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OVERLOAD RESET CIRCUIT

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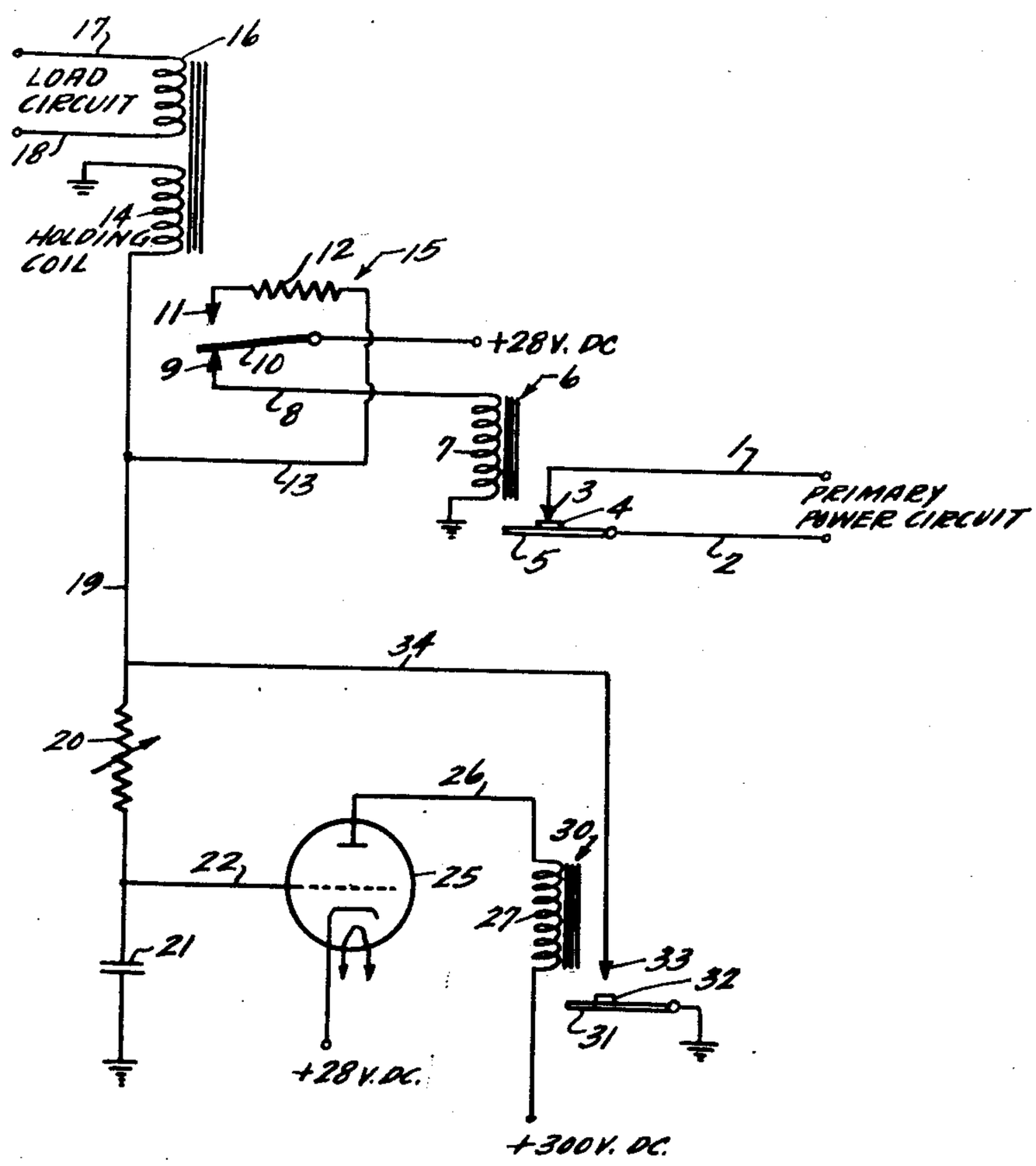

INVENTOR.
HARRY F. MAYER
BY Wade Lovett
Chester Tiedy
ATTORNEYS

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OVERLOAD RESET CIRCUIT

Harry F. Mayer, Baldwinsville, N. Y., assignor to the United States of America as represented by the Secretary of the Air Force

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3 Claims. (Cl. 317—22)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without payment to me of any royalty thereon.

This device relates to overload re-set circuits which have for their function the removal of primary power from a load upon the occurrence of an overload and which will restore the power after a predetermined time interval.

One object of the invention is to provide a circuit of the class described, which is especially adapted to radar modulators and other kinds of electronic equipment. Heavy currents such as are necessary to operate re-setting overload circuit-breakers are not necessary for this circuit.

Another object of the invention is to provide a device of the above character in which the re-setting time delay is adjustable over wide limits.

In radar modulators and in many other types of electronic equipment overload is apt to occur due to occasional intermittent malfunctioning of a tube in the load circuit. For example, the thyratron in the modulator may arc back, or may fail to extinguish after a pulse; or the magnetron load may spark over. Any of these occurrences will cause excessive current to be drawn from the rectifier which supplies the power. It is common practice to include a current-sensitive fault responsive relay in the output circuit of the rectifier, connected so as to interrupt primary power when the output current exceeds a certain value. If the relay returns to its normal position when the primary power is removed and the output current falls to zero, then primary power is immediately re-applied. This happens so quickly that generally the malfunctioning which caused the overload will continue, and the relay will oscillate rapidly, turning power on and off to no avail.

An alternative is to use a holding circuit which will cause the primary power to stay off when interrupted by an overload, until a manual reset switch is operated. This is satisfactory in some applications, but not in others. In particular, it is not satisfactory in a fire control radar system, where the necessity for operating the re-set switch in the middle of a shooting engagement would be disastrous.

The circuit here described removes the primary power, waits a predetermined time (adjustable over wide limits, but for application to radar sets fixed at approximately ½ second), and then restores primary power.

With reference to the drawing, the reference numerals 1 and 2 designate conductors in a primary alternating power circuit such as the input to the power rectifying equipment of a radar set

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and connected in series by the normally closed contacts 3 and 4, the latter contact being mounted on the movable armature 5 of a circuit breaking relay generally indicated at 6. The coil 7 of the relay 6 has one terminal grounded and the other terminal connected by conductor 8 to the lower contact 9 of an overload control relay generally indicated by the reference numeral 15.

The armature 10 of relay 15 is connected to a suitable source of D. C. potential such as 28 volts and normally engages the lower contact 9 when the relay 15 is de-energized. Current from the 28 volt source thus normally flows to ground through the coil 7 of relay 6 maintaining the relay energized and primary circuit breaking contacts 3 and 4 normally closed.

The relay 15 has an upper contact 11 connected by means of a resistor 12 and conductor 13 to one terminal of a holding coil 14 the other terminal of which is grounded. When the relay armature 10 engages contact 11 the holding coil is energized with direct current from the 28 volt source which is reduced across resistor 12 to about 20 volts D. C.

The relay 15 is also provided with a coil 16 connected in series with conductors 17 and 18 of the load circuit to be protected such that current overloads through the coil 16 activate the relay 15 to attract the armature 10 against a suitable biasing force thus energizing the holding coil 14 to maintain the armature in engagement with the upper contact 11 until the holding coil circuit becomes de-energized by means later to be described. When the armature 10 of relay 15 breaks engagement with contact 9 the relay 6 is de-energized and the relay arm 5 drops breaking engagement of contacts 3 and 4 and opening the primary power circuit which also de-energizes the load circuit.

Means are provided for delaying the de-energizing of the holding coil 14 of relay 15 which means comprise a conductor 19 connected to conductor 13 in parallel with the holding coil and which has an adjustable resistance 20 and a capacitance 21 connected in series therewith to ground. A conductor 22 connected to conductor 19 between the resistance 20 and capacitance 21 is connected to the grid of a conventional triode type vacuum tube 25. Whenever the relay 15 is activated, current from the 28 volt source connected to the armature 10 flows through relay contact 11 and resistance 12 to holding coil 14 with a potential of approximately 20 volts. This latter voltage is dropped across resistance 20 to charge condenser 21 with the charging time being dependent on the RC value of the resistance 20 and capacitance 21 and preferably chosen

to be about one-half second. As condenser 21 charges the potential of the grid of tube 25 rises making the grid less negative with respect to a positive 28 volt direct current bias on the cathode of the tube 25 which normally biases the tube 25 beyond cut-off. When the grid reaches for example, a voltage of 20 volts it is negative with respect to the cathode by eight volts and the tube begins to conduct.

The tube 25 has its plate connected by a conductor 26 to the coil 27 of a relay generally indicated at 30, the other terminal of the relay coil being connected to a suitable high voltage plate supply. The relay 30 has its armature 31 and contact 32 connected to ground and the upper contact 33 connected by means of conductor 34 to conductor 19 above the resistance 20. The contacts 32 and 33 of relay 30 are normally separated and engaged when relay 30 is energized by conductance of tube 25 and the contact engagement short circuits the holding coil 14 and de-energizes the same.

From the foregoing it will be apparent that so long as the current in the load circuit 17—18 and in coil 16 of relay 15 is below a predetermined safe value the armature 10 of the relay will remain in engagement with the contact 9 permitting current from the 28 volt source to flow through coil 7 of relay 6 maintaining the same energized and keeping the primary power circuit closed.

Upon occurrence of an overload in the load circuit 17—18 relay 15 will be activated to cause the armature 10 to engage contact 11 which will de-energize relay 6 and open the primary power circuit to relieve the overload by also de-energizing the load circuit. Engagement of the relay armature 10 with contact 11 energizes holding coil 14 to maintain relay 15 activated and simultaneously will charge condenser 21 at a rate determined by the setting of resistance 20.

As the condenser 21 begins to charge the voltage on the grid of vacuum tube 25 will rise making the grid less negative with respect to the voltage on the cathode and eventually the tube will begin to conduct current in its plate circuit. When the plate current rises sufficiently, relay 30 will be energized and its contacts 32 and 33 in engaging will complete a short circuit of holding coil 14 causing relay 15 to drop out and relay 6 to become active to again close the power circuit.

When relay 30 becomes energized and its contacts 33 and 34 short circuit the holding coil 14 of relay 15 the charge on condenser 21 is discharged to ground and the bias voltage on the cathode of tube 25 drives the tube 25 to cut-off, de-energizing the plate circuit and relay 30 which in dropping out, removes the short circuit on holding coil 14, restoring initial conditions.

If the overload condition persists, the above cycle of operations will be repeated with the primary circuit being opened for a one-half second period during each cycle of the overload protective system.

Having now described the invention what I desire to protect by United States Letters Patent is defined in the appended claims.

I claim:

1. A protective arrangement for a power circuit comprising a fault-responsive relay having a first set of contacts, means responsive to the closing of the first set of contacts for closing said power circuit, a second set of contacts closed when said first set of contacts is open, means responsive to a fault condition in said power circuit for causing said first set of contacts to open and said second set of contacts to close, a holding coil means responsive to the closing of said second set of contacts for holding said first set of contacts open and said second set of contacts closed and means energized in response to closing of said second set of contacts for de-energizing said holding coil means after a predetermined time delay, whereby said second set of contacts will then be opened and said first set of contacts will then be closed.

2. A protective arrangement for a power circuit comprising a fault-responsive relay having a first set of contacts, means responsive to the closing of the first set of contacts for closing said power circuit, a second set of contacts closed when said first set of contacts is open, means responsive to a fault condition in said power circuit for causing said first set of contacts to open and said second set of contacts to close, holding coil means responsive to the closing of said second set of contacts for holding said first set of contacts open and said second set of contacts closed and means including an electronic discharge device having at least an anode, a cathode and a control grid, which device is normally non-conducting and means including an adjustable resistor and condenser for applying a potential to the control grid of said electronic discharge device and said potential being of sufficient value to cause said electronic discharge device to be made conducting in response to the closing of said second set of contacts and means responsive to the conductivity of said electronic discharge device for de-energizing said holding coil means.

3. A protective arrangement for a power circuit comprising a fault-responsive relay having a first winding, a second winding, a first set of contacts closed in the non-operative condition of the relay and a second set of contacts closed in the operated condition of the relay, and an electromagnetic power-controlling relay having contacts controlling the flow of power in said power circuit, said contacts being normally open and closed when said electromagnetic power-controlling relay is energized, circuit means including said first set of contacts for energizing said electromagnetic power-controlling relay, circuit means including said second set of contacts for energizing said second winding, circuit means including a resistor and a condenser for producing a voltage which increases as a function of time, and an electronic discharge device having at least an anode, a cathode and a control grid, circuit means for applying said voltage to said control grid, and an anode-cathode circuit for said electronic discharge device including an electromagnetic relay having an energizing winding, contacts controlled by said electromagnetic relay and circuit means for short circuiting said second winding when said contacts are closed.

HARRY F. MAYER.

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