

E. J. MURPHY.
CURRENT REVERSING RELAY.
APPLICATION FILED MAR. 5, 1913.

1,109,244.

Patented Sept. 1, 1914.

Fig. 1.

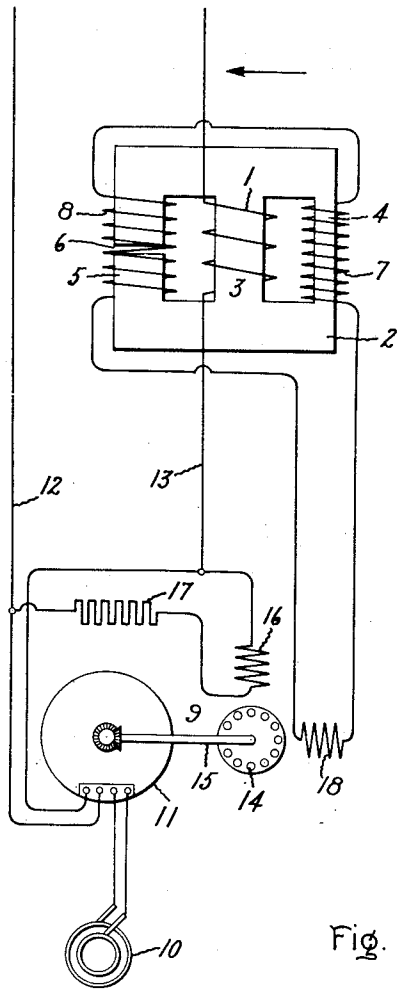


Fig. 2.

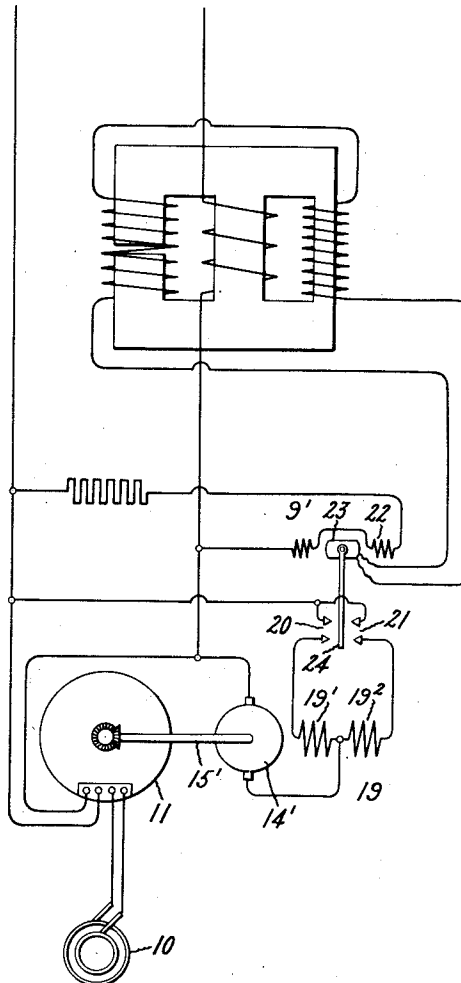
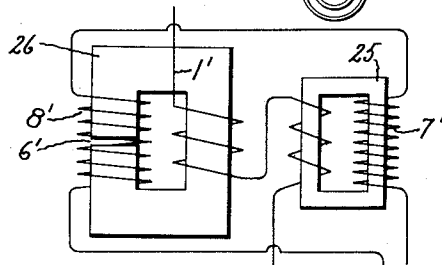


Fig. 3.



WITNESSES:

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UNITED STATES PATENT OFFICE.

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CURRENT-REVERSING RELAY.

1,109,244.

Specification of Letters Patent.

Patented Sept. 1, 1914.

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To all whom it may concern:

Be it known that I, EDWIN J. MURPHY, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Current-Reversing Relays, of which the following is a specification.

My invention relates to current responsive relays and more particularly to relays which utilize a potential or current dependent upon the main current to which the relay responds.

In certain problems which arise in respect to the control of electrical circuits, it is desirable to have a device wherein the current or the direction of impressed potential in a secondary or control circuit reverses when the current in the main circuit exceeds a predetermined amount.

The object of my invention is to provide a device of this character which shall be simple and effective for all purposes to which it may be applied.

In accordance with my invention I employ a device having a primary winding which may be connected to a main circuit which it is desired to control and having secondary windings in inductive relation with the primary winding. In inductive relation with these windings is a magnetic core or cores so fashioned and arranged that when the current in the primary winding is below a predetermined amount the impressed potential or current in the secondary windings is in a given direction, but when the current in the primary winding exceeds this amount the direction of impressed potential or current in the secondary windings is reversed.

For a better understanding of my invention reference may be had to the accompanying drawing, wherein—

Figure 1 shows diagrammatically one form in which my invention may be embodied; Fig. 2 shows diagrammatically an embodiment of my invention as applied to a modification of Fig. 1, and Fig. 3 shows diagrammatically a further modification of my invention.

Referring first to Fig. 1, I have shown my invention as employed for maintaining a constant current in an electric circuit. It will be understood, however, that while I have described my invention as applied for this purpose it may be applied for other purposes, and that the application which I use as an illustration is merely one way in which my invention may be employed. Fig. 1 is a diagrammatic view of my current reversing relay, which comprises a primary winding 1 and a core 2 in inductive relation therewith. This core is shown as having three legs, a central leg 3 surrounded by the primary winding and external legs 4 and 5, the latter being provided with an air gap 6. Surrounding leg 4 is the secondary winding 7, and surrounding leg 5 is the secondary winding 8. These windings are connected together in series so that the electromotive forces induced therein, when current flows in the primary winding, oppose or "buck" each other and they may be considered as portions of a single secondary winding. Leg 4 is constructed so as to have a small cross-section so that it will normally be saturated when current flows in the primary winding. Leg 5 of the core, with the air gap 6, is of a greater cross-section so that it will not be saturated.

The principle upon which my invention works may readily be understood from the following considerations. When current below a predetermined amount flows in the primary winding 1 a flux will be set up in the core in the usual manner, which will induce electromotive forces in the secondary windings 7 and 8. Since these windings are connected in a bucking fashion and the core 4 is of such a small section that it will normally be saturated, the number of turns in the secondary windings may be made to bear such a relation to each other that the electromotive force induced in the secondary winding 7 is greater than that induced in the secondary winding 8 and the current flowing in the circuit energized by these windings will flow, for example, in the direction shown by the arrow. As the amount of current flowing in the primary winding

1 increases in value, the magnetic flux in the core will be correspondingly increased, and, since the leg 4 is saturated, a greater amount of flux will pass through the leg 5, thus increasing the electromotive force induced in the secondary winding 8 surrounding this leg, but since the leg 4 is saturated the increase in electromotive force induced in the secondary winding 7 surrounding this leg will be comparatively slight. If the secondary windings are suitably proportioned, it is obvious that when the current flowing in the primary winding 1 reaches and exceeds a predetermined amount the electromotive force induced in the winding 8 reaches such a value that it becomes equal to and greater than that induced in the secondary winding 7. The current flowing in the total secondary windings, therefore, will reverse in its direction of flow and flow in a direction opposite to that shown by the arrow. It will thus be seen that by my invention I am able to obtain a current which will flow in one direction when the current in an electrical circuit which it may be desired to control is less than a certain amount, but will reverse and flow in an opposite direction when the current in the main circuit exceeds this predetermined amount. I may employ this device for a number of purposes, and, as one example of how it may be employed, I have shown it applied for use as a constant current regulator.

Referring to Fig. 1, 9 is a translating device connected to the secondary windings of the relay. 10 is a source of supply shown for illustrative purposes as a single-phase generator connected to a potential regulator 11 of well known construction. The regulator is in turn connected in the usual way to conductors 12 and 13 which may be connected to translating devices not shown. When my invention is applied as a constant current regulator the primary winding 1 may be connected in series with conductor 13. The translating device is shown as consisting of an induction motor with an armature 14 fastened to a shaft 15 which may be geared to operate the regulator 11 in the usual way. The induction motor is shown as having two field windings; one, 16, connected in series with a resistance or phase displacing device 17 to the conductors 12 and 13, and the other winding, 18, connected to the secondary of the current reversing relay. It will be obvious to those skilled in the art that there will be a phase displacement between the currents in these two windings and consequently the armature will develop a torque and that when the current is reversed in the field 18 of the induction motor, its torque will reverse. Reversal of the current in the secondary circuit of the current reversing relay causes the regulator

11 to raise or lower the voltage of the circuit, in response to variations in the current flowing therein. By properly proportioning the parts, the current reversing relay can be so made that when the current flowing in the circuit and through the primary winding 1 of the device has a certain normal value there will be substantially no current flowing in the secondary windings of the current reversing relay and no tendency for the regulator 11 to either raise or lower the voltage in the circuit. When the current in the circuit becomes less than normal, a current in one direction will flow in the secondary winding of the current reversing relay and in the field 18 of the induction motor, causing a movement of the regulator of such a character as to increase the voltage of the supply circuit and hence increase the current therein. When the current in the circuit exceeds the normal the current in the secondary windings will reverse its direction, causing the torque of the induction motor to reverse and the motor armature to turn in an opposite direction, thereby moving the regulator 11 to lower the voltage in the circuit and decrease the amount of current flowing therein until normal value is obtained.

Fig. 2 shows a modification of the arrangement shown in Fig. 1, wherein the current reversing relay, instead of being directly connected to a motor, is connected to a relay 9'. In the modification as shown, instead of showing an induction motor for driving the regulator 11, I have shown a series motor 19, having an armature 14' fastened to the shaft 15', which drives the regulator in the usual manner. This motor has its field divided into two portions, 19' and 19'', which are connected through contacts 20, 21 to the circuit. The translating device is shown as consisting substantially of a dynamometer having a field 22 which is connected to the circuit and an armature 23 which is connected in series with the secondary winding of the current reversing relay. Fastened to the armature and movable therewith is a contact member 24 which makes contact with contacts 20 or 21 in accordance with the direction in which it moves. From an inspection of the figure it will be seen that when contact 24 moves in one direction, owing to the torque developed between the movable coil 23 and the stationary coil 22, current will flow through a portion of the field of the series motor in one direction, which will cause it to turn the regulator to raise or lower the voltage as desired in the manner previously described until the desired value of current is obtained in the main circuit. When the current, however, exceeds or is less than such amount, the direction of flow of the current in the secondary wind-

ings, as explained above, will reverse, causing the contact 24 to move in a reverse direction, thus causing current to flow in the field of the series motor connected to the regulator in an opposite direction to that previously described and thus move the regulator in a reverse direction until the desired value of current is obtained.

Fig. 3 shows a further modification of my invention, the relay being constructed with two cores instead of a single core as shown in Figs. 1 and 2. Translating devices connected to the secondary windings have not been shown. The primary winding 1' is wound in inductive relation to the two cores 25 and 26. Secondary windings 7' and 8' are also wound respectively on these cores, and are connected so that their induced electromotive forces oppose or "buck" each other. Core 25 is so proportioned as to be normally saturated. Core 26 is so proportioned as to be normally unsaturated and is provided with an air gap 6'. It will be obvious that this arrangement will operate in the same manner as that described with reference to Fig. 1. For normal operation the electromotive force induced in winding 7' will be greater than that induced in winding 8', and current will flow in these windings in a given direction. When, however, the current flowing in the primary winding increases in value, the flux in core 26 will increase to a proportionately greater value than that in core 25, since the latter is normally saturated. The electromotive force induced in winding 8' will, therefore, increase in value until it becomes greater than that induced in winding 7' and hence the current flowing in the secondary windings will reverse in direction, and the operation of the translating devices (not shown) connected to these windings will be the same as that previously described.

While I have described a preferred embodiment of my invention and one mode of its application, I do not limit myself to such embodiment or mode of application, but seek in the appended claims to cover all embodiments and modes of application as will be obvious to those skilled in the art and not depart from the spirit of my invention.

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

1. A current reversing relay comprising in combination a primary winding, a secondary winding in inductive relation thereto composed of a plurality of portions connected in series and to give opposing electromotive forces, and magnetic means in inductive relation with said windings adapted to change the relative values of said electromotive forces when a current exceeding a predetermined amount flows in the primary winding.

2. A current reversing relay comprising in combination a primary winding, a secondary winding in inductive relation thereto composed of two portions connected in series and to give opposing electromotive forces, and magnetic means in inductive relation with said windings adapted to change the relative values of said electromotive forces when a current exceeding a predetermined amount flows in the primary winding.

3. A current reversing relay comprising in combination a primary winding, a secondary winding in inductive relation thereto composed of a plurality of portions connected in series and to give opposing electromotive forces, and magnetic means having one portion normally saturated and another portion normally unsaturated in inductive relation with said windings and adapted to change the relative values of said electromotive forces when a current exceeding a predetermined amount flows in the primary winding.

4. A current reversing relay comprising in combination a three legged magnetic core, a primary winding surrounding one leg of said core, and secondary windings connected to give opposing electromotive forces surrounding the other legs one of which is normally saturated and the other unsaturated when the current flowing in the primary is less than a predetermined amount.

5. A current reversing relay comprising in combination a core having a plurality of legs, a primary winding in inductive relation therewith, one of said legs normally saturated and another unsaturated when the current flowing in the primary is less than a predetermined amount, secondary windings surrounding the saturated and unsaturated legs connected in series to give opposing electromotive forces, and a translating device connected to the secondary windings.

6. A current reversing relay comprising in combination a three legged core having central and external legs and a primary winding surrounding the central leg, one of said external legs adapted to be saturated when current flows in the primary winding, the other external leg having an air gap therein and adapted to be unsaturated when the current flowing in the primary winding is less than a certain amount, and secondary windings one surrounding each of the external legs and connected in series so that their electromotive forces oppose each other.

7. In combination, a current reversing relay comprising a three legged core having central and external legs and a primary winding surrounding the central leg, one of said external legs adapted to be saturated when current flows in the primary winding, the other external leg having an air gap therein and adapted to be unsaturated when

the current flowing in the primary winding
is less than a certain amount, two secondary
windings one surrounding each of the ex-
ternal legs and connected in series so that
5 their electromotive forces oppose each other,
and a translating device connected to the
secondary windings.

In witness whereof, I have hereunto set
my hand this 4th day of March, 1913.

EDWIN J. MURPHY.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.