Aug. 16, 1932. E. J. HAVERSTICK 1,872,285

SHORT CIRCUITING DEVICE

Filed Nov. 30, 1926

Fig. 1.

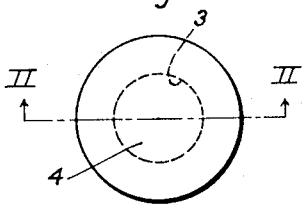


Fig. 2.

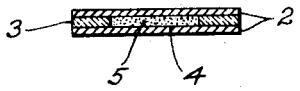


Fig. 3.

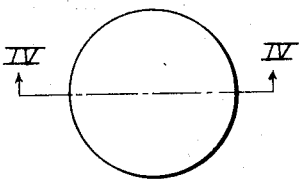


Fig. 4.

Fig. 5.

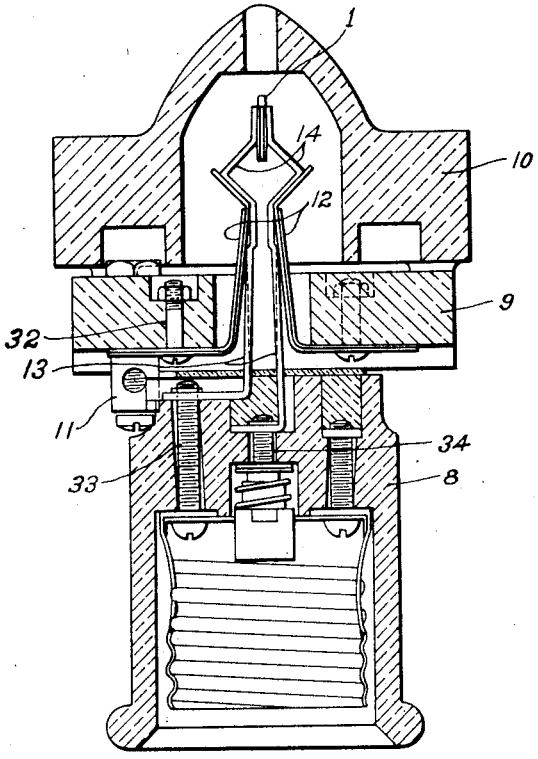
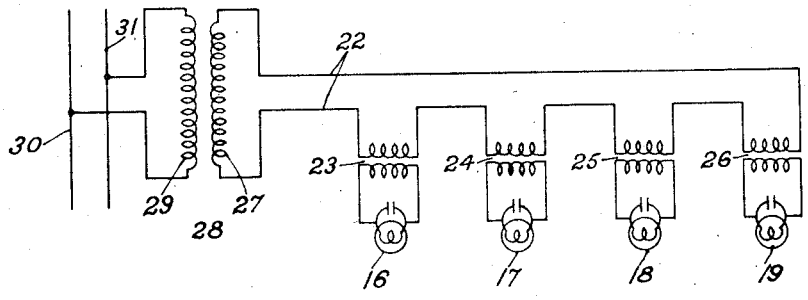


Fig. 6.



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1,872,285

UNITED STATES PATENT OFFICE

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SHORT CIRCUITING DEVICE

Application filed November 30, 1926. Serial No. 151,692.

My invention relates to circuit making and breaking devices and specifically to short-circuiting devices for series lighting circuits or the like.

My invention relates particularly to series street-lighting circuits in which the individual lamps are connected to the circuit by current transformers. Heretofore, when a lamp of such a system failed, it was customary to leave the secondary of the transformer open, whereupon the secondary voltage would build up to a very limited value, limited by saturation of the transformer. From the standpoint of the lamp engineer, such practice was not objectionable, but from the standpoint of the telephone engineer in charge of near-by telephone circuits, the practice was highly objectionable because of the harmonics introduced in the series lighting circuits, which were inductively transferred to the telephone circuits, thus causing serious interference.

However, lamp cut-outs, such as had been developed for series lighting circuits, in which the lamps were connected directly in series, would not break down for voltages under 350 volts, which was considerably higher than the peak voltages of 100 or 200 volts which were encountered in the open-circuited secondaries of the current transformers.

Cut-outs, to be practicable on a lighting circuit utilizing individual transformers, have to be inexpensive, so that the advantages gained by the use of series transformers are not offset by the maintenance cost of the cut-outs; they must be small enough to be attached to the standard lamp socket and housed in the standard lamp housing; they must be capable of withstanding the high temperatures encountered in the lamp housings; they must break down on voltages as low as 50 volts but not at the normal operating voltage of the lamps; and they must operate quickly and positively, upon failure of a lamp, forming a conducting path which is able to carry the short-circuit current and which will not open again when the lighting circuit is de-energized, as was the case with prior-art cut-outs such as were utilized in lighting circuits in which the lamps were conductively connected in series.

My invention provides a device that will operate at a relatively low voltage, such as 50 volts. The value at which the breakdown will occur may be closely regulated, and changes in temperature on account of varying operating conditions, do not materially affect the breakdown value.

My invention may best be understood by reference to the accompanying drawing, in which

Fig. 1 is an enlarged top plan view of a device embodying the principles of my invention;

Fig. 2 is an enlarged sectional view, taken on the line II—II of Fig. 1;

Fig. 3 is an enlarged top plan view of an alternative form of a device embodying my invention;

Fig. 4 is an enlarged sectional view, taken on the line IV—IV of Fig. 3;

Fig. 5 is a view, partially in section and partially in elevation, of a lamp base in which my invention is embodied, and

Fig. 6 is a diagrammatic view showing the preferred manner of utilizing my invention.

A preferred form of my device is shown in Figs. 1 and 2. Two plates or conducting surfaces 2, preferably made of aluminum, although other readily fusible electrically conducting materials may be utilized, are separated by a perforated washer-like spacer 3 of mica, asbestos or similar non-conducting material. The spacer has an opening or aperture 4 in its center, in which finely divided particles 5, of metal dust are placed.

I prefer to utilize aluminum for the filling material. Aluminum dust is an electric conductor but, in the finely divided state, it is substantially a non-conducting or insulating

medium on account of the oxide layer thereon. The aluminum dust maintains itself in its non-conducting condition until a voltage sufficiently high to break down the insulation therethrough is reached. The breakdown value of aluminum dust in its finely divided state is not high. When aluminum dust is placed in an opening one quarter inch in diameter, in an insulating spacer .01 inch thick and metal electrodes are placed on both sides of the spacer, the powder will break down at about 50 alternating current volts. When a breakdown occurs, a conducting path is formed between the electrodes or plates. The conducting path may be an almost imperceptible fused metallic connection traversing the dust between the plates, or it may be a relatively large bead of fused metal.

An alternative construction of my device is shown in Figs. 3 and 4. Two conducting plates 6 are employed, as before. The spacer 7 is a disc of cloth, paper or the like, the fine openings of which form the apertures in which the metal dust is placed. In order to coat the cloth and to obtain a material which will be integral with the cloth, I prefer to use a composition comprising carborundum powder, lamp black and powdered zinc (30 mesh), bonded together with water glass, the latter being subsequently treated with ammonium chloride in order to remove free alkalis. The zinc may be replaced by aluminum dust, aluminum powder or powdered iron, and the proportions of the ingredients may be varied in accordance with the requirements. The water-glass binder may also be replaced by litharge and glycerine, thereby avoiding the necessity for the ammonium chloride treatment. The cutout device is assembled by placing the treated cloth between the two plates.

It will be noted that the essential ingredients of the composition utilized in the embodiment of my invention shown in Figs. 3 and 4 are a high-resistance material, interspersed therewith a finely divided metallic element which is capable of readily fusing over into a permanent conducting path or paths upon breakdown of the cut-out, and a binder.

In use, my cutout device may be mounted in a lamp support, as shown in Fig. 5, comprising an ordinary incandescent lamp socket 8 and a base 9 provided with a cap 10. Connections for leads from line to lamp are made at the binding posts 11. Resilient conductor strips 12, mounted on the base 9 by means of bolts 32, make contact engagement with similar strips 13 which are attached to the lamp socket by means of bolts 33 and 34. The strips 13 are so shaped as to constitute spring fingers 14 for holding the cutout device 1 and for engaging the ends of strips 12 to retain the socket 8 and base 9 on the cap 10 when they are assembled.

In operation, I insert one of the prepared discs 1 between spring fingers 14. If interruption of the circuit through the lamp occurs, the voltage across the lamp terminals builds up. When a predetermined voltage is reached, the insulation through the powder will break down and form a good conducting path through the powder, thereby short circuiting the lamp.

My invention may be utilized in lamps that are associated with a high-tension line, in the manner shown in Fig. 6. For example, lamps 16, 17, 18, 19, normally operating at twenty volts, are connected in a branch line 22, through series transformers 23, 24, 25 and 26. The branch line is connected to the secondary winding 27 of a constant-current transformer 28, the primary winding 29 of which is connected across the main line 30, 31. The lamp transformers 23, 24, 25 and 26 are so proportioned as to deliver the proper voltage to the lamps 16, 17, 18 and 19. When interruption of the circuit through a lamp occurs, as by rupture of its filament, the above-noted building up of the voltage and automatic short-circuiting of the lamp occurs through the fingers 14 and the metal dust 5. Thus, the voltage across terminals of the secondary winding of the transformer associated with the burnt-out lamp is reduced to substantially zero.

An advantage of my invention is that a device may be constituted so that it will break down at a voltage of the order of fifty volts, if desired.

When using a metal powder of given properties, the value of the voltage at which breakdown occurs may be easily controlled. The breakdown voltage may be increased by using a thicker spacer and a smaller opening. Conversely, if the spacer is made thinner or the opening is made larger, the breakdown voltage will be lowered. Compressing the aluminum dust materially lowers the breakdown voltage.

Treating the aluminum dust with a dilute solution of hydrofluoric or chromic acid coats the aluminum particles with a film. This treatment is preferably employed when it is desired to raise the breakdown voltage and to insulate the particles and so that variations of operating temperature do not materially affect the breakdown voltage. Experiments indicate that the discharge occasioned by the release of a bound charge, such as lightning, does not rupture treated aluminum powder or untreated aluminum powder.

It will be understood that the device shown and described is purely illustrative: that many modifications may be made therein and that the device may be utilized in connection with other electrical devices without departing from the spirit and scope of my invention, as set forth in the appended claims.

I claim as my invention:

1. A circuit-locing device comprising a plurality of conducting bodies, an apertured spacer disposed therebetween and loosely confined particles of conducting material confined within the space bounded by said bodies and the aperture of said spacer.

2. A circuit-closing device comprising a plurality of conducting bodies, an apertured spacer disposed therebetween and particles of a readily fusible metallic material disposed between said bodies in the aperture of said spacer.

3. A circuit-closing device comprising a plurality of conducting bodies, an apertured spacer disposed therebetween and a filling containing powdered aluminum disposed between said bodies.

4. A circuit-closing device comprising a plurality of conducting bodies, an apertured spacer disposed therebetween and loosely confined powdered aluminum disposed between said bodies in the aperture of said spacer.

5. A short-circuiting device comprising a plurality of conducting bodies and readily fusible metallic particles disposed therebetween to collectively constitute an insulating medium until subjected to a breakdown voltage.

6. A short-circuiting device comprising a plurality of conducting surfaces and particles disposed therebetween to collectively constitute an insulating medium permitting the flow of only small leakage currents until subjected to a breakdown voltage, said particles including a readily fusible powdered ingredient that is conducting when fused.

7. A short-circuiting device comprising a plurality of conducting surfaces and an interposed foraminous non-conducting spacer impregnated with finely divided particles of a readily fusible metallic dust to constitute an insulating medium until subjected to a breakdown voltage.

8. A short-circuiting device comprising a plurality of conducting surfaces and an interposed foraminous spacer impregnated with finely divided readily fusible particles which are substantially insulated from each other until fused, to constitute substantially an insulating medium until subjected to a breakdown voltage.

9. A short-circuiting device comprising two electrically conducting plates and an interposed porous non-conducting spacer impregnated with finely divided particles of aluminum dust to constitute an insulating medium until subjected to a breakdown voltage.

10. A short-circuit device comprising two electrically conducting plates, a non-conducting spacer having an opening therein and finely divided particles of aluminum dust disposed in said opening to constitute an insulating medium until subjected to a breakdown voltage.

11. In combination with an electric circuit, a short-circuiting device comprising two electrically conducting plates, and an interposed foraminous non-conducting spacer impregnated with finely divided particles of a readily fusible metallic dust to constitute an insulating medium until subjected to a breakdown voltage.

12. A short-circuiting device comprising two electrically conducting plates, a non-conducting spacer having an opening therein and finely divided particles of a readily fusible metallic dust disposed in said opening to collectively constitute an insulating medium until subjected to a breakdown voltage.

13. A short-circuiting device comprising two electrically conducting plates, and an interposed porous non-conducting spacer impregnated with a compound comprising carborundum powder, lamp black, a readily fusible powdered metal and a binder.

14. A short-circuiting device comprising two electrically conducting plates, and an interposed porous non-conducting spacer impregnated with a compound comprising lamp black, a readily fusible metallic dust, litharge and glycerine.

15. A cut-out device comprising two spaced electrode surfaces of a readily fusible metal and a filling of finely powdered oxide-coated, readily fusible, metallic particles therebetween.

16. A cut-out device comprising two spaced electrode surfaces of a readily fusible metal, a loose filling of aluminum powder therebetween, and an annular member of insulating material for confining the aluminum powder.

17. A cut-out device comprising two aluminum plates and an insulating spacing member therebetween, said spacing member comprising a normally high-resistance mixture including a finely divided metallic element which is capable of readily fusing over into a permanent conducting path upon breakdown of the cut-out.

18. A cut-out device comprising two spaced electrode surfaces of a readily fusible metal and a filling comprising a high-resistance material, interspersed therewith a finely divided metallic element which is capable of readily fusing over into a permanent conducting path upon breakdown of the cut-out, and a binder.

19. In connection with a current-translating device, a short-circuiting device adapted to become conductive on breakdown of the current-translating device and constituted by aluminum in powdered form having its granules in light contact and a thin insulating coating of aluminum oxide separating the granules.

20. In connection with a current-translat-

ing device, a short-circuiting device adapted to become conductive on breakdown of the current device and constituted by finely divided metal having its granules in light contact and a thin insulating coating of the oxide of the metal separating the granules.

21. In an incandescent electric lamp for connection in series, a safety device comprising a normally non-conductive shunt to the filament of the lamp capable on the filament being destroyed of becoming conductive by the action of the total voltage applied to the series and when thus rendered conductive of bridging over the faulty place, the shunt being constituted by aluminum in powder form having its granules in light contact and thin insulation separating the granules.

22. In an incandescent electric lamp for connection in series, a safety device comprising a normally non-conductive shunt to the filament of the lamp capable on the filament being destroyed of becoming conductive by the action of the total voltage applied to the series and when thus rendered conductive, of bridging over the faulty place, the shunt being constituted by aluminum in powder form having its granules in light contact and a thin insulating coating of aluminum oxide separating the granules.

23. In an incandescent electric lamp for connection in series, a safety device comprising a normally non-conductive shunt to the filament of the lamp capable on the filament being destroyed of becoming conductive by the action of the total voltage applied to the series and, when thus rendered conductive, of bridging over the faulty place, the shunt being constituted by aluminum powder mixed with a plasticizing agent and having its granules in light contact and thin insulation separating the granules.

24. In a series of incandescent electric miniature lamps combined to form a Christmas tree illumination, a safety device for each lamp, this safety device comprising a normally non-conductive shunt to the filament of the lamp, capable on the filament being destroyed, of becoming conductive by the total voltage applied to the series and when thus rendered conductive of bridging over the faulty place, the shunt being composed of aluminum powder and being contained in the interior of the lamp.

25. An electric device adapted for connection to an incandescent filament having a shunt for said filament comprising a supply of loosely aggregated particles and being non-conductive upon application of the normal voltage of the filament and becoming conductive upon the application thereto of a higher voltage.

26. An electric-light device comprising electric contact terminals adapted for connection to a resistance element and a shunt connecting said terminals comprising a supply of metallic granules.

27. An electric device comprising electric contact terminals adapted for connection with a resistance element, and a shunt connecting said terminals comprising a supply of loosely aggregated metal particles and being non-conductive upon application thereto of a predetermined voltage and becoming conductive upon application thereto of a relatively higher voltage.

In testimony whereof, I have hereunto subscribed my name this 24th day of November, 1926.

EARL J. HAVERSTICK.