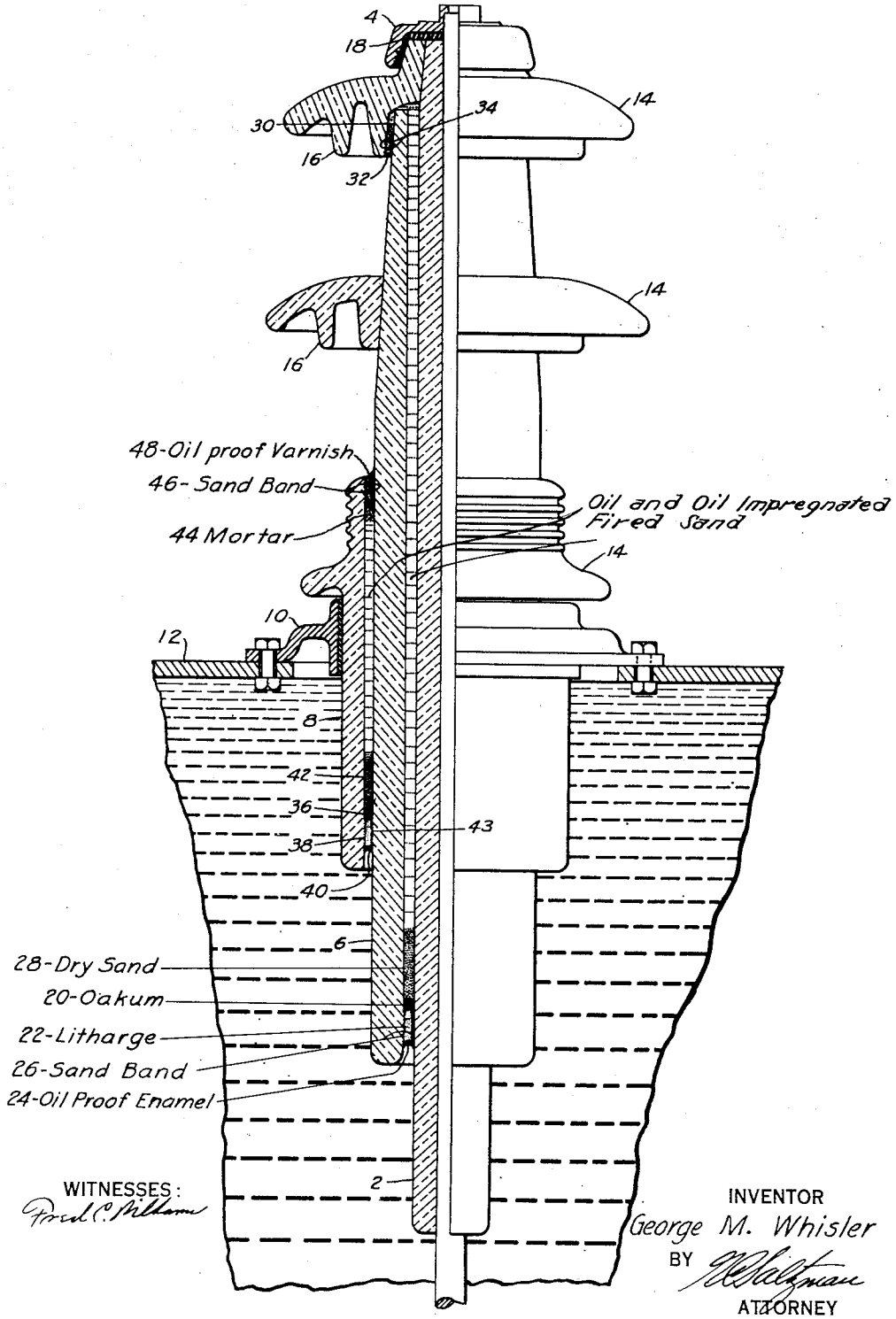
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OIL AND SAND FILLED BUSHING

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WITNESSES:

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OIL AND SAND FILLED BUSHING

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My invention relates to electrical insulators of the bushing type, such as are used for encasing the leads of high-tensioned electrical apparatus of the oil-filled type.

The construction of bushings for oil-immersed circuit-breakers, transformers, and the like, has always presented a problem by reason of the necessity of providing an oil-tight joint on the end of the bushing which is immersed in the circuit-breaker or transformer insulating oil. Such bushings, particularly in the case of high-tension apparatus, are usually formed of a plurality of concentrically arranged porcelain shells which are radially spaced to obtain the desired insulating properties, and the space between the shells is filled with a fluid dielectric material. In the past, the dielectric material employed has usually been a highly viscous compound, such as asphaltum, but recent investigations have indicated that such material is not altogether satisfactory because when subjected to the heating and cooling cycles of ordinary weather conditions, the insulating oil from the transformer or circuit-breaker tank creeps past the supposedly fluid-tight joint at the bottom of the bushing, and mixes with the asphaltic compound. As a result, the oil which is drawn into the bushing and into contact with the asphaltum, becomes of such viscosity that it cannot flow back into the transformer or circuit-breaker tank when the heating cycle occurs. Therefore, with each cooling cycle the volume of material between the porcelain shells becomes greater, and after a period, perhaps only a matter of months, a heating cycle will cause sufficient expansion of the material between the shells to crack the shells, thereby ruining the bushing.

It is an object of the present invention to provide, in a bushing of the multi-part porcelain shell type, an improved dielectric filling between the shells which shall be effective under varying temperature conditions to maintain the proper insulating value of the bushing without injuring it mechanically.

In practicing the present invention, the annular spaces between the porcelain shells of a bushing for high-tension electrical apparatus are closed at each end with a suitable sealing medium and the chamber is substantially filled with a mixture of oil and porous sand, so that the oil impregnates the grains of the sand and fills the voids therebetween. The oil is preferably of the same viscosity as that in which the high-tension apparatus is immersed.

A preferred embodiment of the invention is disclosed in the attached drawing, wherein the single figure is a view, in elevation, partially in section, of a bushing design embodying the invention.

Referring more specifically to the drawing, the bushing of my invention comprises a tube or shell **2** of dielectric material, such as porcelain, adapted to surround a metallic conductor, as shown, the upper end of which may be suitably secured to a metallic cap **4** in a usual and well known manner.

Surrounding the shell **2** and slightly radially spaced therefrom is a second tube **6** of dielectric material, such as porcelain, which is, in turn, surrounded by a tube **8** of the same material. A mounting flange **10** of metal is suitably cemented or secured to the shell **8** and is adapted to be secured to the tank **12** of the electrical apparatus with which the bushing is associated.

The tank **12** may contain a transformer, circuit breaker or other electrical apparatus, having a lead which extends through the shell **2** for connection, by means of the cap **4** and a suitable terminal, to the associated electrical circuit.

The shells **6** and **8** are provided with weather sheds and creepage flanges **14** and **16**, in accordance with usual practice. The upper weather shed **14** may be integral with the upper end of the shell **2**, or comprise a separate piece, as shown in the drawing, suitably secured to the upper end of shell **2**, and is provided with a crown proportioned to be received within the metal cap **4**. The metal cap is suitably cemented to the crown portion as shown, and if desired, a spacer member **18** of resilient material may be interposed between the top of the crown and the base of the recess in the metal cap **4**.

At the lower extremity of the shell **6** a seal is provided to close the bottom of the annular chamber defined by the adjacent walls of shells **2** and **6**. This seal is made as nearly fluid-tight as possible, but it has been found in practice that it is practically impossible to make a seal which is always fluid-tight under varying temperature conditions. In the present embodiment, the seal comprises a packing **20** of oakum or similar fibrous packing material and a layer **22** of litharge, which is quite commonly used for this purpose. The exposed surface of the layer **22** may be covered, as indicated at **24**, with a varnish or other suitable oil-proof coating. Glazed sand bands **26** may be provided on confronting areas of the shells **2** and **6** to anchor the litharge layer **22** in the position shown.

Above the layer **20** of oakum is a quantity of

dry sand 28 constituting an expansion space, as will appear hereinafter.

The upper end of the chamber defined by shells 2 and 6 is closed by a layer 30 of sand and cement mortar and a sealing coat of oil-proof varnish 32 on the exposed face thereof. Sand bands 34 may be provided to anchor the mortar.

The chamber defined by the shells 6 and 8 is closed at the lower end thereof, similarly to the closure for the chamber between shells 2 and 6, by strata of oakum, litharge and an oil-proof varnish, indicated as 36, 38 and 40, respectively, a quantity of dry sand 42 above the oakum layer and fired sanded surfaces or bands 43 for anchoring the litharge layer in position. The upper end of the chamber is closed by a layer 44 of sand and cement mortar anchored in position by sand bands 46, and capped by a coat 48 of oil-proof varnish.

The two chambers defined by the three shells are filled with a viscous mixture of sand and oil. The sand chosen is usually a sagger sand which has been fired to completely burn and remove the soluble and vegetable matter which might have a deleterious effect on the insulating qualities of the bushing, and to render the sand grains porous. The oil, therefore, impregnates the grains of the sand as well as completely filling the voids between the grains, and the sand tends to maintain the oil in position in the bushing by capillary attraction.

In assembling the bushing, the cemented points at the upper end are completed and the bushing is then inverted for receiving the oil and sand filling. This is accomplished, preferably, by first pouring in the desired amount of oil and adding the porous sand to it. Of course, the sand and oil may be mixed and then inserted between the shells, but the viscous character of the mixture would render such procedure somewhat difficult. A quantity of dry sand is then placed on top of the mixture, corresponding to the layers 28 and 42, to constitute an expansion chamber to receive the oil drawn into the bushing from tank 12 upon cooling of the bushing.

The layers 20 and 36 of oakum are then tamped into position on top of the sand, the litharge applied and, subsequently, the oil-proof varnish coated over the exposed area of the litharge.

It has been found in practice that when the temperature of the bushing drops, some of the oil from the tank may be drawn past the seals at the bottom of the chambers between the shells. If such chambers are packed with an asphaltic compound, as is present usual practice, the oil and compound will mix, thereby increasing the viscosity of the oil and preventing it from flowing back into the tank 12 as the bushing temperature rises. Upon repeated cycles of this character, all of the space within the chambers defined by the shells will become completely filled, including any expansion spaces that may have been provided, and ultimately upon a rise in temperature, the mixture of compound and oil will expand with sufficient force to rupture the shells.

In accordance with the present invention, if oil is drawn into the chambers between the shells from the tank 12, it will mix with the oil and sand in such chambers, and when a heating cycle occurs, it will be forced back into the tank 12. For this reason, it is desirable that the oil mixed with the sand in the chambers between the shells shall be of substantially the same viscosity as the oil used in the tank 12.

Of course, an ideal bushing should have completely oil-tight joints between the shells within the tank, but since this is impracticable, because of cost and other considerations, the present invention was made and has successfully met the requirements of the industry.

Quite obviously, various modifications may be made in the invention without departing from the spirit and scope thereof. For example, the form of bushing shown in the drawing is only one possible application for the invention, as it obviously may be applied to bushings of various types and shapes, and to oil-filled electrical apparatus, generally where difficulties due to thermal expansion of the oil are encountered.

I claim as my invention:

1. In a high-tension electrical bushing comprising a pair of coaxially disposed cylindrical shells of dielectric material proportioned to define an annular chamber therebetween, means adjacent the ends of one of said cylindrical shells for closing said chamber, and an insulating medium substantially filling said chamber comprising a body of fired sand substantially filling said chamber and a quantity of oil impregnating the grains thereof and filling the voids therebetween.

2. A bushing for an electrical conductor including a substantially cylindrical shell of dielectric material for surrounding a conductor, means for closing the ends of said shell, and an insulating medium substantially filling said shell comprising a volume of porous granular dieleceric material and a dielectric fluid filling the voids between the grains of such material and impregnating them.

3. A bushing for an electrical conductor including a substantially cylindrical shell of dielectric material for surrounding a conductor, means for closing the ends of said shell, and an insulating medium substantially filling said shell comprising a volume of porous granular dielectric material and a dielectric fluid filling the voids between the grains of such material and impregnating them, said material being ceramic and of substantially greater porosity than electrical porcelain.

4. A bushing for an electrical conductor including a substantially cylindrical shell of dielectric material for surrounding a conductor, means for closing the ends of said shell, and an insulating medium substantially filling said shell comprising a volume of porous granular dielectric material and a dielectric fluid filling the voids between the grains of such material and impregnating them, said material being a ceramic material fired to render it porous.

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