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D. F. WINTER ET AL

2,953,628

HIGH-VOLTAGE BUSHING

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FIG. 1.

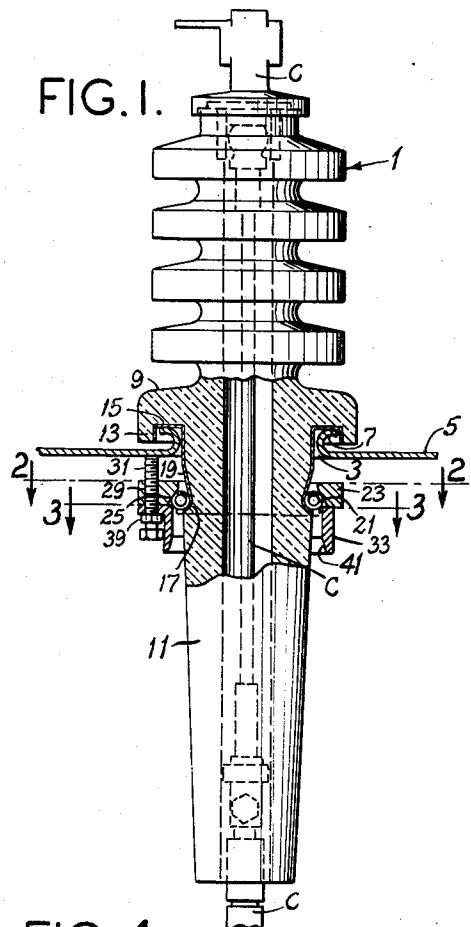


FIG. 2.

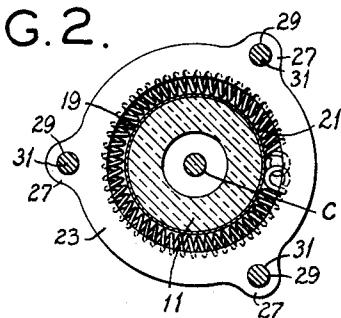


FIG. 3.

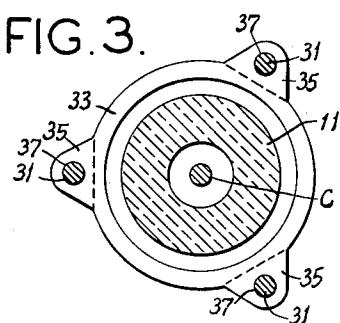


FIG. 4.

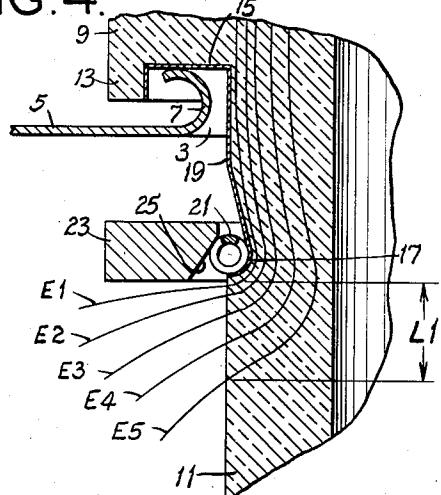
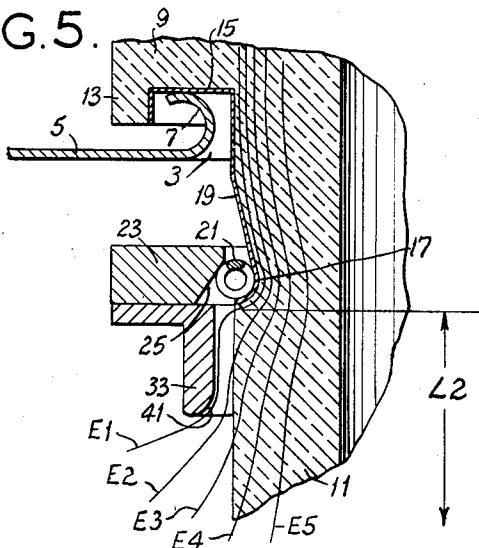


FIG. 5.



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HIGH-VOLTAGE BUSHING

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1 Claim. (Cl. 174—142)

This invention relates to high-voltage bushings, and more particularly to a construction for high-voltage bushings for transformers and the like.

Among the several objects of the invention may be noted the provision of a high-voltage bushing construction for use in a transformer or other electrical apparatus where a high-voltage conductor must be carried through a metal wall, which bushing construction includes means for inhibiting corona discharge between the exterior of the bushing and the wall and also between the exterior of the bushing and means for fastening the bushing to the wall; the provision of such means which is particularly useful in conjunction with bushing fastening means of a type comprising a spring ring snapped into a groove in the bushing and a clamping ring having wedging engagement with the spring ring; and the provision of such means which is economical as regards both manufacture and installation. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claim.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a view in elevation with parts broken away and shown in section of a bushing construction equipped with corona-inhibiting means of this invention installed on a transformer tank cover;

Figs. 2 and 3 are enlarged transverse sections taken on lines 2—2 and 3—3, respectively, of Fig. 1;

Fig. 4 is a section illustrating equipotential lines and the voltage gradient along the shank of the bushing with a corona-inhibiting shield of this invention omitted; and,

Fig. 5 is a section illustrating equipotential lines and the voltage gradient along the shank of the bushing with the corona-inhibiting shield of this invention in place.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to the drawings, there is indicated at 1 a tubular dielectric (porcelain) bushing clamped in position in an opening 3 in the sheet metal cover 5 of a transformer tank. Only a portion of the cover 5 is shown, and none of the tank proper, since they are of conventional construction. The cover 5 has an upwardly extending annular bead 7 around the opening 3. The bushing has a flange 9 bearing on the bead 7 outside the cover and a shank 11 extending down into the tank through the opening 3. Flange 9 has a downwardly extending peripheral rim 13 providing in conjunction with shank 11 an annular groove 15 receiving the bead 7. Below the flange 9, the shank 11 has an annular peripheral groove 17. The surface of the bushing within the groove 15 and down the shank 11 to and including the groove 17 has a conductive coating 19, e.g., a metallic glaze of copper or other metal, or an electrically conductive material such as Aqua-dag.

Snapped into the groove 17 is a coiled spring clamping

ring 21, which may be formed, for example, from stainless steel wire. Surrounding the spring ring 21 is a metal keeper plate or clamping ring 23. The opening 25 in this clamping ring is of conical form convergent in upward direction, of larger diameter than spring ring 21 at the bottom and of smaller diameter than spring ring 21 at the top. The clamping ring 23 bears down on the spring ring 21 in wedging engagement therewith. The clamping ring 23 has radial ears 27 having tapped holes 29 receiving screws 31 which are threaded upward in holes 29. The upper ends of the screws engage the tank cover 5 for forcing the clamping ring 23 in downward direction firmly to clamp the bushing in place.

In accordance with this invention, an annular metallic corona-inhibiting skirt or shield 33 is provided on the bottom of the clamping ring 23 surrounding the shank 11 of the bushing and projecting inwardly from the clamping ring. This shield comprises a sleeve-like relatively thin cylindrical ring having outwardly extending radial ears 35 at its upper end provided with untapped holes 37 aligned with holes 29 in the clamping ring ears 27. The shield 33 is of somewhat larger internal diameter than the portion of the shank 11 below the groove 17 and is held centered in respect to the shank and spaced from and out of direct contact with the shank by means of the screws 31 and by nuts 39 threaded up on the screws against the ears 35 and holding the ears 37 against the bottoms of clamping ring ears 27. The internal surface of the corona shield 33, toward the lower end of the shield, is flared away from the bushing as indicated at 41 in the direction toward the inner end of the bushing.

The coating 19, being in contact with the tank cover 5, is grounded to the tank. The shield 33 is grounded to the tank via clamping ring 23, spring 21 and coating 19, and also by screws 31.

Fig. 4 illustrates the electric field pattern in the region of the spring 21 and clamping ring 23, such as exists upon high-voltage energization of high-voltage conductor C which extends through the bushing, without the corona shield. The field is represented by equipotential lines indicated at E1—E5, line E1 being the lowest potential line and E5 the highest potential line of the five lines shown. It will be observed that these lines curve relatively sharply starting generally at the level of the lower edge of the conductive coating 19 and pass out of the shank 11 of the bushing within a relatively short portion of the length of the shank indicated at L1. The result is that there is a relatively high-voltage gradient along the length of the shank 11 below the spring 21 and clamping ring 23 which is apt to result in corona discharge.

In contrast, Fig. 5 illustrates the electric field pattern in the region of the spring 21 and clamping ring 23 with the corona shield 33, the equipotential lines again being designated E1—E5. It will be observed that the shield 33 acts to distort the equipotential lines so that, below the lower edge of the conductive coating 19, they curve out of the shank 11 much more gradually than in the absence of the shield, their exit being spread over a distance such as indicated at L2 in Fig. 5 which is much longer than distance L1 of Fig. 4. The result is that there is a relatively low-voltage gradient along the length of the shank 11 below the lower edge of coating 19 so that the corona threshold with the shield is much higher than without it.

It is to be understood that the interior of the bore of bushing 1 may include a conductive coating such as the metallic glaze shown at reference numeral 19.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above con-

structions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim:

In a transformer comprising a metal tank provided with an opening for a bushing, a tubular dielectric bushing extending through the opening, said bushing having a high-voltage conductor extending therethrough, said bushing having a flange on the outside of the tank engaging the tank, said bushing having an annular peripheral groove on the inside of the tank, a spring ring in the groove, a keeper plate surrounding the bushing and engaging the spring ring, screws threaded in the keeper plate engaging the tank for forcing the keeper plate inward, said bushing having an electrically conductive coating on its exterior extending inwardly from outside the tank to and terminating at said spring ring, said coating being grounded to the tank, and an annular metallic

shield carried by said keeper plate and projecting inwardly therefrom beyond the inner end of said conductive coating, said shield surrounding the bushing and being larger than the portion of the bushing which it surrounds so as to be completely spaced from the bushing, said shield having an internal surface which flares away from the bushing in a direction toward the inner end of the bushing, and said shield being grounded to the tank.

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