No. 656,681. Patented Aug. 28, 1900.

E. THOMSON.

CIRCUIT BREAKER.

(Application filed June 12, 1899.)

(No Model.)

Fig. 1.

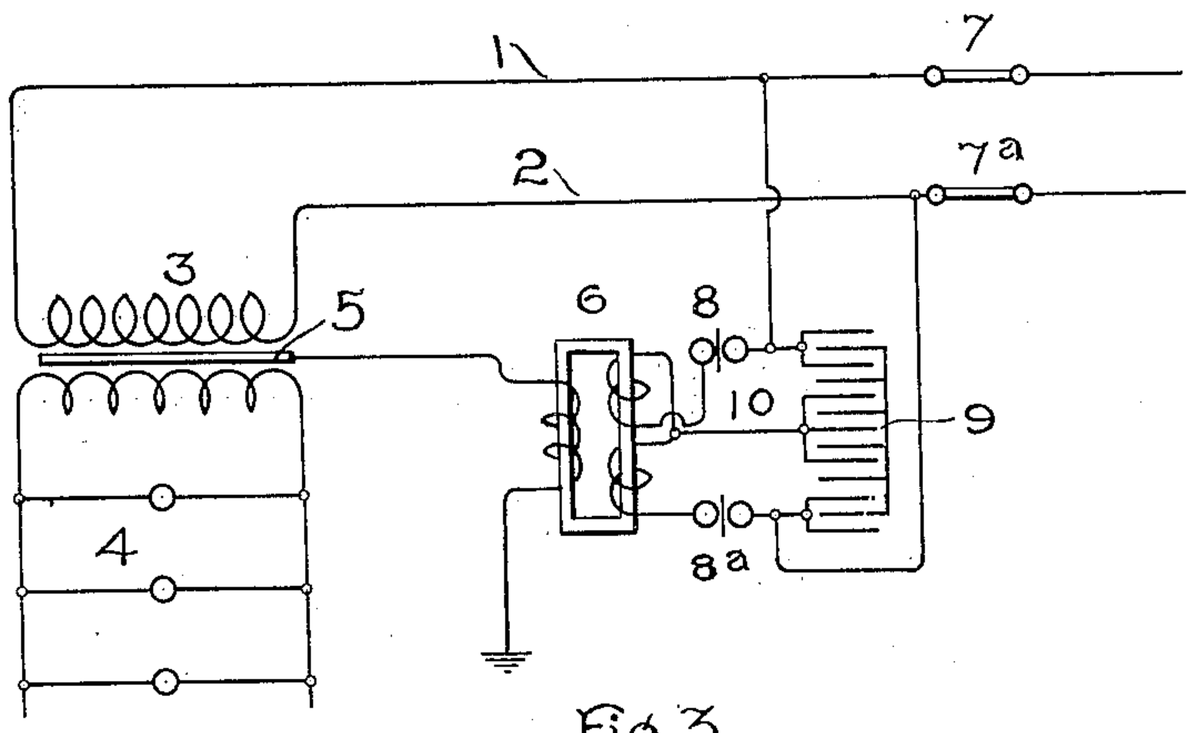


Fig. 2.

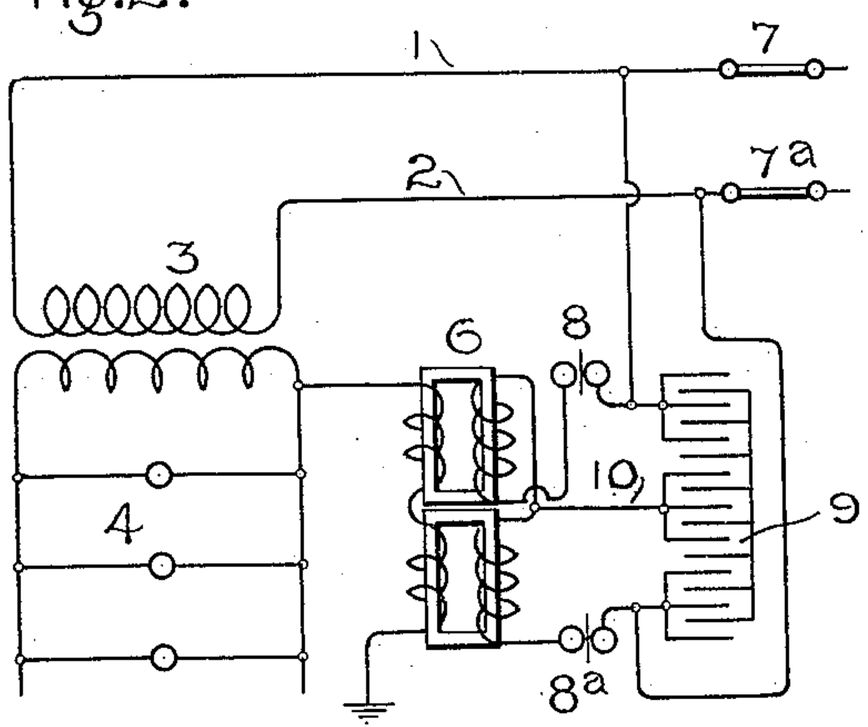


Fig. 3.

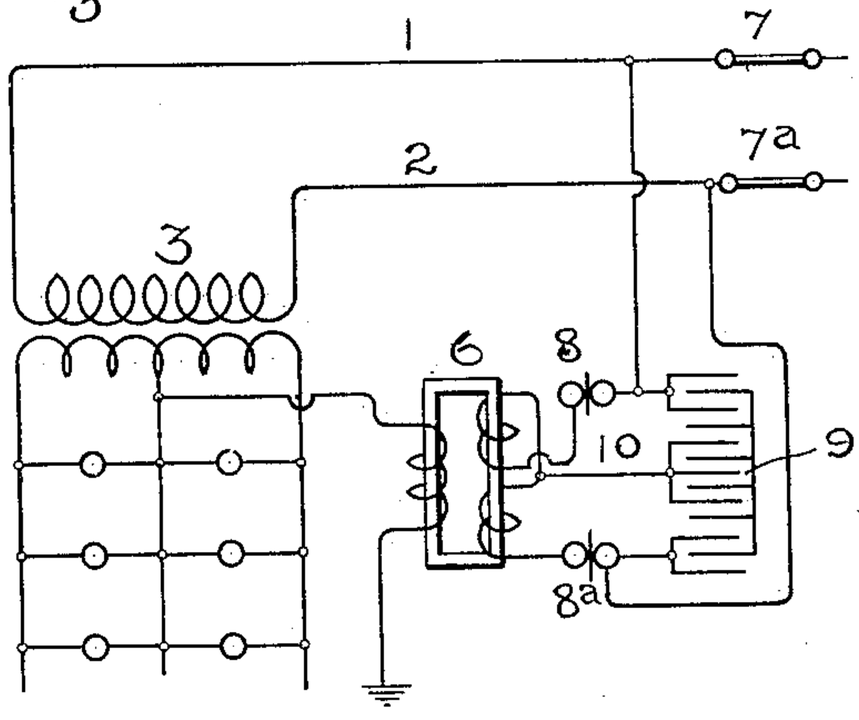
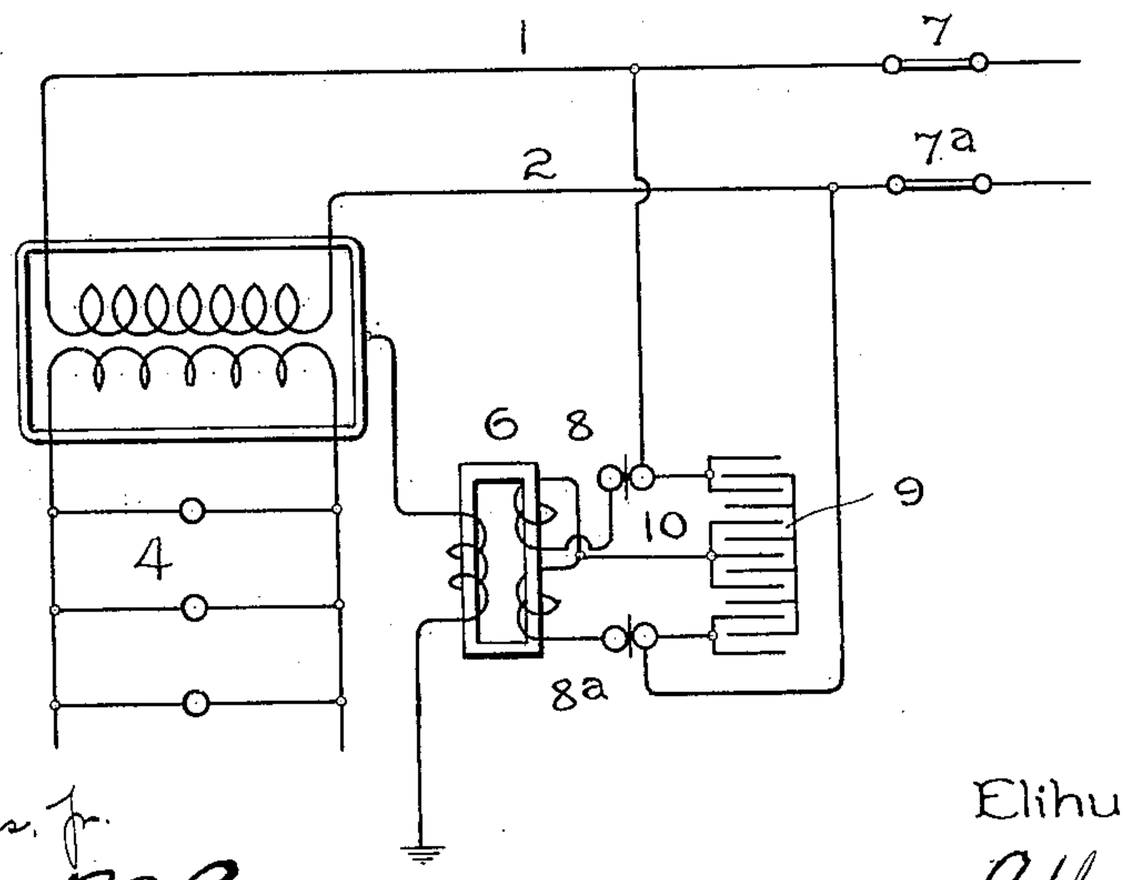


Fig. 4.



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UNITED STATES PATENT OFFICE.

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CIRCUIT-BREAKER.

SPECIFICATION forming part of Letters Patent No. 656,681, dated August 28, 1900.

Application filed June 12, 1899. Serial No. 720,295. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Circuit-Breakers, (Case No. 1,216,) of which the following is a specification.

This invention relates to safety devices for alternating-current systems, the object being to protect translating or consumption devices upon a breaking down of their insulation.

The invention is particularly directed to the protection of transformers and the interruption of the supply-circuit upon failure of the transformer-insulation or extraordinary leakage in the secondary circuit.

In carrying out my invention I provide in the supply-circuit of the transformer or consumption device a thermal or other cut-out and cause a heavy current sufficient to fuse or operate the same to flow when a leakage or ground branch of the consumption device is energized by a failure of insulation. I provide between the cut-out and the transformer a short circuit normally open at a spark-gap, through which the line-current may flow when an arc is sprung and provide means for breaking down the gap when the transformer-insulation gives way or when for any reason there is an extraordinary increase of energy in the secondary system. The leakage-current by which the cut-out is controlled may be, for example, from a "grounded sheath" or conductor between the primary and secondary transformer-windings or from a ground to the transformer-casing or from the secondary mains, the result being in any case that upon the breaking down of the insulation sufficient current will leak to ground to close the short circuit through the spark-gap and actuate the thermal cut-out and interrupt the circuit.

My invention therefore in one of its aspects comprises a distribution-circuit for alternating currents, including a consumption device fed through a thermal cut-out and means for operating said cut-out upon the energization of a ground branch controlled by a rupture of insulation of the consumption device.

The invention further comprises a distribution-circuit including a transformer and a cut-out in the main or primary circuit thereof, depending for its operation upon the energization of a ground branch controlled by the condition of the insulation of the transformer or by the potential of its secondary circuit and controlling in turn a short circuit of the primary mains through the cut-out.

The invention also comprises other and more specific features, which will be hereinafter more fully described, and will be definitely indicated in the claims.

In the drawings, Figure 1 is a diagram showing a cut-out operated by the grounded sheath of the transformer. Fig. 2 shows a system in which the controlling ground connection is taken from one side of the secondary. In Fig. 3 the ground connection is taken from the neutral wire of a three-wire system. In Fig. 4 the ground connection is made with the transformer frame or casing.

Referring to the drawings, 1 2 represent the primary leads of a transformer or the supply-leads of a consumption device of other character.

3 represents the primary winding of the transformer, the secondary of which feeds a lamp or other consumption circuit 4.

5 represents what is known in the art as a "ground-shield," being a copper separating medium between the two transformer-windings provided with an earth connection. In this connection I interpose the primary of a small auxiliary transformer 6, the secondary of which controls the operation of a thermal cut-out 7 7ª. (Shown specifically as fuse-wires.) To prevent the reaction of the secondary winding of the transformer 6 upon the line and permit easy flow of current when the protective device acts, I differentially connect the windings, so that like terminals—that is to say, those which are in the same inductive relation to the transformer-core—connect with opposite mains of the supply-circuit. In order to prevent the secondary circuit of this auxiliary transformer from normally short-circuiting the main supply-circuit of the consumption device or main transformer, I interpose between the main circuit-leads 1 2 and the said secondary circuit spark-

gaps S S^a, consisting of metallic terminals separated by an air-space or by a thin film or stratum of insulating material adapted to break down upon a definite increase of potential. The sparking devices are connected through a condenser 9. The parts may with advantage be arranged as shown in the diagram, the connections from the main circuit leading to a point between the spark-gaps and the condenser-terminals and the middle point of the differential winding on the secondary of the auxiliary transformer 6 being connected with an intermediate part of the condenser. The condenser is of comparatively-small capacity. Its leaves are provided with three terminals, two connecting with the mains and the third with the junction of the differential transformer-coils. The auxiliary transformer should preferably be step-up in character, the number of turns being such as to admit of a small reactance. As thus organized it will be seen that upon the breaking down of the insulation of the transformer part of the primary current will leak through the grounded sheath 5 and react inductively upon the auxiliary transformer 6, thereby breaking down the insulating-film in the spark-gaps and exciting the condenser 9 rhythmically with the line-rate. The bridging of the spark-gaps permits a heavy current to be drawn through the fusible cut-outs 7 7^a, causing their fusion and the opening of the circuit.

In Fig. 2 an organization somewhat similar to that which has just been described is depicted, except that herein the auxiliary transformer 6 is provided with independent magnetic circuits for the two secondary sections, which are differentially connected and discharge into the line-terminals through the common connection 10. This arrangement is not so satisfactory, as the separate magnetic circuits produce a larger reactance than a superposed winding. In this diagram I show the secondary circuit as connected with the ground or leakage branch. It follows in this case also that if the insulation of the transformer break down the secondary circuit will be charged with extraordinary potential and will cause the primary fuse or thermal cut-outs to act in the same manner as described in connection with Fig. 1.

In Fig. 3 the relationship of the parts is the same as in Fig. 1, except that the secondary is shown as a three-wire system, the middle wire being connected in the ground branch which controls the automatic cut-out.

In Fig. 4 the organization differs from that shown in Fig. 1 in that the transformer frame or casing is connected in the ground or leakage branch instead of the grounded sheath between the two windings.

It will be evident that my invention may be applied to various types of electrical devices for transferring, translating, or consuming electric energy, and I refer to such generically in the claims by the comprehensive term "translating device."

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

1. In a system of alternating-current distribution, the combination of two circuits insulated from one another, one including a source of current and the other consumption devices, a thermal cut-out in the supply-circuit, and a magnetic operating device determining the operation of the cut-out actuated upon failure of the insulation.

2. In a system of alternating-current distribution, the combination of a transformer the primary circuit of which includes a thermal cut-out and the secondary translating devices, a leakage branch, and magnetic means controlled thereby to admit an operating current through the cut-out.

3. In a system of alternating-current distribution, the combination of a transformer, the primary of which includes a thermal cut-out, and the secondary translating devices, a leakage branch, and magnetic means controlled thereby to admit an operating-current through the cut-out upon extraordinary rise of potential in the secondary system.

4. In a system of alternating-current distribution, the combination of a transformer, the primary of which includes a thermal cut-out, a leakage branch from the transformer fed with current upon a failure of insulation, an auxiliary transformer having its primary in said branch and its secondary controlling the cut-out.

5. In a system of alternating-current distribution, the combination of a transformer, the primary of which includes a thermal cut-out, a leakage branch from the transformer rendered active upon a failure of insulation, an auxiliary transformer having its primary in said branch and its secondary adapted to short-circuit the primary mains of the cut-out.

6. The combination with a translating device of a ground branch normally completed from a metallic part of said device but insulated from the supply-circuit adapted to be energized upon a failure of insulation in said device, and a current-interrupter controlled by said branch.

7. The combination with a translating device, of a leakage branch for current operating upon the failure of insulation in the said device, a transformer fed by such leakage-currents, the secondary winding of which is connected with the supply-circuit through a spark-gap and controlling a thermal cut-out in the supply-circuit.

8. The combination with a translating device, of a ground branch protecting the same, energized upon a breaking down of the insulation, a transformer having its primary in said branch, and a split secondary differentially connected with the supply-circuit to neutralize the effect of the several sections upon said circuit, a spark-gap between the

transformer secondary and the supply-circuit, and a thermal cut-out in the supply-circuit controlled by said secondary.

9. The combination with a translating device, of a ground branch energized upon a failure of insulation in said device, a circuit-breaker in the supply-circuit, and a spark-gap in a branch of the supply-circuit controlled by said ground branch.

10. The combination with a translating device, of a ground branch protecting the same and adapted to be energized upon a failure of the insulation in the device, a transformer controlled by said ground branch, and a circuit-interrupter actuated by said transformer.

11. The combination with a translating device, of a branch connection open at a point closely related to its winding so as to complete a leak upon rupture of the insulation, and a circuit-interrupter for the supply-circuit operated by said branch.

12. The combination with a translating device, of a branch connection open at a point closely related to its winding so as to complete a leak upon rupture of the insulation, a thermal cut-out in the supply-circuit, and means controlled by the branch when energized to direct an operating-current through the cut-out.

13. The combination with a translating device, of a branch connection open at a point closely related to its winding so as to complete a leak upon rupture of the insulation, a fuse in the supply-circuit, and means for directing current through the fuse sufficient to blow it when the branch is energized.

14. The combination with a translating device, of a branch connection open at a point closely related to its winding so as to complete a leak upon rupture of the insulation, a circuit-interrupter in the supply-circuit operating upon determinate increased current-flow, a short circuit including said interrupter and a spark-gap, an electromotive device controlled by the leak branch for bridging the spark-gap, and a condenser around the spark-gap.

15. In an alternating-current system, the combination of a supply-circuit, consumption devices inductively fed thereby, a cut-out, and a circuit controlling its operation energized on a failure of insulation between the supply-circuit and the circuit including the consumption devices.

16. In an alternating-current system, the combination of a supply-circuit, a transformer connected therewith, a cut-out controlled by a circuit including a spark-gap, a differential transformer feeding the spark-gap, and means for energizing the differential transformer upon a failure of insulation of the distributing-transformer.

In witness whereof I have hereunto set my hand this 9th day of June, 1899.

ELIHU THOMSON.

Witnesses:
DUGALD MCKILLOP,
HENRY O. WESTENDARP.