

May 8, 1928.

W. R. G. BAKER

PROTECTIVE RELAY

Filed Sept. 14, 1925

1,669,154

Fig. 1.

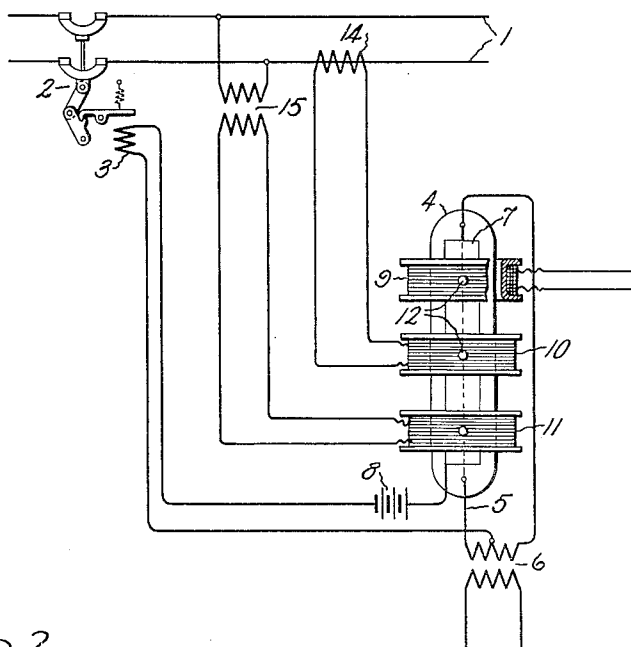
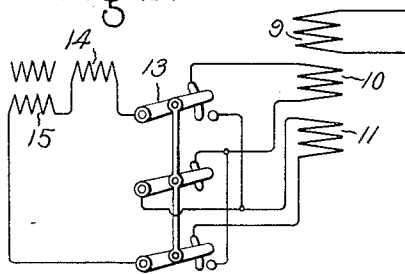


Fig. 2.



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UNITED STATES PATENT OFFICE.

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PROTECTIVE RELAY.

Application filed September 14, 1925. Serial No. 56,115.

My present invention relates to the use of protective means in connection with power circuits.

It is one of the objects of my invention to employ an electron discharge device of the magnetron type as a relay to control the operation of a power circuit. It is a further object of my invention to provide a protective device which may be readily adjustable to operate under various conditions of current and voltage in a load circuit.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation will best be understood by reference to the following specification taken in connection with the accompanying drawing, in which Fig. 1 shows diagrammatically a circuit organization whereby my invention may be carried into effect. Fig. 2 shows a modified form of my invention.

Referring to the drawing, I have indicated at 1 the mains of a power distribution system or work circuit. Connected with the mains 1 is a switch or circuit interrupter 2 which is adapted to be operated by a trip coil 3. Associated with the power system is an electron discharge device of the magnetron type, comprising an elongated evacuated glass receptacle 4 containing an axially extending filamentary cathode 5 which is adapted to be heated to incandescence by means of a suitable source of energy which, in the present instance, includes a transformer 6. Surrounding the cathode 5 is a cylindrical anode 7. The output circuit of the discharge device includes a storage battery 8, or other suitable source of energy and the trip coil 3.

In electron discharge devices of the magnetron type shown, if a given voltage is applied to the cathode and anode, and a magnetic field is generated parallel to the axis of the tube and gradually increased from zero, the current in the output circuit of the tube will be a maximum at the start, and will be unaffected over a certain range of values. Then as the magnetic field exceeds a predetermined value, depending on the

characteristics of the particular device and the voltage applied to the cathode and anode, the electron or output current of the tube abruptly decreases and finally at a sufficiently high field value becomes substantially zero.

In the present case, I make use of this characteristic of a magnetron by providing a plurality of field windings, certain of which are adapted to be energized in accordance with variations in line conditions to thereby vary the output current of the tube. As shown in the drawing, I have indicated at 9 a separately excited coil adapted to be energized from a suitable source of energy, not shown. Coils 10 and 11 are energized in accordance with current and voltage conditions in the load circuit. The latter coils are arranged to assist each other and to oppose the action of coil 9. Each of the coils may have in circuit therewith, if desired, an adjustable impedance device, whereby the excitation of its associated winding may be varied. In the operation of the device, the excitation of coil 9 is adjusted so that under ordinary working conditions the resultant field has a strength sufficient to hold the output current of the tube substantially at zero. If under such circumstances the field due to voltage or current, or both, is increased, the resultant field will be reduced in strength, and if sufficient reduction takes place in the resultant field, the output current of the magnetron will rise abruptly from zero to a maximum and energize coil 3 to open the load circuit. The amount of change in voltage or current from normal condition which will be necessary to supply sufficient current to operate the circuit breaker may be controlled by varying the excitation of coil 9 or by controlling the excitation of coils 10 and 11. In this manner the circuit breaker 2 may be operated either upon small or large variations from normal line conditions.

In order to vary the effect of any one or all of the field coils I have provided means whereby each coil may be pivotally mounted on the magnetron, as indicated at 12. The direction of the resultant field may in this manner be varied to further control the out-

put current of the tube. With the pivoted coils I may arrange the windings so that, under normal conditions, the characteristic of the magnetron does not show an abrupt drop from a maximum to a minimum current when the field excitation is increased beyond a certain point, but rather a gradual slope which may not reach zero. With this arrangement coil 3 may be operated at one of a plurality of points on the characteristic curve of the magnetron as desired.

The coils 10 and 11 may be arranged to be connected to the power line in different ways, depending on the type of regulation desired. In Fig. 2 I have shown one such arrangement in which coils 10 and 11 are adapted to be connected in series or in parallel to each other by means of a switch 13, and to be energized from coils 14 and 15 connected in series. The coils shown in this figure may be pivotally mounted as in Fig. 1.

While I have shown an alternating current power system it is obvious that the relay is equally well adapted for use with direct current systems. Various other modifications of my invention will readily suggest themselves to those skilled in the art without departing from the scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In combination, a work circuit and an electron discharge device associated with said circuit, said discharge device having a cathode and an anode, an output circuit connected to the discharge device, a switch in the work circuit, means in the output circuit for controlling the switch, and a plurality of windings controlling the output circuit of the electron discharge device, one of said windings being responsive to an electrical condition in said work circuit.

2. In combination, a work circuit, an electron discharge device associated with said circuit, said discharge device having a cathode and an anode, an output circuit connected to the discharge device, means in the output circuit for opening the work circuit, and means including a winding surrounding said discharge device and responsive to an electrical condition in said work circuit for controlling the output circuit of said electron discharge device.

3. In combination, a work circuit, an electron discharge device associated with said circuit, said discharge device having a cathode and an anode, an output circuit connected to the electron discharge device, a switch in the work circuit, means in the output circuit for controlling the switch, and means for producing a magnetic field for controlling the current in said output circuit, said latter means including a winding responsive to an electrical condition in an electric circuit.

4. In combination, a load circuit, an electron discharge device associated with said circuit, the discharge device having a cathode and an anode, an output circuit connected to the electron discharge device, means in the output circuit for controlling the load circuit and a plurality of windings controlling the output circuit of the electron discharge device, one of said windings being responsive to variations in line current and another of said windings being responsive to variations in line voltage.

5. In combination, a load circuit, a circuit interrupter included in said circuit, an electron discharge device comprising a cathode and an anode, an output circuit associated with said discharge device, means for impressing a plurality of magnetic fields upon the electron discharge device to vary the current output thereof, one of the fields being separately excited and another of the fields being determined by an electrical condition in the load circuit, and means in the output circuit of the electron discharge device for controlling said circuit interrupter in the load circuit.

6. In combination, a load circuit, a circuit interrupter included in said circuit, an electron discharge device comprising a cathode and an anode, an output circuit associated with said discharge device, a pair of differentially related windings surrounding the discharge device and controlling the current output thereof, one of said windings being responsive to an electrical condition in the load circuit, and means in the output circuit of the electron discharge device for controlling said circuit interrupter in the load circuit.

7. In combination, a load circuit, an electron discharge device comprising a cathode and an anode, an output circuit associated with the discharge device, electromagnetic means in the output circuit for controlling the load circuit, a plurality of windings surrounding the discharge device and adapted to control the current output thereof, one of the windings being energized from a substantially constant source, another of the windings being responsive to variations in the load voltage, and another of the windings being responsive to variations in current in said load circuit.

8. In an electric discharge device comprising a cathode operable at incandescence, an anode arranged in unobstructed spacial relation to the cathode and an enclosing evacuated envelope, means for generating a magnetic field having a certain direction with respect to said cathode to thereby control the output of the discharge device, and means surrounding said envelope and adapted to vary the direction of said magnetic field.

9. In combination, an electron discharge device comprising a cathode and an anode,

an output circuit associated with said device and means including a pivoted winding surrounding said discharge device for controlling the current in said output circuit. with the electron device and adapted to control the current in the output circuit, and means whereby the position of said windings may be varied independently of one another. 10

5 10. In combination, an electron discharge device comprising a cathode and an anode, an output circuit connected with the electron device, a plurality of windings associated In witness whereof, I have hereunto set my hand this 11th day of September, 1925.

WALTER R. G. BAKER.