April 7, 1942. P. L. CHRISTENSEN 2,278,974

BUSHING FOR ENCASED ELECTRICAL APPARATUS

Filed May 2, 1940

Fig.1.

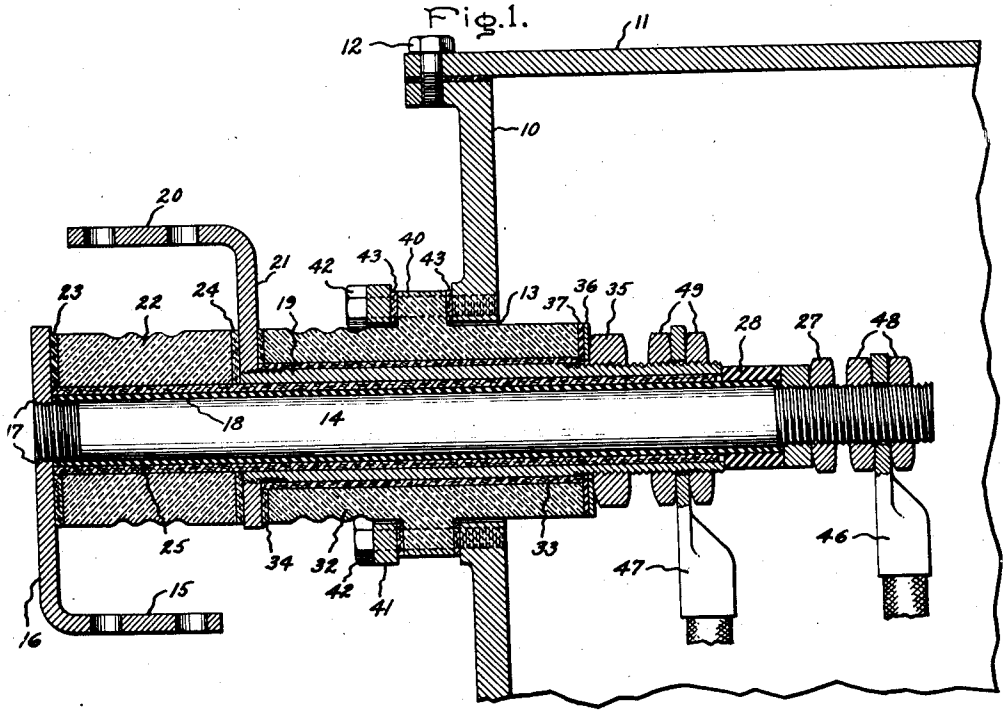
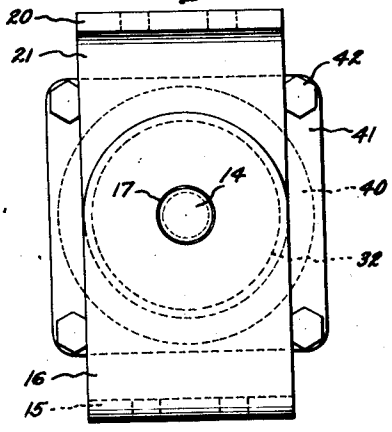


Fig.2.



Inventor:
Paul L. Christensen,
by Harry E. Dunham
His Attorney.

Patented Apr. 7, 1942

2,278,974

UNITED STATES PATENT OFFICE

2,278,974

BUSHING FOR ENCASED ELECTRICAL APPARATUS

Paul L. Christensen, Pittsfield, Mass., assignor to General Electric Company, a corporation of New York

Application May 2, 1940, Serial No. 332,981

3 Claims. (Cl. 174—167)

The instant invention relates to encased electrical apparatus such as transformers and more particularly to conductor bushings therefor. Its general object is to provide a new and improved conductor bushing arrangement suitable for conducting a relatively heavy current through a casing wall of magnetic material between the apparatus and the outside circuits or terminals to which the leads are connected and supply current. Transformer cases are usually constructed of a magnetic material such as sheet steel and in the usual arrangement the leads are brought through the casing wall by separated stud type bushings. A magnetic field is set up between the bushings which extends into the adjacent magnetic material of the casing around the bushing openings causing a high stray loss in the tank walls. If the current flow through the conductors is of a large value, the loss in the casing around the openings frequently causes heating thereof to objectionably high temperatures. A common means for reducing such stray losses is to provide a non-magnetic plate between the bushings but such an arrangement is relatively expensive particularly in the case of sealed type transformers.

It is a further object of the present invention to provide a new and improved plural conductor bushing for use with encased electrical apparatus, the conductors being so arranged that the stray losses produced in the casing walls are reduced to a minimum, the bushing being substantially gas-tight, and of a rugged construction.

Further objects and advantages will appear from the following description taken in connection with the accompanying drawing in which Fig. 1 is a cross-sectional view of a bushing constructed in accordance with the invention and Fig. 2 is a plan view of one end thereof.

Referring now to the drawing the bushing according to the invention is shown as applied to a casing for electrical apparatus such as a transformer having a wall 10 and a cover 11 secured thereto as by suitable bolts 12. The bushing extends through an opening 13 in the tank wall and is secured thereto in a manner as will be more fully described hereinafter. The bushing itself comprises an inner axially extending conductor 14 having a terminal blade 15 suitably secured to the outer end thereof and which blade has an annular portion 16 forming a shoulder extending at right angles with respect thereto. As illustrated, the terminal blade may be threaded onto the outer end of the axial conductor 14 and may also be welded thereto as indicated at 17. Surrounding the axial conductor 14 for the greater portion of the length thereof is a tube 18 of insulating material such as fibre and which is preferably pressed onto the conductor. An outer cylindrical conductor 19 somewhat shorter than the axial conductor 14 is arranged concentrically around the axial conductor and is provided with a terminal blade 20 fixedly secured to the outer end thereof and which blade has an annular portion 21 forming a pair of oppositely facing shoulders extending at substantially right angles with respect thereto. The terminal blade portions 16 and 21 are spaced apart by means of the tubular collar 22 of suitable insulating material, such as porcelain, gaskets 23 and 24 of compressible material such as cork being provided between the opposite ends of the collar 22 and the adjacent terminal blades. A tube 25 of compressible insulating material which may also be of cork is provided between the fibre tube 18 and the porcelain collar 22 and conductor 19. In order that a pressure-tight seal be obtained therebetween, it is preferred that the cork tube 25 is tightly compressed such as to substantially one-half of its original thickness. The gaskets 23 and 24 at the outer end of the bushing are compressed by means of a clamping nut 27 on the inner end of the conductor 14 which is tightened so as to exert a pressure against the inner end of the cylindrical conductor 19 through the short sleeve 28 of relatively hard fibrous insulating material. A tubular member 32 of suitable insulating material such as porcelain concentrically surrounds the conductor 19, a suitable cylindrical gasket 33 such as cork being tightly compressed therebetween. A suitable gasket 34 which may also be of cork is also provided between the outer end of the tubular insulator 32 and the adjacent terminal blade portion 21. The gasket 34 is tightly compressed by means of a clamping nut 35 threaded onto the inner end of the tubular conductor 19 which is tightened against the metal and fibre washers 36 and 37, respectively, so as to exert a longitudinal pressure against the inner end of the tubular insulator 32.

The tubular insulator 32 is provided at its mid section with a circumferentially extending flanged portion 40 by which the bushing is fastened to the casing wall through means of the metal clamping plate 41 and bolts 42, suitable gaskets 43 being provided on the opposite sides of the flanged portion 40.

Terminal lugs 46 and 47 of enclosed apparatus leads may be secured to the threaded inner ends

of the conductors 14 and 19 by means of nuts 48 and 49, respectively while the external connections may be readily made to the ends of the terminal blades 15 and 20.

The bushing described is particularly adaptable for use in the secondary low voltage circuit of a distribution type transformer which usually carries a relatively heavy current. Due to the concentric arrangement of the bushing conductors, the magnetomotive force of the current in one neutralizes that force of the current in the other. The conductor arrangement being therefore non-inductive, no stray flux and loss result in the tank wall and the need for a non-magnetic insert in the tank wall about the bushing is thereby eliminated. The two conductor circuits are adequately insulated for relatively low secondary voltages though of course the insulation thickness may be varied as required. The bushing assembled in the manner described is substantially gas-tight so that it is suitable for use with sealed type transformers.

Having described the principle of my invention together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the specific arrangement shown is merely illustrative and that the invention may be carried out by other means.

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

1. A bushing comprising an inner and an outer longitudinal concentric conductor, a tubular member of insulating material arranged over said inner conductor for spacing said concentric conductors apart, each of said conductors having a terminal member secured thereto at adjacent ends, said terminal members having annular portions extending at right angles around said ends, a tubular spacer of insulating material around said inner conductor between said terminal members, compressible gaskets between said spacer and said terminal members, a clamping nut threaded on the opposite end of said inner conductor insulated from and exerting a pressure against the adjacent end of said outer conductor so as to compress said gaskets between said spacer and said right angularly extending terminal portions, a tubular insulator surounding said outer conductor, a gasket between an end of said insulator and the terminal member of said outer conductor, a clamping nut threaded on the opposite end of said outer conductor exerting a pressure against the adjacent end of said insulator to compress the gasket at the opposite end thereof, and means provided on the outer surface of said insulator whereby said bushing may be securely clamped to a wall opening.

2. A bushing comprising an inner and an outer longitudinal concentric conductor spaced apart by a layer of insulating material, terminal members secured to a pair of corresponding ends of said conductors and having portions extending at right angles around said ends, a tubular insulating spacer around said inner conductor between said terminal member portions, a clamping nut threaded on the opposite end of said inner conductor, insulating means between said nut and the adjacent end of said outer conductor so that upon tightening of said nut it will exert a pressure against said outer conductor through said insulating means to clamp said spacer tightly between said right angularly extending terminal member portions, a tubular insulator surounding said outer conductor and having an end adjacent said right angularly extending terminal portion of the outer conductor, and a clamping nut threaded on said outer conductor for exerting a pressure on said insulator for forcing said end against said right angularly extending terminal member portion secured to said outer conductor.

3. A bushing comprising an axial conductor, a tubular conductor concentrically surrounding and spaced from said axial conductor, means including a tubular insulator filling and sealing substantially fluid tight the space between said conductors, conductive means defining annular shoulders around one pair of corresponding ends of said conductors, a solid insulating spacer surrounding said axial conductor between said shoulders, an insulating sleeve around said axial conductor at the end opposite said shoulder, a nut on said axial conductor forcing said sleeve against the adjacent end of said tubular conductor clamping said spacer tightly between said shoulders, a solid insulating member surrounding said tubular conductor in a substantially fluid tight relation therewith, and a nut on said tubular conductor clamping said member tightly against the opposite surface of said shoulder thereon with respect to said spacer.

PAUL L. CHRISTENSEN.