June 1, 1965 R. F. SCHRADER 3,187,146

BUSHING FUSE PROVIDED WITH A FUSE BODY OF STRONG INSULATING MATERIAL HAVING FLATTENED ENDS

Filed Feb. 16, 1962

Fig. 1.

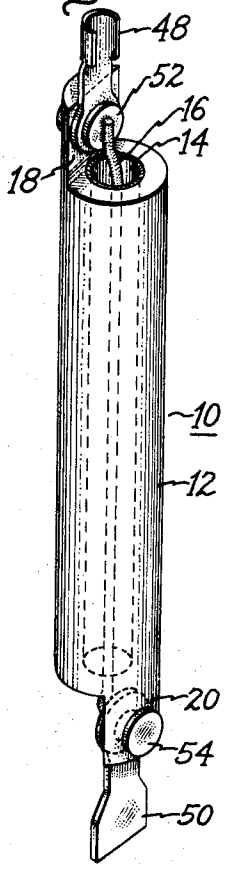


Fig. 2.

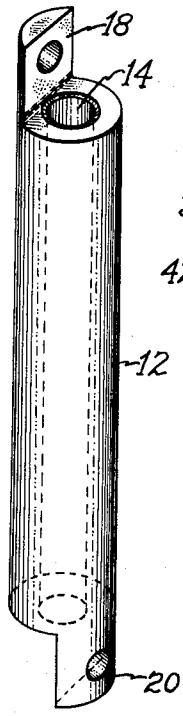


Fig. 3.

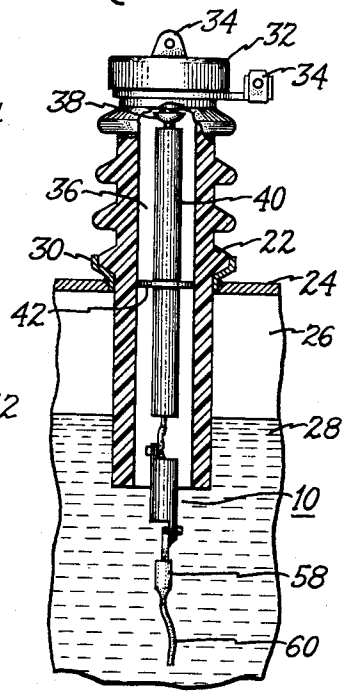


Fig. 4.

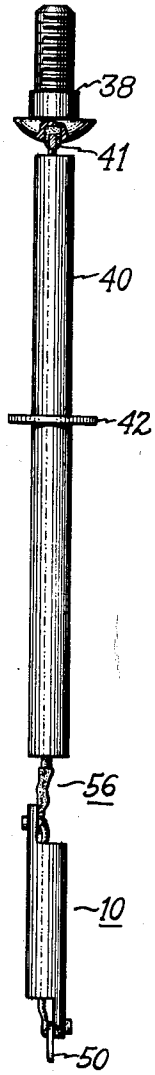
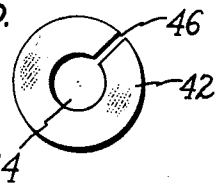


Fig. 5.



Inventor,
Roger F. Schrader,
by Francis X. Doyle
His Attorney.

United States Patent Office

3,187,146

Patented June 1, 1965

3,187,146

BUSHING FUSE PROVIDED WITH A FUSE BODY OF STRONG INSULATING MATERIAL HAVING FLATTENED ENDS

Roger F. Schrader, Pittsfield, Mass., assignor to General Electric Company, a corporation of New York

Filed Feb. 16, 1962, Ser. No. 173,736
3 Claims. (Cl. 200—113)

This invention relates to fuses and more particularly, to a fuse which is designed to fit within a bushing to provide protection for electrical apparatus such as transformers, and the like.

In the present state of the electrical apparatus protection art, and specifically the bushing fuse art, it is customary to provide a fuse in the high voltage bushing of the electrical apparatus. This fuse is usually connected between the high voltage lead to the electrical apparatus, and the high voltage portion of such electrical apparatus. As is well understood, in the transformer art, for example, the fuse serves as a protective device to remove high or low fault currents from the high voltage winding of the transformer. These bushing fuses are usually mounted completely within the high voltage bushing, and are generally provided with caps enclosing the end of the fuse. Of course, in some instances, it is known to provide a cap on one end of the fuse device while crimping or otherwise closing the opposite end thereof, to make the desired connection to a high voltage lead. These fuses, as is known, are generally of the expulsion type, such that when the fuse operates gases are generated which blow off the fuse cap and the terminal connected thereto. This normally provides an efficient means of positively disconnecting the fuse and expelling one terminal from the bushing. One example of this type of fuse is show in Patent No. 2,337,-353, granted December 21, 1943, and assigned to the same assignee as the present invention.

One of the basic problems which this type of fuse encounters is the tendency of the fuse tube to rupture within the bushing, due to the large quantity of gas evolved. As will be understood, this rupture of the fuse tube sometimes leads to damage of the high voltage bushing on the electrical apparatus. Another problem which is frequently encountered in these fuses is that the large volume of gas evolved on rupture of the fuse is generally directed in such a manner that the fuse tube and insulation are forced into the bushing. This operation of the fuse also tends to cause damage to the bushing. A further problem which has been encountered is found where the fuse is not maintained below the level of the liquid dielectric in the electrical apparatus. In these instances, the shock of the rupturing fuse has been known to rupture the bushing and at times, to blow off the cover of the electrical apparatus. A further problem which is always met in any manufacture, and particularly in the manufacture of protective devices for electrical apparatus, is the problem of the expense involved in manufacturing such fuse and providing it on the electrical apparatus. Clearly, the manufacturers of such devices are constantly faced with the problem of lowering the cost of these types of protective devices.

It is, therefore, one object of this invention to provide a new and improved bushing fuse in electrical apparatus.

A further object of this invention is to provide a bushing fuse for electrical apparatus having a fuse tube which will not rupture during operation of the fuse.

A still further object of this invention is to provide a bushing fuse designed such that the gas pressure will tend to force the fuse out of the bushing.

Still another object of this invention is to provide a bushing fuse which will always be maintained below the liquid dielectric of the electrical apparatus on which it is used.

A still further object of this invention is to provide a bushing fuse for electrical apparatus which will be simple in construction and inexpensive to manufacture.

In carrying out this invention in one form, a bushing fuse is provided having a fuse body of strong, insulating material. The body is open at each end, and has a fuse wire extending through the tube and secured to each end thereof. Means are provided at each end of the fuse tube for connecting such fuse into the high voltage side of an electrical device. The fuse is mounted within a bushing with a portion of the fuse extending below the bushing and into the liquid dielectric of the electrical device on which the fuse is used.

The invention which is desired to be protected will be particularly pointed out and distinctly claimed in the claims appended hereto. However, it is believed that this invention and the manner in which its objects and advantages are obtained, as well as other objects and advantages thereof, will be better understood from the following detailed description of a preferred embodiment thereof, especially when considered in the light of the accompanying drawing, in which:

FIGURE 1 is a perspective view of one form of bushing fuse made according to this invention;

FIGURE 2 is a perspective view of the fuse tube used in the bushing fuse shown in FIG. 1;

FIGURE 3 is a partial sectional view showing one application of the fuse of FIG. 1, the fuse being mounted in the bushing of an electrical transformer;

FIGURE 4 is a plan view of the form of bushing fuse shown in FIG. 1, showing its connection to a high voltage lead; and

FIGURE 5 is a top view of a spacing collar which may be used in one form of this invention.

Referring now to the drawing, in which like numerals are used to indicate like parts throughout the various views thereof, this invention in one form is shown as comprising a bushing fuse **10** which comprises an elongated fuse tube or body **12** having a central bore **14** extending axially therethrough. A fuse wire **16** extends through the bore **14** of the fuse tube **12** and is secured to the ends **18**, **20** of the fuse tube **12**. As will be understood, the bushing fuse **10** may be applied to any type of electrical apparatus where such protection is desired. However, for purposes of illustration, this invention will be described as being used to protect an electrical transformer.

Considering FIG. 3 of the drawing, the bushing fuse **10** is shown as being mounted within an insulated high voltage bushing **22**. The bushing **22** is mounted on a cover **24** of an electrical transformer, indicated by the partial tank wall **26**. The transformer will generally contain the usual windings (not shown) and is substantially filled with an insulating liquid dielectric material, generally indicated by the numeral **28**. The high voltage bushing **22** is mounted on the cover **24** and is usually sealed thereto in any desired manner, such as by the gasket material **30**. The bushing **22** is provided with a metallic cap member **32**, having lugs **34** for connection to a high voltage line, as will be well understood by those skilled in the art. The bushing **22** is provided with a central bore or chamber **36**, which is closed at the top by the metallic cap **32**. The cap **32** is provided with an opening (not shown) into the chamber **36** for connection to a bolt member or similar connector means, indicated at **38**, to provide the desired connection to a high voltage line, as is well understood.

An insulated lead is generally provided within the chamber **36** of the bushing **22** for connecting the high voltage winding (not shown) of the transformer to the high voltage line. In this instance, the insulated lead is

shown as the lead 40 which is secured in any desired manner, for example, by brazing as shown at 41 in FIG. 4 to the bolt member 38. The high voltage lead 40 extends through the interior chamber 36 of bushing 22, and at the lower end thereof the bushing fuse 10 is connected. One end of the bushing fuse 10 is secured to the lower end of the insulated lead 40, in any desired manner. As is well understood, when the insulated lead 40, extending through the bushing 22, is subjected to high voltage impulses, it tends to cause radio interference in the range of the transformer voltage rating, and also corona discharges between the insulated lead 40 and the sides of the bushing 22. This is generally due to the inequality of the high voltage stresses between the insulated lead 40 and the various sides of the bushing 22 around the chamber 36. In order to substantially eliminate these unequal high voltage stresses and thereby substantially cut down on any corona discharge and radio interference, it has been the practice to substantially completely fill the interior chamber 36 of the bushing 22 with insulation, such as, for example, crepe paper insulation completely wrapped around the insulated lead 40. However, as will be understood, this will materially increase the cost of the bushing and the lead 40. Therefore, it is desired to eliminate this filling insulation, if possible. In order to provide the desired equality of voltage stresses between the insulated lead 40 and the bushing 22 without filling chamber 36 with insulation, a collar member 42 is provided which is secured about the insulated lead 40. Collar 42 functions as a spacer member to maintain the insulated lead 40 centrally located within the chamber 36 of the bushing 22.

Referring to FIG. 5 of the drawing, the collar or spacer 42 is shown as comprising an insulated washer member having a central opening 44 therein, which is slightly smaller in diameter than the outside diameter of the insulated lead 40. A slot 46 is provided so that the member 42 may be stretched slightly about its opening 44 to fit about the insulated lead 40. There is sufficient resiliency in the insulated member 42 to enable it to be stretched and then to allow the spacer member 42 to retract about the insulated lead 40, securely maintaining the spacer 42 in any desired position on the insulated lead 40. Of course, it will be understood that washer member 42 is made of an insulation material sufficiently rigid to provide the desired spacing function, yet resilient enough to enable it to be stretched about lead 40. One material having these characteristics is kraft board. It will be understood that other insulating materials having these characteristics may be used, if desired. As shown in FIG. 3, the spacer 42 is placed about the insulated lead 40 so as to provide equal spacing of the lead within the chamber 36, the spacer 42 being positioned at approximately the position of the cover 24 of the transformer. This will provide the maximum spacing of the entire lead 40 and will substantially prevent unequal stresses being set up about the insulated lead 40, thereby substantially relieving the problem of corona discharge and radio interference.

Referring now to FIGS. 1 and 2 of the drawing for a more complete description of the bushing fuse of this invention, it can be seen that the bushing fuse 10 is comprised of a fuse body 12 which is made of a strong, insulating material, such as for example, epoxy bonded glass cloth. Of course, it will be understood, that this invention is not limited to the particular type of material, since any strong, rigid, insulating material which will withstand the rupture of the fuse member 16 will meet the requirements of the fuse tube 12. Since fuse tube 12 is a substantially rigid member, it is cut at each end to provide the flat surfaces 18 and 20 for connecting the fuse wire 16 through the fuse tube 12. As shown, particularly in FIG. 1, connecting means in the form of a crimp member 48 and a spade member 50 are connected to the flattened ends 18 and 20, respectively, in any desired manner. As shown in FIG. 1, the crimp connector 48 is connected to the flattened end 18 by means of a rivet 52, and, in a similar fashion, the spade connection 50 is connected to the flattened end 20 by means of a rivet 54. As will be understood, the fuse wire 16 is soldered to the rivets 52 and 54 to provide the desired electrical connection between connectors 48 and 50 and the fuse wire 16. The crimp connector 48 is connected to the conductor of the insulated lead 40 of bushing 22 by crimping over the conductor in the manner particularly shown at 56 in FIG. 4. Thus, a firm, electrical connection is provided between the lugs 34 of the bushing 22, and the fuse wire 16 through bolt 38, insulated lead 40, and the crimp connection 56. The spade connector 50 is forced into firm electrical contact with a female member 58 on the lead 60 from the high voltage winding (not shown) as indicated particularly in FIG. 3 of the drawing. In this manner, the bushing fuse 10 is mounted with bushing 22 in series in the high voltage line of the electrical transformer.

As shown, especially in FIG. 3 of the drawing, the insulated lead 40 is of such length that the bushing fuse 10 will be mounted in the bushing 22 with substantially half of the fuse member extending below the base of the bushing 22. As shown in FIG. 3, the level of the insulating liquid dielectric is maintained sufficiently above the bottom of the bushing 22 such that the entire bushing fuse 10 will be surrounded by the insulating liquid dielectric 28. By means of this mounting, and by having the lower portion of the bushing 10 outside of the bushing 22, it will be understood that when the fuse ruptures due to high or low fault currents the shock of the rupturing in the lower portion of the fuse will be absorbed throughout the quantity of the liquid dielectric material 28. However, the gases generated through the upper portion of the fuse 10 will be concentrated within the bushing 22 and will therefore provide a substantial expulsion force on the fuse 10; tending to force the fuse 10 out of the lower end of the bushing 22. As the fuse ruptures, especially on a high fault current, the expulsion forces will expel the fuse out of the lower end of the insulating bushing 22. In this operation of the fuse, the conductor of the insulated lead 40 will be snapped substantially directly above the crimped connection 56. Thereby, the entire bushing fuse 10 will be forced out of the bushing 22, severing the connection between lead 40 and bushing fuse 10. Thus, by means of the bushing fuse of this invention the entire fuse is blown out of the bushing 22 and the force of the expulsion is, in general, absorbed by the expulsion of the fuse 10. It should also be noted that since the lower portion of the bushing fuse 10 is mounted below the bushing 22, the expulsion forces at the lower end of the fuse are not concentrated so as to react against the expulsion forces at the top of the bushing fuse. These forces are substantially absorbed by the insulating liquid dielectric, and therefore, do not counteract the expulsion forces at the top of the bushing fuse, thereby allowing the entire bushing fuse to be forced out of the bushing 22. In this manner, it can be seen that the expulsive forces on the rupturing of the fuse, disconnect the fuse from the conductor of the insulated lead 40 and immediately remove the bushing fuse from bushing 22 without any of the deleterious effects on the bushing 22, as have been found in the prior art. Further, since the fuse tube 12 is made of a rigid, strong insulating material, such as for example, epoxy bonded glass cloth, the tube will not itself rupture during the rupturing of the fuse 10, and therefore substantial damage to the bushing 22 is also eliminated.

From the above description of the preferred embodiment of this invention it is believed clear that all of the objects and advantages hereinbefore set forth have been attained. However, it should be understood that while there has been shown and described a particular embodiment of the invention, it will be obvious to those

skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as set forth in the claims appended hereto.

What is claimed as new and which it is desired to secure by Letters Patent of the United States is:

1. A protective device for electrical apparatus which has a tank and a cover therefor, comprising, in combination; a bushing member secured to the cover of the electrical apparatus and extending therethrough, an insulated lead connected to one end of said bushing and extending through the major portion thereof, a fuse member having a fuse body of strong, rigid, insulating material, flattened end portions on each end of said fuse body, an electrical connector secured to each of said flattened end portions, one said electrical connector secured to said insulated lead, the other said electrical connector connectible to an internal lead of the electrical apparatus, a fuse wire electrically connected to each said electrical connector and extending through a bore in said fuse body, said fuse body being held in said bushing by said one electrical connector connected to said insulated lead with substantially half of said fuse extending below the bottom of said bushing, whereby when said fuse wire melts the gases generated thereby expel said fuse from said bushing.

2. A protective device for electrical apparatus comprising in combination a bushing member, an insulated lead connected to one end of said bushing member and extending substantially throughout a chamber formed in said bushing, a fuse member comprising a fuse body made of

strong, rigid insulating material, flattened end portions on each end of said fuse body, electrical connector means connected to each of said flattened end portions, said electrical connector means on one end of said fuse body being connected to said insulated lead, the electrical connector on the other end of said fuse body being adapted to be connected to the electrical portion of an electrical apparatus, a fuse wire electrically connected to each of said electrical connectors and extending through a bore in said fuse body, said fuse body being maintained in said bushing with substantially half of said fuse extending below the bottom of said bushing.

3. A protective device for electrical apparatus in combination as set forth in claim 2 in which a collar member is provided surrounding the insulated lead member and spacing said insulated lead member equally from all portions of said chamber formed in said bushing.

References Cited by the Examiner

UNITED STATES PATENTS

2,223,232	11/40	Smith	200—127 X
2,223,726	12/40	Hodnette	200—113
2,351,969	6/44	Hurst	200—117
2,509,935	5/50	Nelson	200—113
2,870,295	1/59	Haroldson et al.	200—120 X

FOREIGN PATENTS

492,029	2/19	France.
25,478	11/07	Great Britain.

BERNARD A. GILHEANY, *Primary Examiner.*