

Dec. 28, 1943.

A. M. LOCKIE

2,337,829

PROTECTIVE SYSTEM FOR ELECTRICAL APPARATUS

Filed July 15, 1941

Fig. 1.

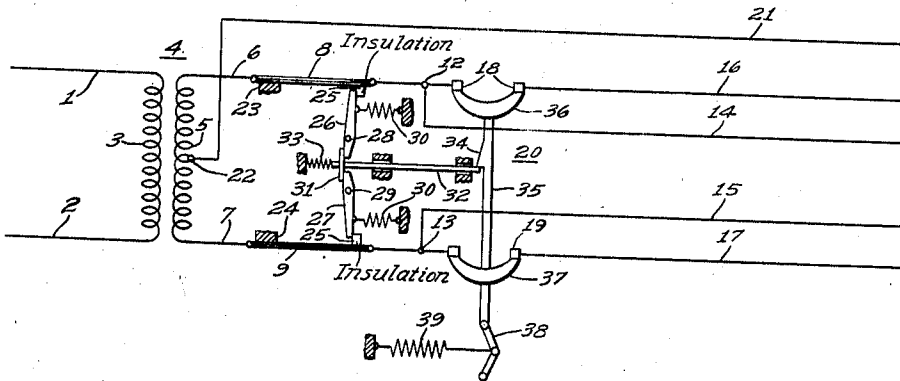


Fig. 2.

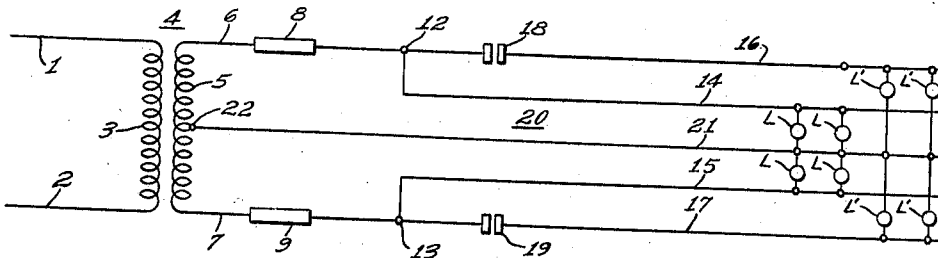
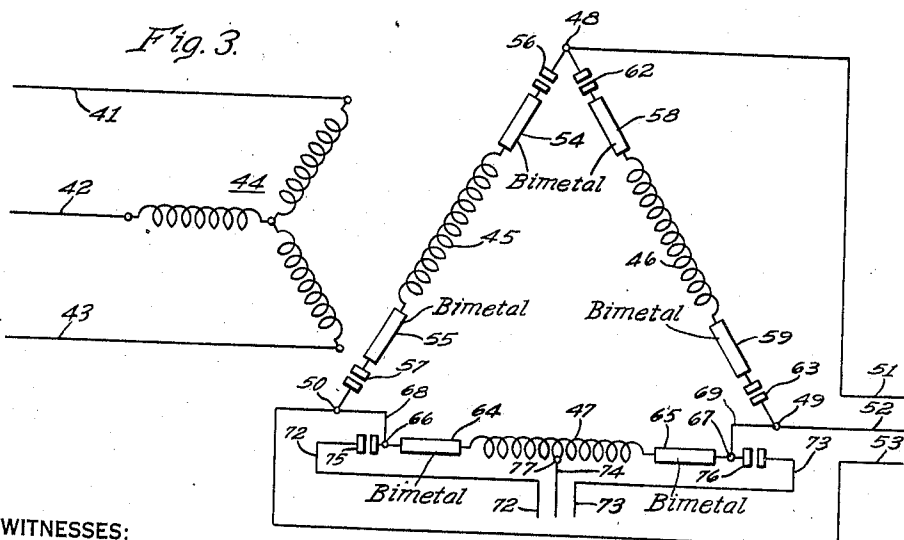


Fig. 3.



WITNESSES:

C. J. Weller.
W. L. Groome

INVENTOR

Arthur M. Lockie.

BY

Franklin E. Hardy
ATTORNEY

UNITED STATES PATENT OFFICE

2,337,829

PROTECTIVE SYSTEM FOR ELECTRICAL APPARATUS

Arthur M. Lockie, Sharon, Pa., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application July 15, 1941, Serial No. 402,473

5 Claims. (Cl. 171-97)

My invention relates to a protective system for electrical apparatus such as transformers and, more particularly, to means for selectively unloading the apparatus to thereby prevent interrupting the service of the apparatus in supplying other loads.

It is an object of the invention to provide electrical apparatus for supplying electric energy to a plurality of load circuits and to provide means responsive to the load output of the apparatus for interrupting a selected number of circuits leading from the apparatus.

It is a further object of the invention to provide a plurality of load circuits each having conductors supplied from common terminal points on the apparatus and circuit interrupting means for disconnecting the conductors of one circuit or certain of them from the terminal points in response to a predetermined flow of energy from the apparatus through all or some of said terminal points.

The invention will be better understood by reference to the accompanying drawing, in which

Figure 1 is a diagrammatic view of circuits and apparatus organized in accordance with one preferred embodiment of the invention;

Fig. 2 is a simplified diagrammatic view of the circuits shown in Fig. 1; and

Fig. 3 is a simplified diagrammatic view of circuits illustrating another embodiment or application of the invention.

In Figs. 1 and 2 of the drawing, a supply circuit is represented by conductors 1 and 2 that are connected to the primary winding 3 of a transformer 4 having a secondary winding 5, the outer ends of which are connected through conductors 6 and 7 and bimetal load responsive elements 8 and 9 to junction points 12 and 13, respectively.

Conductors 14 and 15 that are connected to the junction points 12 and 13, respectively, comprise the two end terminal conductors of one circuit supplied from the transformer 4. A second output circuit from the transformer is also provided, comprising conductors 16 and 17, that are connected to junction points 12 and 13 through contact members 18 and 19, respectively, of a circuit interrupting device. A load circuit conductor 21 is provided connected to a point 22 on the winding 5 intermediate its ends, this conductor being common to the circuit having conductors 14 and 15 and to the circuit having conductors 16 and 17.

The bimetal elements 8 and 9 constitute thermally actuated load responsive elements for initiating the operation of the circuit interrupting

device 20 to disconnect circuit conductors 16 and 17 from the transformer winding 5. The bimetal elements 8 and 9 are mounted on suitable abutments 23 and 24, respectively, and are provided with latches 25 adjacent their outer or moving ends that are adapted to disengage tripping members 26 and 27 pivotally mounted on pins 28 and 29, respectively, and biased by springs 30. The ends of the actuating members 26 and 27 remote from the latches 25 are positioned adjacent to an operating member 31 attached to a latch rod 32 normally biased by a spring 33 to its illustrated position to engage a projection 34 carried by a switch operating member 35 for maintaining the switch operating contact members 36 and 37 in circuit closing position. Upon disengagement of the rod 32 with the projection 34, the circuit interrupting member 20 is actuated through toggle mechanism 38 by a spring 39 to disconnect both conductors 16 and 17 from the transformer winding 5. This may be brought about by heating either of the bimetal elements 8 or 9 sufficiently to release its associated latch 25 from engagement with the associated tripping member 26 or 27 so that should the output current from either of the terminal conductors 6 or 7 increase above the desired value for which the equipment is set to operate, the circuit connection between the transformer winding 5 and the circuit conductors 16 and 17 will be simultaneously broken.

The circuit interrupting device 20 and the control mechanism therefor that is actuated in response to the bimetal elements 8 and 9 may correspond to the circuit breaker disclosed in United States Patent No. 2,169,586, issued to M. G. Leonard, August 15, 1939, and assigned to the same assignee as this application. Such a device is usually mounted to operate under oil in which the transformer or like apparatus is immersed, so that the elements 8 and 9 are responsive both to the temperature of the apparatus as a whole as indicated by the oil temperature and also by the current flowing in the circuit.

It will be noted that the temperature responsive thermal elements 8 and 9 are connected between the terminals of the winding 5 and the junction points 12 and 13, respectively, so as to be affected by the total output currents from the two ends of the winding 5 supplying the two circuits. It will be appreciated that the load devices L, connected between conductors 14 and 21, are not necessarily of the same current consuming capacity as the devices L that may be connected between conductors 15 and 21 in the above-mentioned three-wire circuit and also that

the load devices L', connected between conductors 16 and 21, are not necessarily of the same current consuming capacity as those that may be connected between conductors 17 and 21, so that the current flow through the bimetal elements 8 and 9 are not necessarily alike. When the current flow from either end of the winding 5 is increased to a point causing a dangerous overload on the apparatus, the circuit conductors 16 and 17 will be disconnected from the circuit to decrease the load on the apparatus while at the same time maintaining service on the circuit represented by conductors 14, 15 and 21. The winding 5 may, therefore, be used as the supply source both for an emergency system which must be carried without interruption and for supplying also a second circuit which may be interrupted without serious consequences.

Another application of the invention is illustrated in Fig. 3 in which primary circuit conductors 41, 42 and 43 are shown as supplying a 3 phase Y-connected transformer primary winding 44. The secondary windings 45, 46 and 47 are connected in delta to junction points 48, 49 and 50 comprising the terminal points of the secondary circuit represented by conductors 51, 52 and 53. As shown, the winding 45 is connected between bimetal element 54 and 55 and between the contact members 56 and 57 of a circuit interrupting device which may be similar to that shown in Fig. 1, so that upon overheating of either element 54 or 55, the circuit breaker would operate to disconnect the winding 45 from the circuit through switch contact members 56 and 57. The phase winding 46 is similarly connected to the secondary circuit conductors through bimetal elements 58 and 59 and switch contact members 62 and 63 so that, upon the heating of either of the two bimetal elements connected in circuit therewith, the winding 46 will be disconnected from the circuit.

The third winding 47 is connected between bimetal elements 64 and 65 and junction points 66 and 67 which are connected by conductors 68 and 69 to the junction point 50 and 49, respectively.

It will be noted that provision is made to disconnect the windings 45 and 46 from the three-phase circuit represented by conductors 51, 52 and 53, upon heating of the bimetal elements in circuit with the windings 45 and 46 but that the third phase winding 47 is always connected between junction points 50 and 49. The winding 47 not only is connected as a part of the delta winding supplying the three-phase circuit but is also connected to supply a single phase three-wire circuit represented by conductors 72, 73 and 74. The conductors 72 and 73 are connected to junction point 66 and 67, respectively, by switch contact members 75 and 76, which are jointly operated in response to the thermal action of the bimetal elements 64 or 65 in the same manner as the circuit interrupting device 20 illustrated in Fig. 1. The third conductor 74 of the single phase circuit is connected to a point 77 intermediate the ends of winding 47 so that the single phase circuit represented by conductors 72, 73 and 74 is similar to that illustrated in Figs. 1 and 2 by conductors 16, 17 and 21.

In the application of the invention illustrated in Fig. 3 in which one phase winding 47 carries both a part of the three-phase load and a single phase load, the circuit interrupting device having contacts 75 and 76 would be adjusted to operate to disconnect a single phase circuit from the system whenever the combined load on the two

circuits would endanger the apparatus if allowed to persist. This circuit interrupter will not, however, disconnect the polyphase load. The polyphase circuit is protected by circuit interrupting devices associated with windings 45 and 46, respectively, to interrupt the connections of these windings from the three-phase circuit should the bimetal elements connected in circuit therewith become overheated. It will be noted that both in the single-phase circuit shown in Fig. 3 and in the circuits shown in Figs. 1 and 2, the single-phase circuits always operate with a stable neutral thereby avoiding the danger of excessive voltage on one side of the system as might result if simultaneous disconnection of the terminal conductors of the circuit were not provided for.

While the applications of the invention have been illustrated particularly with reference to transformers as the apparatus to be protected, it will be evident that the arrangement of the load responsive elements and the circuit interrupting devices illustrated and described may be applied to the protection of the windings of generators or other sources of electrical energy. It will also be apparent that the load responsive elements may be thermal relays in which the thermally-responsive element is heated by current flowing from current transformers, or by other heaters responsive to the maximum permissible loads, or the load responsive elements may be current actuated devices.

Various modifications in the circuits and apparatus shown to illustrate embodiments of the invention will occur to those skilled in the art and I do not wish to be limited otherwise than by the scope of the appended claims.

I claim as my invention:

1. In a protective system for electrical apparatus having a phase winding for supplying electric energy to load devices, a load circuit comprising two conductors conductively connected to opposite ends of said phase winding and a conductor conductively connected to a point on said winding intermediate its ends, a second load circuit comprising two conductors also conductively connected to opposite ends of said winding and the conductor of the first named circuit connected to a point on said winding intermediate its ends, a circuit interrupter for disconnecting the two first named conductors of one of said circuits from said winding, and means responsive both to the temperature of the apparatus as a whole and also to the current in both of said circuits for operating said circuit interrupting device.

2. In a protective system for electrical apparatus immersed in a cooling and insulating liquid and having a phase winding for supplying electric energy to load devices, a load circuit comprising two conductors conductively connected to opposite ends of said phase winding and a conductor conductively connected to a point on said winding intermediate its ends, a second load circuit comprising two conductors also conductively connected to opposite ends of said winding and the conductor of the first named circuit connected to a point on said winding intermediate its ends, a circuit interrupter for disconnecting the two first named conductors of one of said circuits from said winding, thermal means immersed in said cooling liquid and responsive both to the temperature of the apparatus as a whole and to the current flowing through both conductors connected to one end of said phase winding for operating said circuit interrupter and additional

thermal means also immersed in said cooling liquid and responsive to the current flowing through both conductors connected to the other end of said phase winding for operating said circuit interrupter.

3. In a protective system for electrical apparatus, in combination, a plurality of apparatus windings connected in delta for supplying energy to a polyphase electric circuit comprising phase conductors connected to the points of common connection between the windings, a second circuit comprising a pair of conductors connected to the opposite ends of one of the delta connected phase windings and a conductor connected to a point on said winding intermediate its ends, a circuit interrupter for disconnecting said pair of conductors of said second circuit from the opposite ends of said phase winding, and means responsive both to the temperature of the apparatus as a whole and also to the current in said phase winding resulting both from power flow in said polyphase circuit and in said second circuit for operating said circuit interrupter.

4. In a protective system for electrical apparatus, in combination, a plurality of apparatus windings immersed in a cooling and insulating liquid and connected in delta for supplying energy to a polyphase electric circuit comprising phase conductors connected to the points of common connection between the windings, a second circuit comprising a pair of conductors connected to the opposite ends of one of the delta connected phase windings and a conductor connected to a point on said winding intermediate its ends, a circuit interrupter for disconnecting the pair of conductors of said second circuit from the opposite ends of said phase winding, thermal means immersed in said cooling and insulating liquid so as to be responsive to the temperature of the apparatus as a whole and also connected in circuit to be responsive to current flow from one end of said phase winding to the conductors of both the polyphase circuit and the second circuit for operating said circuit interrupter, and thermal means immersed in said cooling and insulating liquid so as to be responsive to the

temperature of the apparatus as a whole and also connected in circuit to be responsive to current flow from the other end of said phase winding to the conductors of both the polyphase circuit and the second circuit for operating said circuit interrupter.

5. In a protective system for electrical apparatus, in combination, three apparatus windings immersed in a cooling and insulating liquid and connected in delta relation for supplying energy to a polyphase electric circuit comprising phase conductors connected to the points of common connection between the windings, a circuit interrupter associated with each of two of said windings for disconnecting the opposite ends of the winding from the points of common connection to adjacent windings and thermal means immersed in said cooling and insulating liquid so as to be responsive to the temperature of the apparatus as a whole and also connected in circuit to be responsive to current flow from either end of said winding for operating said circuit interrupter, a second circuit comprising a pair of conductors connected to the opposite ends of the third one of the delta connected phase windings, and a conductor connected to a point on said winding intermediate its ends, a circuit interrupter for disconnecting said pair of conductors of said second circuit from the opposite ends of said phase winding, thermal means immersed in said cooling and insulating liquid so as to be responsive to the temperature of the apparatus as a whole and also connected in circuit to be responsive to current flow from one end of said phase winding to the conductors of both the polyphase and the second circuit for operating said circuit interrupter, and thermal means immersed in said cooling and insulating liquid so as to be responsive to the temperature of the apparatus as a whole and also connected in circuit to be responsive to current flow from the other end of said phase winding to the conductors of both the polyphase and the second circuit for operating said circuit interrupter.

ARTHUR M. LOCKIE.