

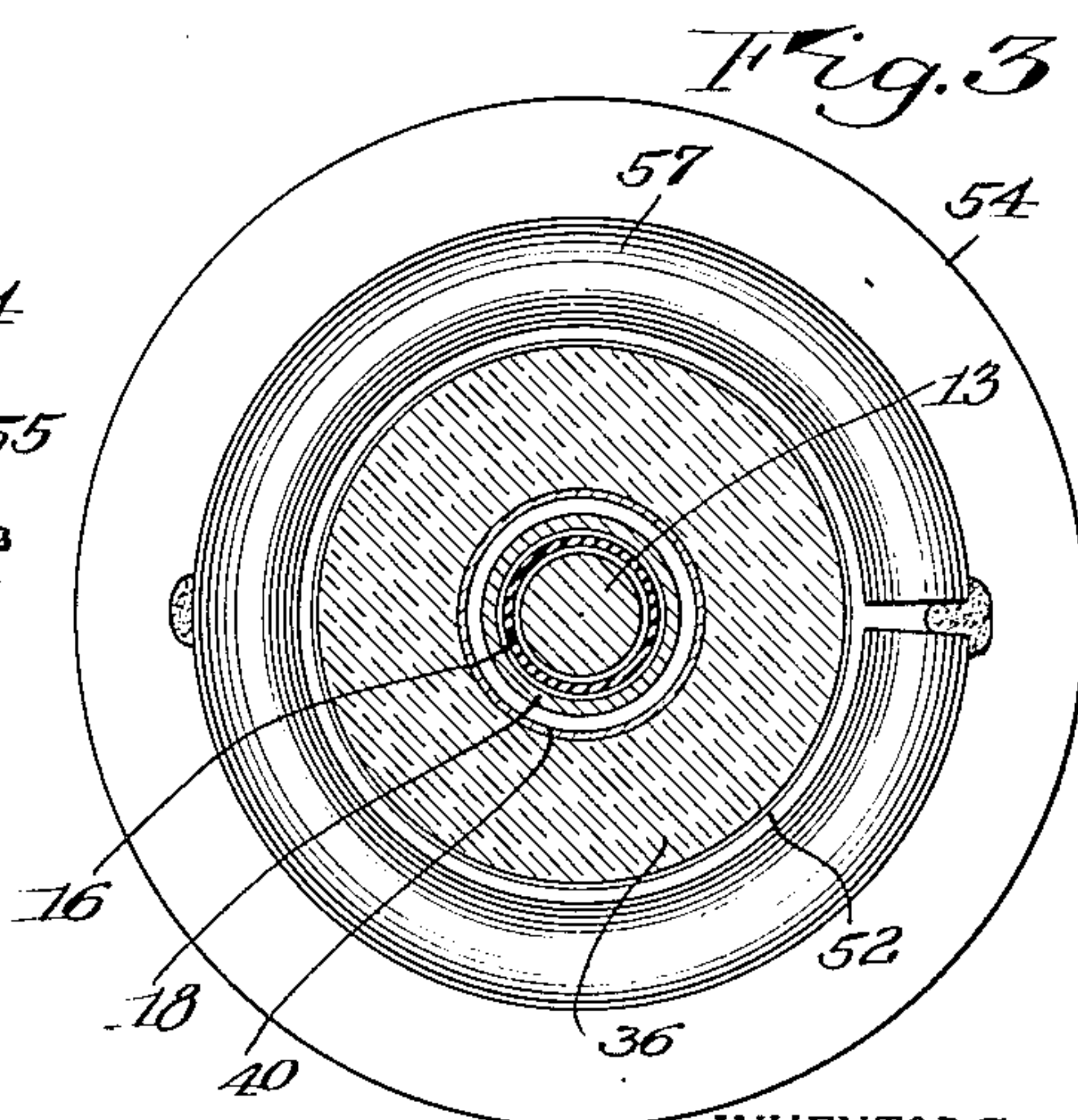
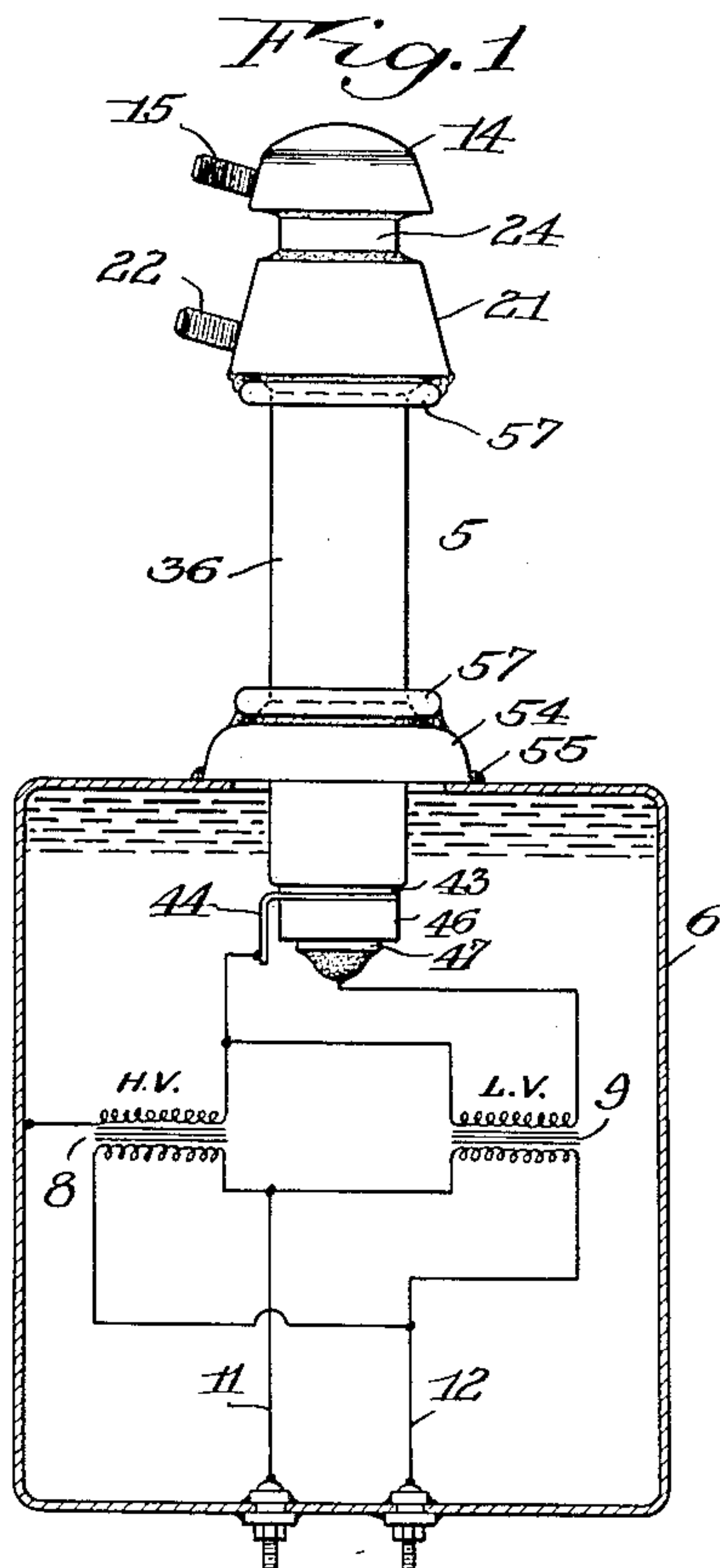
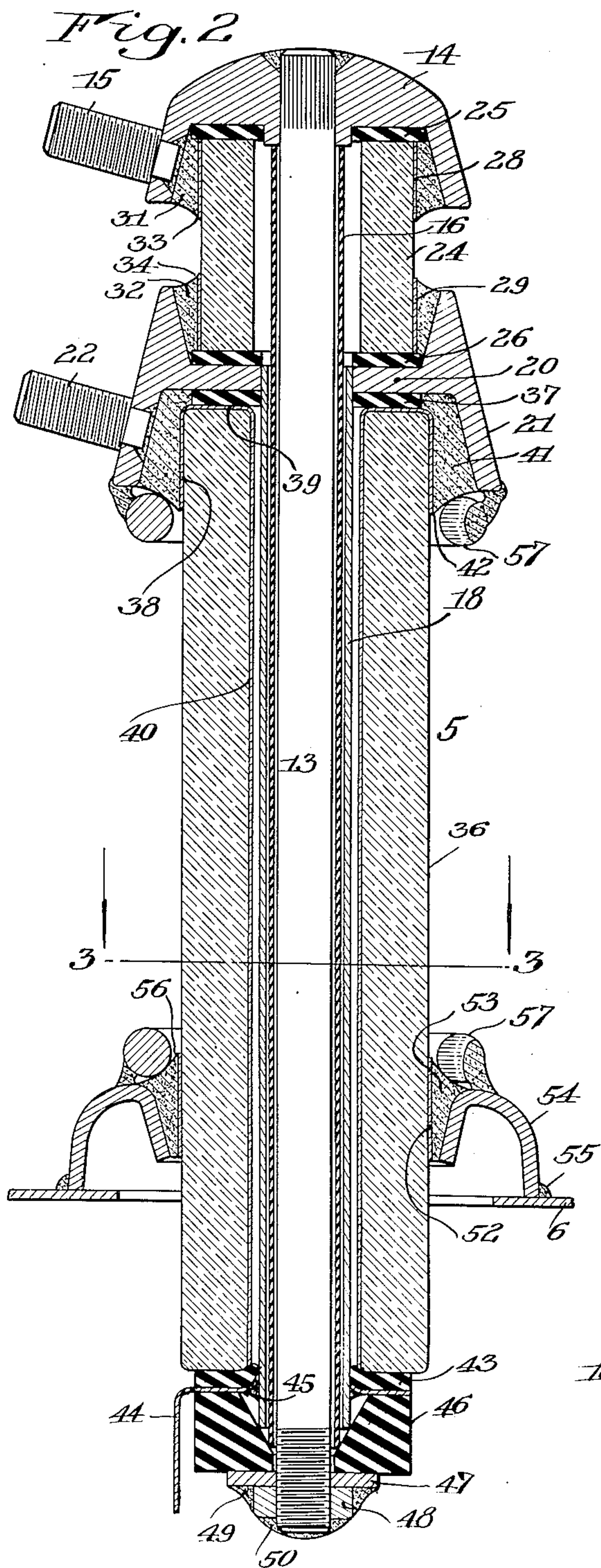
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COAXIAL BUSHING

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## UNITED STATES PATENT OFFICE

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## COAXIAL BUSHING

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This invention relates to insulating bushings especially adapted for use in connection with high voltage apparatus.

In certain high voltage devices such as in an oil-immersed transformer, it is essential that two output conductors thereof be extended through the wall of the transformer to suitable terminals, in a way that will prevent oil leakage and yet will insure that there will be no voltage breakdown or corona effects between the several parts.

The present invention has for its main purpose the production of a coaxial bushing which will satisfy the mentioned requirements and in addition will be sturdy in construction as well as especially compact in design.

The various features and advantages of the invention will appear from the detailed description and claims when taken with the drawing in which:

Fig. 1 illustrates a side elevation of the coaxial bushing of the present invention, together with a fragment of an oil-filled transformer on which it is mounted, the transformer units being diagrammatically illustrated;

Fig. 2 is a longitudinal section through the bushing; and

Fig. 3 is a cross-sectional view of the bushing taken on the line 3—3 of Fig. 2.

Referring especially to Fig. 1, the numeral 5 generally designates the coaxial insulating bushing of the present invention, having its lower portion extending through an opening in the top of an oil-filled metal transformer case 6. Within this case there are mounted the oil-immersed transformer units 8 and 9. The primary windings of these transformers are connected in multiple to the conductors 11 and 12 which respectively lead to a low voltage supply, such as a hundred ten volt alternating current source. These conductors pass through spaced openings in the bottom of the transformer case where they are sealed against oil leakage by well-known fibre and screw terminals having a suitable adhesive such as "Glyptal" applied to the joints between the several parts. The secondary winding of the high voltage transformer unit 8 has one terminal conductively connected to the case 6 as by means of solder and has its other terminal conductively connected through terminal 44, to one conductor 13 of the bushing 5. This conductor of the bushing is also connected in multiple to one terminal of the secondary winding of the low voltage transformer 9. The remaining terminal of this winding is conductively con-

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nected to the other conductor 13 of the bushing as will appear later.

The bushing 5 has the central metal conductor or stem 13 (just mentioned) which is provided at its lower end with a threaded portion and is provided at its upper end with a mushroom-like metal cap 14 having a screw terminal 15. As illustrated, the upper end portion of the stem is knurled so that when it is forced into the opening in the cap, a close fit results and the joint between these parts can be sealed by soldering or brazing. The stem is enclosed by a paper or other insulating sleeve 16 extending from the inner surface of the cap 14 to the threaded lower portion of the stem. The other conductor 18 (previously mentioned) of the bushing comprises a brass tube which surrounds the paper sleeve 16, with the stem 13 enclosed therein. Thus, the two conductors 13 and 18 are concentrically arranged with respect to each other. The tube 18 has its upper end fusibly joined in concentric relation to the inner border of an annular disc 20, so that the disc extends perpendicular to the axis of the tube. This disc is provided with an integral ferrule 21 having a screw terminal 22. This ferrule tapers in the direction of the cap, the outer edge of the disc being connected to an intermediate portion of the inner surface of the ferrule, to provide a recess at each surface of the disc.

The cap 14 and the ferrule 21 are insulated from each other by a porcelain sleeve or insulator 24. This insulator, with asbestos washers 25 and 26 engaging its respective ends, surrounds the stem 13 and the enclosing paper tube 16. It will be seen that the upper end of the insulator extends into the recess at the under side of the cap, while the lower end thereof extends into the recess at the upper part of the ferrule. Since hot oil tends to seep through any mechanical joint, it is essential that such a joint be avoided at any part of the bushing. On the other hand, solder or other fused metal will not adhere to glazed porcelain when untreated. In this construction, however, bands 28 and 29 of the porcelain glaze at the respective ends of this insulator are metallized by having a thin film of metal fused or sputtered into the glaze at these portions. The unoccupied portion of the recess in the cap is filled with molten solder 31 while the unit is held inverted from the position illustrated. This solder becomes fused to the cap and to the metallized band 28 of the insulator 24, thereby providing an oil-proof seal at this joint. Similarly, the unfilled portion of the recess in the top of the



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ferrule 21 is filled with molten solder 32, while the unit is held in the upright position shown. This solder likewise becomes fused to the ferrule and to the metallized band 29 on the insulator thereby affording an oil-proof seal at this second location. It should be noted that the fillets 31 and 32 of solder taper to sharp edges at 33 and 34 at the boundaries between the metallized bands and the adjacent insulator portion, i. e., where they merge with the outer surface of the insulator. The thin edges of solder at the mentioned points tend to reduce the strain and thereby reduce the danger of fracture of the porcelain insulator resulting from the unequal rate of expansion and contraction of porcelain and solder.

The part of the hollow conducting tube 18 which extends from the ferrule to almost the lower end of the assembly, is enclosed by a second porcelain sleeve or insulator 36, an asbestos washer 37 being placed between the upper end of the insulator and the under surface of the disc 20. A band-like portion at the upper part of the outer surface of the insulator as well as the top edge and the entire inner surface of the insulator are provided with a continuous metallized film of the character mentioned, as indicated at 38, 39 and 40. Molten solder 41 is used to fill the recess in the under part of the ferrule and to make a fused joint between the ferrule and the metallized band 38. In this instance also, the solder is caused to thin out to a sharp edge 42 at its junction with porcelain insulator, for the reason given above. It should be mentioned that the metallized layer at 39 and 40, which covers the end and the inner surface of the insulator 36, is conductively connected to the ferrule 21 through the layer at 38 and through the solder in contact therewith. The construction just described substantially eliminates any corona effect between the inner surface of the insulator 36 and the adjacent parts.

The lower end of the insulator is engaged by an asbestos washer 43 through which the conductor tube 18 is inserted. An annular metal terminal 44 which snugly contacts the lower surface of the asbestos washer 43, is soldered on the tube 18 as indicated at 45. An insulating collar 46 is next assembled over the lower end of the tube 18 as well as over the threaded portion of the stem 13 where a lock washer 47 and a nut 48 tightly hold the parts in assembled relation as indicated. The washer 47 and nut 48 are dipped into molten solder to provide soldered joints as indicated at points 49 and 50.

Since the bushing must make an oil-tight seal with the transformer casing, provision must be made to solder these parts together. To this end, the outer surface of the insulator sleeve is provided with a metallized band 52 at an intermediate point thereon. To this band there is sealed as by solder 53, the inner part of an inverted channel-shaped ring or apron 54 which encircles the insulator. The outer edge of this apron is soldered, as indicated at 55, to that portion of the top of the transformer case 6 surrounding the opening therein.

It will be noted that the fillet of solder 53 tapers to a thin edge 56. This sharp edge is directed toward the sharp edge 42 of the fillet of solder 41. With a great difference in potential between the apron 54 and the ferrule 21, the respective sharp edges 56 and 42 thereof would promote corona discharge effects. In order to avoid such effects, the fillets of solder 41 and 53 have metal rings 57, 57, of circular cross section, soldered thereto

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in a position to encircle the insulator. The diameters of these rings are such that they project beyond the adjacent sharp edges 42 and 56 (Fig. 2) of the mentioned fillets.

The coaxial bushing is particularly applicable where two conductors, such as 13 and 18, both at high potential with respect to a case but at low potential with respect to each other, are to be brought through the case.

While the invention has been illustrated with two conductors extending from within the case 6, through the insulator 36, it also includes an arrangement wherein but a single conductor extends through the mentioned insulator. Also, the invention has been particularly described with reference to an oil-sealed device but it is equally applicable to any fluid-sealed electrical device where the fluid may be air at any predetermined pressure, nitrogen or the like.

The terms porcelain and ceramic, as used herein, are intended to include those materials possessing good insulating properties and having a vitreous surface.

What we claim is:

1. A coaxial bushing for use with a fluid-filled receptacle of an electrical device, said bushing comprising a hollow conductor, a second conductor extending through said hollow conductor in insulated relation thereto, each conductor terminating in an annular terminal, a hollow ceramic insulator enclosing one of said conductors and spacing said terminals, band-like surface areas of said insulator encircling both end portions thereof being metallized, fused metal connections sealing each terminal to an adjacent metallized band, a second ceramic insulator enclosing said conductors, spaced band-like surface areas of said second insulator encircling the same being metallized, a fused metal connection sealing one of said metallized areas to the terminal of the hollow conductor, a metal ring encircling said last-mentioned insulator and adapted to be metal sealed to the margin of the wall of the receptacle defining an opening therein, and a fused metal connection sealing said ring to the remaining band-like metallized area of said second insulator, certain of said metal connections having relatively thick portions tapering to thin edges at the boundaries between the several metallized bands and the adjacent insulator portion.

2. A coaxial bushing for use with a fluid-filled receptacle of an electrical device, said bushing comprising a hollow conductor, a second conductor extending through said hollow conductor in insulated relation thereto, each conductor terminating in an annular terminal, a hollow ceramic insulator enclosing one of said conductors and spacing said terminals, band-like surface areas of said insulator encircling both end portions thereof being metallized, fused metal connections sealing each terminal to an adjacent metallized band, a second ceramic insulator enclosing said conductors, spaced band-like surface areas of said second insulator encircling the same being metallized, a fused metal connection sealing one of said metallized areas to the terminal of the hollow conductor, a metal ring encircling said last-mentioned insulator and adapted to be metal sealed to the margin of the wall of the receptacle defining an opening therein, a fused metal connection sealing said ring to the remaining band-like metallized area of said second insulator, the fused connections related to said second insulator having relatively thick portions tapering to thin edges directed toward each



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other, and a ring of curved cross section individual to each of said last-mentioned connections and conductively connected thereto, said rings encircling said second insulator and projecting beyond the thin edges of their related connections.

3. A coaxial bushing for use with a fluid-filled receptacle of an electrical device, said bushing comprising a hollow conductor, a second conductor extending through said hollow conductor in insulated relation thereto, each conductor terminating in an annular terminal, a hollow ceramic insulator enclosing one of said conductors and spacing said terminals, band-like surface areas of said insulator encircling both end portions thereof being metallized, fused metal connections sealing each terminal to an adjacent metallized band, a second ceramic insulator enclosing said conductors, spaced band-like surface areas of said second insulator encircling the same being metallized, a fused metal connection sealing one of said metallized areas to the ter-

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minal of the hollow conductor, a substantial portion of the inner surface of said second insulator being provided with an electrically conducting coating conductively connected to the terminal of the hollow conductor, a metal ring encircling said last-mentioned insulator and adapted to be metal sealed to the margin of the wall of the receptacle defining an opening therein, a fused metal connection sealing said ring to the remaining band-like metallized area of said second insulator, the fused connections related to said second insulator having relatively thick portions tapering to thin edges directed toward each other, and a ring of curved cross section individual to each of said last-mentioned connections and conductively connected thereto, said rings encircling said second insulator and projecting beyond the thin edges of their related connections.

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