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PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS

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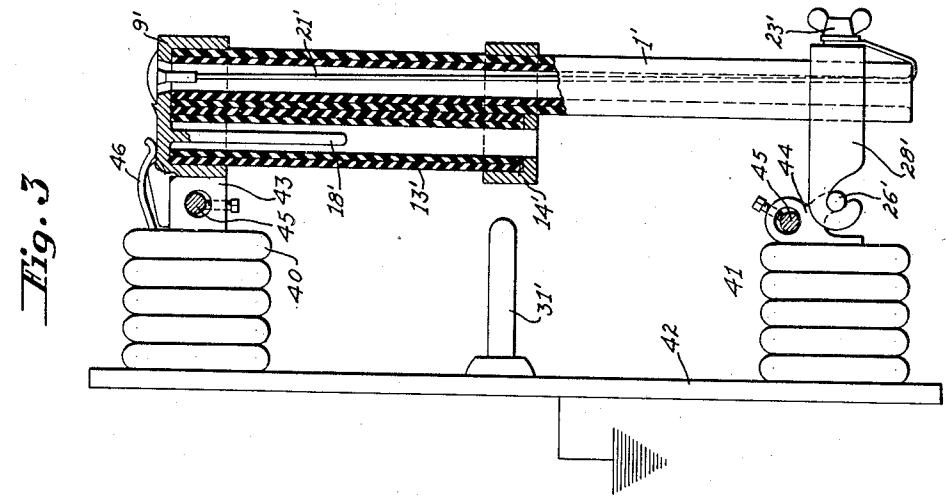


Fig. 3

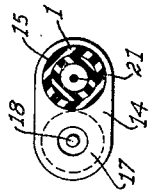


Fig. 2

Fig. 1

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PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS

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9 Claims. (Cl. 200—115)

This invention relates generally to protective devices for electric circuits, and more specifically to a protective device which is in the form of a cartridge adapted for arrangement in a switch mounting and including in combined unitary form a tube or other enclosing member in which a fusible element is arranged that is adapted to be ruptured by short circuit or overload in an electric circuit with which the device is associated, and a surge tube or other enclosing member having an air gap formed therein at which an electric arc is formed by passage through the surge tube of current surges due to cloud discharge, switching, and other causes, the predominant object of the invention being to provide a device of this type which is capable of performing its intended function in a highly efficient manner.

An important feature of the invention is that the surge tube is formed of or includes material which gives off gas when subjected to heat of an electric arc, which gas tends to extinguish the electric arc. Also, although it is not absolutely necessary that I do so, I prefer to arrange the surge tube of the improved structure in permanent, parallel contact with the fuse tube of the structure so as to provide a compact, unitary cartridge structure that is adapted for ready use with various types of switch mountings.

Fig. 1 is a side elevation of the improved protective device in association with a switch mounting, the surge tube and part of the fuse tube of the device being shown in section.

Fig. 2 is a cross-section taken in line 2—2 of Fig. 1, looking in the direction of the arrow.

Fig. 3 is a view of a slightly different form of the invention.

In the drawing, wherein are shown for the purpose of illustration, merely, two embodiments of the invention, Fig. 1 shows the invention as a part of a trip-out or drop-out fuse switch structure. In this view 1 designates a tubular fuse housing which constitutes a part of a cartridge that is removably and pivotally associated with the lower of a pair of relatively vertically spaced terminal members 2 and 3, the upper terminal member 3 being adapted to engage the free end of the fuse cartridge when the latter is disposed in switch closed position as appears in Fig. 1. The terminal members 2 and 3 are shown as mounted on an insulator 4 which is engaged by a suitable base element 5 which in turn is fixed to a cross arm or other support (not shown). Line connection with the lower terminal 2 is effected by means of a suitable connector 6 and with the upper terminal 3 by means of a vertically extended arm 7 and a suitable connector 8. The fuse tube 1 is of the expulsion type, said tube being open at the bottom and being formed of insulating material. If desired the tube 1 may be of composite construction, embodying an inner, tubular portion 1^a of horn fibre and an outer, jacketing portion 1^b of Bakelite or other insulating material having equivalent weather-resisting properties. It has been found advantageous to employ horn fibre in the construction of the tube because of the fact that such material has a beneficial de-ionizing effect on the arc which occurs when the fuse link ruptures, aiding materially in causing the arc to become quickly extinguished.

Secured to the tube 1 at the upper end thereof is a contact member 9 which is in the form of a cap, said member being provided with a bore 10 which snugly receives the upper portion of the tube 1. The member 9 includes a laterally extended portion 11 which is provided with a bore 12, and this bore snugly receives the upper portion of a surge tube 13. Fixed to the tube 1 at a point intermediate the opposite ends thereof is a member 14 which is provided with a bore 15 through which the tube 1 passes. The member 14 includes also a bore 16 which snugly receives the lower end portion of the surge tube 13, said member being open at its bottom face so that the bore of the surge tube is open to atmosphere. Also at the bottom face of the portion of the member 14 which receives the lower end of the surge tube 13 an annular flange portion 17 is provided which underlies and contacts with the lower edge of the wall of the surge tube.

From the foregoing it is plain that the members 9 and 14 securely fix the surge tube 13 to the fuse tube 1 so that said surge tube is arranged in contact and parallel with said fuse tube, whereby said fuse tube and surge tube constitute parts of an integral, unitary cartridge structure.

The member 9 is provided with a wall portion that closes the upper end of the bore formed through the surge tube 13, and extended downwardly from this wall portion into said bore of the surge tube is an electrode 18 which constitutes an arcing terminal. The member 14 constitutes a companion electrode or arcing terminal, the arc being formed between the lower end of the electrode 18 and the inner face of the annular flange portion 17 of said member 14 which is exposed in spaced relation to said lower end of said electrode 18 immediately beneath the

lower end of the face of the bore of the surge tube 13. The surge tube 13 is preferably of composite construction embodying an inner, tubular portion 13a of horn fibre and an outer, jacketing portion of Bakelite or other insulating material having equivalent weather-resisting properties, an inner, tubular portion of horn fibre being employed as a part of the surge tube because this material has been found to give off gas when subjected to heat of an electric arc that restores ionized air within the surge tube to its normal condition, and thereby causes quick extinguishment of the electric arc.

The upper wall of the member 9 which is disposed above the bore of the fuse tube 1 has an aperture formed therein through which is extended a portion 19 of a head element 20 which is attached to the fuse link 21, the outer, larger portion of said head element completely closing or sealing said aperture and having an externally convex upper face which provides contact surface for direct engagement by resilient arm portions of the upper terminal 3. The fuse link 21 extends downwardly through the tube 1 and out of the mouth at the lower end thereof, passing about an end portion of a hinge member 22 which abuts the lower end of the tube 1, the fuse link then extending to a binding post 23 on said hinge member by which it is engaged. This hinge member 22 is provided with a bifurcated portion 24 which straddles a portion of the lower terminal 2, and downwardly opening, hook-like portions 25 are provided at opposite sides of said bifurcated portion which engage trunnions 26 on the lower terminal 2. Also the hinge member 22 is pivotally connected at 27 to a laterally extended bracket 28, which is secured to the tube 1 at a point adjacent to its lower end. The member 9 is provided with a longitudinally extended guiding finger 29 which is adapted to pass between the parallel, resilient arms of the upper terminal 3, and also said member 9 is provided with a pull ring 30 which serves as a manipulating member for the cartridge.

Extended outwardly from the base element 5 of the insulator 4 is an arcing terminal 31 which is so disposed that its outer end is in spaced relation with respect to the member 14, so as to provide an air gap 32 between said elements which is in series with the air gap within the surge tube between the lower end of the electrode 18 and the member 14. The base element 5 has electrically connected thereto a conductor 33 which leads to ground.

When in the operation of the device a surge comes on the line an arc is formed within the surge tube 13 between the arcing terminals 18 and 14, and outside of the surge tube between the arcing terminals 14 and 31. When the power current attempts to follow, the heat of the arc within the surge tube causes the inner horn fibre element of the surge tube to give off gas which tends to extinguish or expel the arc and interrupt the flow of current to ground, thus restoring the circuit to normal condition. Also when the fuse link 21 of the device becomes ruptured, as by reason of abnormal current passing therethrough, the hinge member 22, freed at its outer or link-engaging end and acting under the forces imparted thereto, turns rapidly about the two axes defined by the trunnions 26 and the pin 27. Movement of the hinge member about the trunnions is accompanied by an endwise lowering of the cartridge which, when clear of the upper terminal 3, swings outwardly under gravity action to the full open position.

It is to be noted that operation of the device in response to surges coming on the line does not cause the cartridge to drop out of the circuit, and therefore surge protection is had in the use of the device until such a time as a short circuit or overload condition may rupture the fuse link and thus cause the cartridge to drop out of the circuit and interrupt said circuit.

The structure illustrated in Fig. 3 differs from the structure of Fig. 1 mainly in that the cartridge of the structure of Fig. 3 does not drop out of the circuit when the fuse link is ruptured. In Fig. 3 a pair of insulators 40 and 41 are mounted on a grounded base element 42, and these insulators support an upper terminal 43 and a lower terminal 44 to which line sections 45 are suitably connected. The cartridge of the structure of Fig. 3 includes a fuse tube 1' to which is attached through the instrumentality of the members 9' and 14' a surge tube 13'. The surge tube has an electrode or arcing terminal 18' extended downwardly into its bore, this electrode being supported by and extended from the member 9' and its lower end being in spaced relation with respect to the member 14' which constitutes a companion arcing terminal to said electrode. Also, an arcing rod 31' extends from the base element 42 so as to provide an air gap between the outer end of the arcing rod 31' and the member 14'. The fuse tube 1' has fixed to it a laterally extended bracket 28' provided with hook-like end portions which engage trunnions 26' on the lower terminal 44, and the upper portion of the cartridge is engaged by a resilient finger 46 whereby said cartridge is held in the switch closed position. A fuse link 21' is extended longitudinally through the bore of the tube 1', the upper end of said fuse link being attached to a head element which closes an opening in the top wall of the member 9' through which a portion of said head extends, and the opposite end of the fuse link passing from the open, lower end of the tube 1' and being engaged by a binding post 23' on the bracket 28'.

The operation of the device illustrated in Fig. 3 is the same as the operation of the device of Fig. 1 as already described herein, with the exception, as previously mentioned, that the cartridge of the structure of Fig. 3 does not drop out of the circuit when the fuse link is ruptured.

I claim:

1. A cartridge for a protective device for electric circuits adapted for disposition between spaced terminals of a switch mounting, comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube and provided with an air gap formed therein across which an electric arc is formed by electric current passing through said surge tube, a contact member at an end of the cartridge which receives in electrical contact therewith one of said spaced terminals and serves as a common contact for said fuse tube and said surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc.

2. A cartridge for a protective device for electric circuits adapted for disposition between spaced terminals of a switch mounting, comprising a fuse tube, a fuse link arranged in said fuse

tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube in parallel relation with respect thereto and provided with an air gap formed therein across which an electric arc is formed by electric current passing through said surge tube, a contact member at an end of the cartridge which receives in electrical contact therewith one of said spaced terminals and serves as a common contact for said fuse tube and said surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc.

3. A cartridge for a protective device for electric circuits adapted for disposition between spaced terminals of a switch mounting, comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, and a surge tube fixedly associated with said fuse tube and provided with an air gap formed therein across which an electric arc is formed by electric current passing through said surge tube, a contact member at an end of the cartridge which receives in contact therewith one of said spaced terminals and serves as a common contact for said fuse tube and said surge tube, said air gap being provided by spaced arcing terminals associated with said surge tube one of which is carried by said contact member, and said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc.

4. A cartridge for a protective device for electric circuits adapted for disposition between spaced terminals of a switch mounting, comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube, a contact member at an end of the cartridge which receives in electrical contact therewith one of said spaced terminals and serves as a common contact for said fuse tube and said surge tube, an arcing terminal extended longitudinally into said surge tube from said common contact, and a second arcing terminal associated with said surge tube in spaced relation with respect to said longitudinally extended arcing terminal so as to provide an air gap within the surge tube across which an electric arc is formed by electric current passing through the surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc.

5. A cartridge for a protective device for electric circuits adapted for disposition between spaced terminals of a switch mounting, comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube in parallel relation with respect thereto, a contact member at an end of the cartridge which receives in electrical contact therewith one of said spaced terminals and serves as a common contact for said fuse tube and said surge tube, an arcing terminal extended longitudinally into said surge tube from said common contact, and a second arcing terminal associated with said surge tube in spaced relation with respect to said longitudinally extended arcing terminal so as to provide an air gap within the surge tube across which an electric arc is formed by electric current passing through the surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc.

6. A cartridge for a protective device for electric circuits adapted for disposition between spaced terminals of a switch mounting, comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube in parallel relation with respect thereto, a contact member at an end of the cartridge which receives in electrical contact therewith one of said spaced terminals and serves as a common contact for said fuse tube and said surge tube, an arcing terminal extended longitudinally into said surge tube from said common contact, and a second arcing terminal associated with said surge tube in spaced relation with respect to said longitudinally extended arcing terminal so as to provide an air gap within the surge tube across which an electric arc is formed by electric current passing through the surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc, said member which provides a common contact for the fuse tube and the surge tube aiding in retaining said fuse tube and said surge tube in their assembled relation.

7. A cartridge for a protective device for electric circuits adapted for disposition between spaced terminals of a switch mounting, comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube in parallel relation with respect thereto, a member at an end of the cartridge which serves as a common contact for said fuse tube and said surge tube, an arcing terminal extended longitudinally into said surge tube from said common contact, and a second arcing terminal associated with said surge tube in spaced relation with respect to said longitudinally extended arcing terminal so as to provide an air gap within the surge tube across which an electric arc is formed by electric current passing through the surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc, said member which provides a common contact for the fuse tube and the surge tube being arranged in embracing relation with respect to corresponding ends of said fuse tube and said surge tube and thereby aiding in retaining said fuse tube and said surge tube in their assembled relation.

8. A protective device for electric circuits comprising a mounting providing spaced terminals and including a grounded base element, a cartridge disposed between said spaced terminals, said cartridge comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube and having spaced arcing terminals which provide an air gap within said surge tube, across which an electric arc is formed by electric current passing through said surge tube,

and an arcing terminal arranged outside of said surge tube and in electric connection with said grounded base element, the last-mentioned arcing terminal being disposed in spaced relation with respect to one of the arcing terminals of the surge tube to provide an air gap outside of the surge tube which is in series with the air gap within the surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the arc.

9. A protective device for electric circuits comprising a mounting providing spaced terminals and including a grounded base element, a cartridge disposed between said spaced terminals, said cartridge comprising a fuse tube, a fuse link arranged in said fuse tube and adapted to be ruptured by abnormal current passing therethrough, a surge tube fixedly associated with said fuse tube in parallel relation with respect thereto and having spaced arcing terminals which provide an air gap within said surge tube, across which an electric arc is formed by electric current passing through said surge tube, and an arcing terminal arranged outside of said surge tube and in electric connection with said grounded base element, the last-mentioned arcing terminal being disposed in spaced relation with respect to one of the arcing terminals of the surge tube to provide an air gap outside of the surge tube which is in series with the air gap within the surge tube, said surge tube being located at one side only of said fuse tube and being formed of material which gives off gas in the presence of an electric arc that tends to extinguish the electric arc.

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