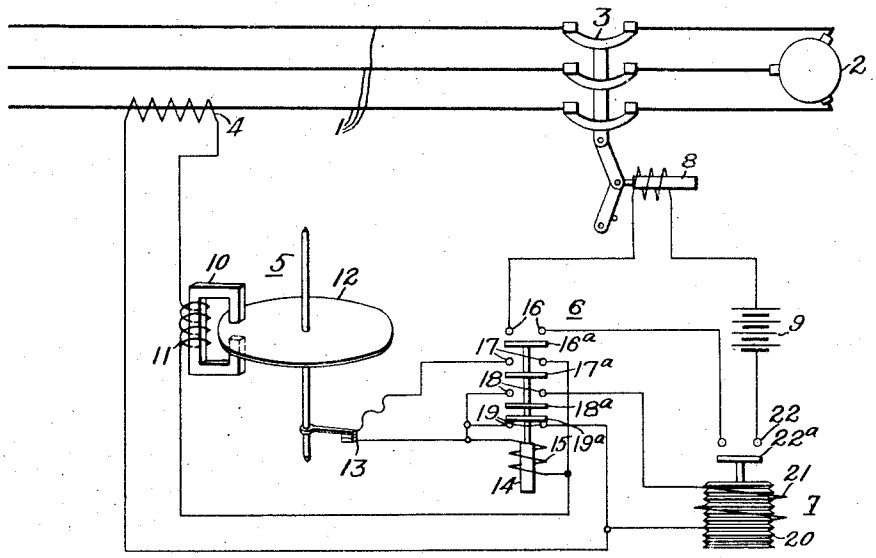
Jan. 25, 1927. 1,615,677

F. M. BILLHIMER

RELAY SYSTEM

Filed June 3, 1920



WITNESSES:

J. A. Helsel

J. E. Foster

INVENTOR

Frank M. Billhimer

BY

Wesley G. Carr

ATTORNEY

Patented Jan. 25, 1927. 1,615,677

UNITED STATES PATENT OFFICE.

FRANK M. BILLHIMER, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

RELAY SYSTEM.

Application filed June 3, 1920. Serial No. 386,404.

My invention relates to relay systems and particularly to load-limiting relay systems.

One object of my invention is to provide means for disconnecting a distributing circuit from a source of energy when the power demand upon the distributing circuit exceeds a predetermined value for a predetermined interval of time.

Another object of my invention is to provide a relay system, of the above-indicated character, that shall be simple and reliable in its operation.

In practicing my invention, I provide an overload relay, a thermal relay and an underload relay which co-operate to trip an interrupter when an amount of energy equal to or exceeding a predetermined value traverses the interrupter for a predetermined interval of time. While current below the full-load value traverses the interrupter, only the underload and the overload relays are energized from the current transformer in the distributing circuit. When the current that traverses the interrupter attains or exceeds a predetermined value, as, for example, 100% full load, the overload relay is actuated to include the thermal relay in circuit with the current transformer by means of auxiliary contact members that are controlled by the overload relay. If the overload obtains for a predetermined interval of time, the thermal relay will actuate its contacts to complete a circuit for tripping the interrupter. The interval of time required for the operation of the thermal relay varies inversely with the overload on the circuit.

The single figure of the accompanying drawing is a diagrammatic view of a relay system embodying my invention.

A distributing circuit 1 is adapted to receive energy from a source 2 of electromotive force through a circuit interrupter 3. An auxiliary relay circuit for controlling the tripping of the interrupter 3 comprises a current transformer 4, an underload relay 5, an overload relay 6 and a thermal relay 7. The operation of the relays, according to predetermined conditions, completes a circuit whereby a tripping magnet 8 of the interrupter 3 is energized, from a source 9 of electromotive force, to trip the interrupter.

The underload relay 5 comprises a magnetizable core member 10 having an energizing winding 11 therefor, a rotatively movable member 12 and a pair of contacts 13 one of which is operated by the member 12 of the relay. The overload relay 6 is of solenoid type and comprises a movable magnetizable member 14, an energizing winding 15 therefor and a plurality of stationary contact members 16, 17, 18 and 19 that are adapted to be engaged by corresponding movable bridging contact members 16^a, 17^a, 18^a and 19^a. The thermal relay 7 comprises a thermal-storage means 20, a heating winding 21, and a plurality of contact members 22 engagement of which by a bridging contact member 22^a is effected when the relay 7 is heated to a predetermined degree.

When the value of the current that traverses the circuit is less than that of full-load current, a circuit obtains from one terminal of the current transformer 4, through the winding 11 of the relay 5, the winding 15 and the contact members 19 and 19^a of the relay 6, to the other terminal of the current transformers 4. This causes the contact members 13 of the relay 5, one of which is connected to one of the contact members 17, and the other of which is connected to one of the contact members of each of the pairs 18 and 19, to engage. The circuit of the winding 21 of the relay 7 is controlled by the contact members 18 and 18^a of the relay 6. When the circuit current attains full-load value, the contact members of the relay 5 are disengaged by the movement of the movable member 12, and the member 14 of the relay 6 is likewise actuated, whereby the respective pairs of contact members 16, 17 and 18 are connected together by the corresponding bridging members 16^a, 17^a and 18^a and the bridging contact member 19^a is disconnected from the contact members 19. Upon the actuation of the relay 6, a circuit is completed from one terminal of the current transformer 4, through the winding 11 of the relay 5, the winding 15, the contact members 18 and 18^a of the relay 6 and the winding 21 of the relay 7, to the other terminal of the current transformer 4. The actuation of the relay 6 thus serves to introduce the relay 7 into the circuit of the current transformer 4.

If the current that traverses the circuit is maintained at a value in excess of full load, the relay 7 becomes heated in accordance with such excess value. When the relay 7 becomes heated to a predetermined degree, its contact members 22 are connected

by the member 22ª, whereby a circuit is completed from one terminal of the source 9 of electromotive force, through the contact members 22 and 22ª of the relay 7, contact members 16 and 16ª of the relay 6 and the winding of the trip magnet 8, to the other terminal of the source 9 of electromotive force. The tripping magnet 8 thereupon becomes energized to trip the interrupter 3. The thermal characteristics of the relay 7 may be made such that the relay will operate when currents of predetermined value traverse the circuit for predetermined intervals of time. For example, the relay may be arranged to actuate the interrupter when a current that is 125% of normal full-load current traverses the circuit for five minutes, when a current that is 150% of full-load current traverses the circuit for two minutes, or when a current that is 200% of normal full-load current traverses the circuit for one-half minute.

If the value of the current that traverses the interrupter decreases below full-load current before the relay 7 effects engagement of its contact member 22ª with contact members 22, it is desirable to disconnect the thermal relay 7 from the circuit in order to dissipate the heat stored therein. The relay 6, being of the solenoid type, tends to remain in the actuated or closed position even when the current traversing the winding 15 drops considerably below the operating value. Consequently, the relay 5 is arranged to restore the relay 6 to normal. Upon a predetermined drop in load, the relay 5 will effect re-engagement between the contact members 13, whereupon a circuit will be completed from one terminal of the winding 15, through the contact members 13 and the contact members 17 and 17ª of the relay 6, to the other terminal of the winding 15 to short-circuit the latter winding and permit the relay 6 to return to its de-energized position. The thermal relay 7 is thereupon removed from the circuit of the current transformer and receives no further energy while the value of the current that traverses the circuit remains below full-load value. The heat energy that has been stored in the relay 7 is so dissipated, in the meantime, that the relay is permitted to return to its initial position.

While I have shown one arrangement of the relay system embodying my invention, I do not limit it thereto, as various modifications may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim as my invention:

1. A load-limiting device for an electric circuit comprising an electromagnetic relay responsive to the current in the circuit, a second relay for controlling the actuation of the firstmentioned relay and means having a time element varying inversely in accordance with the current in the circuit for connecting a source of current to the contacts of said first-mentioned relay.

2. A load-limiting device for an electric circuit comprising an overload relay responsive to the current in the circuit, means responsive to a predetermined value of current in the circuit for controlling the actuation of said overload relay, and means having a time element varying inversely in accordance with the current in the circuit for controlling the supply of current to the contacts of said relay.

3. In a load-limiting device for an electric circuit, the combination with an interrupter for the circuit, of an underload and an overload relay energized from the circuit, a thermal relay, connections for energizing the thermal relay from the circuit upon the actuation of the overload relay at a predetermined value of current in the circuit, the overload and the thermal relays co-operating to actuate the interrupter, and connections whereby the underload relay restores the overload relay at a predetermined load.

4. In a load-limiting device for an electric circuit, the combination with an interrupter for the circuit, of a relay responsive to the current in the circuit, a time-element relay controlled thereby for acutating the interrupter after an interval of time that varies inversely as the current in the circuit varies, and controlling means for both said relays energized from the circuit.

5. In a load-limiting device for an electric circuit, the combination with an interrupter for the circuit, of means responsive to a predetermined value of current, co-operating thermal means subject to control thereby having a time limit that is inversely proportional to the current for actuating the interrupter upon the maintenance of the predetermined value of current for the interval of time required for the operation of the thermal means, and electro-responsive means for controlling the effectiveness of both of said means.

6. In a load-limiting device for an electric circuit, the combination with an interrupter for the circuit, of means responsive to a predetermined value of current, and co-operating thermal means having a time limit that is inversely proportional to the current for actuating the interrupter upon the maintenance of the predetermined value of current for the interval of time required for the operation of the thermal means, and means energized from the circuit for rendering the thermal means inoperative upon a decrease of the current in the circuit below the predetermined value for actuating the current-responsive means.

7. In a load-limiting device for an electric circuit, the combination with an inter-

rupter for the circuit, of means responsive to the current in the circuit and co-operating thermal means for actuating the interrupter under predetermined conditions, and means responsive to a predetermined value of current for rendering the current-responsive means and the thermal means inoperative for actuating the interrupter.

8. In a load-limiting device for an electric circuit, the combination with an interrupter for the circuit, of means responsive to the current in the circuit and co-operating thermal means for actuating the interrupter under predetermined conditions, and means responsive to a predetermined minimum value of current for controlling the interrupter-actuating means.

9. A load-limiting device for an electric circuit comprising means responsive to and traversed by the current in the circuit, means having a time element varying inversely as the current in the circuit varies, and means responsive to a predetermined minimum value of current for controlling the current-responsive means and the time-limit means.

In testimony whereof, I have hereunto subscribed my name this 27th day of May, 1920.

FRANK M. BILLHIMER.