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J. K. HODNETTE

2,424,314

PROTECTIVE LINK

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Fig. 1.

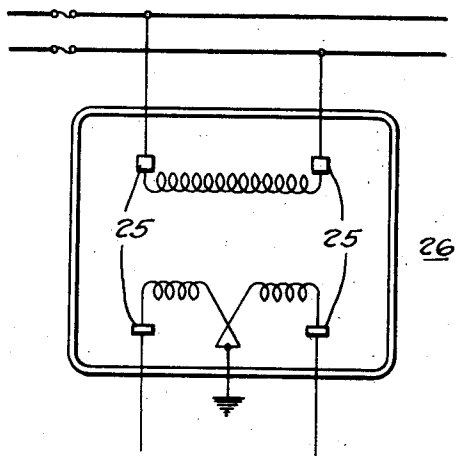


Fig. 2.

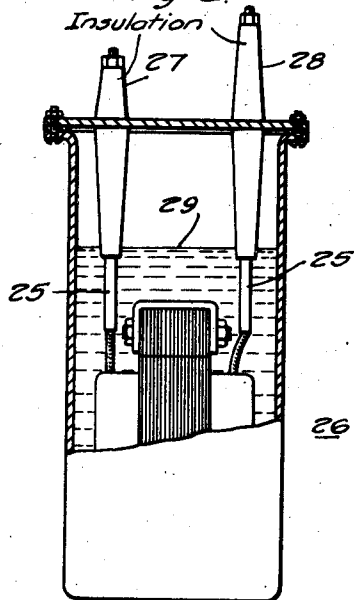
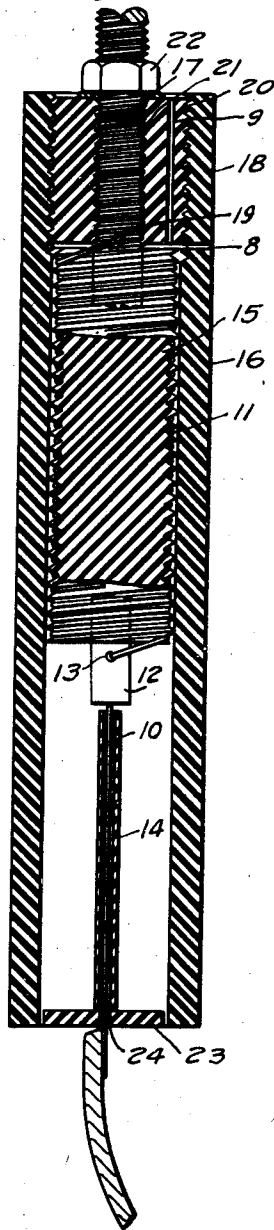


Fig. 3.



WITNESSES:

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PROTECTIVE LINK

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2 Claims. (Cl. 200-113)

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The invention relates generally to protective devices for electrical apparatus, and more particularly to the protective links for disconnecting the electrical apparatus to which it is connected when predetermined abnormal voltage and current conditions occur.

The object of the invention is to provide for restricting the amount of short-circuit current to which protective links are exposed in order to protect the electrical apparatus with which the protective links are employed.

The invention, accordingly, is disclosed in the embodiment thereof shown in the accompanying drawing and comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a diagrammatic view of the windings of a transformer showing the location of the protective link when it is connected in circuit relation with the transformer.

Fig. 2 is a view partly in section and partly in side elevation showing a protective link in a position in a transformer, and

Fig. 3 is a view partly in section and partly in side elevation showing a protective link constructed in accordance with this invention.

While this protective link has general application, it has particular value with power transformers where high short-circuit currents occur. It has been found that in designing protective links for transformers where the short-circuit current is not great that the external impedance and the arc drop in the link itself will so limit the short-circuit current that the electrical apparatus will be protected. However, there are situations when these protective links are employed with large power transformers where it is desirable to incorporate greater factors of safety to assure the complete protection of the transformer. The present link has incorporated in it protective features which adapt it for use with large power transformers.

Referring now to the drawing and Fig. 3 in particular, the protective link comprises a fusible conductor 10 and a resistor 11 which are shown connected in series circuit relation. The resistor and fusible conductor may be connected to one another in any suitable manner and in this instance, they are connected through a terminal stud 12. As shown, the fusible conductor 10 extends into an opening provided in the end of the terminal stud and may be brazed into the stud.

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The resistor 11 extends into an opening 13 in the side of the terminal stud 12 and it may be brazed to it.

The fusible conductor 10 may be made from some suitable material having the desired characteristics such as fusing temperature and capacity to resist corrosion by dielectrics and adequate mechanical strength. It has been found that a wire sold to the trade under the trade name of Everdur has these characteristics in sufficient degree to adapt it for use as the fusible conductor. Other materials that may be used are copper, aluminum and metals and alloys which are not effected by dielectrics.

The selection of the proper size of wire to be utilized in different fuses can readily be made in accordance with the teachings of my Patent 2,223,726, issued December 3, 1940, when the details of the transformer or other electrical apparatus to be protected are available. Therefore, it is believed to be unnecessary to go into detail on how to select or design a fusible conductor.

In the embodiment of the invention illustrated, a tube 14 is shown mounted on the fusible conductor 10. While in many instances, the fusible conductor 10 can be utilized without the tube, it has been found, as explained in the patent hereinbefore referred to, that the temperature at which the fusible conductor will fuse can be predetermined with much greater exactness when the tube is employed.

In this embodiment of the invention, the resistor 11 is wound in a groove provided in a cylindrical fiber member or plug 15 by threading it. The size and length of the resistor will depend on the conditions to be met in protecting predetermined electrical apparatus. When people skilled in the art have all the details on the apparatus to be protected available, they can readily select the size and length of the resistor and so it is believed to be unnecessary to give further details on the selecting of the resistor. It has been found that the resistor may be made from German Silver wire, Nicrome wire and other similar alloy wires or materials such as used in forming the link element itself.

A case 16 is provided for the fusible link 10 and resistor 11. In the embodiment illustrated, the cylindrical case 16 is made with an inside diameter only slightly greater than the outside diameter of the plug 15. The purpose of the small clearance between the plug and the inside wall of the case 16 is to permit the escape of gases entrapped therein and also to prevent flashovers across the turns of the resistor 11 when the fusible conductor 10 is fused upon the flow of predetermined currents. A threaded terminal member 17 engages in a threaded opening provided in the upper end of the cylindrical fiber member 15. This terminal member 17 is pro-

vided with an opening 19 for receiving the upper end of the resistor 11. The end of the resistor may be brazed to the terminal member in any well-known manner.

As illustrated, the upper end of the case 16 is threaded to receive an externally threaded plug 20. The plug 20 has an opening 21 therein through which the terminal member 17 extends. The diameter of the opening 21 may be made slightly greater than the external diameter of the terminal member 17 to permit a certain leakage of gas to clear the entrapped gas that may accumulate in the case. In some instances a vertical opening 9 may be made in the plug 20 or a horizontal opening 8 in the case 16 for the escape of gas.

A nut 22 is provided on the terminal member to support it in the plug 20. In this manner, the resistor 11 and fusible member 10 may be supported in position in the case. This also permits a predetermined adjustment of the position of the resistor 11 and fusible conductor 10 in the case.

In this modification of the invention, the lower end of the case is partially closed by a disk 23 provided with an opening 24 through which the fusible conductor 10 extends. When the fusible conductor is fused, the gases generated will project the disk 23 downwardly, thereby effecting a quick separation of the fused portions of the fusible conductor 10. The protective link described hereinbefore is shown diagrammatically at 25 as connected in the high and low-voltage sides of the transformer shown generally at 26.

In mounting the link in the transformer, any suitable method may be employed and in this particular example it is supported from the bushings 27 and 28. The protective link 25 is shown in Fig. 2 suspended from the terminal bushings 27 and 28. The functioning of the fusible member 10 is described in detail in my patent identified hereinbefore. A link of the proper capacity may readily be selected by referring to the curves which are always prepared in designing a link for particular apparatus. However, when the protective link is provided with a resistor, the design engineer will have to take into account the features of the resistor employed. When a resistor is utilized, the size of the link may be greatly decreased.

The link is immersed in a dielectric 29 as shown in Fig. 2. The dielectric cooperates in predetermining the characteristics as described in the foregoing patent.

A typical example which has been tested and found to be successful was in connection with 40,000 kv. a. transformers in which the voltage was stepped down from 132,000 to 11,000. The transformers were connected directly to the generators through disconnect switches. Inside the main transformer case there were 11,000 volt auxiliary transformers for supplying low-voltage power to the fans and pumps. These auxiliary transformers were protected by protective links. The short-circuit capacity of the low-voltage system was approximately 385,000 kv. a. By employing a protective link equipped with a resistor having a value of 1 ohm, the short-circuit current was reduced to 5500 amperes. This effected a great distance in the size of the link employed. Further, the normal loss in the resistor element

was small, since the normal current was approximately 1 ampere.

While in this embodiment of the invention the protective link is shown mounted completely in one case, it is to be understood that it would be possible to mount the resistor in a separate case from that of the fusible conductor provided they were electrically connected. Many different arrangements and combinations of the resistor and fusible conductor may be made while still following the disclosure made herein.

Since certain changes may be made in the above article and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. In a protective device for electrical apparatus provided with a dielectric liquid, in combination, a conductor having predetermined fusing characteristics, a resistor connected in series circuit relation with the fusible conductor, the resistor having a greater thermal capacity than the fusible conductor whereby the fusible conductor will fail before the resistor when they are subjected to fusing currents, a case for the fusible conductor and resistor, and means for carrying the resistor, the resistor and carrying means being so disposed in the case as to provide a passageway for a predetermined flow of gases such as occur in normal operation of the transformer through the case, the case being open at the lower end to admit the dielectric liquid and at the upper end to permit the escape of gases produced in operation.

2. A protective device for electrical apparatus provided with a dielectric liquid, in combination, a conductor having predetermined fusing characteristics, a resistor connected in series circuit relation with the fusible conductor, the resistor having a greater thermal capacity than the fusible conductor whereby the fusible conductor will fail before the resistor when they are subjected to fusing currents, a case for the fusible conductor and resistor, and a threaded insulator for carrying the resistor, the resistor being wound in the grooves provided in the insulator by the thread, the insulator being disposed in the case and smaller in outside diameter than the internal diameter of the case, thereby to provide a passageway for a predetermined flow of gases such as occur in normal operation of the transformer, the case being open at the lower end to admit the dielectric liquid and at the upper end to permit the escape of gases.

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