Nov. 16, 1937. S. TERPAK 2,099,666

HIGH VOLTAGE LIQUID FILLED BUSHING

Filed June 30, 1937

Fig. 1.

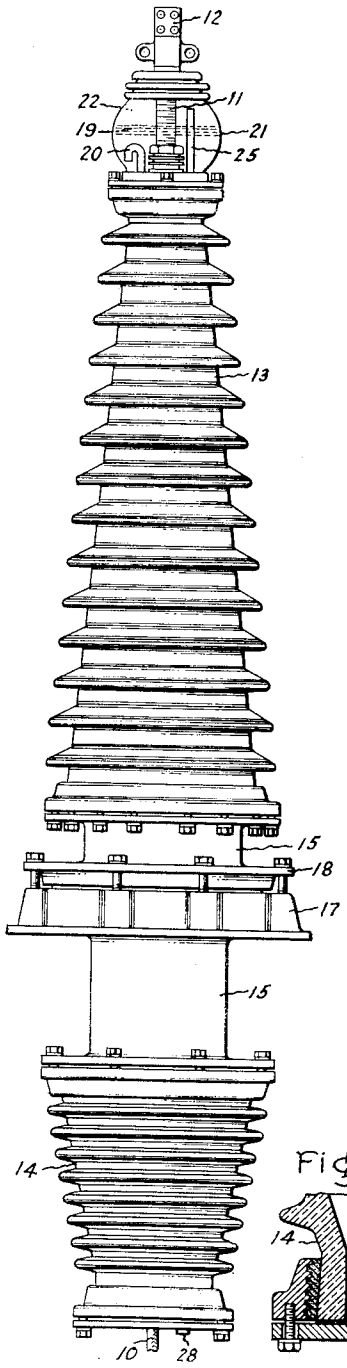


Fig. 2.

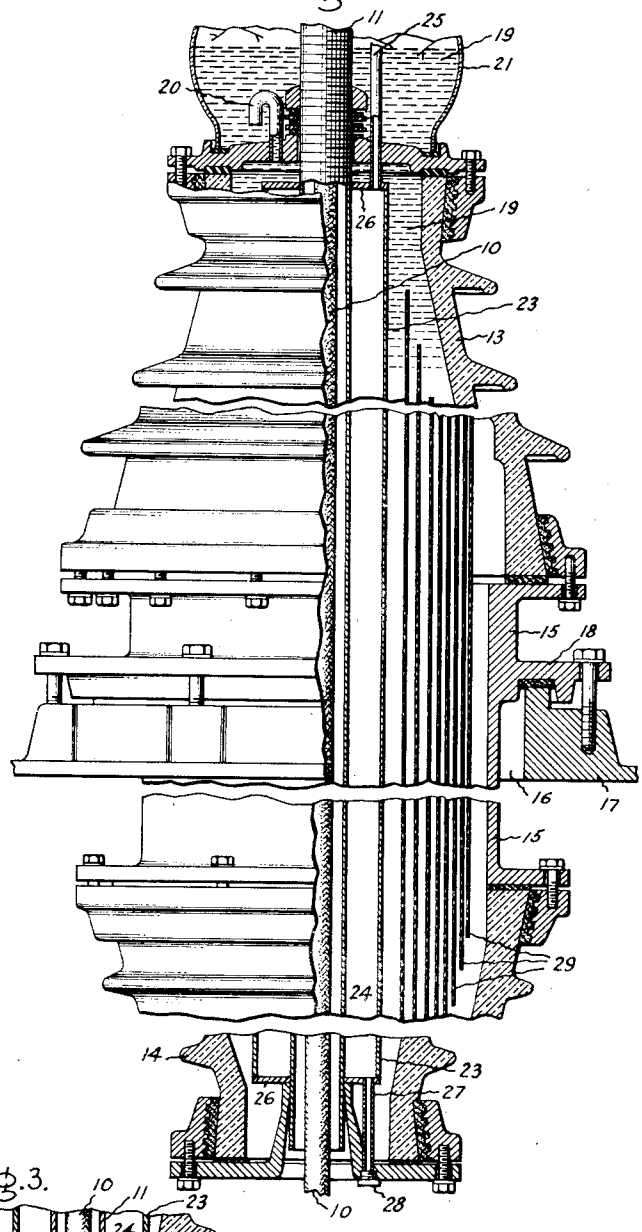
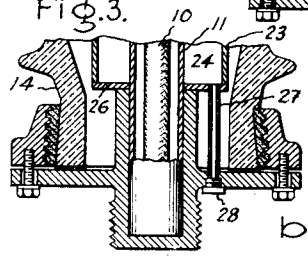


Fig. 3.



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HIGH VOLTAGE LIQUID-FILLED BUSHING

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4 Claims. (Cl. 173—318)

My invention relates to high voltage liquid-filled bushings. A bushing of this type commonly includes a conductor surrounded by a casing or housing filled with an insulating liquid and provided with an expansion chamber, the liquid extending into a partly filled expansion chamber to permit thermal expansion and contraction of the liquid. The expansion chamber commonly communicates with the outside air to prevent excessive pressure within the bushing and expansion chamber when the liquid is fully expanded. Whenever the temperature of the liquid decreases, however, some outside air is drawn into the expansion chamber and this air frequently contains moisture which may be absorbed by the liquid and seriously reduce its dielectric strength. The usual expansion chamber is a glass globe or cylinder mounted on the outer end of the bushing. It has been suggested that this expansion chamber be large enough so that it may be sealed to exclude outside air with its moisture and still permit the necessary expansion of the insulating liquid without excessive increase of pressure in the bushing and expansion chamber. An expansion chamber large enough for this purpose, however, would be objectionable.

The general object of the present invention is to provide an improved liquid-filled bushing in which the space above the liquid in the expansion chamber communicates freely with a sealed space within the main body of the bushing so that the expansion chamber may be of normal size and full thermal expansion of the liquid may occur without producing excessive pressure.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which Fig. 1 is a view of a high voltage liquid-filled bushing constructed in accordance with the invention; Fig. 2 is a view partly in section and with parts broken away of the bushing shown in Fig. 1; and Fig. 3 is a sectional view of a modified form of the lower or inner end of the bushing.

The high voltage bushing shown in Figs. 1 and 2 includes a central or axial conductor 10 extending through and surrounded by a conductive tube 11, the conductor 10 and tube 11 being connected to an outer terminal 12. The conductor 10 and tube 11 are surrounded by a casing or housing including an outer porcelain section 13, an inner porcelain section 14 and an intermediate connecting metal section 15. The bushing is mounted through an opening 16 in a support 17 which may be the cover of the casing of a transformer or other electrical apparatus. The bushing is supported by a flange 18 resting on the support 17. The bushing is filled with an insulating liquid 19 which extends through a pipe 20 into an expansion chamber 21 mounted on the outer or upper end of the bushing, the liquid partly filling the expansion chamber so as to leave a space 22 above the upper surface of the liquid. The expansion chamber 21 is tightly sealed to exclude outside air and moisture.

The conductor 10 and tube 11 are surrounded by a second conductive tube 23 which is concentrically spaced from the tube 11 to enclose a space 24. This space 24 communicates through a pipe 25 with the space 22 above the insulating liquid 19 in the expansion chamber 21. The spaces 22 and 24 are filled with any suitable gas which may be dry air but which is preferably some inert gas such as dry nitrogen. The tube 23 is of course sealed at its upper and lower ends to the inner tube 11 by annular seals 26. A drain pipe 27 normally closed by a plug 28 may be provided to permit any liquid incidentally found in the space 24 to be withdrawn. Cylindrical insulating barriers 29 may be provided between the tube 23 and the metal section 15 of the casing which is of course normally at ground potential. The outer tube 23 is preferably of conductive material and is conductively connected to the inner tube 11 and the conductor 10 so that its potential is always the same as that of the conductor.

Any increase in the temperature of the surrounding air or any heat reaching the insulating liquid 19 from the electrical apparatus with which the bushing is associated will cause the liquid to expand and its level to rise in the expansion chamber 21. This will compress the gas in the upper part of the expansion chamber but this gas can expand into the space 24 inside the tube 23 within the body of the bushing. The space 24 may obviously be made large enough to prevent excessive pressure within the expansion chamber 21 at all times and particularly when the liquid 19 is at its maximum temperature and has risen to its maximum level in the expansion chamber. The upper end of the pipe 25 which provides communication between the gas space 22 in the expansion chamber and the space 24 inside the outer tube 23 should extend well above the highest level ever reached by the liquid 19 in the expansion chamber 21 so that this liquid can never enter the space 24 through this tube 25. In addition to providing additional expansion space for the gas above the liquid in the expan-

sion chamber 21, the diameter of the conductive tube 23 is of course considerably larger than that of the inner tube 11 and the curvature of the surface is consequently not so great so that the tube 23 has the incidental advantage that the voltage applied to the terminals of the bushing may be very high without danger of corona.

As shown in Figs. 1 and 2, the inner tube 11 and the outer tube 23 are connected at their upper ends to the terminal 12 of the bushing so that these parts are always at the same potential. The lower or inner ends of the tubes 11 and 23 are not connected, however, to the conductor 10 so that these tubes do not carry any of the current flowing between the terminals of the bushing. A modified form of the invention is indicated in Fig. 3 in which the conductor 10 and tubes 11 and 23 are all conductively connected together at the lower or inner end of the bushing. The conductor 10 and tubes 11 and 23 are therefore all connected in parallel between the two terminals of the bushing so that the conductor 10 does not have to carry all the current.

The invention has been explained by describing a particular bushing construction and a modification thereof, but it will be apparent that changes may be made without departing from the spirit of the invention and the scope of the appended claims.

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

1. A high voltage bushing including a casing surrounding a conductor, an expansion chamber at one end of the casing, an insulating liquid in the casing and extending into and partly filling the expansion chamber, an expansion chamber within said casing and communicating with the space above the liquid in the other expansion chamber, and a gas in said expansion chambers, said expansion chambers being sealed from the outside air.

2. A high voltage bushing including a casing surrounding a conductor, an expansion chamber at one end of the casing, an insulating liquid in the casing and extending into and partly filling the expansion chamber, an expansion chamber within said casing and concentrically surrounding the conductor, said latter expansion chamber communicating with the space above the liquid in the other expansion chamber, and a gas in said expansion chambers, said expansion chambers being sealed from the outside air.

3. A high voltage bushing including a casing surrounding a conductor, an expansion chamber at one end of the casing, a tube surrounding the conductor, an insulating liquid surrounding the tube in the casing and extending into and partly filling the expansion chamber, a space within said tube being sealed from the liquid and communicating with the space above the liquid in said expansion chamber, and a gas in said space and in the space above the liquid in the expansion chamber, said space and expansion chamber being sealed from the outside air.

4. A high voltage bushing including a casing surrounding a conductor, an expansion chamber at one end of the casing, two tubes surrounding the conductor and concentrically spaced from each other, an insulating liquid surrounding the outer tube in the casing and extending into and partly filling the expansion chamber, the space between the tubes being sealed from the liquid and communicating with the space above the liquid in the expansion chamber, and a gas in said space and in the space above the liquid in the expansion chamber, said space and expansion chamber being sealed from the outside air.

STEPHEN TERPAK.