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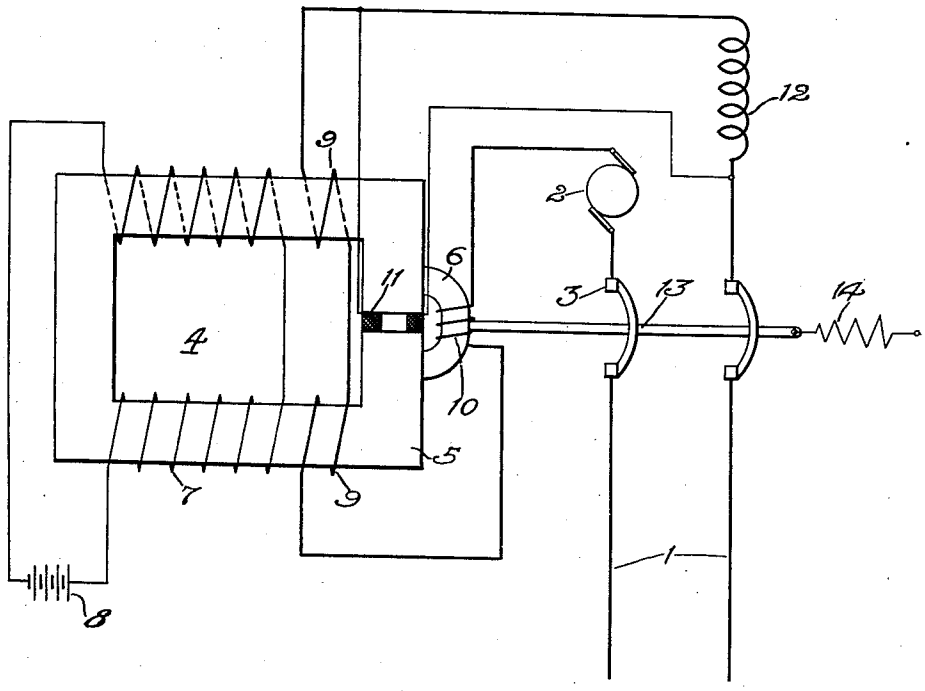
C. LE G. FORTESCUE

CIRCUIT INTERRUPTER

Filed Jan. 3, 1920



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UNITED STATES PATENT OFFICE.

CHARLES LE G. FORTESCUE, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

CIRCUIT INTERRUPTER.

Application filed January 3, 1920. Serial No. 349,252.

My invention relates to circuit interrupters and particularly to quick-acting-circuit interrupters.

One object of my invention is to provide an electromagenet for holding the circuit interrupter closed, that shall be relatively more sensitive to short-circuiting conditions than to slow changes of load.

Another object of my invention is to provide a device of the above indicated character that shall actuate an interrupter in anticipation of a short circuit thereon.

Another object of my invention is to provide a device of the above indicated character that shall be simple and inexpensive to construct, and sensitive and reliable in its operation.

Letters Patent Serial No. 1,427,367, issued Aug. 29, 1922, to Charles Le G. Fortescue and Frederic C. Hanker, and assigned to the Westinghouse Electric & Manufacturing Company discloses an electromagnet for a circuit-interrupter, that has a winding which serves to energize it while conditions in the circuit are normal and a second winding which serves to so divert the normal flux from the armature of the electromagnet as to permit the disengagement thereof from the core member thereof when a short circuit occurs on the interrupter. The release of the armature permits the immediate opening of the circuit interrupter.

In practicing my invention, I provide an electro-magnet comprising a core member having an air gap therein and an armature member adapted to bridge the air gap. The armature member is directly connected to the movable member of the circuit interrupter. A winding is supplied with current from a source of constant electromotive force for constantly energizing the core member of the electromagnet. A plurality of series windings, that are traversed by the current of the main circuit, is provided for energizing the core and the armature members, respectively. A shunt winding, that is adapted to energize the air gap of the core member, is connected across the terminals of a reactor that is connected in series with the circuit. The shunt winding is differentially connected with respect to the series windings on the armature and core members and, consequently, relatively slow load changes in the circuit produce no material changes in the flux traversing the core and the armature members. A sudden rush of current, however, such as might occur upon short-circuit conditions, induces a large potential difference across the terminals of the reactor, and, since the shunt winding is connected thereacross it will develop its magnetic flux more quickly than the series windings, which are traversed by the circuit current. The rate of energization of the series windings is dependent upon the time constant of the reactor, being in series therewith. The shunt winding, being so disposed that the flux developed thereby neutralizes the flux traversing the armature member, it causes the armature flux to shift, in effect to the air gap, thus, rendering the armature member non-responsive to the core member, in anticipation of large short circuit currents. The circuit interrupter may now be opened quickly by springs employed for that purpose before large short-circuit currents traverse the circuit.

The single figure of the accompanying drawing is a diagrammatic view of a circuit interrupter embodying my invention.

A circuit 1, that is supplied with energy from a source 2 of electromotive force, is provided with a circuit interrupter 3 having a retaining electromagnet 4. The electromagnet 4 comprises a core member 5 having an air gap therein and an armature member 6 adapted to bridge the air gap. A winding 7 is supplied with current from a source 8 of constant electromotive force for energizing the core member 5. Windings 9 and 10 are connected in series with the circuit 1 for energizing the core member 5 and the armature member 6, respectively, of the electromagnet 4. A winding 11 is adapted to energize the air gap of the core member and is connected across the terminals of a reactor 12 that is connected in series with the circuit 1. The armature 6 is connected to the movable member 13 of the circuit interrupter 3 and is adapted to be actuated by a spring 14 when it is released by the core member 5.

The shunt winding 11 is differentially wound with respect to the windings 9 and 10 in order to neutralize the flux changes effected by the windings 9 and 10 by reason of relatively slow load changes in the circuit 1. Upon the occurence of short-circuit conditions, however, the coil 11, being connected to the terminals of the reactor 12, develops its magnetic flux more quickly than

do the windings 9 and 10. The increased flux developed by the shunt winding 11 neutralizes the flux that normally traverses the armature 6 and creates a larger flux in the core member 5, thus, shifting, in effect, the flux that normally traverses the armature 6, to the air gap in the core member 5, and rendering the armature 6 non-responsive thereto. The armature member 6, being rendered non-responsive to the core member 5, is disengaged therefrom by the spring 14, to thus permit the circuit interrupter 3 to open quickly.

Although I have shown one device embodying my invention I do not limit it thereto since various changes may be made in the arrangement and construction of the various elements thereof without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim as my invention:

1. In an electric circuit, the combination with a circuit interrupter and a reactor, of an electromagnet for holding the interrupter closed, said electromagnet comprising a magnetizable core member having an air gap therein, an armature member adapted to bridge the air gap, a winding for energizing the core member, windings in series with the circuit for energizing the core and the armature members, respectively, and an auxiliary winding energized from the reactor, so shifting the flux from the armature member as to render the armature member non-responsive to the core member.

2. In an electric circuit, the combination with a circuit interrupter and a reactor, of an electromagnet comprising a magnetizable core member having an air gap therein, an armature member adapted to bridge the gap for holding the interrupter closed, means for normally energizing the core member, windings mounted on the core and the armature members and energized in accordance with the current traversing the circuit, and an auxiliary winding adapted to be so energized from the reactor as to shift the flux normally traversing the armature to the air gap bridged thereby.

3. In an electric circuit, the combination with a circuit interrupter and a reactor, of an electromagnet comprising a magnetizable core member having an air gap therein, an armature member adapted to bridge the gap for holding the interrupter closed, a winding for normally magnetizing the core member, a second winding for magnetizing the core and the armature members in accordance with the circuit current, and a flux-shifting winding so energized by the reactor as to develop a magnet field to neutralize the flux traversing the armature in accordance with the rate of change of large short circuit currents.

4. In an electric circuit, the combination with a circuit interrupter and a reactor, of a magnetizable core member having an air gap therein and an armature member for bridging the gap, means for energizing the core member, means for further energizing the core member and the armature member in accordance with the current traversing the interrupter, and a winding energized from the reactor to produce a magnetic flux to neutralize the flux normally traversing the armature member in accordance with the rate of change of large short circuit currents.

5. The combination with a circuit interrupter and a reactor, of an electromagnet comprising a magnetizable core member having an air gap therein, an armature for bridging the air gap, a winding for producing a constant flux in the core and in the armature, windings disposed on the core member and on the armature, respectively, to produce a slow change in flux therethrough when the current traversing the circuit interrupter varies slowly, and an auxiliary winding energized from the reactor for producing a counter magnetic flux to neutralize the flux traversing the armature more quickly than the normal flux could be increased therein in accordance with the current traversing the interrupter.

6. In an electrical circuit, the combination with a circuit interrupter, and a reactor connected in series with the interrupter, of an actuating electromagnet therefor comprising a magnetizable core member having an air gap therein, an armature member adapted to bridge the gap holding the interrupter closed, means for normally energizing the magnet, windings in series with the circuit for energizing the core and the armature members in accordance with the current therethrough, and a shunt winding connected to the terminals of the reactor, the shunt winding being differentially connected with respect to the series windings to so neutralize the magnetic effect of the armature winding, in accordance with the rate of change of large short circuit currents, that the armature member may be rendered non-responsive to the core member.

7. In an electrical circuit, the combination with a circuit interrupter and a reactor, of an electromagnet having energizing means therefor, series windings mounted thereon and energized in accordance with the current traversing the circuit, and a shunt winding energized from the reactor to be energized more quickly than the series windings.

8. In an electromagnet for actuating a circuit interrupter, the combination with means energized in accordance with the current traversing the circuit, of means energized in accordance with the rate of change of large short circuit currents for shifting the magnetic flux developed in the electro-

magnet by said circuit-current energizing means.

9. The combination with a circuit interrupter and a reactor, of an electromagnet energized in accordance with the current traversing the circuit, a shunt winding connected across the reactor and energized in accordance with the rate of change of large short circuit currents, said shunt winding being adapted, upon such energization, to shift the magnetic flux that is developed in the electromagnet by the means energized in accordance with the circuit current.

10. The method of diverting a magnetic flux from a main path to an auxiliary path in response to an occurrence of short-circuit conditions in an electric circuit which consists in magnetizing the main path in accordance with the current traversing the circuit and in magnetizing the auxiliary path in accordance with the potential difference across the terminals of a reactor in the circuit, whereby the relatively quick increase in the potential difference across the reactor may magnetize the auxiliary path more quickly than the circuit current may magnetize the main path.

11. The method of diverting a magnetic flux from a main path to an auxiliary path in response to an occurrence of short-circuit conditions in an electric circuit which consists in magnetizing the main path in accordance with the current traversing the circuit and in magnetizing the auxiliary path by means of a winding connected across the terminals of a reactor in the circuit and embodying a time constant equal to that of the reactor.

12. A controlling device for an electric circuit comprising means energized in accordance with the current traversing the circuit to induce a magnetic flux in a predetermined path and means energized in accordance with the rate of change of circuit currents for shifting the said magnetic flux.

13. A controlling device for an electric circuit comprising means energized in accordance with the current traversing the circuit to induce a magnetic flux in a predetermined path and means energized in accordance with the rate of change of a fault current for shifting the said magnetic flux.

14. A controlling device for an electric circuit comprising means energized by a constant source of potential and means associated therewith energized in accordance with the current traversing the circuit to induce a magnetic flux in a predetermined path; and means energized in accordance with the rate of change of circuit currents for shifting the said magnetic flux.

In testimony whereof, I have hereunto subscribed my name this 18th day of December, 1919.

CHARLES LE G. FORTESCUE.