L. M. KLAUBER.

AUTOMATIC CIRCUIT CONTROLLING APPARATUS.

APPLICATION FILED MAR. 4, 1920.

1,395,046.

Patented Oct. 25, 1921.

2 SHEETS—SHEET 1.

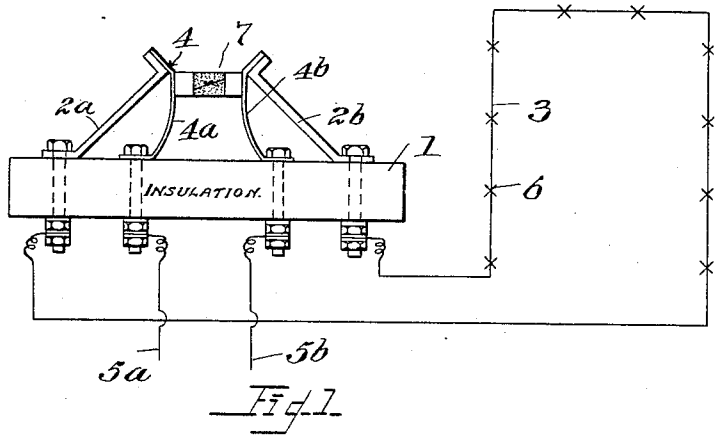

Fig. 1.

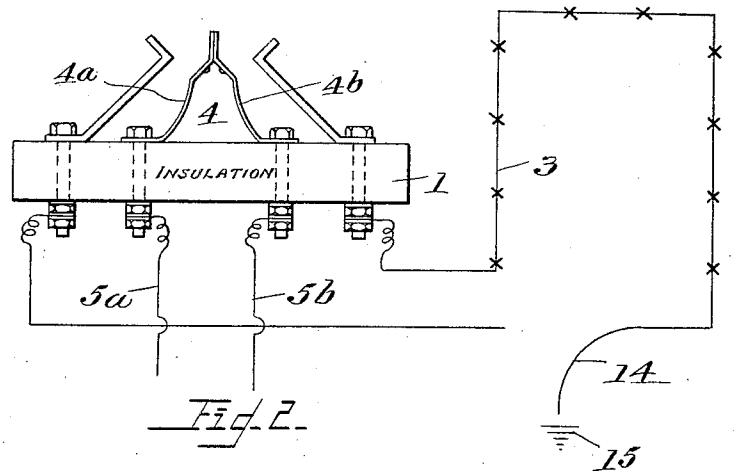

Fig. 2.

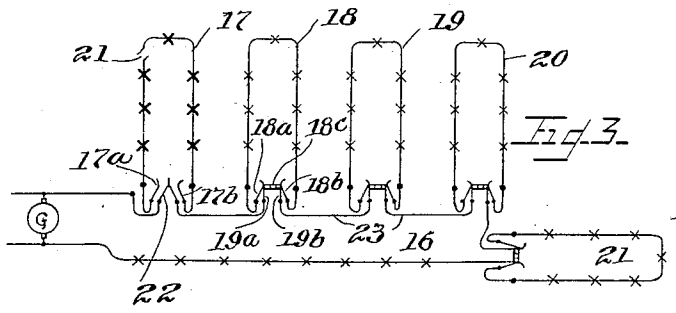

Fig. 3.

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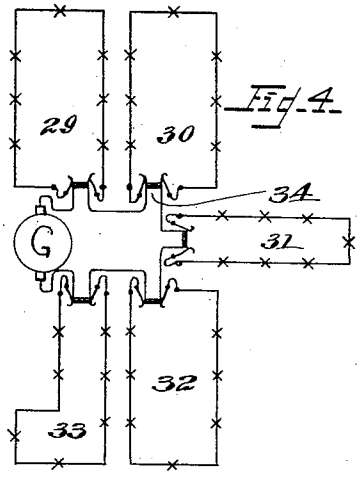

Fig. 4.

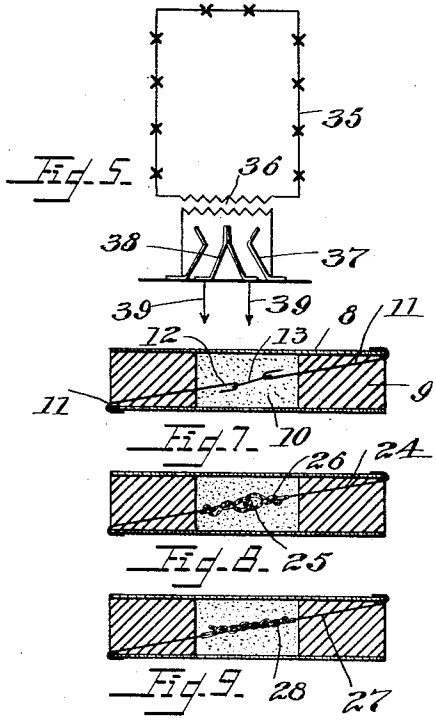

Fig. 5. Fig. 7. Fig. 8. Fig. 9.

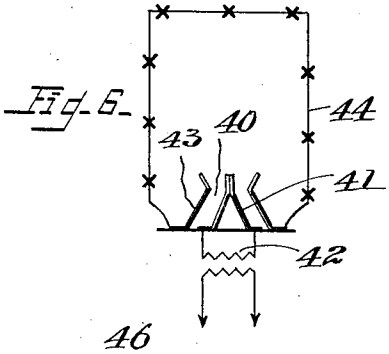

Fig. 6.

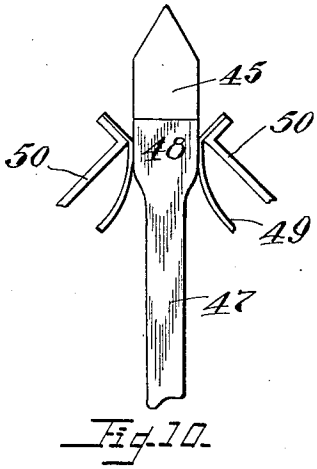

Fig. 10.

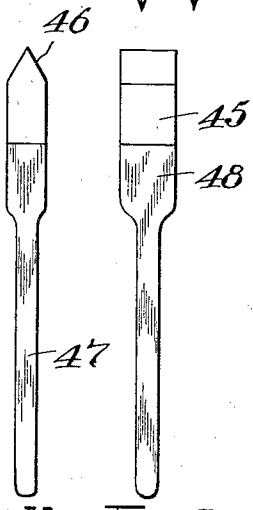

Fig. 11.

Fig. 12.

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UNITED STATES PATENT OFFICE.

LAURENCE M. KLAUBER, OF SAN DIEGO, CALIFORNIA, ASSIGNOR OF ONE-HALF TO SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY, OF SAN DIEGO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

AUTOMATIC CIRCUIT-CONTROLLING APPARATUS.

1,395,046. Specification of Letters Patent. Patented Oct. 25, 1921.

Application filed March 4, 1920. Serial No. 363,308.

To all whom it may concern:

Be it known that I, LAURENCE M. KLAUBER, a citizen of the United States, residing in the city of San Diego, county of San Diego, and State of California, have invented new and useful Improvements in Automatic Circuit-Controlling Apparatus, of which the following is a specification.

This invention relates to automatic circuit controlling apparatus and the general object of the invention is to eliminate dangers which are incidental to the operation of such circuits, particularly series electric light circuits; according to my invention I provide simple apparatus which is placed in the circuit, operating so that if the circuit becomes broken, the break in the circuit is automatically cut out of the regular circuit. That is so say, the line wires leading to and from the broken point are short-circuited. It has been one of my objects to accomplish this result by very simple means without entailing the use of many mechanical parts; I also provide a circuit arranged in sections or circuit-loops which are protected in such a way that if a break in any loop occurs, this loop will be immediately short-circuited, cut-out or disconnected from the circuit, which then passes through the other loops. The apparatus includes simple means for renewing the destructible parts of the apparatus and for testing a circuit which has been cut out in the manner suggested to ascertain the condition of the line in the cut-out circuit loop.

Further objects of the invention will appear hereinafter.

The invention consists in the general combination of parts or in the features of said parts hereinafter described, all of which contribute to produce an efficient automatic circuit controlling apparatus. A preferred embodiment of my invention will be particularly described in the following specification, while the broad scope of my invention will be pointed out in the appended claims.

In the drawing,

Figure 1 is a side elevation of the mechanical part of the apparatus indicating the manner in which it will protect a simple circuit; the circuit is supposed to be intact;

Fig. 2 is a view similar to Fig. 1 but showing the condition of the apparatus after it has operated to protect the circuit when a break has occurred;

Fig. 3 is a diagrammatic view indicating a circuit arrangement having a plurality of protected sections or circuit loops, one of which is represented as having been "cut-out" from the regular or main circuit;

Fig. 4 is a diagram indicating a circuit arrangement where the circuit consists entirely of protected sections or loops;

Fig. 5 is a diagrammatic view illustrating the use of the apparatus for protecting a loop and a transformer feeding said loop, the apparatus being placed on the primary side of the transformer:

Fig. 6 is a view similar to Fig. 5 with a slightly modified wiring arrangement, the apparatus being placed on the secondary side of the transformer;

Fig. 7 is a longitudinal section through a dielectric resistance device or cut-out which coöperates with the contact device to maintain the normal circuit through the protected loop, but which coöperates with the contact device to enable it to effect the cutting out and disconnection of a broken or defective circuit-loop;

Fig. 8 is a view similar to Fig. 7 but showing a slightly modified form of the dielectric resistance;

Fig. 9 is a view similar to Fig. 8, showing still another form of the dielectric resistance;

Fig. 10 is a side elevation illustrating the operation of the apparatus in replacing the "cut-out" and incidentally testing to ascertain the condition of the circuit-loop;

Fig. 11 is a side elevation of the device which I may employ for this purpose; and

Fig. 12 is an elevation of another side of the tool shown in Fig. 11.

In carrying out my invention, I provide a series electric circuit with a section or circuit-loop carrying electric translating devices, for example, electric lights, and between the sides or ends of the loop I provide a dielectric resistance device or "cut-out" which is so constructed that it will sustain the normal potential existing across the circuit-loop. I also provide means in the form of a contact device which is controlled by the resistance device in such a way as to hold the circuit normally closed through the loop.

With such an organization, if the circuit-loop should become open or broken for any reason, the dielectric resistance device will then be subjected to a very much higher potential. This resistance device or "cut-out" is so constructed that it will fail under this higher potential and its elimination automatically effects the short-circuiting of the circuit-loop; in this way, the apparatus automatically cuts out the defective loop, breaks the connection to the loop, and maintains substantially the original or regular circuit with the defective loop omitted from the circuit. I accomplish this effect without the use of any machinery or mechanism by employing a very simple contact device.

Apparatus embodying my invention is illustrated in Fig. 1, in which 1 represents an insulating support carrying terminals or fixed contacts 2^a and 2^b which are connected to a circuit loop 3. Between these terminals I provide a cut-out or dielectric resistance device, which, when it is in position, maintains the circuit closed through the loop 3. Any suitable simple means may be employed for this purpose. However, I prefer to provide a contact device 4, having a movable part or means preferably in the form of two movable contacts 4^a and 4^b which are mounted on the insulating support 1 and which tend, by their resiliency, to come together (see Fig. 2). These movable contacts 4^a and 4^b are connected respectively with the circuit wires 5^a and 5^b. The circuit 3 may include electric translating devices of any kind, for example, electric lamps 6 connected in series. Between the terminals 2^a and 2^b, I provide a dielectric resistance device or "cut-out" which coöperates with the contact device 4 so as to hold the circuit closed through the circuit-loop 3. In the present instance, this dielectic resistance device is formed of a member or tube, the ends of which engage the resilient contacts 4^a and 4^b and hold the same apart, at the same time holding the contact 4^a in engagement with the terminal 2^a and the contact 4^b in engagement with the terminal 2^b. This device is preferably of the type referred to because this type of dielectric resistance device has considerable length and therefore enables the terminals 2^a and 2^b to be placed a sufficient distance apart to insure that they will sustain (without arcing), the normal potential existing between the two terminals, and furthermore, this type of resistance device is admirably adapted for making variations in its details of construction to vary the potential under which the resistance will break down. This property enables the dielectric resistance device to be readily altered or adapted to all kinds of peculiar service conditions. In other words, the dielectric resistance device can be adapted to coöperate with a loop circuit having various translating devices, for example, a small number of lamps or a great number of lamps, and of high or low voltage.

In Figs. 7 to 9, I illustrate different forms of this type of "cut-out"; in Fig. 7, 8 represents a tube of insulating material, such as glass, the ends of which are closed by plugs 9 of paraffin, ozite or similar material, the interior of the tube forming a chamber carrying an explosive substance, such as gun-powder 10. The ends of the tubes are provided with terminal wires or pins 11 which project beyond the plugs 9 so as to lie in engagement with the contacts 4^a and 4^b. The adjacent ends of the contact wires or pins 11 are formed into hooks 12 connected by a short loop 13 of thread or similar non-conductive material. If a number of these dielectric resistance devices are constructed in this way, and if the loops 13 are of the same diameter, the resistance devices will break down very uniformly at about the same potential. However, when subjected to a higher potential than that which should exist in the circuit-loop for which they are designed, the current will jump between the hooks 12 and ignite the gun-powder thereby exploding the same and destroying the tube and "cut-out." When this occurs the contact device 4 closes the circuit; in the present instance, the two contacts 4^a and 4^b merely come together by their own resilience as in Fig. 2, thereby short circuiting the loop and breaking the electrical connection to it. This operation of the device is so rapid that if a part of the circuit-loop 3 becomes broken so that a depending wire 14 falls toward the ground 15, the loop will actually be cut out and disconnected before the wire touches the ground. This fact gives my improvement real value as a safety device to prevent an accident to passersby in case an electric light wire becomes broken and falls into a street or roadway. It also prevents accidents such as sometimes occur from a broken wire charging a pool of water lying in a roadway.

By forming a number of loops in a circuit to be protected, in the manner described above, I can protect the circuit in such a way that if a break occurs in any loop, that loop will be automatically short-circuited and disconnected. In Fig. 3 I have illustrated a simple circuit arrangement of this character in which G represents a generator supplying current to a circuit 16; in this circuit I have indicated a plurality of circuit-loops 17, 18, 19, 20 and 21, the ends of each loop being attached to terminals. For example, the loop 17 has its ends attached to terminals 17^a and 17^b. Similarly the circuit-loop 18 has its ends attached to terminals 18^a and 18^b. Cooperating with terminals 18^a and 18^b I provide a contact device which may include two movable contacts 19^a and 19^b which are nor-

mally held in contact with the terminals 18^a and 18^b by means of a destructible dielectric resistance device 18^c, such as that described. If the circuit-loop 17 should become open or "broken" at any point, such as the point 21, then the dielectric resistance device such as 18^c would "blow" or explode, thereby permitting the contacts 22 of the contact device corresponding to that loop to come together. These contact devices are connected together by conductors 23 in the circuit. That is to say, the contact devices of the loops are connected in series. If any loop becomes open, the corresponding dielectric resistance device will "blow" or explode and short-circuit the defective loop.

In practice, the dielectric resistance device, of course, is designed or constructed to adapt it specially to peculiar circuit conditions; for example, in a circuit containing 100 lamps, each lamp requiring a potential of 50 volts, the total voltage across the circuit, with all the lamps in operation, would be 5,000 volts. If the loop or branch to be protected contains 20 lamps, the voltage across the terminals of this loop would be 1,000 volts. It is then essential that whatever form of rupturable cut-out or dielectric resistance device be used, it should have a breakdown dielectric resistance somewhat in excess of 1,000 volts and less than 5,000 volts. In practice, I have found that with the type of resistance device shown in Fig. 7, if the thread 13 is about $\frac{3}{16}$ of an inch long, the cut-out will break down at approximately 5,500 volts. With a loop of about $\frac{3}{32}$ of an inch in length the device will break down at about 3,300 volts. Lower voltages, of course, require smaller loops. Where the break down voltage has to be so low that it becomes inconvenient to tie so short a loop as would be required, I provide other means for varying the dielectric resistance between the terminal pins of the cut-out. For example, in Fig. 8, I illustrate a form of "cut-out" in which the two terminal pins or wires 24 are looped together, insulation between the loops 25 of the wire being provided, by means of a coating 26 of enamel, varnish, cotton, or cotton impregnated with enamel or varnish. When a voltage sufficient to break down two layers of this insulation is impressed across the terminals, a puncture will occur at the loops 25 of the two wires, producing a small spark which will ignite the powder. This type of cut-out or dielectric resistance may be employed successfully to produce cut-outs which will operate to fail or "blow" at a voltage from 500 volts up. Fig. 9 shows another variation of this general type of cut-out in which the pins or wires 27 are first covered with an insulation 28, such as layers of varnish, and then twisted together for a considerable distance.

In Fig. 4, I illustrate a circuit composed entirely of circuit-loops 29, 30, 31, 32 and 33; the ends of each loop being connected by my controlling apparatus such as illustrated in Fig. 1, and designated by the number 34 in this figure.

It is not necessary that the circuit controlling apparatus such as illustrated in Fig. 1 should be directly connected into the circuit-loop; for example, I may use a circuit arrangement such as shown in Fig. 5 in which the loop 35 is protected by a transformer 36, the primary of which is connected to fixed terminals 37 corresponding to the terminals 2^a and 2^b of Fig. 1. With these terminals a contact device coöperates, including a dielectric resistance device such as that described. This figure illustrates the contacts 38 in engagement with each other as though the "cut-out" had "blown" or failed. The contacts 38 are connected respectively to the line wires 39.

If desired, a somewhat different variation of wire arrangement may be employed, (see Fig. 6), in which my apparatus 40 is wired in such a way that the contacts 41 are connected with the secondary of a transformer 42, the terminals 43 being connected with the ends of the loop 44.

My apparatus includes means for handling the cut-outs and contacts without danger when it is necessary to replace a blown cut-out. I construct this means in such a way that it incidentally enables the circuit to be tested to indicate the condition of the lately defective loop. For this purpose I prefer to employ a device or tool such as that illustrated in Figs. 11 and 12, the same having a head 45 of conductive material with a wedge-shaped contact point 46, and an insulating handle 47 of wood or similar material. The end of the handle 47 adjacent to the metal head 45 is formed into a head 48 which is preferably of the same width and thickness as the head 45. In this way, a head for the device is formed, composed of the two heads 45 and 48. In using the tool the conducting portion 45 would always be inserted first; thus maintaining the continuity of the main circuit. It would then be pushed inwardly, slowly, until the non-conducting portion 48 reaches the terminals. If the loop connected to terminals 50 were intact the loop would then light up. If it were not intact a small spark would be drawn across the surface of the non-conducting portion 48 as the circuit would endeavor to maintain itself from 49 to 45 and back to the other side of 49; such a spark would indicate to the lineman that the circuit-loop is intact again, indicating that the defect in the circuit-loop was simply due to a temporary open circuit. However, if a spark can be drawn from the terminals in the manner suggested, it will be evident that the circuit-loop is still open and that it will require repair when the break is lo-

cated. Fig. 10 shows the tool pushed in a little beyond the sparking position.

If the loop is found to be intact, the lineman simply inserts a new dielectric resistance device or cut-out between the contacts 49 and then withdraws the tool from between the contacts.

It is understood that the embodiment of the invention described herein is only one of the many embodiments my invention may take, and I do not wish to be limited in the practice of my invention nor in my claims, to the particular embodiment set forth.

What I claim is:

1. In an automatic series circuit-controlling apparatus a circuit-loop including electric translating devices and having terminals, a dielectric resistance device located between said terminals and constructed to sustain the normal potential existing between said terminals, and means for holding the circuit closed through the circuit-loop controlled by said dielectric resistance device, said means having a movable part operating to break the connection to the circuit-loop adjacent the terminals when said dielectric resistance device is destroyed.

2. In an automatic series circuit-controlling apparatus, line wires, a circuit-loop including electrical translating devices and having terminals, a dielectric resistance device located between said terminals and constructed to sustain the normal potential existing between the terminals, and a contact device including contacts held together by said dielectric resistance device to maintain the circuit through the circuit-loop, said dielectric resistance device being destructible by a higher potential than that normally existing across the terminals, said contact device having a movable part operating when the dielectric resistance is destroyed, to permit the contact device to short-circuit the line wires of the circuit adjacent the terminals, and also disconnect the circuit-loop.

3. In an automatic series circuit-controlling apparatus, a circuit-loop including electrical translating devices and having terminals, a contact device connected with the line, a dielectric resistance device located between said terminals, coöperating with said contact device to maintain the normal circuit through the circuit-loop, said resistance device constructed to sustain the normal potential existing between said terminals and operating to break down under a potential higher than the said normal potential and permitting said contact device to short-circuit the line adjacent the terminals and also break the connection to the circuit-loop.

4. In an automatic series circuit-controlling apparatus, a circuit-loop including electrical translating devices, and having terminals, a contact device including a pair of movable contacts, a dielectric resistance device normally holding said movable contacts in engagement with the terminals to maintain the normal circuit through the circuit-loop, said resistance device constructed to sustain the normal potential existing between said terminals, and operating, if the circuit-loop becomes broken, to break down under a potential higher than the said potential, said movable contacts operating to come together when said resistance device breaks down, thereby short-circuiting the line adjacent the terminals and breaking the connection to the circuit-loop from the line.

5. In an automatic series circuit-controlling apparatus, a lighting circuit composed of a plurality of circuit-loops connected in series, each loop having terminals, a dielectric resistance device disposed between each pair of terminals, contacts coöperating with the dielectric resistance devices to maintain the circuit closed through the loops, each dielectric resistance device being constructed to sustain the potential normally existing between the terminals while its corresponding loop is intact but constructed to fail under the existing potential if the circuit-loop becomes broken and open, thereby permitting the contacts to come together to maintain the lighting circuit and disconnect the open loop.

6. In an automatic circuit-controlling apparatus, a circuit including a plurality of circuit loops, each circuit-loop carrying electric translating devices and having a pair of terminals, a dielectric resistance device located between each pair of terminals and constructed to sustain the normal potential existing between the same, and a contact device corresponding to each loop, including contacts held by its corresponding dielectric resistance device, so as to maintain the circuit closed through all the circuit loops, each dielectric resistance device constructed to fail under the existing potential if its corresponding loop becomes broken and open, thereby permitting the contact device corresponding to the open loop to disconnect that loop.

7. In an automatic circuit-controlling apparatus, a circuit including a circuit-loop carrying electric translating devices, a contact device including terminals, a dielectric resistance device located between the said terminals and constructed to sustain the normal potential existing between the same, said contact device including movable contacts held against the terminals by the dielectric resistance device to maintain the circuit closed through the loop, said dielectric resistance device constructed to fail under the potential of the entire circuit if the loop becomes broken and open, thereby permitting the movable contacts to break the con-

nection to the loop and come together to maintain the remainder of the circuit.

8. In a circuit-controlling apparatus, the combination of a circuit loop including electric translating devices and having terminals, a pair of movable contacts disposed between said terminals and connected with the line wires, said contacts adapted to be held against the terminals by a destructible dielectric resistance device, and a hand-operated testing device having a head adapted to be thrust between the said movable contacts to hold the same against the terminals.

9. In a circuit-controlling apparatus, the combination of a circuit-loop including electric translating devices and having terminals, a pair of movable contacts disposed between said terminals and connected with the line wires, said contacts adapted to be held against the terminals by a destructible dielectric resistance device, and a hand-operated testing device having a head adapted to be thrust between the said movable contacts to hold the same against the terminals, said head having a conductive portion and an insulated portion adjacent thereto, so that a short gap may be formed between the terminals and the conducting portion of the head to indicate by a spark, the condition of the circuit-loop.

10. In an automatic circuit-controlling apparatus, a circuit-loop including electrical translating devices and having terminals, a contact device including movable contacts, a dielectric destructible tube normally holding said movable contacts in engagement with the terminals to maintain the normal circuit through the circuit-loop, and an explosive substance carried by said tube, the explosive substance and said tube being capable of sustaining the normal potential existing between said terminals, but incapable of sustaining the potential developed if the circuit-loop becomes broken, the explosion of the explosive substance operating to destroy the tube and permit the movable contacts to come together and disconnect the circuit-loop.

11. In an automatic circuit-controlling apparatus, a circuit-loop including electrical translating devices, a contact device including a pair of movable contacts, fixed terminals, a destructible insulating member normally holding said movable contacts in engagement with the terminals to maintain the normal circuit through the circuit-loop, an explosive substance, and a dielectric resistance carried by said member capable of sustaining the normal potential existing between said terminals, but incapable of sustaining the potential developed if the circuit-loop becomes broken, thereby exploding the explosive substance and eliminating the said member to permit the movable contacts to come together and disconnect the circuit-loop.

12. In an automatic circuit-controlling apparatus, a circuit-loop including electrical translating devices and having terminals, a contact device, a dielectric resistance including a destructible tube carrying an explosive substance and capable of sustaining the normal potential existing between the terminals, said tube and explosive substance being incapable of sustaining the potential developed between the terminals if the circuit-loop becomes broken, the explosion of the explosive substance operating to destroy the tube and permit the contact device to break the connection to the circuit-loop.

13. In an automatic series circuit-controlling apparatus, a circuit-loop including electric translating devices and having terminals, a dielectric resistance device located between said terminals and constructed to sustain the normal potential existing between said terminals, said dielectric resistance device being destructible by a higher potential than that normally existing across the terminals, and means controlled by the destruction of the dielectric resistance device for breaking the connection to the circuit-loop from the series circuit, and for maintaining the series circuit.

In testimony whereof, I have hereunto set my hand.

LAURENCE M. KLAUBER.