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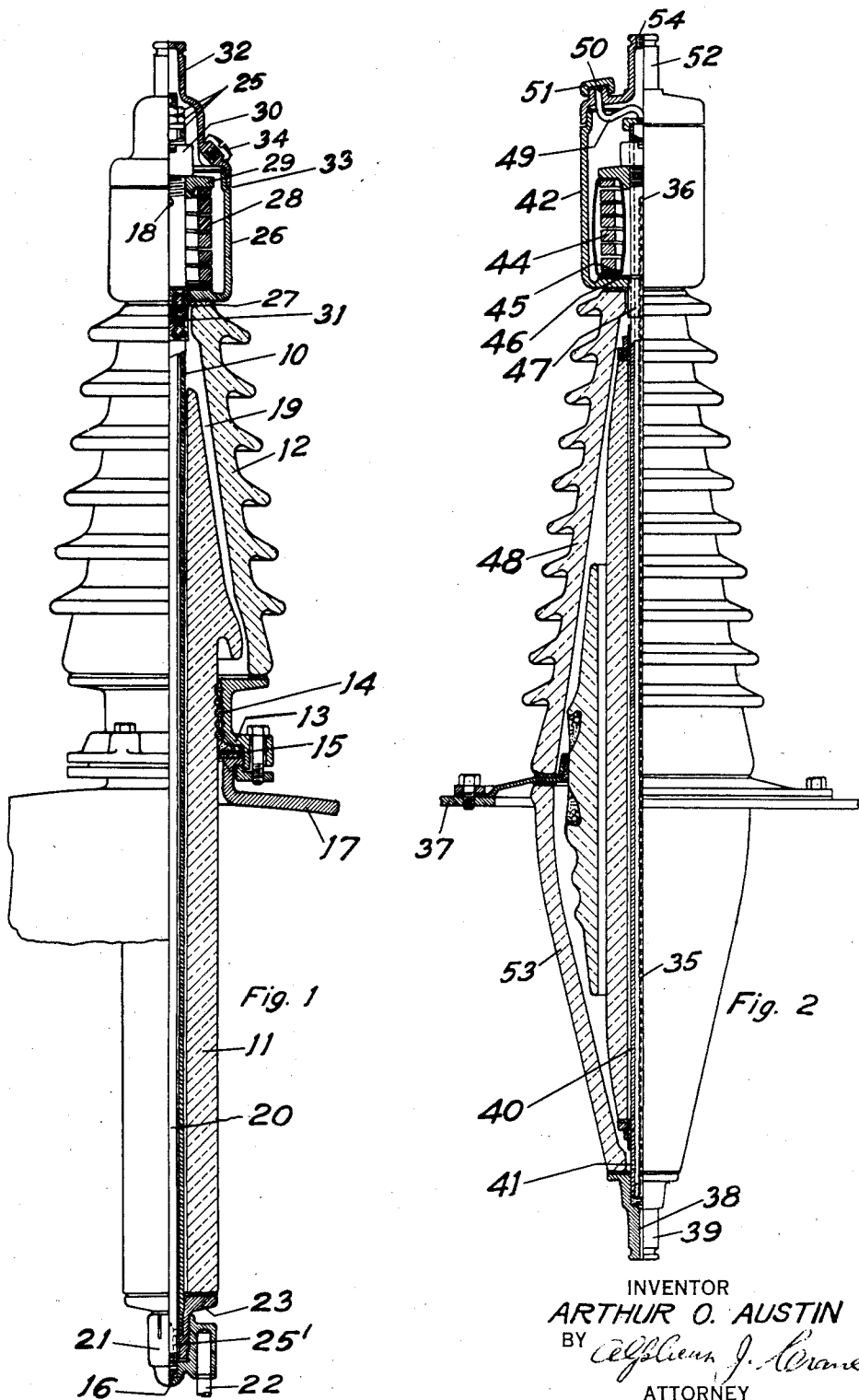
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BUSHING INSULATOR

Filed Dec. 26, 1931

2 Sheets-Sheet 1



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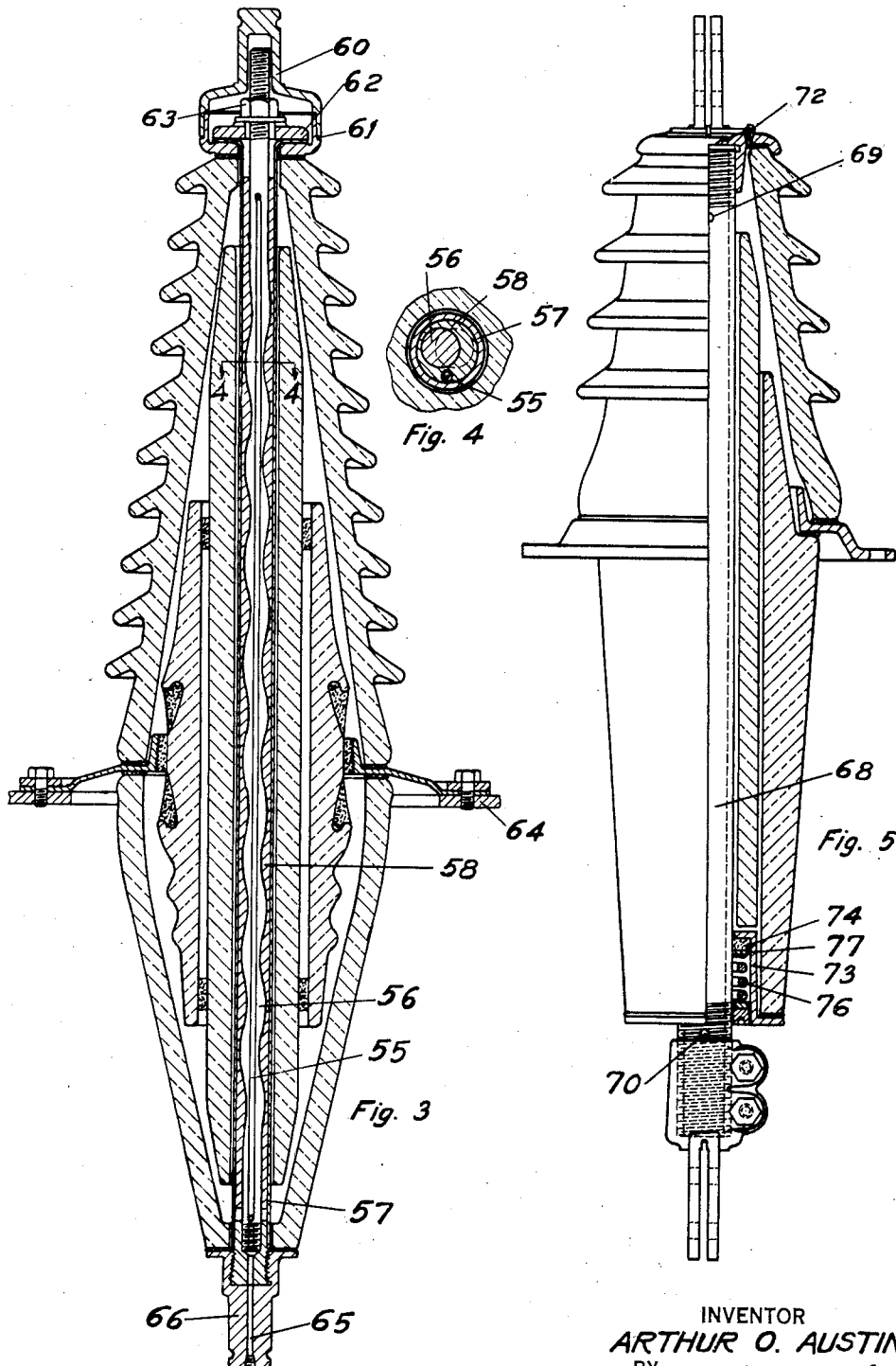
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INVENTOR
ARTHUR O. AUSTIN
BY *Alphonse J. Crane*
ATTORNEY

UNITED STATES PATENT OFFICE

1,983,335

BUSHING INSULATOR

Arthur O. Austin, near Barberton, Ohio, assignor,
by mesne assignments, to The Ohio Brass Com-
pany, Mansfield, Ohio, a corporation of New
Jersey

Application December 26, 1931, Serial No. 583,191

22 Claims. (Cl. 173—318)

This invention relates to bushing insulators and has for one of its objects the provision of a bushing insulator for oil filled housings in which the bushing will be automatically filled from the oil in the housing and kept full at all times.

A further object of the invention is to provide a bushing for an oil filled housing which will not leak.

10 A further object is to provide a bushing insulator which shall be of improved construction and operation.

Other objects and advantages will appear from the following description.

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

20 This application is in part a continuation of application Serial No. 563,342, filed September 17, 1931.

In the drawings:

25 Figs. 1 and 2 are elevations with parts in section showing various embodiments of the present invention.

Fig. 3 is a vertical section of another form of the invention.

Fig. 4 is a section on line 4—4 of Fig. 3.

30 Fig. 5 is a view similar to Figs. 1 and 2 showing another form of the invention.

In bushing insulators having insulating shells with enclosed insulating baffles, and particularly those used on circuit breakers and transformers, it is highly advisable that the space within the bushing be filled with oil so that any discharge due to an abnormal voltage will be forced over the outside of the bushing, as an internal discharge would destroy the bushing. It is also highly advisable to maintain the surface level of the oil high enough that radio interference will not be produced by a discharge from the conductor lead or between metal parts. While the oil filled type of bushing has many advantages, particularly where the voltages are high, it is necessary to provide some means of filling the bushings and maintaining the correct oil level.

40 In the present invention a type of construction is used in which the bushing will tend to fill itself under normal working conditions. A bushing which will fill itself under normal operating conditions can be built more cheaply, as expansion chambers, gage glass or other means to indicate that the bushing is full may be dispensed with. The construction may be varied

considerably, depending upon the general design or limitations of the bushing and still conform to the general principle of the invention.

In the form of the invention shown in Fig. 1, a conductor 10 passes through the bushing which is made up of insulating members 11 and 12. The insulating member 11 forms an internal baffle for the upper part of the insulator as well as an external surface below the flange 13 to which it is attached by the joint 14 or by any other convenient means which will provide an approximately tight joint. If the joint 14 is not tight, it may be necessary to use a gasket 15 which will form a tight seal between the flange 13 and the member 11 in order that the self-filling features of the bushing will be effective. The member 10 is commonly tubular and runs through the member 11 and connects by means of an opening 16 with the filling medium in the transformer or circuit breaker tank 17. Another opening is provided in the tube at 18. The opening 18 should be above the upper end of the dielectric member 11 in order that the space 19 between the insulating baffle 11 and the shell 12 will be filled with oil, as will be described. If the surface of the oil in the tank 17 is below the opening 16, it will be necessary to extend the tube 10 so that the end will be below the surface of the oil.

If the bushing is tightly sealed so that any communication with the inside of the bushing must be through the opening 16 and the tubular member 10, an expansion of the air within the bushing, due to rise in temperature, will force air out through the opening 16. When the temperature subsequently lowers, the air inside the bushing will contract and the atmospheric pressure will force oil up through the opening in the tube 10, causing it to discharge into the inside of the bushing through the opening 18. As bushings are generally subject to daily fluctuations in temperature, due to atmospheric changes as well as load changes, it is readily seen that a pumping action will be set up in the bushing. Even though the amount of displacement is small, this continued pumping action will supply a very considerable amount of oil in time to the inside of the bushing. Where the air space inside the bushing is small, the effective cross section of the tube should be small so that a slight expansion of the air will dispel some air at the lower end of the tube 10 and not simply lower the oil level in the tube. The space within the tube may be readily limited as desired by using a very small tube opening at the point 18 or by filling up a portion of the space within a larger tube with a

rod or other internal member. In Fig. 1 the bushing is shown with a draw rod 20 extending through the tube 10. This draw rod serves the purpose of reducing the effective space inside the tube 10 and, at the same time, draws the lower terminal 21 with its lead 22 into contact with the flanged member 23 at the lower end of the bushing. The draw rod 20 is bored at 25' to connect the space between the draw rod and interior of the tube 10 with the opening 16 and the upper end of the draw rod is provided with a washer and lock nuts 25 resting on the upper end of tube 10. An expansion tank 26 bears on a gasket 27 on top of the shell member 12 and is pressed down on the bushing by a spring 28 which engages a washer 29 held by a nut 30 threaded on the tube 10. Electrical connection is formed between the conductor 10 and tank 26 by a sleeve 31 which may be copper webbing or other flexible material. The sleeve 31 is soldered or otherwise secured to the conductor 10 and has its upper portion flared outwardly and extended between the spring 28 and the bottom portion of the tank 26 so that it is held in good electrical contact at all times with the tank 26 as also described and claimed in my copending application Serial No. 565,047, filed September 25, 1931. The tank 26 is provided with a combined cover and terminal member 32 which may be soldered at 33 to insure a tight closure. A filling plug 34 is provided in the cover 32. By pouring oil through the filling opening, the bushing may be filled to the outlet opening 18, after which the oil discharges through the tube. This permits the bushing to be filled for test or shipping and eliminates the necessity for the time required for automatic filling.

The construction not only makes it possible to insure filling of the bushing but also maintains an absolutely tight seal, as any pressure will be relieved by discharge into the case 17. The construction is also such that even though the oil level drops in the case the oil level in the bushing will not drop below the point 18. Any slight leakage which would affect the oil level after a long period of time will be more than supplied by the pumping action where the parts are properly proportioned. Filling oil has a very considerable volumetric expansion or contraction for changes in temperature, therefore, adequate pumping action will be developed under practically any working condition. Where the fluctuations in temperature or in the pressure are very small, more care is required in the design. In some cases, it may be advisable to provide an additional chamber connected with the tank 26 which will increase its effective volume. The construction will work equally well on transformers or circuit breakers where the oil level is well below the flange or with conservator type equipment where the oil level of a conservator tank may be well above the flange 13 or even above the top of the bushing.

In many types of bushings the volume inside the bushing may be very small, in which case a very small opening between the tube and the inside of the bushing will suffice. A broken or damaged upper member will not permit a rapid discharge of the oil which may be supplied by a high conservator tank because the only escape is through the limited opening 18.

In the construction shown in Fig. 2 a small tube 35 opens into the inside of the bushing at the point 36 and connects with the interior of the housing 37 through a passage 38 in the lower terminal 39. The conductor tube 40 is provided with

an opening 41 which connects to the inside of the bushing shell. The upper end of the bushing is sealed by a conducting shell 42. This shell encloses a spring 44 or other tightening mechanism. The spring 44 bears against a washer 45 which presses a conducting member 46 in electrical contact with the shell 42. The conducting member 46 is attached to the central conducting tube 40 at some convenient point, such as at 47. This conducting material may be ribbon, braid or other conductor which will permit the tubular member 40 to move upward or downward due to compression of the gaskets or any relative movement between the tube 40 and the porcelain housing 48. The interior of the tubular member 40 is connected to a tube 49 which terminates in an outlet opening 50 which is provided with a valve or cap 51 as also described and claimed in my copending application Serial No. 565,047, filed September 25, 1931. The lead to the outside of the bushing is connected to the upper terminal lug or boss 52. Under operating conditions any change in the volume of the air or fluid included within the insulating shells 48 and 53 can be used to cause a pumping action through the tubular member 35 when the bushing is entirely sealed. This will tend to maintain the oil level up to the point of discharge of the outlet 36. This point of discharge may be below the top of the dielectric member 48 or may be well up toward the top of the chamber 42. If, for any reason, it is desired to sample or remove the oil within the bushing, all that is necessary is to remove the cap 51 and insert a suitable connection in the opening 50. If there is a positive pressure on the bushing, due to a head produced by pressure in the case or by a conservator tank, oil will readily flow from the opening 50. If the lower end of the bushing is not immersed, the bushing may be emptied by attaching a tube to the opening 50 and siphoning the oil or filling medium from the bushing. If the lower end is immersed, oil will be drawn through the opening 36 to supply that taken out through the opening 50. If, therefore, it is desired to empty the bushing with the lower end immersed, the vent 54 may be opened to allow air to enter. The bushing may be readily emptied through the opening 50 by supplying air pressure to the inside of the bushing, either through the vent 54 or through the tube 35. The small separate tube may be replaced by a double shell or, in some places, the tube may be placed outside the conducting member.

A small tube inside the conductor may be used with a draw rod or other device to facilitate attaching the lower terminal. One arrangement of this kind is shown in Figs. 3 and 4 in which a small pumping tube 55, together with a clamping rod 56 is placed inside of a conducting tube or braid 57. This arrangement makes it possible to provide an effective bushing for very small as well as for large sizes at relatively low cost. The conducting braid or tube 57 makes it possible to use a high tension member of steel or other material having a lower linear coefficient of expansion for changes in temperature than that of copper. Usually a high strength member of steel will provide a higher elastic limit and maintain the desired pressure through a greater range of movement than is possible with a copper tension rod. Where the current capacity is low, the tension member 56 may be made in the form of a tube and plated with copper or other material to increase the conductivity. A fairly uniform electrode surface for the braid or conducting lay-

er 57 may be obtained by filling in around the small pumping tube and the tension rod with a metal 58 having a low fusing point or with insulating material so as to provide a core of circular cross section or, if desired, a thin tube may be placed about the rod 56 and tube 55. The bushing is closed tightly at its upper end by a two part terminal 60 soldered together at 61 after the parts are assembled. The conductor 57 is flanged out at its upper end and pressed against the lower flange on the terminal 60 by a washer 62 and nut 63. The tube 55 communicates at its lower end with the oil in the housing 64 through an opening 65 in the lower terminal 66. The rod 56 is provided at its lower end with a central bore registering with the opening 65 and connecting with the lower end of the tube 55. The upper end of the tube 55 opens into the interior of the bushing near its upper end to effect a pumping action to fill the bushing, as previously explained.

In Fig. 5 the invention is applied to a heavy current bushing although the particular construction of the bushing is not limited to this type. The tubular conductor 68 opens into the interior of the bushing shell at the point 69 and opens to the oil in the housing at the point 70. The construction shown is such that a conservator head would ordinarily keep the bushing filled at all times without the use of the automatic pumping system. In order to allow the bushing to be filled quickly, the vent 72 may be provided. This vent is preferably made so that it is not necessary to remove it entirely but only to loosen it to allow air to escape. With the proper arrangement, it is possible to shut off the opening quickly and effectively as soon as the air is allowed to escape and the oil begins to appear. Where the oil level in the housing is low or it is desired to use the automatic pumping system described above to maintain the oil in a bushing of the general construction shown, it is necessary to effectively seal the opening in the shell 73 through which the tube 68 extends. This is accomplished by a gasket 74 which fits tightly between the compression shell 73 and the conductor rod 68. The pressure exerted by the spring 76 upon the washer 77 causes the gasket 74 to expand laterally against the rod or tube 68, insuring a tight seal, but at the same time permitting movement between the rod and the gasket. The pressure insures a tight fit at all times. It is only necessary to provide a fit, however, which will be sufficiently tight so that temperature fluctuations will cause a scavenging of any air in the bushing. This scavenging would only be necessary where the oil level is below the top of the bushing.

I claim:

1. An insulator having an internal cavity adapted to contain a filling liquid, a source of liquid supply for filling said cavity and means operated by temperature changes to which said insulator is subjected under working conditions for pumping liquid from said source into said cavity.

2. An insulator having an internal hermetically sealed cavity adapted to contain a filling liquid and a source of liquid supply for filling said cavity, said insulator having a passage opening at its upper end into said cavity and having its lower end submerged in a supply of filling liquid in said source, said passage opening into said cavity above the desired surface level of the filling liquid within said cavity to permit entrance of filling

liquid to said cavity but to prevent draining of said liquid from said cavity through said passage.

3. A bushing insulator having an internal cavity for containing an insulating liquid, a container for liquid for filling said cavity said cavity being tightly sealed to atmosphere and having a conduit opening into the upper portion thereof and arranged to communicate with a body of liquid in said container so that contraction of the content of said cavity will draw liquid into said cavity and expansion of said content will discharge, through said conduit, gas that may be trapped at the top of said cavity.

4. An electrical device having a hermetically sealed internal cavity, a container for a supply of liquid for filling said cavity a conduit communicating with said cavity near the top thereof, the lower end of said conduit being arranged to dip into a supply of liquid in said container, the space within said conduit being less than the volumetric displacement to and from said cavity caused by expansion and contraction of the contents of said cavity for temperature changes to which said device is subjected under working conditions so that liquid will be pumped into said cavity and air or gas trapped in the top thereof will be discharged therefrom by such expansion and contraction.

5. The combination with a bushing insulator having an internal cavity, of a supply of liquid for filling said cavity and means actuated by thermal expansion and contraction for automatically filling said cavity with liquid from said supply, said means comprising a relatively small conduit having its lower end submerged in said supply of liquid and having its upper end opening in said cavity above the desired surface level of liquid in said cavity.

6. An insulator having a hermetically sealed internal cavity, a supply of liquid for filling said cavity, the surface level of which is below the upper portion of said cavity and a relatively small conduit opening into the upper portion of said cavity and having its lower end dipping into the liquid in said supply.

7. A bushing insulator having an internal hermetically sealed cavity, a conduit extending upwardly through the interior of said insulator and having its upper end opening near the upper portion of said insulator, a housing into which the lower end of said insulator extends, said housing being arranged to contain an insulating liquid, the lower end of said conduit opening beneath the surface of the liquid in said housing, the internal capacity of said conduit being less than the displacement therethrough of fluid to or from said cavity caused by expansion or contraction of the fluid in said cavity for temperature changes within the working range of said bushing insulator.

8. The combination with a housing for containing electrical apparatus and an insulating liquid, of a bushing insulator extending through the top of said housing and having its lower end extending into the liquid in said housing, said bushing insulator having a hermetically sealed internal cavity and a conduit opening through the lower end of said bushing insulator and extending to a point near the upper end of said internal cavity so that expansion and contraction of fluid within said cavity will draw liquid through said conduit and discharge it into said cavity and will expel, through said conduit, accumulated air or gas from the top of said cavity.

9. The combination with a housing for containing electrical apparatus and an insulating

liquid, of a bushing insulator extending through the top of said housing and having its upper end hermetically sealed, said bushing insulator having an electrical conductor extending through the central portion thereof, and means providing a relatively small passage from the interior of said housing adjacent the lower end of said bushing insulator to a point within said insulator near the upper end thereof to permit automatic filling of said insulator due to expansion and contraction of fluid within said insulator.

10. A bushing insulator composed of a plurality of parts forming a closed hermetically sealed container, a source of liquid supply outside of said container for filling said container, resilient means holding said parts together to maintain tight joints between said parts at all times, and means for automatically supplying filling liquid from said source to the interior of said container and for scavenging air or gas from the upper portion of said container, said means comprising a conduit opening into the interior of said container in the upper portion thereof, the lower end of said conduit communicating with said source of liquid supply outside of said container.

11. A bushing insulator comprising complementary shell members, a conductor extending through said insulator, resilient means for holding said shell members together to form a closed hermetically sealed container, a source of liquid supply outside of said insulator for filling said insulator and means forming a restricted passage from said source to a point within the upper portion of the interior of said insulator to permit liquid to be drawn through said passage into said insulator by contraction of the internal content of said insulator and to accumulate in the lower portion of said insulator so that gas or air trapped in the upper portion of said insulator may be expelled therefrom through said passage by expansion of the internal content of said insulator.

12. The combination with a housing for electrical apparatus adapted to contain a filling liquid, of a bushing insulator extending through the wall of said housing and having an internal cavity for containing insulating liquid, a conduit communicating with the liquid in said housing and with the upper portion of said cavity, said cavity being hermetically sealed except for said conduit, and resilient means for holding the parts of said insulator together to insure a tight joint between said parts.

13. The combination with a housing for electrical apparatus adapted to contain an insulating liquid, of a bushing insulator extending through the wall of said housing and having an internal hermetically sealed cavity, a conduit connecting the liquid of said housing with the upper portion of the cavity in said insulator to permit automatic filling of said insulator from the liquid in said housing by expansion and contraction of the internal content of said cavity, said insulator having an opening for initially filling said cavity and means for closing said opening.

14. A bushing insulator formed of a plurality of parts, a resilient tension member extending through said insulator and holding said parts together, and a tubular conductor surrounding said tension member and extending through said insulator.

15. A bushing insulator comprising a pair of shell members disposed end to end, packing inter-

posed between said shell members to form a tight joint, a resilient tension member extending through said insulator to hold said shell members together, means held in place by said tension member for closing the ends of said shell members to form a tightly closed container, and a conduit arranged to connect the upper portion of the interior of said container with a supply of liquid having its surface below the desired surface level of liquid in said insulator, said conduit being adapted to discharge liquid into said insulator when the content of said insulator contracts and to discharge air or gas from the upper portion of said insulator when the content of said insulator expands.

16. The combination with a bushing insulator, of a resilient tension rod extending through said insulator, a filling tube disposed adjacent said tension rod and opening at its lower end outside of said insulator and at its upper end near the upper portion of the interior of said insulator, and a tubular conductor surrounding said tension member and filling tube.

17. The combination with a bushing insulator, of a tension member extending through said insulator, portions of said tension member being distorted from a straight line to provide resiliency therein, a tubular conductor surrounding said tension member and filling material within said conductor and disposed about said tension member.

18. A bushing insulator comprising a pair of shell members disposed end to end, a resilient tension member extending through said shell members for holding said shell members together, means held in place by said tension member for closing the outer ends of said shell members, a conduit opening at one end outside of said insulator and at the other end within the upper portion of the interior of said insulator to facilitate filling of said insulator and scavenging of air therefrom by expansion and contraction of the content of said insulator, a tubular conductor surrounding said tension member and conduit and filling material disposed about said tension member and conduit within said tubular conductor.

19. A bushing insulator comprising a pair of dielectric shells, a tubular conductor extending through said insulator, a draw rod disposed within said conductor and a terminal secured to the lower end of said draw rod and adapted to make electrical connection with said conductor, and means for holding said draw rod in position in said insulator to hold said terminal in electrical connection with said conductor.

20. A bushing insulator comprising a pair of shell members, a tubular conductor extending through said insulator, a draw rod extending through said tubular conductor and a terminal held in electrical connection with said conductor by said draw rod, said draw rod partially filling the interior of said conductor and leaving room within said conductor for a restricted passage which opens at its lower end outside of said insulator and opens at its upper end near the upper portion of said insulator to permit filling of the interior of said insulator through said passage by contraction of the contents of said insulator and to permit scavenging of air or gas from the upper portion of said passage by expansion of said insulator.

21. A device for containing liquid having a hermetically sealed internal cavity, a conduit communicating with said cavity near the top

thereof and above the desired surface level of the liquid in said cavity, the lower end of said conduit being arranged to dip into a supply of liquid for filling said cavity, said conduit being closed to atmosphere by the liquid in said supply, the space within said conduit being less than the volumetric displacement to and from said cavity caused by expansion and contraction of the contents of said cavity for temperature changes to which said device is subjected under working conditions so that liquid will be pumped into said cavity and air or gas trapped in the top thereof will be discharged therefrom by such expansion and contraction.

22. The combination with a source of liquid supply, of a container disposed above the surface level of the liquid in said supply and sealed against entrance of atmospheric air thereto, and means operated by temperature changes for raising liquid from said supply to said container, said means comprising a tube having its lower end extending into the liquid in said supply and having its upper end opening in the upper portion of said container and above the desired surface level of the liquid in said container, the internal capacity of said tube above the surface level of the liquid in said supply being less than the volumetric displacement of the liquid through said tube due to expansion and contraction of the contents of said container for temperature changes within the range to which said container is subjected.

ARTHUR O. AUSTIN.

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