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J. D. HILLIARD, JR.

SAFETY SYSTEM FOR HIGH TENSION TRANSMISSION LINES.

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Fig. 1.

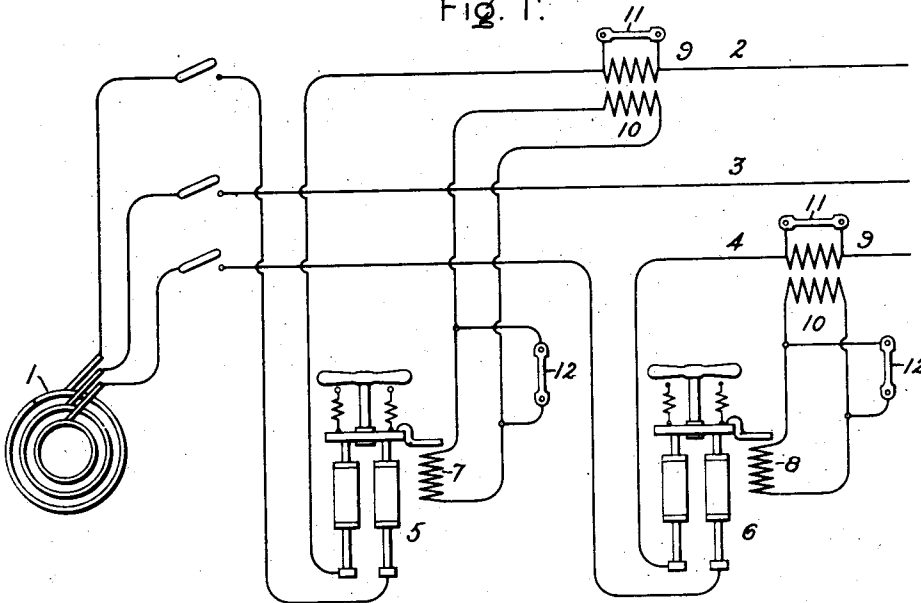


Fig. 2.

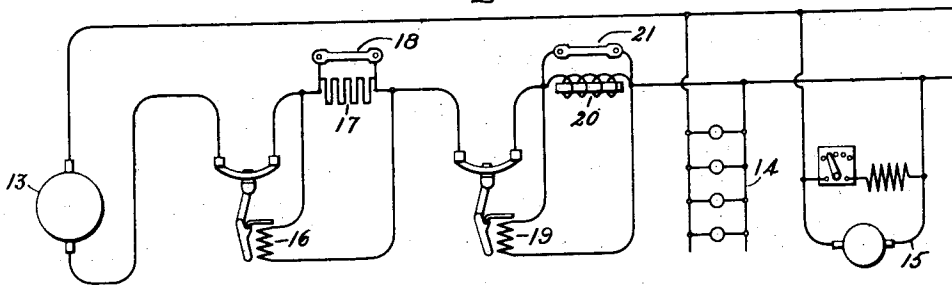
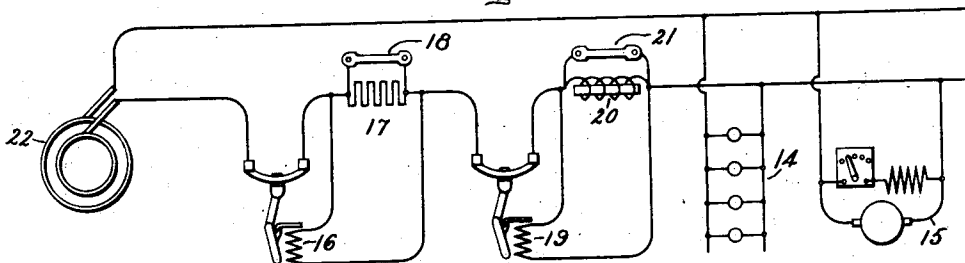


Fig. 3.



Witnesses.

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UNITED STATES PATENT OFFICE.

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SAFETY SYSTEM FOR HIGH-TENSION TRANSMISSION-LINES.

No. 833,211.

Specification of Letters Patent.

Patented Oct. 16, 1906.

Application filed April 20, 1904. Serial No. 204,075.

To all whom it may concern:

Be it known that I, JOHN D. HILLIARD, Jr., a citizen of the United States, residing at Glens Falls, county of Warren, State of New York, have invented certain new and useful Improvements in Safety Systems for High-Tension Transmission-Lines, of which the following is a specification.

This invention relates to systems of transmission of high-tension electric currents; and the object of the invention is to enable lines carrying heavy currents to be safely opened with moderate-sized and not expensive switches. With the greatly-increased use of such systems has come a demand for higher voltages and greater output of current, so that the switches are frequently unable to stand the strain of opening under excessive overloads unless they are quite large and costly.

My invention aims to relieve this difficulty and enable smaller and less expensive switches to be used. In order to accomplish this, I use a series transformer connected in the line, two such transformers being used for a two-phase or three-phase circuit. Both the primary and secondary of this transformer are shunted by fuses or other automatic circuit-breaking devices, and across the secondary terminals is connected a trip-coil to operate the automatic line-switch. The action of these parts will be described hereinafter.

In the accompanying drawings, Figure 1 is a diagram showing my invention applied to a three-phase alternating-current circuit. Fig. 2 shows a direct-current circuit, and Fig. 3 a single-phase alternating-current circuit similarly equipped.

Let 1 represent a three-phase generator supplying current to the conductors 2 3 4, two of which are provided with automatic circuit-breakers 5 6, which are released by the energizing of the trip-coils 7 8. In each of two legs of the line is the primary 9 of a series transformer. The secondary winding 10 of each transformer is in series with one of the trip-coils of the switch. In shunt to each primary winding is a fuse 11 of a wide-opening or arc-extinguishing type. The secondary windings are each short-circuited by a fuse 12.

Under normal conditions of service the drop across each primary winding is small,

owing to the mutual induction of the primary and the short-circuited secondary. The current in the secondary does not affect the trip-coil, because said coil is shunted by the fuse 12; but when an excessive overload is applied to the line the increased current through the fuse 11 causes it to blow. The entire current is thereby thrown upon the primary, and the secondary current consequently increases and blows the fuse 12. This causes the secondary current to energize the trip-coil, release the switch, and open the line; but the instant the fuse 12 blows the secondary circuit is practically opened by reason of the great resistance and self-induction of the trip-coil, which is wound to give this effect. The reactance of the primary winding 9 is therefore greatly increased, causing a large drop across the terminals of said coil, and this affords a sure protection for the line-switch against the liability of blowing up, so that smaller and less expensive switches can be used than would be safe otherwise.

In Fig. 2 a direct-current generator 13 is shown carrying a non-inductive load 14 and an inductive load 15. Two automatic circuit-breakers are shown in circuit with the generator, one of which has its overload-coil 16 shunted by a non-inductive resistance 17 and a fuse 18, arranged in multiple, the overload-coil 19 of the other circuit-breaker being similarly shunted by an inductive resistance 20 in multiple with a fuse 21. In the case of an overload the fuses 18 and 21 will blow and the resistances serve not only to protect the circuit-breakers from an excessive potential, but to force sufficient current through the coils 16 and 19 to trip the circuit-breakers.

In Fig. 3 the circuits and apparatus are the same as in Fig. 2, except that the generator 22 is a single-phase alternator.

In accordance with the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new, and desire to secure by Letters Patent of the United States, is—
1. The combination with an electric circuit, of an impedance in said circuit, a fuse in shunt to said impedance, a circuit-breaker, a

trip-coil therefor, and means for energizing said trip-coil to open said breaker when an overload causes said fuse to blow and the excessive current is opposed by the impedance.

5 2. The combination with an electric circuit, of two parallel branches therein, one of which is fusible on an overload and the other adapted in such event to oppose an excessive flow of current, an automatic circuit-breaker, 10 and means for causing an increased current in its tripping-coil when the excessive current-flow is so opposed.

3. The combination with an electric circuit, of an inductance therein, an automatic 15 fusible cut-out normally shunting the same, a switch in circuit, and a trip-coil energized through the agency of the inductance when the automatic cut-out acts.

4. The combination with an electric circuit, of an inductance, a trip-circuit of high impedance operatively related thereto, a 20 trip-coil in said trip-circuit, an automatic cut-out normally shunting the inductance, and a switch governed by the trip-coil and in series with the inductance.

5. The combination with a high-tension line, of an automatic switch, a series transformer in said line adapted to operate said 25 switch, means whereby an overload will practically open-circuit the secondary of said transformer, and a fuse short-circuiting the transformer primary.

6. The combination with a high-tension line, of an automatic switch, a series transformer in said line adapted to operate said 35 switch, and fuses short-circuiting the transformer-windings.

7. The combination with a high-tension line, of a series transformer therein, an automatic line-switch having a trip-coil in circuit 40 with the transformer secondary, and fuses short-circuiting the windings of said transformer.

8. The combination with a high-tension line, of a series transformer therein, an automatic line-switch provided with a trip-coil 45 having high self-induction and connected in circuit with the secondary of said transformer, a fuse in shunt to the primary of said transformer, and a fuse short-circuiting the 50 secondary thereof.

9. The combination with an electric circuit, of an automatic circuit-breaker, a trip-coil therefor, a cut-out in parallel relation to 55 said trip-coil, an impedance shunting the cut-out, and means for energizing the trip-coil when the cut-out operates.

In witness whereof I have hereunto set my hand this 8th day of April, 1904.

JOHN D. HILLIARD, JR.

Witnesses:

J. M. SEAY,
C. L. SNOW.