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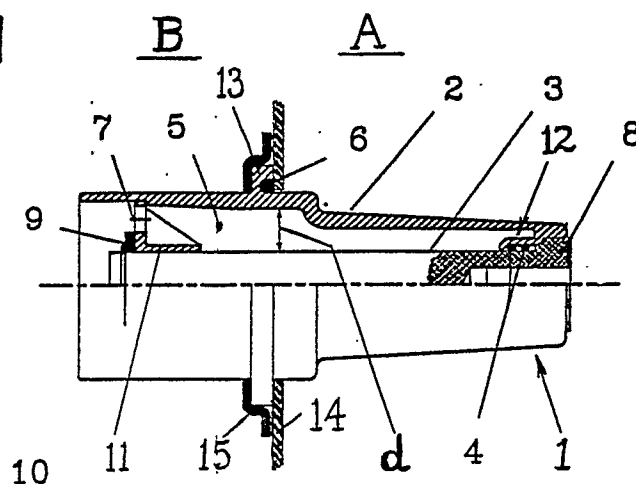
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54 **An electric conductor bushing.**

57 An electric conductor bushing, especially for use in distributing plants which are insulated by the aid of an insulating gas (SF₆), and in which the conductor bushing constitutes a tubular insulating body (2) which is designed to pass through a hole in the plant wall (14) and is secured in a gastight manner (6, 13, 15) to wall (14). A first portion of body (2) extending into plant (B) has at least one opening (7) permitting penetration of insulating gas into void (5) inside said insulating body. A bushing conductor (3) extends coaxially through said body and is supported (11) in said first portion and is, additionally, supported in a gastight manner (4) at the extreme end of a second portion of said body which is provided outside (A) the wall (14).

FIG. 1



An electric conductor bushing

The present invention relates to an electric conductor bushing, especially for use in high-voltage distribution plants which are insulated by an insulating gas. SF₆ may be a suitable insulating gas.

Electric conductor bushings are generally manufactured to comprise a conductor with a solid insulation which insulates against the surrounding earthed encapsulation wall. In case of high voltages this will cause problems in the form of partial discharges (glowing) in narrow air or gas gaps across the width of the insulation. This problem is substantially, due to unequal distribution of the voltage drop across solid insulation and air/gas, which is, in turn, caused by different dielectric constants.

In order to avoid this problem some kind of potential screen is commonly inserted, e.g. an embedded earth screen or a conductive surface cover to short-circuit the air/gas gap in critical locations.

SE Laid-Open Publication No. 457 487 discloses the manufacture of a pressure-tight bushing, this, however, being accomplished by the aid of conventional technology as regards control of dielectric conditions in the passage area through the wall, i.e. by utilization of a solid insulation and, consequently, necessary screening electrodes.

It is an object of the present invention to eliminate the requirement of such a potential screen by minimizing the thickness of insulation, at the same time as the internal spacing of insulation through an insulating gas, e.g. SF₆, is made long enough to reduce the voltage so that the residual voltage across the external air gap towards the earth potential is at an acceptable low level, which means below the breakdown voltage of air.

According to the invention the above mentioned electric conductor bushing is characterized by comprising a tubular insulating body, which extends continuously from the inside of the plant to its outside through a hole in the wall of the plant and is gastightly secured to the wall by the aid of a sealing flange on the insulating body. Also, at least a first portion of said body extending into the plant has at least one opening permitting insulating gas to penetrate into the void of said insulating body. An integral bushing conductor extends coaxially and continuously through the insulating body from the inside of the plant to its outside and is supported in said first portion and is, furthermore, supported in a gastight manner at its extreme end by a second portion of said body provided outside the wall. Also, the insulating body has a wall thickness ensuring that the voltage drop across the insulating material of said body does not exceed 5-

20%, and the voltage drop in gas and air constitutes approximately 95-80% of the total voltage drop.

Further characterizing feature of the electric conductor bushing is that the section of insulating gas between the internal surface of said body and the bushing conductor in said second portion is gradually reduced towards said extreme end in a manner known per se.

Alternatively, the section of insulating gas between internal surface and bushing conductor along said second portion is essentially constant in a manner known per se. It would, furthermore, be suitable to maintain the spacing of insulating gas between the internal surface of said body and the bushing conductor approximately constant across the first portion in a manner known per se.

In case of a different kind of connection, e.g. an open cable or bar, it would seem natural to make said second portion cylindrical, if desired, with insulating screens like the arrangement of a common support insulator.

It would be suitable to provide said body with a wall thickness causing the voltage drop across the insulating material of said body not to exceed 5-20%, the voltage drop in gas and air constituting approximately 95-80% of the total voltage drop.

The invention is disclosed in more detail below with reference to the enclosed drawings, in which

Figure 1 shows an electric conductor bushing partially shown in section, and

Figure 2 illustrates how e.g. a cable is connected with the electric conductor bushing.

A non-limiting embodiment shown in Figure 1 represents a bushing for an insulated cable connection with a standard conical shape 1. Insulating body 2 of the bushing is here made from a material permitting utilization of a thin wall which will, nevertheless, maintain sufficient mechanical strength. Such a material is, e.g. a thermoplastic material. Bushing conductor 3 is cylindrical with a hexagonal portion 8 at one end to prevent rotation when a cable is connected, and with a stop against displacement in the longitudinal direction. Its other end is provided with a stop ring and washer 9 preventing displacement. Bushing conductor 3 is mounted in guides 11, 12, respectively at bushing ends. An opening 7 provides for communication between the insulating gas, e.g. SF₆ of the encapsulation (distribution plant) and the internal space 5 of the bushing. A gastight seal 4 prevents gas from leaking from internal space 5 of the bushing to the environment A, and a corresponding seal 6 is provided between bushing flange 13 and space B inside the encapsulation. The seal may, if desired,

be provided outside wall 14 if flange 13 is provided outside the encapsulation, i.e. outside wall 14. In order to obtain firm and secure mounting a fixing collar 15 is achieved, which will urge flange 13 towards wall 14 of the encapsulation.

Connection of a cable is achieved by the aid of a cable end connector 10 of a flexible material (see Figure 2) which is, upon connection of the conductor by the aid of a screw or plug connection, pushed onto cone 1 and will form a seal against penetration of dirt and moisture, as well as increasing flash-over resistance to earth. Internal connection of bushing connector 3 with bus bars or conductors inside the distribution plant is carried out in a manner known per se.

The above mentioned cone 1 is just a function of the conical shape of insulated cable end connector 10 and is, thus, not to be regarded as critical to the conductor bushing. If another kind of connection is used, e.g. an open cable or a bar, portion 1 will, obviously, rather be cylindrical than conical. Insulating screens, like a common support insulator may also be used with such a concept.

If a cable end termination with an external screen to earth is used, it may be necessary to have a metallization or another kind of seal 4, since field density will be high in this area due to a thick insulation and a correspondingly reduced insulating section through gas. This problem would, obviously, not exist if said second portion is cylindrical, if desired, provided with insulating screens, as mentioned.

In the shown embodiment, insulating spacing d through the insulating gas is approximately 16 mm in the critical area straight inside the earthed wall 14 and securing flange 13 and the wall thickness of the insulating body is approximately 6 mm, whereas the external air gap (i.e. between insulating body and wall 14) may, e.g. be 1 mm. With a dielectric constant of approximately 4 of the insulating material, as compared to 1 of SF₆ gas and air, a voltage drop constituting 92% of the total voltage drop will occur in gas and air.

24 kV AC on the conductor provides 19.6 kV to earth. In this case the voltage drop across gas and air will be $19.6 \times 0.9 = 18$ kV, i.e. approximately 1-2 kV/mm, which is below the breakdown voltage of air, even in case of a slightly unsuitable electrode shape. There will, thus, be no great hazard of any discharge.

Claims

1. An electric conductor bushing, especially for use in high-voltage distribution plants which are insulated by an insulating gas, e.g. SF₆, **characterized in** that it comprises a tubular insulating

body (2) extending continuously from the inside of said plant to its outside through a hole in the plant wall (14) and being mounted in a gastight manner in said wall by the aid of a sealing flange on said insulating body, that at least a first portion of said body extending into plant (B) is provided with at least one opening (7) permitting insulating gas to penetrate into void (5) of the insulating body, that an internal bushing conductor (3) is provided coaxially and continuously through insulating body (2) from the inside of the plant to its outside and is supported in said first portion, as well as being supported in a gastight manner (4) at the extreme end of a second portion of body (2) extending outside (A) said wall (14), and that the insulating body has a wall thickness causing the voltage drop across the insulating material of said body not to exceed 5-20%, the voltage drop in gas and air constituting approximately 95-80% of the total voltage drop.

2. An electric conductor bushing according to claim 1, **characterized in** that the insulating section between the internal surface of said body and bushing conductor (3) in said second portion gradually decreases towards said extreme end (8) in a manner known per se.

3. An electric conductor bushing according to claim 1, **characterized in** that the insulating gas section between the internal surface of said body and bushing conductor (3) is essentially constant along said second portion, in a manner known per se.

4. An electric conductor bushing according to claim 1, 2, or 3, **characterized in** that the insulating section (d) between the internal surface of said body and bushing conductor (3), as known per se, is essentially constant across said first portion.

FIG. 1

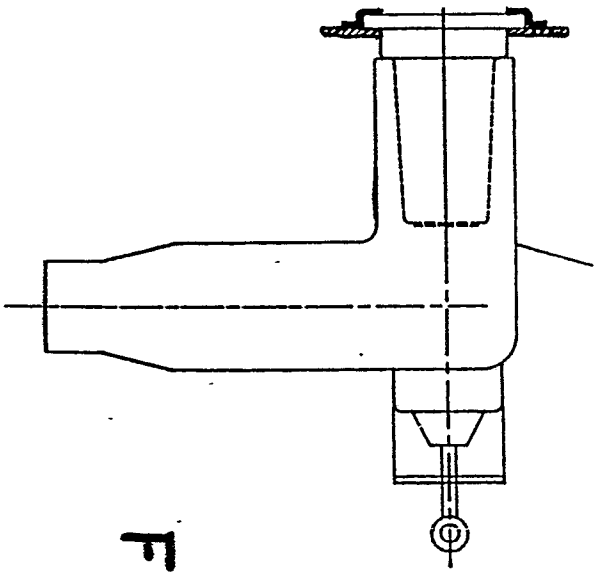
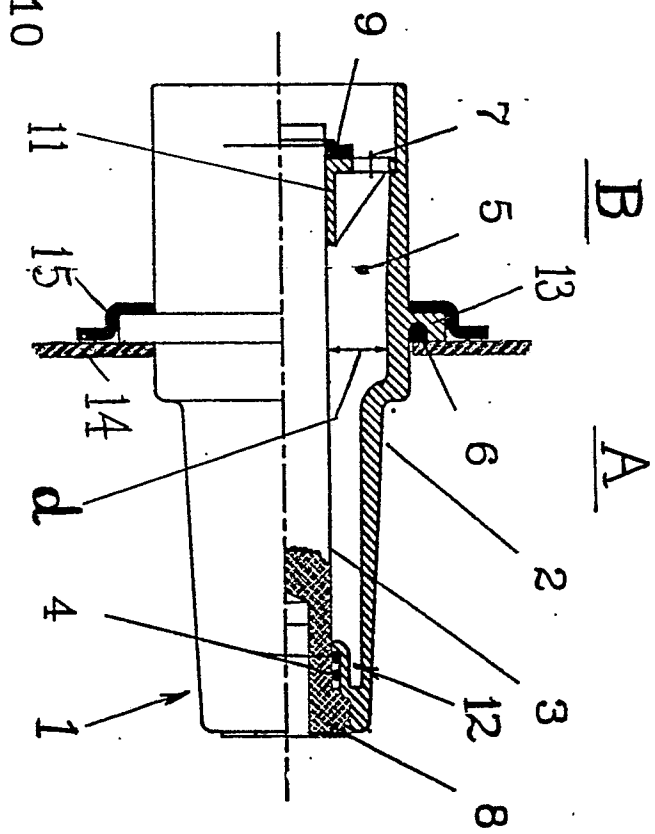


FIG. 2