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R. HIGGINS

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BUSHING INSULATOR

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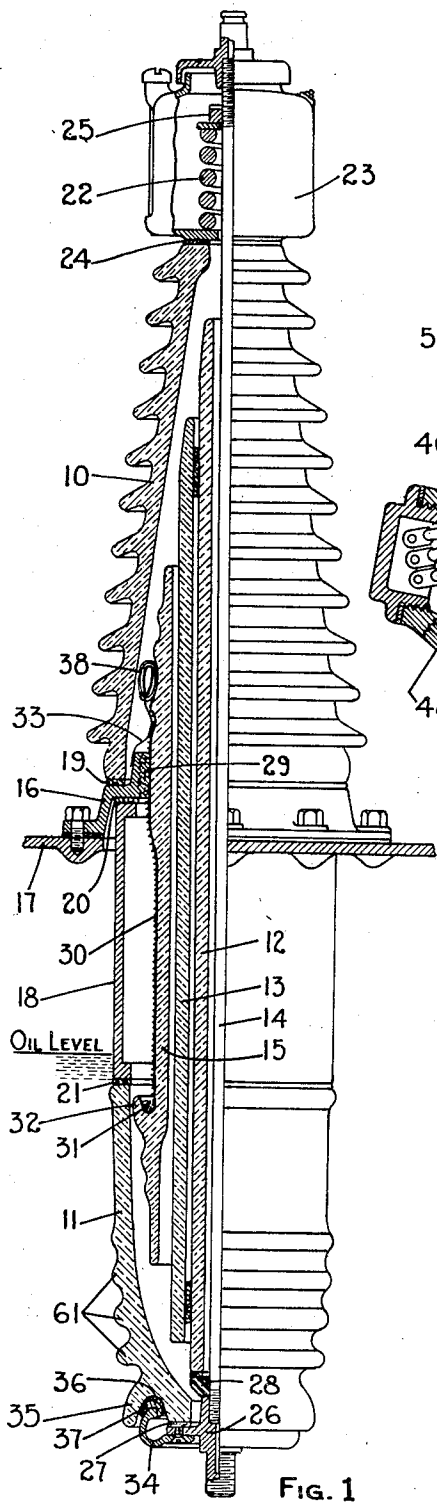


FIG. 1

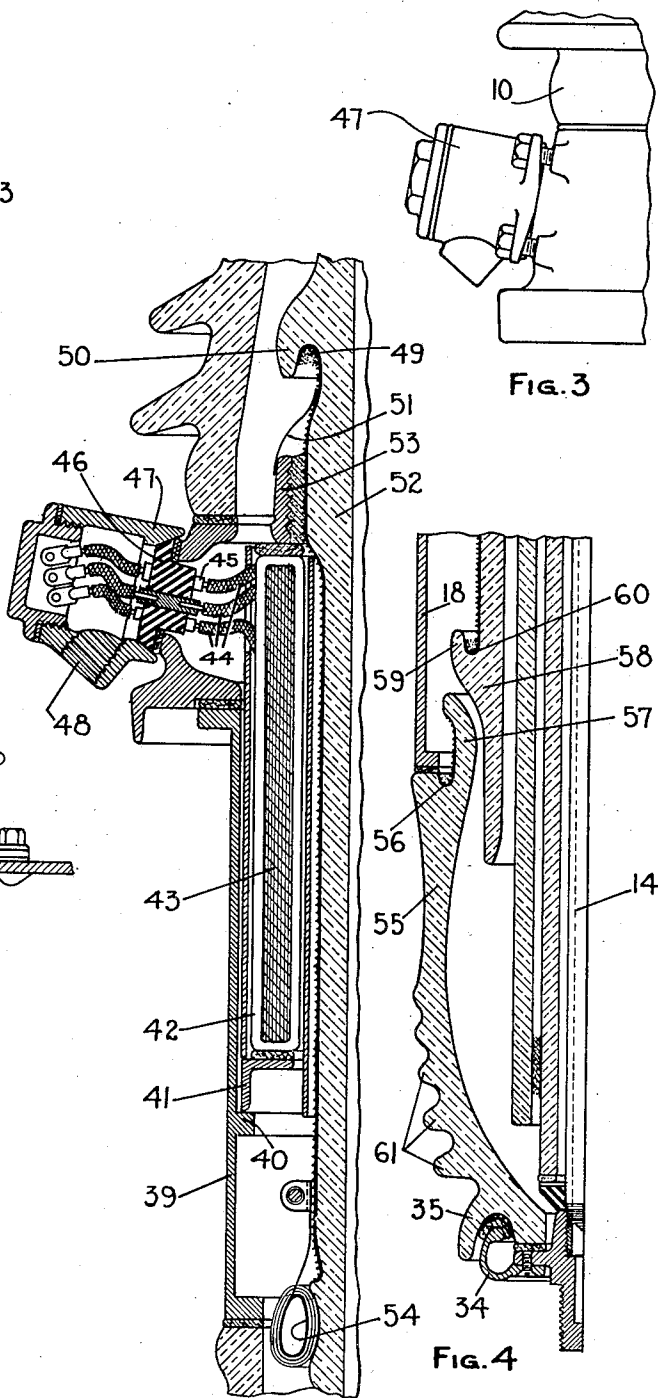


FIG. 2

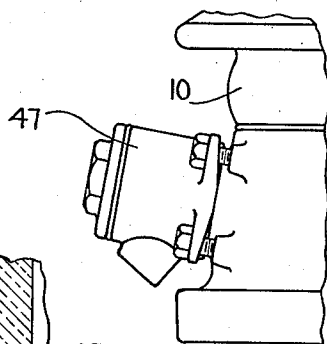


FIG. 3

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BUSHING INSULATOR

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7 Claims. (Cl. 173-318)

This invention relates to a bushing insulator such as are used for insulating the conductors leading into housings for electrical apparatus, and particularly to insulators for high voltage apparatus such as transformers and switches.

One object of the invention is to provide a bushing insulator which will decrease the danger of explosions within the housing on which the insulator is mounted.

Another object of the invention is to provide improved means for controlling the electrostatic field about the insulator so as to avoid formation of corona and prevent sparking.

A further object of the invention is to provide a device of the class named which shall be of improved construction and operation.

Other objects and advantages will appear from the following description.

The invention is exemplified by the combination and arrangement of parts shown in the accompanying drawing and described in the following specification, and it is more particularly pointed out in the appended claims.

In the drawing:

Fig. 1 is an elevation partly in section showing one embodiment of the present invention.

Fig. 2 is a fragmentary section showing a modified form of the invention.

Fig. 3 is a fragmentary elevation of the current transformer outlet of Fig. 2.

Fig. 4 is a fragmentary section of a portion of the bushing insulator showing another modification of one feature of the invention.

In housings for electrical apparatus, it is frequently the case that the insulating oil does not completely fill the space within the housing so that a portion of the space next the cover is filled with air or a mixture of gases. In some cases, particularly in switch housings, a combustible gas may be generated by arcs below the oil surface and this gas, by mixing with the air in the upper part of the housing, forms an explosive mixture which, if ignited, may produce a disastrous explosion.

Heretofore where bushing insulators have been used having dielectric members extending to the cover of the housing, it has sometimes happened that sparking occurs along the dielectric surface, which sparking is apt to ignite any explosive mixture which may be within the upper portion of the housing. This sparking is probably due to leakage or charging currents over the portion of the surface of the lower dielectric member of the bushing above the oil and is apt to be aggravated by deposits of conducting material on the surface

of the bushing. Such deposits are usually quite irregular and provide gaps over which arcing takes place. To avoid this, a conductor sleeve has sometimes been formed on the flange about the bushing, the sleeve extending down to the oil level; or a metal sleeve has been placed about the outer surface of the lower bushing member extending from the housing cover to the oil level. Such expedients are effective in short-circuiting leakage currents over the bushing but are not so effective in overcoming charging currents as they usually do not make perfect contact with the entire outer surface of the dielectric member. Furthermore, as heretofore constructed, various expedients for short-circuiting the leakage currents over the bushing above the oil level have been objectionable for the reason that they reduce the insulation between the top of the housing and the conductor at the lower end of the bushing, thus increasing the danger of flashover within the housing. This danger is largely due to the tendency for corona to form at the lower end of the conductor sleeve and also at the lower end of the bushing where the conductor emerges from the bushing. The present invention secures the advantages of the long ground sleeve and at the same time overcomes the difficulties heretofore present when the use of ground sleeves has been attempted.

In the form of the invention shown in Fig. 1, the numeral 10 designates the upper shell member or cone of a bushing insulator and 11 the lower shell member or dome within the apparatus housing. Sleeves 12 and 13 may also be used to provide further insulation about the conductor 14 and an outer sleeve or keg 15 may be employed outside of the sleeves 12 and 13. These insulating members may all be made of porcelain or other suitable dielectric material. In practice, it has been found that porcelain has many advantages in bushing construction over other insulating materials so far discovered. The cone 10 is supported by a flange 16 which is bolted to the top 17 of the apparatus housing. A metal ground sleeve 18 is interposed between the flange 16 and the upper end of the insulating dome 11. Suitable gaskets 19, 20 and 21 are provided to insure tight joints between adjacent portions of the bushing. The parts of the bushing are held together by tension on the conductor 14 exerted by a spring 22 located in an expansion chamber 23 at the upper end of the bushing, the spring serving to press the bottom of the expansion chamber against a gasket 24 resting on the cone 10. The reaction of the spring is trans-

mitted to the conductor 14 by a ring nut 25. A fitting 26 closes the lower end of the bushing and is threaded onto the conductor 14 and is held tightly against a gasket 27 by the reaction of the spring 22, thus insuring a tight joint at the lower end of the bushing. A suitable drain plug may be provided in the fitting 26. A collar 28 of molded insulation rests upon the terminal member 26 and supports the system of dielectric sleeves 12 and 13. The keg 15 is secured to the flange 16 by cement 29. The gasket 20 is metallized so as to insure a ground connection between the sleeve 18 and the flange 16. This gasket may be made of cork covered with a thin copper sheet or if an insulating gasket is used, the sleeve 18 may be grounded in any suitable manner.

To avoid the formation of corona at the lower end of the sleeve 18 and the danger of arcing over the dome 11 from this point, applicant has provided a flux control member consisting of a metallic coating 30 on the outer surface of the keg 15 which extends below the lower end of the sleeve 18 and within the dome 11. This metallic coating terminates in a pocket 31 formed by an upwardly and outwardly extending flange 32 on the outer face of the keg 15. The metallized surface 30 is grounded on the flange 16 by any suitable means, such as a jumper 33. The cement 29 also acts as a conductor between the metallized surface 30 and the flange but the jumper 33 is used to augment the electrical connection provided by the cement. Since the grounded pocket 31 extends closer to the lower terminal of the bushing than does the lower end of the sleeve 18, most of the static lines of force connecting the two oppositely charged conductors will emanate from the flux control pocket 31 through the porcelain surrounding the lower end of the pocket rather than from the lower end of the sleeve 18. This will overcome the tendency for the formation of corona from the lower end of the sleeve and consequent danger of arcing over from this point.

To avoid the formation of corona from the conductor at the lower end of the bushing, the terminal member 26 is provided with a ring 34 comprising a plate or disc bent to provide a widely rounded lower surface, the outer edge of the plate being bent upwardly and extending into a pocket formed by a flange 35 on the lower end of the dome 11. The interior of this pocket is provided with a metallized coating 36 and a metallized gasket 37 consisting of a layer of cork or other suitable resilient material covered by thin sheet metal interposed between the edge of the member forming the ring 34 and the inner surface of the pocket 36. This insures electrical connection between this metallized surface and the ring 34 and at the same time prevents undue pressure between the porcelain and metal at this point. With this arrangement, the greatest concentration of flux will emanate from the surface 35 through the porcelain of the dome 11 which will prevent formation of corona or discharge streamers where the flux is most concentrated. The rounded surface of the ring 34 will distribute the flux at the lower portion of the ring so as to prevent concentration and consequent corona at these points. A wrapped control 38 similar to that shown in my prior Patent No. 1,972,590, granted Sept. 4, 1934, may be used above the top of the flange 16 to prevent the formation of corona from the upper surface of the flange.

The space between the ground sleeve 18 and the dielectric keg 15 may be, in some instances, utilized to considerable advantage for containing the secondary winding of a current transformer, of which the main conductor 14 serves as the primary. An arrangement of this kind is shown in Fig. 2 in which the ground sleeve 39 is provided with a shoulder 40 which carries a ring 41 for supporting the secondary windings 42 of the current transformer. The transformer is provided with a ring core 43. Various taps 44 for the transformer winding may be carried out to terminals 45 supported in an insulating block 46, the terminals extending through the block into an outlet housing 47 provided with suitable contacts for a cable which may be led into the housing through an opening 48.

In the form of the invention shown in Fig. 2, the wrapped control above the flange is replaced by a formed control comprising a pocket having a metallized inner surface 49 enclosed by a flange 50, the surface being provided with a grounded jumper 51. When the keg 52 carries the flange 50, the lower end of the keg must be small enough to pass through the ring 53 which supports the keg. In order to permit this, a wrapped control 54 is provided at the lower end of the keg instead of the integrally formed control shown in Fig. 1.

Another form of control for the lower end of the sleeve 18 is shown in Fig. 4 in which the dome 55 is provided with a pocket 56 at its upper end, the inner surface of which is metallized and electrically connected with the ground sleeve 18, the lower end of the pocket extending below the upper outer edge of the dome 55 and the lower edge of the ground sleeve 18. An upwardly extending flange 57 forms a continuation of the pocket wall within the lower end of the sleeve 18 so as to provide an insulated control for the electrostatic lines of force extending inwardly toward the inner conductor 14. In this case the keg 58 may be shorter than the keg 15 in Fig. 1 and is preferably provided with an upwardly extending outer flange 59 forming a pocket 60 which provides a supplemental insulated control for the electrostatic field. The outer surface of the lower dome is preferably provided with corrugations 61 for increasing the leakage surface over the dome and decreasing the danger of flashover on the outside of the lower dome.

I claim:

1. The combination with a housing for electrical apparatus having an opening through the top thereof and having insulating liquid therein, the surface level of which is spaced below the top of said housing, of a bushing insulator comprising a supporting flange mounted on said housing and surrounding said opening, upper and lower dielectric shell members, a conductor insulated from said flange by said members, a ground sleeve electrically connected with said flange and extending downwardly therefrom and adapted to bridge the space above the insulating liquid in said housing, said lower shell member being connected with the lower end of said ground sleeve, and a flux control of conducting material electrically connected with said flange and extending below the surface level of the oil in said housing and below the lower end of said ground sleeve, and solid dielectric material disposed about the lower extremity of said flux control.

2. A bushing insulator for use in connection with an electrical apparatus housing comprising

a supporting flange having an opening through which a conductor extends, an upper dielectric shell member extending upwardly from said flange for supporting the upper end of said conductor, a ground sleeve extending downwardly from said flange and adapted to bridge the space above the insulating liquid in said apparatus housing, a lower dielectric shell extending downwardly from the lower end of said ground sleeve for insulating the lower end of said conductor from said ground sleeve, said lower dielectric shell member having an outwardly extending flange adjacent its lower end forming a downwardly opening pocket, the upper portion of said pocket being closed by the dielectric material of said shell member, and conducting means disposed within said pocket and electrically connected with said conductor to provide a flux control for the electrostatic lines of force emanating from the lower end of said conductor where it leaves said lower shell member.

3. A bushing insulator comprising a flange arranged to be mounted on an electrical apparatus housing, a dielectric member extending upwardly from said flange for supporting a conductor extending through said flange into said housing and for insulating said conductor from said flange, a ground sleeve electrically connected with said flange and extending downwardly therefrom and adapted to bridge the space above the insulating liquid in said apparatus housing, a dielectric shell extending downwardly from the lower end of said ground sleeve for insulating the lower end of said conductor from said ground sleeve, a flux control comprising a member of conducting material electrically connected with said ground sleeve and extending below the lower end of said ground sleeve within said shell, solid dielectric material disposed about the lower extremity of said flux control member of conducting material and a second flux control at the lower end of said conductor where it emerges from said dielectric shell, said second flux control comprising a member of conducting material electrically connected with said conductor and extending into a pocket formed in the material of said shell and having its upper portion covered by the material of said shell.

4. A bushing insulator comprising a supporting flange, a conductor extending through said flange, an upper shell member carried by said flange and supporting the upper end of said conductor, a ground sleeve extending downwardly from said flange and adapted to bridge the space between said flange and the insulating liquid in an electrical apparatus housing on which said flange is mounted, a lower shell member extending downwardly from the lower end of said ground sleeve, a fitting secured to said conductor and supporting said lower shell member, a tubular dielectric member disposed between said conductor and said ground sleeve, a conductor covering for the outer surface of said tubular dielectric member, said conductor covering being electrically connected to said ground sleeve, an upwardly extending flange on the outer surface of said tubular dielectric member forming a pocket closed at its lower extremity, said conductor covering terminating in said pocket to form a flux control to prevent formation of corona at the lower extremity of said ground sleeve, a downwardly extending flange on the outer surface of said lower shell member adjacent the lower end

thereof forming an upwardly extending pocket closed at its upper extremity, a member of conducting material electrically connected with said conductor and extending into said pocket and forming a flux control for the electrostatic field about said conductor at the lower end of said lower shell member.

5. A bushing insulator comprising a flange, an upper shell member carried by said flange, a conductor extending through said flange and insulated therefrom by said upper shell member, a ground sleeve extending downwardly from said flange, a lower shell member forming a continuation of said ground sleeve and insulating the lower end of said conductor from said ground sleeve, an insulating keg surrounding said conductor and separating said conductor from said ground sleeve, a covering of conducting material on the outer surface of said keg, said covering being electrically connected with said ground sleeve, a flux control of conducting material electrically connected to said covering, dielectric material disposed about the lower extremity of said flux control for preventing formation of corona from said flux control, a conductor ring extending outwardly from the lower end of said conductor, said lower shell member having a pocket therein closed at its upper extremity, the periphery of said ring being disposed in said pocket, the lower surface of said ring being convexly rounded to prevent concentration of electrostatic flux thereon.

6. The combination with a housing for electrical apparatus, of a conductor extending through an opening in the top of said housing, an upper shell member for supporting said conductor, a ground sleeve surrounding said conductor and extending downwardly from the top of said housing to bridge the space between the top of said housing and the surface level of insulating liquid within said housing, a lower shell member connecting the lower end of said ground sleeve with said conductor, an insulating keg surrounding said conductor within said ground sleeve, a conductor covering for the outer surface of said keg within said ground sleeve, said conductor covering extending beyond said ground sleeve at both ends of said sleeve and insulated flux controls at both ends of said conductor covering, the flux control at one end of said conductor covering comprising a pocket formed by an integral flange on said keg.

7. The combination with a conductor, of a bushing insulator for said conductor, said bushing insulator comprising a shell member and a tubular dielectric member surrounding said conductor and overlapping said shell member, a ground sleeve disposed outside of said tubular dielectric member and forming a continuation of said shell member, said shell member having a pocket formed therein and located beyond the extremity of said ground sleeve, a conductor lining for said pocket electrically connected with said ground sleeve, said tubular dielectric member having a flange thereon forming a pocket and a conductor covering for the outer surface of said tubular dielectric member extending into the pocket formed by said flange and cooperating with the lining for the pocket in said shell member to control electrostatic flux adjacent the extremity of said ground sleeve.