Aug. 9, 1949. D. F. DE VINE 2,478,624

CENTRIFUGAL CASTING OF GLASS BUSHINGS

Filed Dec. 10, 1946

Fig. 1.

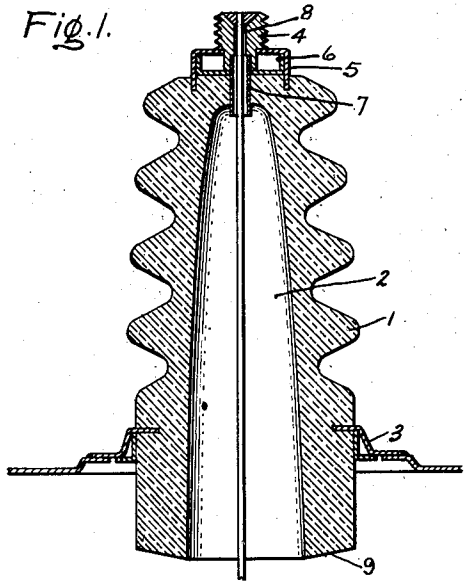


Fig. 2.

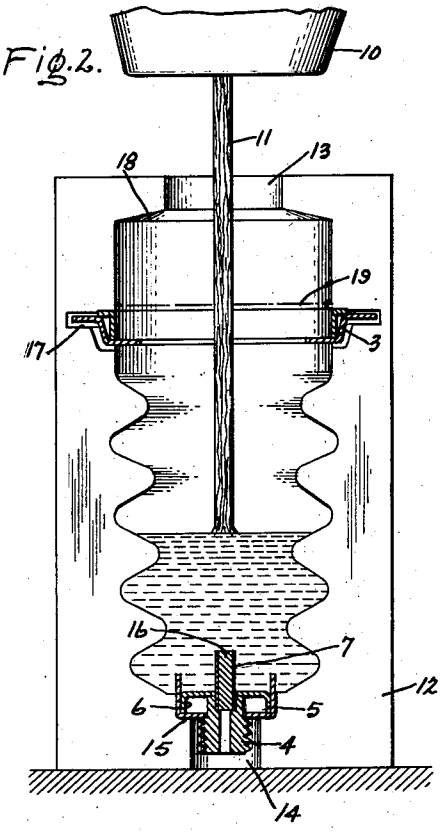


Fig. 3

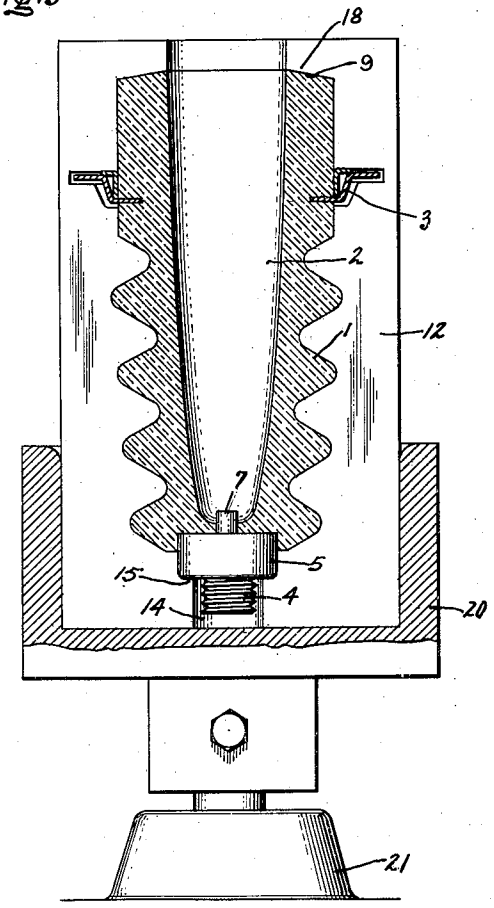
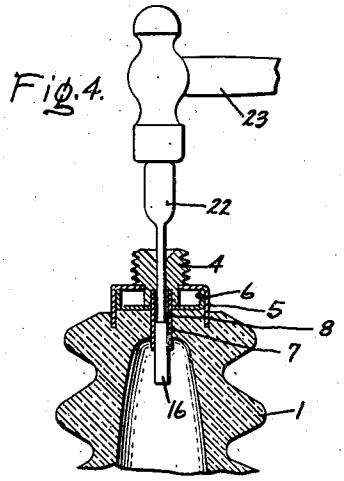


Fig. 4.



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CENTRIFUGAL CASTING OF GLASS BUSHINGS

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2 Claims. (Cl. 49—85)

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This invention relates to electrical insulating bushings and more particularly to a new and improved method of centrifugally casting such bushings and to the product of such method.

So-called glass bushings usually consist of a main body of glass to which metal parts are sealed. The glass acts as the insulation between the metal parts, one of which is usually a mounting flange that is normally at ground potential and another of which is a terminal that is normally at line potential. The metal and glass have such thermal expansion characteristics that a gas and liquid-tight permanent bond or seal is maintained between them throughout a wide range of rapid temperature changes.

The two principal methods of making such bushings are, first, to form the glass shape and then press the metal parts into the glass which is softened at the points of contact with the metal parts for this operation and, second, to cast the bushing in a mold in which the metal parts have already been placed in the proper relation. Casting has the advantage over the pressed method that the bushing, with its hardware, is formed in a single operation.

Conventional casting of bushings or what I call stationary solid casting of bushings, has however a number of disadvantages. In the first place, it is necessary to provide a metal tube or sheath extending entirely through the bushing from the bottom to the terminal end at the top. This is for the purpose of permitting a wire lead or conductor to be passed through the bushing. This metal tube or sheath must be made of material which properly expands and contracts with the glass in order to prevent cracking of the glass due to wide range, rapid temperature changes. Metal alloys which fulfill this requirement are relatively expensive. In the second place, the glass when it cools and hardens shrinks and forms a large irregular and uncontrollably shaped depression. It is therefore necessary to make a substantially longer casting than the finished bushing and then cut off the part of the glass casting which contains the shrunken depression. Consequently, a substantial amount of glass is wasted and the cutting operation is an additional item of expense.

One way to eliminate the tubular metal sheath is to use a flint coated steel core pin which is centrally located in the mold. However, this is troublesome and expensive and not very satisfactory for a number of reasons. For example, it leaves a very small space between the central core pin and the outer edge of the mold for the glass to be poured through, thus making the pouring

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operation difficult and limiting the kinds of glass which can be used because certain glasses will not pour in a fine enough stream to enter such a space.

In accordance with this invention, the mold can be essentially the same as is used in the conventional solid casting method. However, the mold is only partly filled with glass and is then spun rapidly about a vertical axis which coincides with the axis of the bushing, while the glass is still soft. The centrifugal force causes a hollow space to form in the center of the glass and causes the glass to rise at the edges or, in other words, along the surface of the mold. In this way a central opening is automatically formed in the bushing so that no central tubular sheath need extend throughout the length of the bushing and also the bottom of the bushing is formed smoothly by the mold.

In addition to eliminating the usual sheath which extends throughout the length of the bushing, the centrifugal casting method also insures that the length of the bushing will be correctly formed in the mold so that no glass need be wasted by cutting off the bottom of the bushing as is the practice when the bushings are solid cast. Furthermore, the central opening or depression in the bushing materially reduces the amount of glass in the bushing. Another advantage is that the hollow construction of the centrifugally cast bushing anneals more thoroughly and in less time than the solid stationary cast bushing and is less liable to have strains in the glass. Still another advantage is that the uniform relatively thin wall of the centrifugally cast bushing gives a higher thermal shock level than is obtained in the solid stationary cast bushing.

Comparative tests have shown that the thermal shock level of centrifugally cast bushings is 65° to 72° C. as compared to 50–55° C. for solid stationary cast bushings. The temperatures referred to are the differences in temperature between two water baths, held at constant temperatures, in which the bushing can be alternately immersed without cracking.

A still further advantage of the centrifugal casting method is that the shrinkage of the glass at the lower end of the bushing, which is unavoidable in the solid stationary casting method, is eliminated in the hollow centrifugally cast bushing. This prevents the possibility of the glass cracking away from the sheath and also improves the appearance of the bushing.

An object of the invention is to provide a new and improved electrical bushing.

Another object of the invention is to provide a novel, simple, and inexpensive method of casting glass bushings.

A further object of the invention is to reduce the cost and improve the strength and appearance of cast glass bushings.

The invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing, Fig. 1 is a longitudinal sectional view of a bushing made in accordance with the invention; Fig. 2 is a longitudinal sectional view of the pouring operation in the plane of separation of the two halves of the mold; Fig. 3 is a view similar to Fig. 2 illustrating the centrifuging operation in the making of a bushing, and Fig. 4 illustrates one of the later steps in the completion of the centrifugally cast bushing.

Referring now to the drawing, and more particularly to Fig. 1, the bushing is shown as consisting of a main body of glass 1 having a central hollow space 2 and outer petticoats. Embedded in and surrounding the lower end of the bushing is a mounting flange 3 of suitable metal alloy, while mounted on the top of the bushing is a terminal 4. This terminal is brazed or welded to a cup-shaped metal alloy member 5 whose edges are embedded in the glass. An inverted guard member 6 of the same material as the cup-shaped member 5 is fitted into the latter for the purpose of preventing the glass from coming in contact with the terminal 4 which is ordinarily of copper and does not have the proper coefficient of thermal expansion. A suitable alloy of which the parts 3, 5, and 6 may be made is one consisting of about 42% nickel and the rest iron. A short tubular member 7 of the same alloy as that of which the members 3, 5, and 6 are made extends between the end of the hollow space 2 and the terminal 4. This is for the purpose of accommodating a lead or conductor so that it may be connected to the terminal 4 and the latter is provided with an axial opening 8 to which the conductor may be fastened in any suitable manner as by brazing or soldering. This is shown in Fig. 1, which also shows the mounting flange 3 brazed or soldered to a supporting surface. The bottom of the glass member 1 is shown slightly beveled at 9 and this beveled surface is smooth like the other surfaces of the glass member 1. The glass 1 may be colored so as to prevent sunlight from sludging oil or other dielectric liquid which sometimes fills the hollow space 2. A suitable color is amber.

In Fig. 2 glass from a furnace 10 is being poured in a stream 11 into a mold 12 through an opening 13 provided for this purpose. The mold is split longitudinally through its center for removing the bushing after it has hardened and in Fig. 2 the face of half the mold is in the plane of the paper. The mold has a bottom opening 14 and a shoulder 15 for supporting the terminal assembly. The inside of the mold is ordinarily a surface of revolution about its center line.

For preventing the molten glass from running out of the short tube 7, a plug 16 has been inserted therein. For accommodating the mounting flange 3, the mold is provided with a circular groove 17. For forming the bottom 9 of the glass bushing, the mold has a turned-in beveled inner edge 18. The mold is filled only to the static level indicated by the dot and dash line 19.

In Fig. 3, the mold 12 has been placed in a suitable jig or chuck 20 which is arranged to be

spun around a vertical axis through the center of the terminal 4 by any suitable means as by an electric motor 21, only part of which is shown. This spinning action takes place while the glass is still soft with the result that centrifugal force causes the hollow space 2 to form in the center of the glass and causes the glass to rise up the sides of the mold where it is pressed against the inwardly turned lip 18 of the mold so as to form the smooth beveled bottom surface 9 of the bushing. The mold is spun until the glass cools sufficiently to retain its shape. The bushing is then removed from the mold 12 and ordinarily is placed in a conventional annealer.

After the bushing has been annealed, the plug 16 is then driven out of the short tube 7 in any suitable manner such as by means of a punch 22 inserted in the bore 8 and a hammer 23.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that changes and modifications can be made without departing from the invention and therefore it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a method of making a glass bushing, the steps of providing a mold having an opening at each end, fitting a bushing mounting flange into said mold, mounting said mold with the openings in vertical alignment, closing the lower opening with means including a tube having a filler plug, said tube extending into said mold a relatively short distance from the bottom thereof, pouring molten glass into said mold until the molten glass level is between the top of said tube and the top of said mold, spinning said mold about a vertical axis at a speed sufficient for centrifugal force to cause the glass to rise up the sides of the mold to the top thereof and form a central hollow space extending down below the top of said tube, continuing said spinning operation until the glass has hardened sufficiently to retain its centrifugally formed shape, and driving said plug out of said tube so as to provide a passageway for an electrical conductor through said bushing.

2. In a method of centrifugally casting a glass bushing, the steps of providing a mold having an opening at each end, fitting a bushing mounting flange in said mold, mounting said mold with the openings in vertical alignment, closing the lower opening with means including a nickel-iron alloy tube having a filler plug, said tube extending vertically into said mold a relatively short distance from the bottom thereof, pouring molten glass into said mold until the molten glass level is between the top of said tube and the top of said mold, spinning said mold about a vertical axis passing through said opening at a speed sufficient for centrifugally forcing the glass to rise up the sides of the mold to the top thereof and form a hollow space extending down below the top of said tube but above the bottom of said mold, continuing said spinning operation until the glass has hardened sufficiently to retain its centrifugally formed shape, removing the glass bushing from said mold, annealing said bushing, and driving said plug out of said tube so as to provide a passageway for an electrical conductor through said bushing.

DONALD F. DE VINE.

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