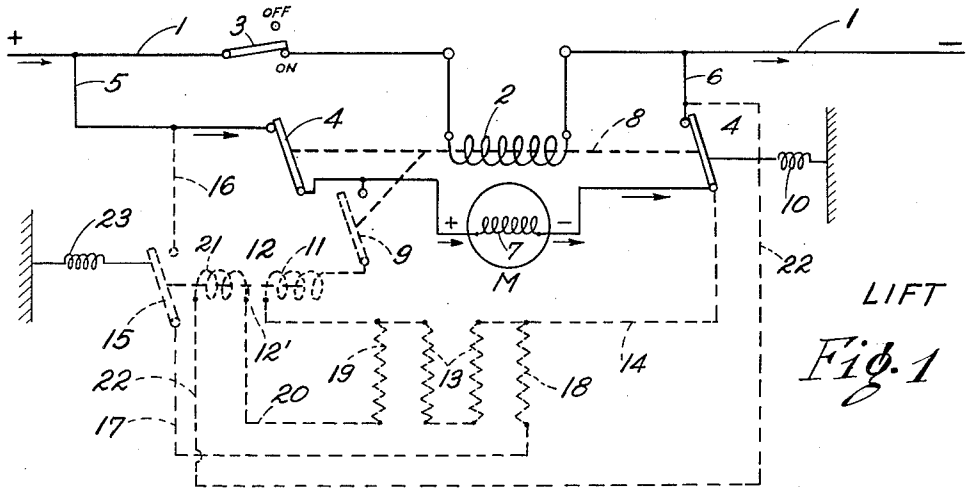
July 2, 1940. R. O. WERTZ 2,206,823

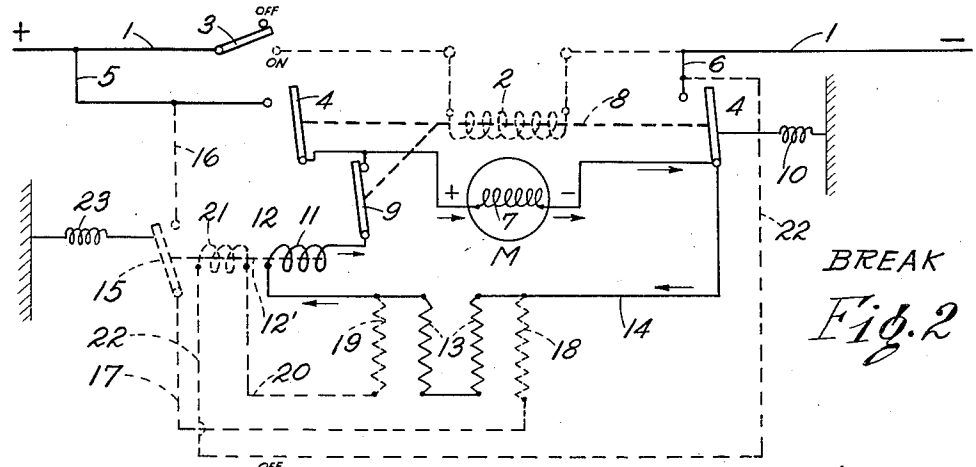
MAGNET CONTROL CIRCUIT

Filed Oct. 28, 1938



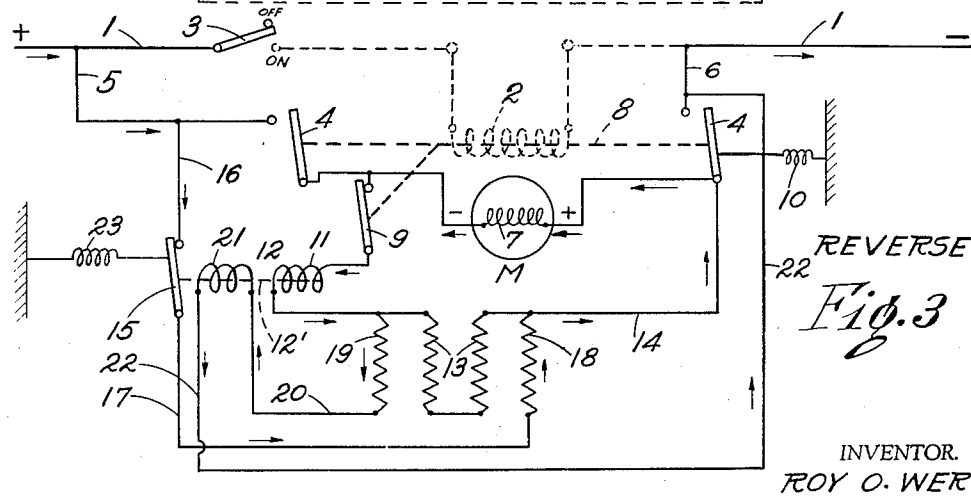
LIFT

Fig. 1



BREAK

Fig. 2



REVERSE

Fig. 3

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MAGNET CONTROL CIRCUIT

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4 Claims. (Cl. 175—335)

This invention relates to improvements in electrical circuits, and more particularly to improvements in electro-magnet control circuits of the nature disclosed in my co-pending application for "Magnet control," filed March 5, 1935, Serial No. 10,243.

In the operation of electromagnets, and particularly those known as lifting magnets, it is highly desirable to provide a control circuit that is partially automatic. Heretofore the magnet control master switch could be operated in two positions besides the "off" position; that is the operator usually lowered the magnet onto or closely adjacent the material to be picked up, and moved the control to the "on" or "lift" position. This caused current to flow through the windings of the magnet, causing the same to be energized and attracting the magnetic material to the magnet. The magnet was then lifted and the material conveyed to the position where it was to be dropped. When the operator wanted to drop the material, he moved the control to the reverse or drop position. This caused current to flow in a reverse direction through the windings and demagnetized the magnet, after which the control was moved to the "off" position. It is with the de-magnetization of the magnet that this invention is particularly concerned. The purpose of reversing the current flow was to reverse the polarity of the magnet and thus dispose of any magnetic flux that might remain therein from the lifting energization. If the control was merely moved to the "off" position from the "lift" position, small bodies of the nature of several pounds might adhere and drop from the magnet when being moved to a position for another pick-up, endangering the lives of the workmen in the vicinity. Reversing the polarity, eliminated any possibility of such small bodies adhering to the magnet. This reversing operation was, however, endowed with several difficulties. In most instances the operator is unable to see if the magnet has been freed of its load and it was only through long experience that he attained sufficient proficiency to determine how long to hold the reversing circuit closed. If he failed to hold the reversing circuit closed long enough, he did not get rid of the magnetic flux; if he held it too long, the polarity became reversed and the magnet partially energized, and he again re-picked up part of his load.

Still other disadvantages of the ordinary circuits included the damage caused by the inductive jump in voltage due to the breaking of the high voltage circuit. The sudden breaking of the main circuit caused an induced voltage to be built up in the magnet which sometimes got into the main line and caused serious damage to other apparatus operating from the main line.

By my present invention I have provided a circuit where the reversing is automatically accomplished, making only the "on" or "lift" and the "off" or "drop" positions of the control necessary. By this improved circuit there can be no question of residual magnetism in the magnet which might hold the small bodies; and the heretofore damaging inductive jump in voltage is not only kept out of the main line, but is used in the operation of the reversing control, and thus substantially all of the deficiencies heretofore mentioned as existing in the prior devices are eliminated.

Still other advantages of the invention and the invention itself will become apparent from the following description of an embodiment thereof. Although I have described and illustrated the same as being applied to lifting magnets, the invention may also be applied to other types of electro-magnets.

The description is illustrated by the accompanying drawing wherein:

Fig. 1 is a schematic diagram of my improved circuit applied to a lifting magnet and showing the same in a lifting position. The components of the circuit not in actual operation during the lift cycle are shown by dotted lines;

Fig. 2 is a similar illustration showing the condition at the time of breaking the main circuit; and

Fig. 3 is a similar view showing the condition during the reversing cycle.

Referring now to the drawing, the main line from which power is obtained is indicated at the positive and negative signs and connected by conductors 1 to the operating winding 2 of a magnetically operated main circuit breaker. Interposed in one of the lines 1 is a remote control switch 3 which may be provided with two selective positions; a closed position indicated by "on" and an open position indicated by "off." The main circuit breaker contemplates two main switch blades 4 for opening and closing the main circuit through the lines 5 and 6 to the winding 7 of the magnet M. When the main circuit breaker is closed, current flows from the positive side of the line through the conduit 5, blade 4, winding 7, and blade 4, to the line 6, and thence is connected to the negative side of the main line. Closing the remote control switch closes the circuit breaker which is opened upon open-

ing the remote control switch by a spring 10 operatively connected to move the blades 4 when the winding 2 is de-energized.

The blades 4 are mechanically connected together as indicated at 8 and operate in unison. Also mechanically connected to the main circuit breaker blades 4 is a switch 9 that comprises a single blade which is so connected to the blades 4 of the main circuit that when the main circuit is closed the switch 9 is in the open position, and when the main circuit is open, the switch 9 is closed.

It is to be noted that current only flows in the main circuit in the direction of the arrows of Fig. 1 during the lift period, the remainder of the circuit shown by the dotted lines being inactive. When the main circuit breaker is opened, which is accomplished by moving the remote control switch to "off", the winding 2 is de-energized and the spring 10 opens the main circuit; simultaneously the switch 9 is closed connecting a shunt circuit across the magnet.

The shunt circuit includes the switch 9 which is connected to a winding 11 of a reversing relay 12. Connected in series with each other and in series with the winding 11 is a pair of resistances 13, the other end of said series connection being by the conductor 14 to the opposite or negative terminal of the magnet winding 7.

The shunt circuit being connected across the winding 7, simultaneously with the breaking of the main circuit, the induced voltage is circulated within the shunt circuit, the current flow being in the direction of the arrows; the resistances 13 serving to lower the current. This flow of current causes the winding 11 of the relay 12 to be energized attracting the armature 12' thereto, which armature is connected to the blade of the reversing switch 15, closing the reversing circuit.

The reversing circuit, controlled by the switch 15, is connected by the conductor 16 to the positive side of the main line. The switch 15 is connected by a conductor 17 and a series resistance 18 to the conductor 14 which, as previously stated, was connected to the negative side of the magnet winding 7. The current path is then, through magnet winding 7, switch 9, winding 11, to the resistor 19 in series with a conductor 20 which connects to a holding winding 21 of the relay 12. The other end of the winding 21 is connected by the conductor 22 to the negative side of the main line through the conductor 6.

When the reversing circuit is closed, the current flowing through the winding 21 polarizes the same and causes it to operate in conjunction with winding 11 to hold the switch closed. In the meantime the inductive current in the shunt circuit gradually dies out because it is substantially a short circuit and because the current from the reversing circuit starts to oppose it. There comes a time, a matter of seconds or fractions of a second, when the winding 11 is without current flow therein and only the magnetic flux in the winding 21 is holding the reversing switch 15 closed; at that time the current starts flowing in the reverse direction through the magnet winding 7, this flow being indicated best by the arrows in Fig. 3.

It should be noted that as soon as the reverse current starts flowing overcoming the reactance of the magnet winding 7, the current flow starts in a reverse direction through the winding 11 to that of the flow immediately after the break. This causes the winding 11 to build up a polarity opposite to its original polarity and which opposes or bucks the polarity of the holding winding 21. When the current flow in the reversing circuit reaches a predetermined amount, the winding 11 which is now a bucking winding, neutralizes the magnetic effect of the winding 21, and the spring 23 opens the switch 15 and the reversing circuit.

The resistances 18 and 19 serve to reduce the current in the reversing circuit.

The constants of the various windings and resistances are so proportioned that the reversing circuit is opened at the time when the reversing current demagnetizes the magnet M.

It will thus be seen that the de-magnetization of the magnet is completely beyond the control of the operator and is fully automatic. Not only is the inducted voltage disposed of, it is actually utilized to initiate the reversing circuit; and finally that the winding 11 for the reversing circuit besides closing the reversing circuit is instrumental in opening the reversing circuit after a predetermined condition has been reached.

Although I have shown no manual reversing circuit, it may sometimes be advisable to provide such an auxiliary circuit, in which event the remote control switch would be provided with another position that would ordinarily be locked against use and would only be used for special applications.

Having thus described my invention in an embodiment thereof, I am aware that numerous and extensive departures will be apparent to those versed in the art, and it is not my intention that the invention be limited to the precise embodiment shown, otherwise than is claimed in the appended claims, and that the claims should be construed with a range of equivalents to which they may be entitled in view of the prior art.

I claim:

1. In a control circuit of the class described, a main circuit and a circuit breaker therefor for connecting a magnet to a current source, a reversing circuit connected to said current source and magnet for reversing current flow through the magnet, a shunt circuit and means for connecting said shunt circuit to said magnet upon the opening of the main circuit and means operable by current flow in the shunt circuit to close the reversing circuit and to open the reversing circuit upon a predetermined increase in current in the reversing circuit.

2. In a circuit breaker for an electro-magnet, a main circuit including a main circuit breaker connected to the magnet for controlling current flow from a current source to said magnet, means for counteracting the residual magnetism in said magnet upon the breaking of the main circuit including a secondary circuit therefor connecting the magnet and current source and adapted to reverse the current flow through the magnet, said secondary circuit including a starting circuit connected in shunt with the magnet for disposing of the induced high voltage caused by the breaking of the circuit and a circuit breaker actuated by current flow in the starting circuit to close said reversing circuit, said starting circuit acting in opposition to the reversing circuit to cause said relay to be released and open said reversing circuit upon a predetermined current flow in the reverse direction in said magnet.

3. In a control circuit for an electro-magnet, a main circuit for connecting a current source

to the magnet, a circuit breaker disposed in said circuit, means for disposing of the induced voltage upon breaking of the main circuit including an auxiliary circuit connected in shunt with the magnet, and a circuit breaker connected to said first circuit breaker adapted to close the auxiliary circuit upon opening of the main circuit, series resistance means in the auxiliary circuit for reducing the voltage therein, a reversing circuit for directing current flow from said source in a reverse direction through said magnet, means for connecting said reversing circuit to the magnet including a circuit breaker for controlling said reversing circuit and including an inductive winding for said circuit breaker connected in said auxiliary circuit adapted to actuate said circuit breaker to close said reversing circuit upon current flow through the auxiliary circuit, a second inductance winding for said circuit breaker disposed in series in the reversing circuit and adapted to hold said circuit breaker closed, said first mentioned winding means acting in opposition to said second winding means upon a predetermined reverse current flow to release said circut breaker and open said reversing circuit.

4. In a control circuit for an electro-magnet, a main circuit breaker for controlling current flow to the magnet from a current source, a reversing circuit for reversing the current flow from said source to the magnet to depolarize the same, a relay for controlling current flow in the reversing circuit and having windings, means to dispose of the inductive voltage in said magnet upon breaking of the main circuit and to initiate the operation of the reversing circuit including an auxiliary circuit having a resistance and one of said relay windings connected in series to each other and connected in shunt with said magnet, said relay windings including a closing winding for operating the relay to close said circuit and a holding winding for holding said reversing circuit in electrical connection with said magnet, said closing winding of said relay operable by a predetermined increase of reversing current through said magnet to release said relay and open said reversing circuit.

ROY O. WERTZ.