with the spring 15 associated with the start push button 16 provides a resilient connection between the plungers.

As thus constructed and arranged, the operation of my invention may be readily understood from a description of Fig. 6 in connection with the other figures of the drawing. In order to close the switch, the push button 16 is depressed against the action of the spring 15, thereby elevating the contact 11 into engagement with the stationary contacts 12 and simultaneously moving the plunger 19 to close the air gap 23. The electric motor 26 is thereby connected across the source of supply 27, and the winding 13 of the controlling electromagnet of the switch is energized to maintain the plunger 19 into engagement with the plunger 20, thereby magnetically holding the switch closed against the action of the spring 15. In case the voltage of the supply circuit 27 should either fail altogether or be reduced below a predetermined minimum value, the magnetic holding effect of the electromagnet will be reduced to such a value that the spring 15 will overpower the holding effect between the plungers 19 and 20, and the switch will be automatically returned to the open position shown in Fig. 1. The switch will remain in the open position until the operator again closes the same by depressing the push button 16, or until

the switch is again closed in any suitable manner in response to any predetermined condition.

If while the switch is magnetically held closed, the current taken by the motor should rise above a predetermined maximum value, the magnet winding 13 will be energized to set up a flux which will produce a pull on the two plungers 19 and 20 across the air gap 24, which will tend to close this air gap. A small movement of the two plungers to close the air gap 24 will move the contact 11 out of engagement with the stationary contacts 12, thereby interrupting the motor circuit and deenergizing the winding of the controlling electromagnet of the switch. It will be understood that when the current in the magnet winding of the switch rises above a predetermined value, the parts of the switch approach their respective positions shown in Fig. 4, but these parts do not necessarily reach the position at which the air gap is entirely closed, since as soon as the circuit through the switch is opened, the magnetic holding effect of the switch is relieved, and the spring 15 together with the spring 25 will effect the return of the parts of the switch to their normally open positions.

When used as a push button or manually operated switch, the invention has the advantages that the switch not only serves the purpose of the ordinary start and stop push button arrangement, but it also combines the features of providing voltage failure and overload protection in a switch which need not necessarily be larger than the ordinary start and stop push button switch. It will also be observed that only a single winding for the controlling electromagnet of the switch is necessary for magnetically holding the switch closed when the current in the winding is above a predetermined minimum value, and for magnetically opening the switch when the current in the magnet winding is above a predetermined maximum value.

It will also be observed that if the start button is held depressed, the switch will be maintained closed and can not open automatically. This feature is used to advantage in a switch for starting a motor driving a washing machine, for example, in which the starting torque required is very great and the normal running torque is materially less. If the start button is held depressed during the starting interval, the switch will be prevented from opening due to the initial rush of current and when the motor has come up to speed the start button may be released to permit the switch to protect the motor from overload and voltage failure conditions.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electromagnetically controlled device comprising a movable controlled member biased to one position, a controlling electromagnet therefor comprising a winding and two normally separated magnetic movable members controlled thereby for controlling the said controlled member, and connections whereby the first of said magnetic members moves into magnetic relation with the second to operate the said controlled member to a second position and the controlled member is magnetically held in the said second position by the magnetic attraction between the said magnetic members while the current in the said winding is above a predetermined minimum value, and the said second magnetic member moves the said first member to operate the said controlled member away from the said second position when the current in the said winding rises to a predetermined maximum value.

2. An electromagnetically controlled device comprising a movable controlled member biased to one position, a controlling electromagnet therefor comprising a winding and two normally separated magnetic movable members controlled thereby for controlling the said controlled member, and connections between the said magnetic members and the said controlled member whereby one of said magnetic members moves into engagement with the other to operate the said controlled member to a second position and magnetically hold the said controlled member in the second position while the current in the said winding is above a predetermined minimum value, and the said magnetic members move as a unit to operate the said controlled member away from the said second position when the current in the said winding is above a predetermined maximum value.

3. An electromagnetically controlled device comprising a movable controlled member biased to one position, a controlling electromagnet therefor comprising a magnetic structure, a winding, and two relatively movable magnetic members controlled thereby for controlling the said controlled member, the first of said magnetic members normally separated from the said second magnetic member by an air gap, and connections between the said magnetic members and the said controlled member whereby operating the said controlled member to a

second position closes the said air gap and places the said controlled member under the control of the said first magnetic member when the current in the said winding is less than a predetermined value, and establishes a second air gap to place the said controlled member under the control of the second magnetic member to operate the said controlled member to a second position by the pull across the said second air gap when the current in the said winding is greater than a predetermined value.

4. The combination in an electric switch of a switch member biased to the open position, a controlling electromagnet therefor comprising a winding and two magnetic movable members controlled thereby for controlling the said switch member, and means whereby the first of said magnetic members moves independently of the second to close the switch and the switch is magnetically held closed thereby while the current in the said winding is above a predetermined minimum value, and the said magnetic members move simultaneously to open the said switch when the current in the said winding rises to a predetermined maximum value.

5. The combination in an electric switch of a switch member biased to the open position, a controlling electromagnet therefor comprising a winding and two magnetic movable members controlled thereby for controlling the said switch member, and means whereby one of said magnetic members moves independently of the other to close the switch and magnetically hold the switch closed, and both of said magnetic members move as a unit to open the switch when the current in the said winding is above a predetermined value.

6. The combination in an electric switch of a switch member biased to the open position, a controlling electromagnet therefor comprising a winding energized responsively to the current through the switch and two magnetic movable members controlled thereby for controlling the said switch member, and means whereby the first of said magnetic members moves independently of the second to close the switch and to close one air gap and open a second air gap and thereby magnetically hold the switch in the closed position while the current in the said winding is above a predetermined minimum value, and both the said magnetic members move to close the said second air gap and open the switch when the current in the said winding rises to a predetermined maximum.

7. The combination in an electric switch of a switch member biased to an open position, a controlling electromagnet therefor comprising a winding, two magnetic movable members for controlling the said switch member, the said magnetic members connected to mechanically operate the said switch member and the first of said magnetic members separated from the second magnetic member by an air gap, and means for closing the switch and the said air gap to place the switch member under the control of the first magnetic member to open the switch when the current in the said winding is less than a predetermined value and under the control of the second magnetic member to open the switch when the current in the said winding is greater than a predetermined value.

8. The combination in an electric switch of a switch member biased to the open position, a controlling electromagnet therefor comprising a winding energized responsively to the current through the switch and two magnetic movable members controlled thereby for controlling the said switch member, a mechanical connection between the first of said magnetic members and the said switch members, and a resilient connection between the said magnetic members, the arrangement being such that the first of said magnetic members is separated from the second by an air gap which is closed when the switch is closed, the said switch member is magnetically held in the closed position while the current is above a predetermined minimum value by the magnetic attraction between the said magnetic members and both of said magnetic members move as a unit to open the switch due to the magnetic pull across the said second air gap when the current in the said magnet winding rises to a predetermined maximum value.

9. The combination in an electric switch of a switch member biased to the open position, manually operated means for closing the switch, a controlling electromagnet for the said switch member comprising a winding energized responsively to the current through the switch, magnetic movable means controlled by the said electromagnet for magnetically holding the switch member in the closed position when the current in the said winding is above a predetermined minimum value and for magnetically returning the switch member to the open position when the current in the said winding is above a predetermined maximum value, and connections between the said manually operated means and switch member whereby the switch member may be held in the closed position regardless of the current in the said magnet winding.

10. The combination in an electric switch of a switch member biased to the open position, a controlling electromagnet therefor comprising a winding energized responsively to the current through the switch and two magnetic movable members controlled thereby for controlling the said switch member,

means whereby the first of said magnetic members moves independently of the second to close the switch and the switch is magnetically held closed thereby while the current in the said winding is above a predetermined minimum value, and the said magnetic members move simultaneously to open the switch when the current in the said winding rises to a predetermined maximum value, manually operated means connected to the said switch member for operating the same to the closed position and holding the switch member in the closed position during the initial rush of current through the said winding.

In witness whereof I have hereunto set my hand this 28th day of September, 1921.

JOHN EATON.