

L. W. CHUBB.
CIRCUIT INTERRUPTER.
APPLICATION FILED JAN. 14, 1918.

1,421,170.

Patented June 27, 1922.

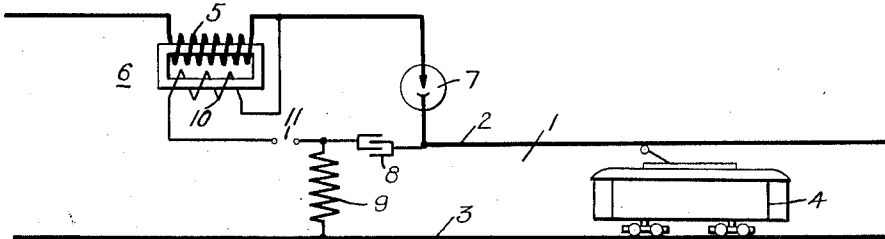


Fig. 1.

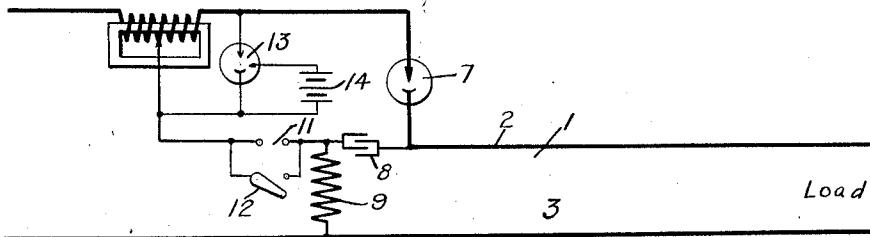


Fig. 2.

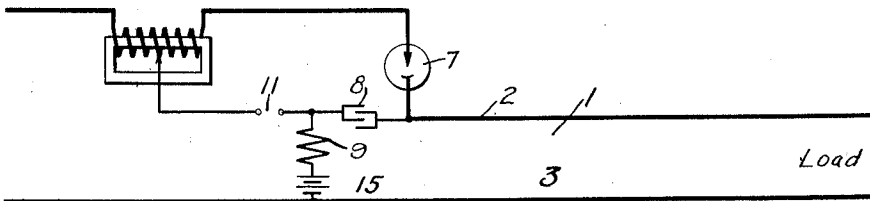


Fig. 3.

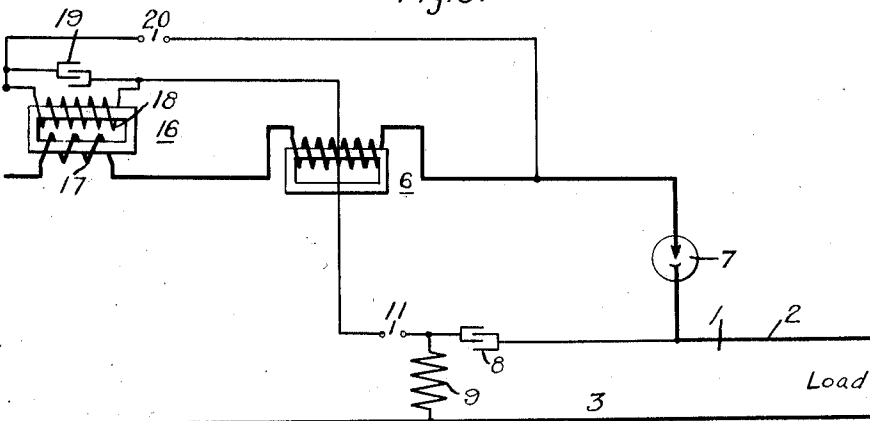


Fig. 4.

WITNESSES:

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CIRCUIT INTERRUPTER.

1,421,170.

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To all whom it may concern:

Be it known that I, LEWIS WARRINGTON CHUBB, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Circuit Interrupters, of which the following is a specification.

My invention relates to circuit interrupters and particularly to means for automatically interrupting electrical circuits, under predetermined conditions.

One object of my invention is to provide an automatic circuit interrupter that shall be adapted to operate quickly when a short circuit, or other similar fault, obtains in the circuit.

Another object of my invention is to provide a circuit interrupter of the vacuum-electric type that shall be automatic in its operation and simple and inexpensive to construct.

In carrying out my invention, I provide a vacuum-electric apparatus or vapor valve that is connected in series with the circuit. A normally charged condenser is connected in series with a spark gap and a portion of the winding of an auto-transformer. Another portion of the winding of the auto-transformer is connected in series with the valve. The condenser circuit is so connected to the valve that, when a short circuit obtains on the circuit, sufficient voltage is induced in a portion of the transformer winding to cause the spark gap to break down and thus permit the condenser to discharge through the valve to extinguish the arc in the same and thereby open the circuit. Since, under short-circuit conditions, the current in the circuit increases quickly, the transformer causes the current to be deflected through the condenser circuit, after the spark gap breaks down, to insure that the arc in the valve will be effectively extinguished.

Figure 1 of the accompanying drawings is a diagrammatic view of circuits and apparatus embodying my invention, and Figs. 2, 3 and 4 are diagrammatic views of modified forms of circuits and apparatus embodying my invention.

An electric circuit 1 comprises conductors 2 and 3 that supply direct current to a load 4. The primary winding 5 of an auto

or other similar transformer 6 is connected in series with a vapor valve or vacuum-electric apparatus 7 and the circuit, thus constituted, is connected in series with the conductor 2. A condenser 8 is connected from the cathode of the valve 7, through a relatively high-resistance resistor 9, to the conductor 3, thus permitting the condenser 8 to be charged, under all normal conditions of operation of the circuit. The secondary winding 10 of the transformer 6 is connected in series with a spark gap 11 and the condenser 8. Since the condenser 8 is operatively connected to one terminal of the valve 7, and the windings of the transformer 6 are connected together, the circuit, comprising the condenser 8, the spark gap 11 and the winding 10 of the transformer 6, is connected in shunt relation to the valve 7.

When a short circuit obtains upon the circuit 1, the relatively quick change in current traversing the winding 5 of the transformer 6 will induce sufficient voltage in the secondary winding 10 thereof to so change the difference in potential across the spark gap 11 as to cause the same to break down. When the spark gap 11 flashes over, by reason of the increase in potential thereacross the circuit of the condenser 8, through the valve 7, the spark gap 11 and the winding 10 of the transformer, will be completed to thus permit the condenser to discharge through the valve 7 in a direction opposite to the normal direction of flow of current therein to extinguish the arc thereof. Since the current traversing the circuit quickly increases when the fault obtains in the circuit 1, the transformer 6 will effectively deflect the current from the valve 7 through the condenser circuit and thereby assist in extinguishing the arc in the valve.

In Fig. 2 of the drawings, a switch 12 is provided around the terminals of the spark gap 11 for the purpose of connecting the condenser 8 in shunt to the valve 7 to open the circuit 1, when desired. However, under this condition, the inductance of the transformer 6 will offer a relatively large impedance to the flow of current through the valve 7 because no voltage is being induced therein. That is, since the circuit 1 is a direct-current circuit, voltage is only induced in a portion of the winding of the transformer 6 when the current traversing

the same changes suddenly. In order to offset the detrimental effect of the inductance of the transformer 6, a second valve 13, having an ionizing means 14, is connected in shunt relation to a portion of the transformer. By this arrangement, when the switch 12 is closed manually, the current from the condenser 8 traverses the valve 13 and, since the circuit is of relatively low impedance, the arc of the valve 7 is extinguished.

If the voltage of the direct-current circuit 1 is below 600 volts, the spark gap 11 will not be reliable, and, in Fig. 3 of the drawings, I have shown a source 15 of electromotive force connected in series with the high-resistance resistor 9 for maintaining the charge of the condenser higher than the voltage of the circuit 1. This permits the use of a greater gap length in the spark gap 11 and thus the spark gap will break down under a much smaller percentage increase of voltage, or, in other words, under a relatively small increase of voltage.

In Fig. 4 of the drawings, a second transformer 16, the primary winding 17 of which is connected in series with the conductor 2, is provided to cause the spark gap 11 to be effective on relatively low-voltage circuits. The secondary winding 18 of the transformer 16, that has a relatively large number of turns, is connected in shunt relation to a condenser 19, and the condenser 19 is connected in series relation to a spark gap 20 and a portion of the winding of the transformer 6. By this arrangement, the spark gap 11 may be set for a relatively high voltage and be caused to break down by reason of a high-voltage impulse produced by the transformer 16.

A sudden change of current in the circuit 1 induces a high voltage in the secondary winding 18 of the transformer 16 which charges the condenser 19 and, when the condenser 19 is charged to a sufficiently high value, it will so raise the potential across the spark gap 20 as to cause the same to break down. When the spark gap 20 breaks down, the sudden application of voltage across a portion of the winding of the transformer 6 will be sufficient to cause the spark gap 11 to break down and thus complete the circuit of the condenser 8 in shunt relation to the valve 7 and thereby permit the condenser 8 to discharge through the valve 7 to extinguish the arc therein.

My invention is not limited to the specific devices 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 electrical circuit, the combination with a vacuum-electric apparatus, of a normally charged condenser connected in

shunt relation thereto, and a spark gap operatively connected in series with the condenser for causing the latter to discharge through the said vacuum-electric apparatus when a fault obtains on the circuit.

2. In an electrical circuit, the combination with a vacuum-electric apparatus, of a normally charged condenser connected in shunt relation thereto, a spark gap connected in series with the condenser, and means for causing the spark gap to break down when a fault obtains on the circuit.

3. In an electrical circuit, the combination with a vacuum-electric apparatus, of a normally charged condenser connected in shunt relation thereto, a spark gap connected in series with the condenser, and means for causing the spark gap to break down when a short circuit obtains on the circuit.

4. In an electrical circuit, the combination with a vacuum-electric apparatus, of a normally charged condenser connected in shunt relation thereto, a spark gap connected in series with the condenser, and a transformer operatively connected to the vacuum-electric apparatus and the condenser and adapted to break down the spark gap to cause the condenser to discharge through the vacuum-electric apparatus under predetermined conditions.

5. In an electrical circuit, the combination with a vapor valve, of a condenser normally connected across the circuit, a transformer, a portion of the winding of which is connected in series with the valve and another portion of the winding of which is connected in series with the valve and the condenser under predetermined conditions.

6. In an electrical circuit, the combination with a vapor valve, of a condenser normally connected across the circuit, a transformer, a portion of the winding of which is connected in series with the valve and another portion of the winding of which is connected to the valve and the condenser when the current traversing the circuit changes quickly.

7. In an electrical circuit, the combination with a vapor valve, of a normally charged condenser, a spark gap connected in circuit with the condenser across the valve, and means for increasing the potential drop across the spark gap sufficiently to break down the same when the current traversing the circuit increases quickly.

8. In an electrical circuit, the combination with a vapor valve, of a normally charged condenser for extinguishing the arc in the valve, a spark gap connected in circuit with the condenser across the valve, and means for so increasing the potential drop across the spark gap that it breaks down when the current traversing the circuit increases quickly.

9. In an electrical circuit, the combination

with a vacuum-electric apparatus, of a normally charged condenser for rendering the vacuum-electric apparatus inoperative, and a spark gap in series with the condenser and the vacuum-electric apparatus to normally disconnect the same and to conduct the condenser discharge through the vacuum-electric apparatus when the current traversing the circuit increases quickly.

10 10. In an electrical circuit, the combination with a vacuum-electric apparatus, of a normally charged condenser operatively connected to the vacuum-electric apparatus for rendering the same inoperative, a spark gap operatively connected in series with the condenser and the vacuum-electric apparatus, and a transformer operatively connected in circuit relation to the spark gap for causing the spark to break down when the current traversing the circuit increases quickly.

20 11. In an electrical circuit, the combination with a vacuum-electric apparatus, of a normally charged condenser operatively con-

nected in circuit relation thereto for rendering the same inoperative, a spark gap operatively connected in series with the condenser and the vacuum-electric apparatus, and a transformer operatively connected in circuit with the spark gap to cause the latter to break down when the current traversing the circuit increases quickly and for maintaining the arc across the spark gap until the arc in the vacuum-electric apparatus is extinguished.

12. In an electrical circuit, the combination with a vacuum-electric apparatus, of a normally charged condenser connected in shunt relation thereto, a spark gap connected in series with the condenser, and means for causing the spark gap to break down under predetermined conditions in the circuit.

In testimony whereof, I have hereunto subscribed my name this 31st day of Dec., 1917.

LEWIS WARRINGTON CHUBB.