Aug. 4, 1931. E. A. HESTER 1,817,486

ELECTRICAL PROTECTIVE DEVICE

Filed Nov. 6, 1919

Fig. 1.

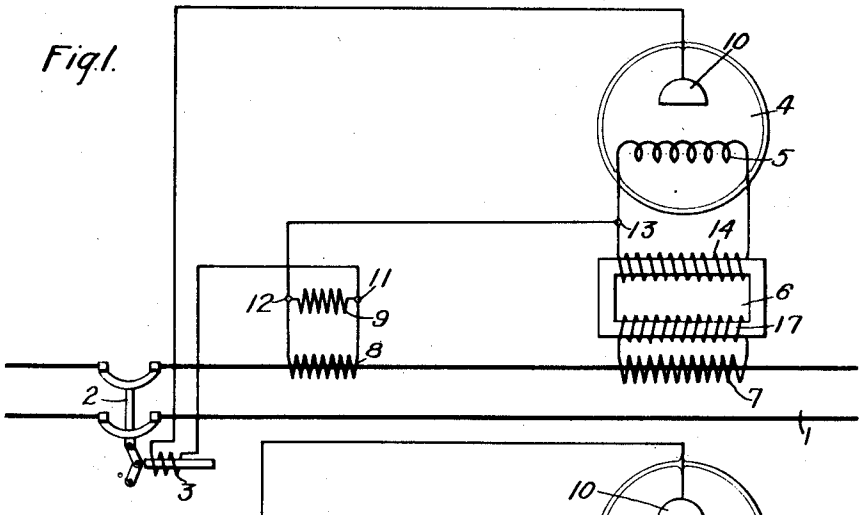


Fig. 2.

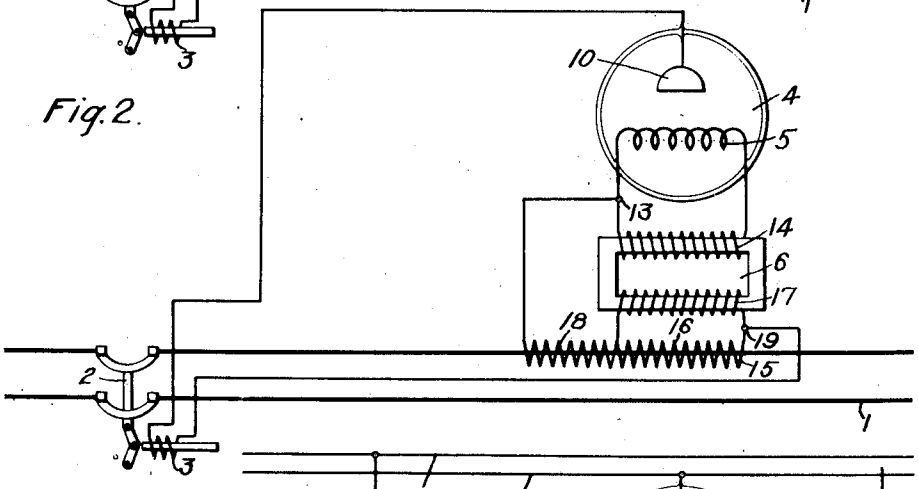
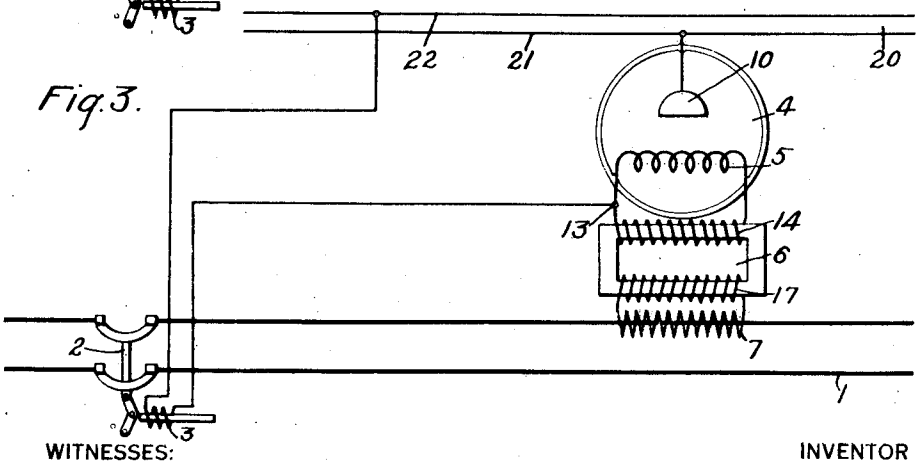


Fig. 3.



WITNESSES:

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UNITED STATES PATENT OFFICE

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ELECTRICAL PROTECTIVE DEVICE

Application filed November 6, 1919. Serial No. 336,079.

My invention relates to electrical protective devices and particularly to relay devices for circuit interrupters.

One object of my invention is to provide an electric valve or electron tube having a time-element characteristic for controlling a circuit-interrupter.

Another object of my invention is to provide a protective device, of the above indicated character, that shall not require the use of contact members or other moving parts.

A further object of my invention is to provide a protective device, of the above indicated character, that shall be simple and inexpensive to construct and effective in its operation.

In practicing my invention, I provide a vacuum-electric valve that is so connected in series with the trip coil of the interrupter and a series transformer that, when the current traversing the series transformer exceeds a predetermined value, the valve will permit current to traverse the same and, thus, the trip coil will be energized. With a device of this type, the trip coil may be energized under predetermined conditions from the circuit in connection with which it is used.

Figure 1 of the accompanying drawings is a diagrammatic view of an electric circuit embodying my invention, and Figs. 2 and 3 are diagrammatic views of electric circuits embodying modified forms of my invention.

An alternating-current circuit 1 is provided with a circuit interrupter 2 and a trip coil 3. A hot-cathode valve 4 is provided and its cathode 5 is connected, through a saturable transformer 6, to a series transformer 7 that is operatively associated with the circuit 1. A second series transformer 8 is connected in circuit with a resistor 9. One terminal of the trip coil 3 is connected to the anode 10 of the valve 4, and the other terminal of the coil 3 is connected to the terminal 11 of the resistor 9, the other terminal 12 of which is connected to a point 13 between the secondary winding 14 of the transformer 6 and the cathode 5 of the valve 4.

The resistor 9 is so proportioned that, when a predetermined value of current traverses the circuit 1, sufficient voltage will be impressed thereacross to break down the valve 4 and permit current to traverse the same. The cathode 5 is heated from the transformer 7 and the transformer 6, by reason of the saturation of its core member upon excessive current flow, prevents overheating the same, and, also, the secondary winding 7 is precluded from being open-circuited when the circuit comprising the cathode 5 burns out. Since the resistor 9 may be any desired value, depending upon the value of current at which it is desired that the valve 4 become operative, it will be seen that no current of operating value traverses the trip coil 3 until it is desired that the interrupter be opened. At this point, sufficient current will traverse the valve 4 and, consequently, the trip coil 3 to open the interrupter 2.

In Fig. 2 of the drawings, a single series transformer 15 is employed, the portion 16 of which is connected, through the primary winding 17 of the transformer 6, and the portion 18 of which is connected to the point 13 between the winding 14 of the transformer 6 and the cathode 5. The trip coil 3 is connected, from a point 19 between the portion 16 of the transformer 15 and the winding 17 of the transformer 6, to the anode 10 of the valve 4. With this arrangement, only a single transformer is necessary to cause the interrupter 2 to be tripped when a predetermined value of current traverses the circuit 1.

In Fig. 3 of the drawings, the cathode 5 of the valve 4, is connected across the winding 14 of the transformer 6 and the winding 17 of the transformer 6 is connected to the series transformer 7. A control circuit 20, that is supplied with current from either an alternating-current or a direct-current source of energy, is provided for energizing the trip coil 3 through the valve 4.

The anode 10, of the valve 4, is connected to the conductor 21 of the circuit 20, and the conductor 22 of the circuit 20 is connected to one terminal of the trip coil 3, the other terminal of which is connected to the point 13 between the cathode 5 and the winding 14. With this arrangement, when sufficient current traverses the circuit 1, the increased electron flow from the cathode 5 permits current

to traverse the valve 4 and, consequently, the trip coil 3 will be energized to open the circuit interrupter 2.

The heating of the cathode of the electron valve to the electron-emitting temperature requires a time that depends upon the character and size of the cathode and the initial and short-circuit currents traversing the same. A predetermined time delay occurs, therefore, after an abnormal current flows in the circuit before the circuit-interrupter is tripped. I consider that this time-element characteristic of the relay is an important feature of my invention and believe it is broadly novel, as the electron relay employed heretofore is instantaneous in operation. The advantage of a time element in many applications of the device will be apparent to those skilled in the art.

My invention is not limited to the specific details illustrated, as it may be variously modified without departing from the spirit and scope of the invention, as set forth in the appended claims.

I claim as my invention:

1. In an electric circuit, the combination with a circuit interrupter and a trip coil therefor, of a hot-cathode valve, a transformer having a saturable core member connected between the cathode of the valve and the circuit and a series transformer connected in series with the valve and the trip coil.

2. In an electric circuit, the combination with a trip coil, of a hot-cathode valve, a transformer having a saturable core member connected between the valve and the circuit, and means connected in series with the trip coil and the valve for supplying the trip coil with current under predetermined conditions.

3. In an electric circuit, the combination with a trip coil, of a hot-cathode valve, a transformer having a saturable core member connected between the valve and the circuit, and means connected in series with the trip coil and the valve for supplying the trip coil with current from the circuit under predetermined conditions.

4. In an electric circuit, the combination of a circuit interrupter having a trip coil, a hot-cathode valve, a transformer adapted to become saturated upon an increase of current in the circuit connected between the circuit and said valve, and means connected in series with the trip coil and valve for energizing the trip coil under predetermined conditions.

In testimony whereof, I have hereunto subscribed my name this 30th day of Oct., 1919.

EDGAR A. HESTER.