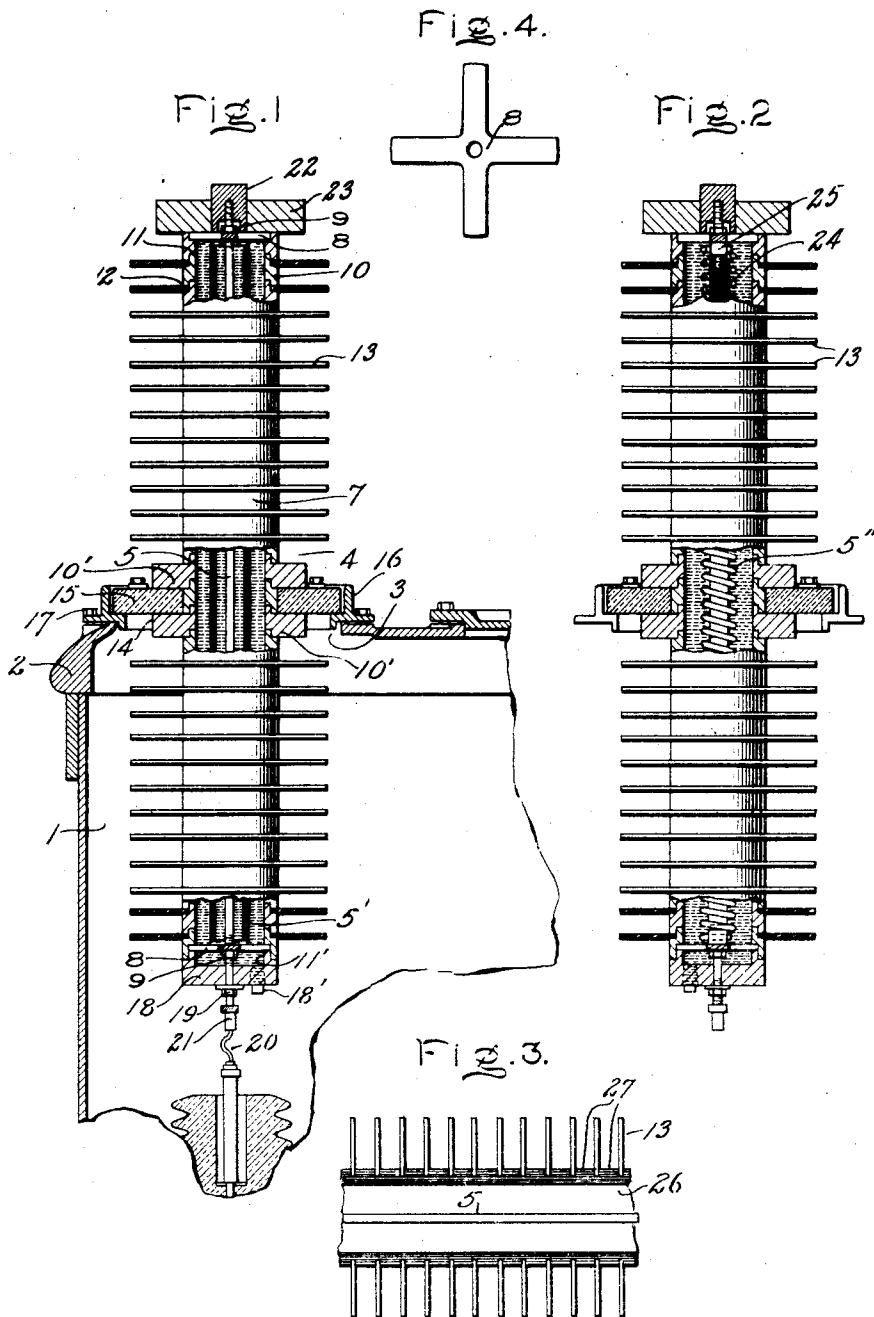


J. J. FRANK.
TRANSFORMER LEAD.
APPLICATION FILED NOV. 16, 1904.



WITNESSES:

George A. Thornton.
Allen Oxford

INVENTOR:

John J. Frank,
By *Arthur B. Davis*
Att'y.

UNITED STATES PATENT OFFICE.

JOHN J. FRANK, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TRANSFORMER-LEAD.

SPECIFICATION forming part of Letters Patent No. 792,016, dated June 13, 1905.

Application filed November 16, 1904. Serial No. 232,942.

To all whom it may concern:

Be it known that I, JOHN J. FRANK, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Transformer-Leads, of which the following is a specification.

Modern transformers, particularly high-voltage transformers, are ordinarily immersed in oil contained in metal casings. Heretofore much difficulty has been experienced with high-voltage transformers of this character in insulating the transformer-leads from the oil-containing metallic casings through the walls of which they must necessarily be passed. To overcome these difficulties and to obtain a sufficient and proper insulation for the terminal conductors of high-voltage transformers, I have devised the construction hereinafter described and illustrated.

The various features of novelty which characterize my invention I have pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, reference may be had to the accompanying drawings, in which—

Figure 1 is an elevation, with parts broken away and in section, showing a portion of a transformer-casing through which passes a transformer lead or conductor and its bushing. Fig. 2 is an elevation, with parts broken away and in section, showing a modified construction. Fig. 3 is a sectional elevation showing another construction of the bushing, and Fig. 4 is an elevation showing a detail of construction.

In the drawings, 1 represents a portion of the wall of a casing in which an oil-cooled and insulated high-potential transformer is located. The cover 2 of the casing is formed with an aperture, as at 3, through which the transformer terminal leads 4 pass. Referring particularly to the construction shown in Fig. 1, a conductor 5 is shown in the form of a rod with threaded ends. A bushing 7, which surrounds the conductor 5 and is substantially concentric therewith, is secured in fixed relation to the conductor by clamping members 8,

formed of metal, and nuts 9, secured on the threaded ends of the conductor. The bushing is formed of a number of similar rings or annular members 10, of suitable insulating material—such as wood, wood-pulp, pressed board, oiled linen, glass, porcelain, or the like—which are formed each with a cylindrical inner tongue or flange portion 11, projecting from the inner side of the body of the ring, and a concentric cylindrical tongue or flange portion 12, projecting from the outer side of the opposite end of the body portion of the ring. These rings are assembled so that the adjacent inner and outer flanges of the adjacent rings or sections overlap. As shown, the outer flange portion 12 of each section is shorter than the inner flange portion 11. As a result a circumferential space or groove is formed between the outer surface of each pair of adjacent rings 10, in which is placed an annular washer member or barrier 13, formed of suitable insulating material, such as pressed board or the like. As shown, the two rings or members 10' adjacent to the middle ring of the bushing extend outward to form collars or flanges 14, between which the annular member 15, which may be formed of marble or the like, is secured. The marble in turn is then secured to an annular member 16, formed of metal. The member 16 is secured to the casing-cover by bolts 17. A bottom member 18 for the bushing may be secured to the lower end of the conductor by a nut 19. The bottom member 18 is formed with an inner flange portion 11', which overlaps the outer flange portion of the adjacent ring. A drain-plug 18' may be employed in the bottom member 18, as shown. After the rings or sections and annular members are secured together between the end members by the conductor 5 the whole is treated in any suitable manner, as by dipping in suitable varnish or other insulating liquid, to increase the insulating properties of the bushing and to fill all the crevices and spaces between different adjacent cylindrical members and disks, thus eliminating any joints in surface of the bushing and obtaining an oil-tight vessel. The space within the bushing surrounding the conductor is then filled with a

suitable insulating material, which may be liquid at ordinary temperatures, such as a suitable oil, or may be a solid at ordinary temperatures, such as wax or the like.

5 The end 20 of the winding of the transformer may be secured to the lower end of the conductor 5, which projects through the end member for the purpose by a threaded coupling member 21. The upper end of the rod 5
10 is tapped into a member 22, of conducting material, as shown. This member is surrounded by an annular washer or member 23, which may be formed out of wood or the like.

The construction employed insures a very
15 high degree of insulation between the conductor and the casing. The annular members 13 or barriers serve to interrupt the continuity of a brush-discharge occurring along the outer surface of the bushing and lessen the liability
20 of and effects produced by such discharges.

The ring-sections 10 when of wood should be so formed that the grain of the wood does not extend parallel to the axis of the bushing, as the insulating properties of wood in the direction of its grain are much less marked than
25 those across the grain of the wood. The construction heretofore described is much less apt to be distorted by warping or the like than would be the case if the wooden rings or sections were integrally connected.
30

To still further increase the insulation about the conductors, I sometimes prefer to surround the rod by tubular members 5', preferably of insulating material, to subdivide the
35 oil into a number of separate and independent ducts.

In some cases it is desirable to employ a certain amount of reactance in series with the terminal conductors or transformers to protect
40 the transformer against the high-frequency discharges. In Fig. 2 I have shown a construction in which this reactance is located within the insulating-bushing. In the construction shown in Fig. 2 a rod 24, of insulating material, has secured to its end threaded
45 rods of conducting material 25. The bushing is held together by nuts on the rods 25 in the same manner as the bushing first described is held together by nuts on the end of the conductor 5. A conductor 5" in the form of a
50 helix surrounds the rod 24, the adjacent turns of which do not touch each other, and has its ends secured to the rods 25. The conductor 5" thus serves to connect the rods 25 and furnish the necessary reactance. Preferably the
55 internal diameter of the helix is such that the helical conductor does not touch the rod of insulating material. With this construction I am able to place the proper amount of reactance to protect the terminal in a very desirable location. Should the strain on the
60 transformer be great enough to cause an arc between the adjacent turns of the helical conductor, the arc formed will be immediately extinguished by the oil in the bushing.
65

In Fig. 3 I have shown a construction in which the body of an insulating-bushing is formed of an inner cylindrical portion 26, which may consist of a number of layers of oiled linen or similar fabric. Annular members 13 are strung on this cylinder and are separated from each other by collar portions or cylinders 27, also formed of a number of layers of oiled linen or similar fabric of insulating material. The linen forming the
75 walls of the bushing in this case is impregnated with oil of such a character that when the bushing is treated in a proper manner the layers will weld together to destroy all joints or surfaces between adjacent layers and also
80 between the ends of the collar portions and the annular members.

I may dispense with an end member, such as the member 18, for closing the lower end of the bushing where it is desired to entirely
85 fill the casing and bushing with oil, in which case it will of course be understood that the joints between the case and cover and in the cover should be oil-tight.

While I have hereinbefore described and
90 illustrated the best form of my invention now known to me, I do not wish the claims herein made to be limited to the particular construction shown other than is made necessary by the state of the art.
95

It will be obvious to those skilled in the art that the construction described can be used for other purposes than that specified.

What I claim as new, and desire to secure by Letters Patent of the United States, is—
100

1. An insulating-bushing formed of annular members of insulating material, each comprising an inner flanged portion and an outer flanged portion, the inner and outer flanged portions of adjacent members overlapping, and
105 a washer or member secured between an adjacent pair of said annular members.

2. An insulating-bushing formed of a number of similar interlocking annular members made of insulating material, and washers located one between each adjacent pair of said members.
110

3. An insulating-bushing formed of a number of annular members, each provided with an inner flanged portion and an outer flanged
115 portion, arranged with the inner and outer flanged portions of adjacent members overlapping, and a rod or bar within said bushing for securing the end members of said bushing together.
120

4. An insulating-bushing formed of a number of annular members, each comprising an inner flanged portion and an outer flanged portion, the inner and outer flanged portions of adjacent members overlapping, and washers secured one between each adjacent pair of members.
125

5. A bushing formed of a number of annular members, each provided with an inner flanged portion and an outer flanged portion,
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and washers placed one on the inner flanged portion of each member, said members being arranged with the inner and outer flanged portions of adjacent members overlapping.

5 6. In combination, a metallic casing formed with an aperture, a bushing of insulating material passing through said aperture, and a conductor axially located in said bushing and separated from the walls thereof by an insulating liquid.

7. In combination, a casing formed with an aperture, a bushing of insulating material passing through said aperture, and a conductor axially located in said bushing and separated therefrom by insulating material inserted in said bushing in the form of a liquid.

8. In combination, a metallic casing formed with an aperture, a bushing passing through said aperture, and a conductor axially located in said bushing and separated therefrom by liquid insulating material.

9. An insulating-bushing, a number of similar interlocking annular members made of insulating material, and means located within said bushing for securing said members together.

10. The method of forming a bushing which consists in forming a cylindrical body portion surrounded by separate washer members located at intervals along said body portion, and then treating the same to destroy all fissures in the surface thereof.

11. In combination, a bushing formed of

insulating material, conductors extending into the ends of said bushing, means within the bushing for engaging the ends of said conductors and securing them and the bushing in fixed relation, and a reactance located within the bushing and having its terminals connected to said conductors.

12. In combination, a bushing formed of a number of annular members of insulating material, conductors engaging the end members of said bushing, and means passing through said bushing for mechanically connecting said conductors.

13. In combination, a bushing formed of a number of annular members of insulating material, conductors engaging the end members of said bushing, means passing through said bushing for mechanically connecting said conductors, and a helical conductor within said bushing having its ends connected to the first-mentioned conductors.

14. An insulating-bushing formed of similar interlocking annular members of insulating material, and a surface-increasing washer member located between an adjacent pair of said annular members.

In witness whereof I have hereunto set my hand this 14th day of November, 1904.

JOHN J. FRANK.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.