

May 12, 1942.

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2,282,838

VOLTAGE BOOSTING SYSTEM

Filed Nov. 27, 1941

Fig. 1

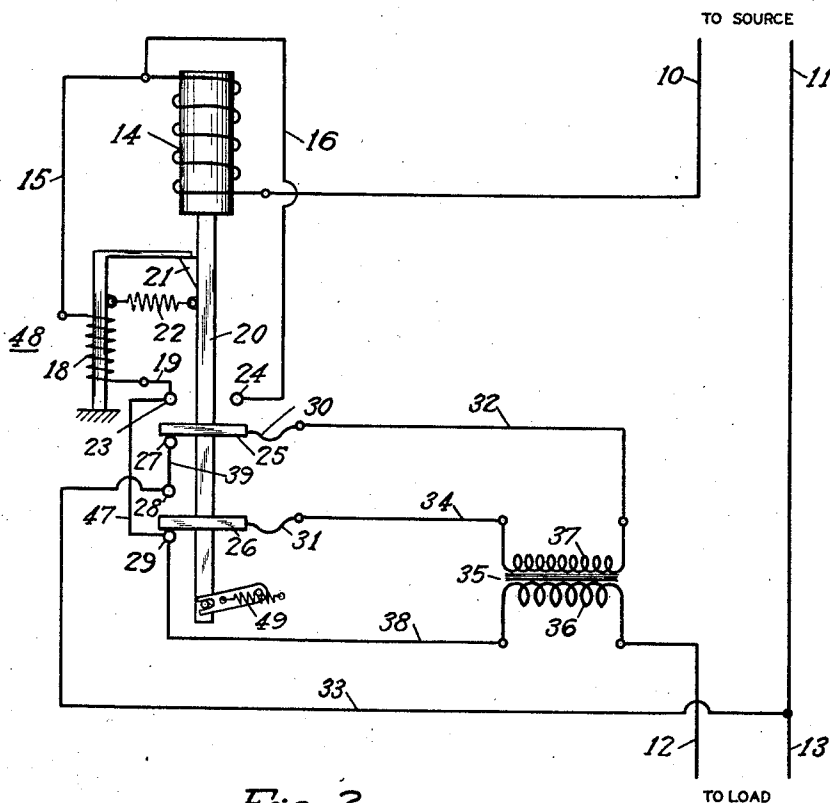


Fig. 2

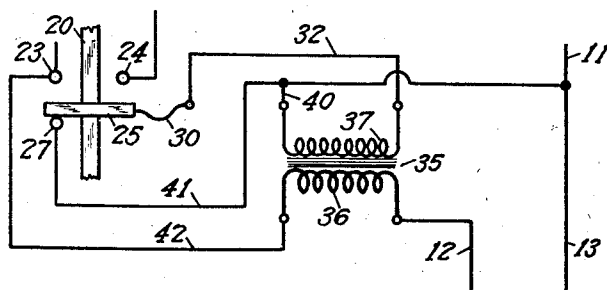
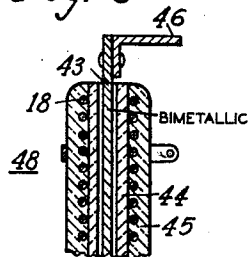


Fig. 3



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2,282,838

VOLTAGE BOOSTING SYSTEM

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Application November 27, 1941, Serial No. 420,687

6 Claims. (Cl. 171-119)

This invention relates generally to systems for the purpose of automatically varying the voltage of a connected circuit in accordance with the magnitude of the current in the circuit.

Among the objects of the invention may be noted the provision of means for increasing the voltage of a connected circuit in response to the passage of a predetermined current through said circuit which continues for a predetermined time; means for reducing the voltage of the circuit from the increased value promptly upon the passage of a current less than the predetermined current; and means for shunt-circuiting the control element of the time-delay means of the system when the current in the circuit exceeds the predetermined amount, thereby avoiding damage to the element from thermal effects of excessive or abnormal current in the circuit. Other objects will be in part obvious, and in part pointed out hereinafter.

The invention comprises the elements and combinations thereof, and arrangement of parts to be exemplified in the following description, and the scope of the invention will be indicated in the accompanying claims.

In the drawing: Fig. 1 schematically illustrates an embodiment of the invention; Fig. 2 is a fragmentary schematic illustration of another embodiment of the invention; and Fig. 3 is a fragmentary sectional view of the thermally responsive element embodied in the construction.

Similar reference characters indicate corresponding parts in the several figures of the drawing.

The present invention is particularly adapted for use in connection with alternating current circuits energized at so-called utilization voltages of less than about 600 volts, for example, as a means of compensation for voltage drop due to loads on such circuits which vary in amount from time to time.

As illustrated in Fig. 1, the invention is applied to a single phase circuit, the conductors 10 and 11 representing the source or line conductors, and the conductors 12 and 13 the load conductors. The arrangement is illustrated in the first or normal position, providing a circuit serially from the conductor 10 through the coil of the solenoid 14, the conductor 15, the heating element 18 of the time-delay device 48, the conductor 19, the contact 23, the conductor 47, the contact 29, the conductor 38, and the winding 36 of the transformer 35, to the load conductor 12.

One terminal of the winding 37 of the transformer 35 is connected to the load conductor 13

through the serial arrangement of the conductor 33, the contact 28, the conductor 39, the contact 27, the conducting bridging contact 25, the flexible conductor 30 and the conductor 32; the other terminal of the winding 37 is connected to the conductor 10 through the serial arrangement of the conductor 34, the flexible conductor 31, the conducting bridging contact 26, and the contact 29.

In the first or normal position of the contact-carrying member 20, the instantaneous polarity of the voltage induced in the winding 36 of the transformer 35 may be such with respect to the instantaneous polarity of the source voltage impressed between the conductors 10 and 11 as to cause the voltage between the conductors 12 and 13 to be the difference between the source voltage and the voltage across the winding 36. As a matter of practical application under ordinary conditions, this arrangement would represent a light load condition, since the current corresponding to such a condition would normally cause a relatively small voltage drop or loss.

The time-delay device 48, as shown in Fig. 3, includes the bimetallic strip 43 which bends when heated and around which is wound the heater coil 18, the layer of heat insulating material 44 being interposed therebetween, and an electrically insulating material 45 may be disposed over the outer surface of this assembly. A detent-engaging member 46 is rigidly secured to the upper end of the bimetallic strip 43, and extends outwardly therefrom to engage the upper surface of the detent 21 of the contact-carrying member 20. The tension spring 22 is arranged to resiliently oppose an outward movement of the latch-engaging member 46 in the direction to disengage the detent 21, and the bimetallic member 43 is arranged to cause such movement upon attaining a predetermined temperature in response to passage of current through the heater coil 18.

The contact-carrying member 20 being in the first position, it is now assumed that a predetermined current passes from the source conductor 10 through the solenoid 14 which is sufficient to overcome the bias of the snap-action spring 49. No movement of the contact-carrying member immediately occurs, but upon continuance of this current for a sufficient length of time to heat the bimetallic strip 43 to a predetermined temperature from the heater coil 18, the contact-carrying member is released, and moves upwardly from the first to the second position.

In the latter position, it will be seen that that end of the transformer winding 37, which is con-

nected to the conductor 10 when the contact-carrying member 20 is in the first position, is connected to the conductor 11 through the engagement of the movable contact member 26 with the contact 28; also that that end of the transformer winding 37, which is connected to the conductor 11 when the contact-carrying member 20 is in the first position, is connected to the conductor 10 through the engagement of the contact member 25 with the contact 24, the latter being connected to the conductor 10 through the conductor 16.

In this manner the instantaneous polarity of the voltage applied to the winding 37 is reversed in the second position of the contact-carrying member 20 with respect to that applied when the latter is in the first position. If the direction of voltage between the conductors 10 and 11 relative to the induced voltage of the winding 36 is as described above for normal bucking of the source voltage under light load conditions, then when the contact-carrying member 20 is in the second position, the load voltage between the conductors 12 and 13 is increased by the amount of the voltage induced in the winding 36.

The second position of the contact-carrying member 20 is maintained so long, and only so long, as the current through the solenoid 14 exceeds the predetermined value. In this position, the contact member 25, through its engagement with the contacts 19 and 24, provides a shunt circuit with respect to the heater coil 18, causing the relative cooling of the bimetallic strip 43, and resulting in the latter assuming the normal or initial position. With such an arrangement, excessive currents due to faults in the load circuit do not pass through the heater coil 18, and thermal damage thereby which otherwise might attend such currents is avoided.

Immediately upon the occurrence of the passage of a current through the solenoid 14 of less than the predetermined magnitude required to overcome the bias of the snap-action spring 49, the contact-carrying member 20 assumes the first position, and is concurrently latched therein by the time delay device 48. Contact chattering or telegraphing is thus avoided. More important, the voltage is reduced on the load circuit instantly when the load is no longer such as to require an increased voltage, preventing damage to lamps or other connected devices.

The modification shown fragmentarily in Fig. 2 is similar to that of Fig. 1, but simplified to the extent that only the movable contact member 25 is employed. As shown in Fig. 1, the winding 36 of the transformer 35 is permanently connected in series with the conductor 10 through the conductor 42. In the normal position, the winding 37 of the transformer 35 is shunt-circuited through the engagement of the movable contact member 25 with the contact 27, and the serial arrangement of the conductor 41, the conductor 40, the winding 37, the conductor 32 and the flexible conductor 30. In this position, the voltage between the load conductors 12 and 13 is the difference between the source voltage and the voltage drop across the winding 36 due to load current.

When the contact member 25 has moved upwardly to engagement with the contacts 23 and 24, in response to the conditions described in connection with Fig. 1, the winding 37 of the transformer 35 is connected between the conductors 10 and 11, and the induced voltage of the winding 36 may be added to the source voltage, resulting

in an increase in the output voltage between the conductors 12 and 13. The time-delay means which cooperates with the contact-carrying member 20 is not shown in Fig. 2, but it will be apparent that the cooperation between these elements will in all respects be the same as that described in connection with Figs. 1 and 3.

From the above description, it may be observed that this system for varying the voltage of a connected circuit includes a transformer, and control means therefor embodying a movable contact-carrying member arranged to cause engagement of certain contacts in each of two positions and time-delay means for initially restraining and subsequently releasing the contact-carrying member when it is urged only toward a certain one of the two positions.

The foregoing description and the figures of the drawing referred to therein are intended as illustrative rather than limiting.

I claim, as my invention:

1. In combination, an electric circuit, a transformer having at least two windings, means connecting one winding permanently in series relation with said circuit, contact means arranged to connect the other winding in shunt with said circuit to provide a first predetermined modification of the voltage of said circuit, said contact means embodying a movable contact-carrying member, means responsive to a predetermined current in said circuit for urging said movable contact-carrying member for movement, means responsive to said movement for connecting said other winding in shunt with said circuit to provide a second predetermined modification of the voltage of said circuit which differs from said first predetermined modification, time-delay means dependent upon the duration of said predetermined current for restraining said contact-carrying member from movement, and means responsive to said movement for rendering said time-delay means inoperative.

2. In combination, an electric circuit, a transformer having at least two windings, means connecting one of said windings permanently in series relation with said circuit, contact means arranged to shunt-circuit the other winding to provide a first predetermined modification of the voltage of said circuit, said contact means embodying a movable contact-carrying member, means responsive to a predetermined current in said circuit for urging said movable contact-carrying member for movement, means responsive to said movement for connecting said other winding in shunt with said circuit to provide a second predetermined modification of the voltage of said circuit which differs from said first modification, time-delay means dependent upon the duration of said predetermined current for restraining said contact-carrying member, and means responsive to said movement for rendering said time-delay means inoperative.

3. In combination, an electric circuit, a transformer having at least two windings, means connecting one of said windings permanently in series relation with said circuit, contact means arranged to connect another winding in shunt with said circuit to provide a predetermined reduction of the voltage of said circuit, said contact means embodying a movable contact-carrying member, means responsive to a predetermined current in said circuit for urging said movable contact-carrying member for movement, means responsive to said movement for connecting said another winding in shunt with said circuit to provide a prede-

terminated increase of the voltage of said circuit, time-delay means dependent upon the duration of said predetermined current for initially holding and subsequently releasing said contact-carrying member to effect said predetermined increase of the voltage of said circuit, and means responsive to said movement for rendering said time-delay means inoperative.

4. In combination, an electric circuit, a transformer having at least two windings, means connecting one of said windings permanently in series relation with said circuit, contact means arranged to connect another winding in said circuit to provide a predetermined reduction of the voltage of said circuit, said contact means embodying a movable contact-carrying member, means responsive to a predetermined current in said circuit for urging said movable contact-carrying member for movement, means responsive to said movement for connecting said another winding in said circuit to provide a predetermined increase of the voltage of said circuit, time-delay means dependent upon the duration of said predetermined current for initially holding and subsequently releasing said contact-carrying member to effect said predetermined increase in the voltage of said circuit, and means responsive to said movement for rendering said time-delay means inoperative.

5. In combination, an electric circuit, a transformer having at least two windings, means connecting one of said windings permanently in series relation with said circuit, contact means arranged to connect another of said windings in said circuit to provide a predetermined reduction of the voltage of said circuit, said contact

means embodying a movable contact-carrying member, means responsive to a predetermined current in said circuit for urging said movable contact-carrying member for movement, time-delay means dependent upon the duration of said predetermined current for initially holding and subsequently releasing said contact-carrying member to effect said predetermined increase of the voltage of said circuit, and means responsive to said movement for rendering said time-delay means inoperative and concurrently connecting said another winding in said circuit to provide a predetermined increase of the voltage of said circuit.

6. In combination, an electric circuit, a transformer having at least two windings, means connecting one of said windings permanently in series relation with said circuit, contact means arranged to connect another of said windings in shunt with said circuit to provide a predetermined reduction of the voltage of said circuit, said contact means embodying a movable contact-carrying member, means responsive to a predetermined current in said circuit for urging said movable contact-carrying member for movement, time-delay means dependent upon the duration of said predetermined current for initially holding and subsequently releasing said contact-carrying member to effect said predetermined increase of the voltage of said circuit, and means responsive to said movement for rendering said time delay means inoperative and concurrently connecting said another winding in said circuit to provide a predetermined increase of the voltage of said circuit.

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