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SEALING ARRANGEMENT FOR ELECTRICAL INSULATING BUSHINGS

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*Fig. 1.*

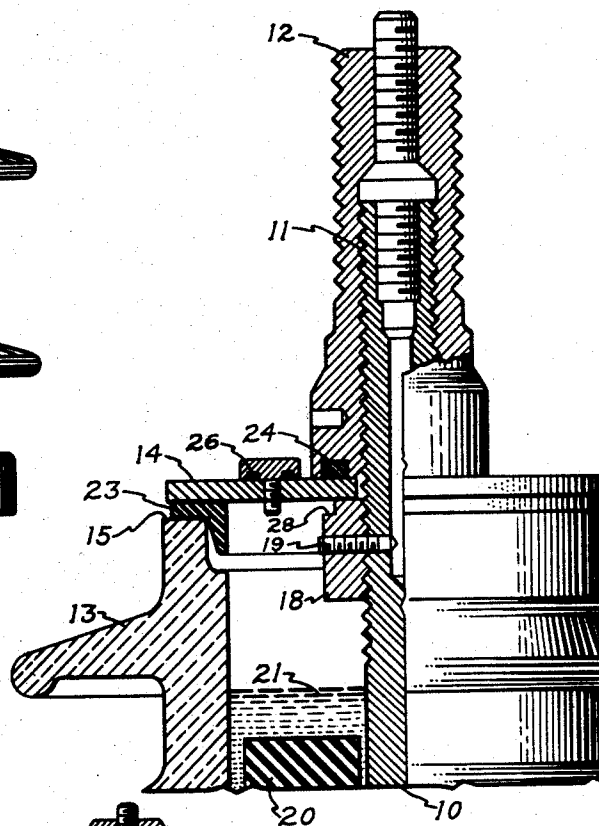
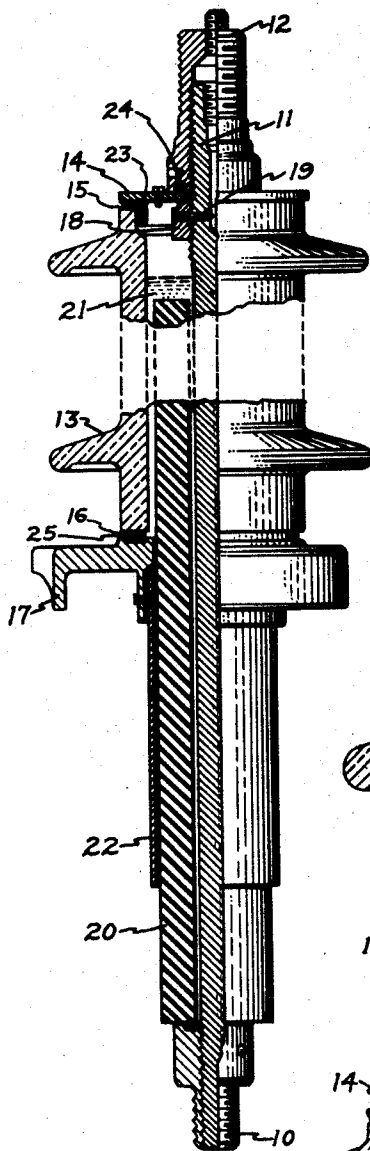


*Fig. 2.*

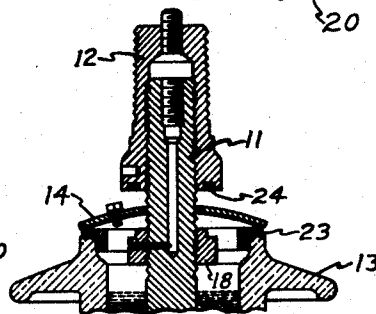


*Fig. 3.*

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## SEALING ARRANGEMENT FOR ELECTRICAL INSULATING BUSHINGS

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2 Claims. (Cl. 174-167)

This invention relates to electrical bushings, and more in particular to an improved sealing arrangement between metallic and porcelain members of a high voltage insulating bushing.

High voltage electrical insulating bushings of one type are comprised of a central conductor extending centrally through the bushing from a terminal assembly at one end thereof. One end of the central conductor is surrounded by a ceramic insulating shell which extends from the terminal assembly to a centrally located mounting flange, the flange being electrically insulated from the central conductor. The present invention relates primarily to the seal between the terminal assembly and the ceramic insulating member.

In one type of terminal arrangement, the central conductor is threaded on its end to receive an internally threaded terminal cap, the terminal cap also having external threads to which external connections may be made. A frustoconical shell disc-type spring washer (hereinafter referred to as a disc-type spring washer or spring washer), commonly known as a Belleville washer, was provided separated from the end of the ceramic insulating member by an annular gasket, the threaded portion of the central conductor extending through the aperture in the disc-type spring washer. The terminal cap, upon being threaded onto the central conductor, engaged the central portion of the spring washer, and applied sufficient deflection force to the spring washer to provide sealing at the annular gasket on the end of the ceramic insulating member and a gasket between the terminal cap and the spring washer. The spring washer was provided to maintain force on the gaskets while allowing for different temperature coefficients of expansion of the central conductor and ceramic shell member.

While the above described arrangement was satisfactory from the standpoint of sealing, it was found to be undesirable in some situations since the back pressure of the spring washer against the terminal cap was limited only by the force deflection characteristics of the spring washer. Thus, with the above described arrangement, it was possible to apply sufficient force on the spring washer to force it out of its desired shape. Thus, it was desirable to provide an arrangement wherein the terminal cap could be tightened with unlimited torque as insurance against loosening of the terminal cap, without adversely affecting the spring washer.

This was accomplished by placing a rigid unthreaded disc between the ceramic shell and the spring washer. The disc was supported at its outside diameter by the porcelain (by way of a gasket). Although this arrangement allowed a very high torque in assembling the top terminal, the back pressure provided by the spring washer was not retained on thermal expansion of the central conductor. In other words, when the central conductor expanded the back pressure on the terminal cap was provided only by the spring washer, and thus the initial tightening of the terminal cap was only effective when the bushing was cool.

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It is therefore an object of this invention to provide an improved high voltage electrical insulating bushing.

It is also an object to provide an improved seal between the ceramic insulating member and central conductor of a high voltage electrical insulating bushing.

It is a further object of this invention to provide a seal for a high voltage electrical insulating bushing of the type having a disc-type spring washer extending between the ceramic insulating member and the central conductor, the seal being characterized by the fact that the terminal cap may be tightened without regard to the force deflection characteristics of the spring washer, and the tightness is not effected by expansion or contraction of the central conductor.

Briefly stated, in accordance with one aspect of this invention, we provide a high voltage electrical insulating bushing comprising a central conductor having at least one threaded end. An insulating shell is provided radially surrounding at least the portion of the central conductor adjacent the threaded end, according to the conventional practice. An internally threaded terminal cap is threaded on the end of the central conductor. A frustoconical shell disc type spring washer is provided extending between the threaded end of the central conductor and one end of the insulating shell, and the terminal cap is arranged to hold the spring washer in sealing engagement with the end of the insulating shell, i.e., to provide a liquid seal between the insulating shell and washer. Stop means, such as a nut, is provided on the central conductor holding the spring washer against the terminal cap, thereby limiting the deflection of the spring washer resulting from tightening of the terminal cap on the end of the central conductor.

While the specifications conclude with claims particularly pointing out and distinctly claiming the subject matter which we regard as our invention, it is believed that the invention will be better understood from the following disclosure taken in connection with the accompanying drawing.

In the drawing:

Fig. 1 is a partially cross sectional view of one form of a high voltage electrical insulating bushing according to the invention,

Fig. 2 is an enlarged partially cross sectional view of the bushing of Fig. 1, and

Fig. 3 is a cross sectional view of a portion of the bushing of Fig. 1 prior to tightening of the terminal cap.

Referring now to the drawing, therein is illustrated a high voltage electrical insulating bushing having a central conductor 10. The central conductor may be solid, as illustrated, as is commonly the practice for circuit breaker bushings, or it may be hollow and be provided with a central cable as is commonly the practice with transformer bushings. The end 11 of the bushing is threaded to engage the internal threads of a terminal cap 12, the terminal cap 12 extending axially from the upper extremity of the central conductor. An insulating shell 13, which is preferably of a ceramic material according to conventional practice is provided radially surrounding the upper portion of the central conductor, and a frustoconical shell disc type spring washer 14 extends between the central conductor and the upper end 15 of the insulating shell 13. The lower end 16 of the insulating shell 13 engages a centrally located mounting flange 17 rigidly mounted with respect to the central conductor and insulated therefrom.

A stop means preferably in the form of a nut 18, is also provided on the upper threaded end 11 of the central conductor. The nut 18 is positioned such that the spring washer 14 is rigidly held between the nut 18 and the terminal cap 12, while sufficient axial force is exerted on the spring washer by the terminal cap to provide a

sealing engagement between the spring washer and the upper end 15 of the insulating shell. The nut 18 is preferably held firmly on the central conductor, such as by a set screw 19.

As is commonly the practice in high voltage electrical insulating bushings, an insulating core 20, preferably of resin-impregnated laminar insulating material, may be provided surrounding the central conductor and extending from the lower end of the bushing, through the mounting flange, and into a dielectric fluid filled chamber 21 defined by the insulating shell 13 and central conductor 10. A ground shield 22 may also be provided surrounding the insulating core 20 and extending from the mounting flange 17 toward the lower end of the bushing.

Suitable gaskets, such as a gasket 23 between the upper end of the insulating shell and the spring washer, a gasket 24 between the spring washer and the terminal cap, and a gasket 25 between the lower end of the insulating shell and the mounting flange, are provided to ensure sealing of the dielectric fluid filled chamber 21. A gasketed plug 26 is provided in the spring washer to facilitate filling of the chamber 21 with dielectric fluid.

In the fabrication of the upper portion of the bushing (see Fig. 3), the stop nut 18 is first threaded onto the end of the central conductor for a predetermined distance, depending upon the length of the insulating shell. It is preferable that the nut be located such that during operation of the bushing the condition never arises when the spring washer is "dished" in the opposite direction from its normal position, the spring washer being initially assembled with its convex surface toward the upper end of the bushing. In order to ensure that the above condition does not occur as a result of thermal contraction of the components of the bushing, a reference surface or line may be provided on the nut, such as the shelf 28 provided below the upper surface of the nut 18, the reference being initially aligned with a reference on the insulating shell, such as the upper end 15, during assembly of the bushing at a predetermined temperature, such as room temperature. The references should be located so that the "opposite dishing" of the washer will not occur when the bushing is subject to the extreme temperatures normally expected during operation of the bushing, and thus, as illustrated in the drawing, the shelf 28 is located within the plane of the upper end 15 of the insulating shell, so that a portion of the nut extends upwardly beyond the upper end 15 of the insulating shell. While the disc type spring washer is illustrated as being flat in Figs. 1 and 2 for the sake of clarity of the drawing, in actual operation of the bushing the center of the washer would be slightly dished toward the upper end of the bushing.

Still referring to Fig. 3, after the nut 18 is in place and secured with the set screw 19, the spring washer is placed over the central conductor, with the convex surface toward the upper end of the bushing. Then the terminal cap is threaded over the end of the central conductor, and provided with sufficient torque that the lower face of the spring washer tightly engages the upper surface of the nut 18, as illustrated in Figs. 1 and 2. At this time, sealing engagement will occur between the outer lower surface of the spring washer and the upper end of the insulating shell.

The arrangement of this invention, as previously disclosed, provides a bushing in which the back pressure on the terminal cap is not limited by the force deflection characteristics, as in the case of previous bushings of this type not supplied with a stop nut, and therefore substantially unlimited torque may be applied to the terminal cap. This is extremely advantageous from the standpoint that personnel assembling previous bushings in some cases applied too much torque to the terminal cap and effective sealing of the bushing was lost because of dishing of the spring washer in the opposite direction (i.e., toward the lower end of the bushing), and the force de-

flection characteristics of the washer varied due to deflection beyond the elastic limit of the material.

The arrangement of this invention also has the advantage that the back pressure on the terminal cap is not lost as a result of thermal contraction or expansion of the bushing, as in the case where a non-threaded disc is placed under the spring washer and bears against the end of the insulating shell, since the spring washer in the arrangement of the present invention is held tightly between the terminal cap and the stop nut.

The stop nut also acts to gauge the deflection of the spring washer, and thus enables the obtaining of maximum sealing benefit from the force deflection characteristics of the spring washer.

It will be understood, of course, that, while the form of the invention herein shown and described constitutes the preferred embodiment of the invention, it is not intended herein to illustrate all of the possible equivalent forms or ramifications thereof. It will also be understood that the words employed are words of description rather than of limitation, and that various changes may be made without departing from the spirit or scope of the invention herein disclosed. For example, while the bushing has been described in terms of "upper" and "lower" parts, these terms are purely relative, and do not indicate the physical position of the bushing in operation. It is aimed in the appended claims to cover all such changes as fall within the true spirit and scope of the invention.

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

1. In a high voltage electrical insulating bushing, a central conductor having a threaded end, dished spring washer means on said threaded end, an insulative shell radially surrounding at least a portion of said central conductor, said washer means being supported at its periphery by one end of said insulating shell, terminal cap means on the threaded end of said central conductor contacting said washer means on one side thereof for causing flexing of said washer means and for holding said washer means in sealing engagement with said one end of said insulating shell, stop means on said central conductor on the side of said washer means opposite said one side thereof for limiting the axial movement of said washer means with respect to said central conductor, said stop means having a washer contacting surface and a shelf portion lying in a plane spaced from said washer contacting surface a predetermined distance, said shelf portion being adapted to serve as a reference plane for aligning said stop means with the washer supporting end of said insulating shell, and said shelf portion being located in the same radial plane with respect to said central conductor as said one end of the insulating shell, so that the washer contacting surface extends beyond the insulating shell a distance equal to said predetermined distance, and said predetermined distance being such that said washer contacting surface when spaced beyond said insulating shell will act as a stop preventing said washer from being flexed beyond its elastic limit, whereby substantially unlimited torque can be applied to said terminal cap means in assembling the parts of the bushing without causing opposite dishing of said washer.

2. The bushing of claim 1 in which said stop means is a nut threaded on said central conductor.

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