L. R. BROWN.

PROTECTIVE DEVICE FOR ELECTRICAL APPARATUS.

APPLICATION FILED DEC. 9, 1918.

1,310,054. Patented July 15, 1919.

Fig. 1.

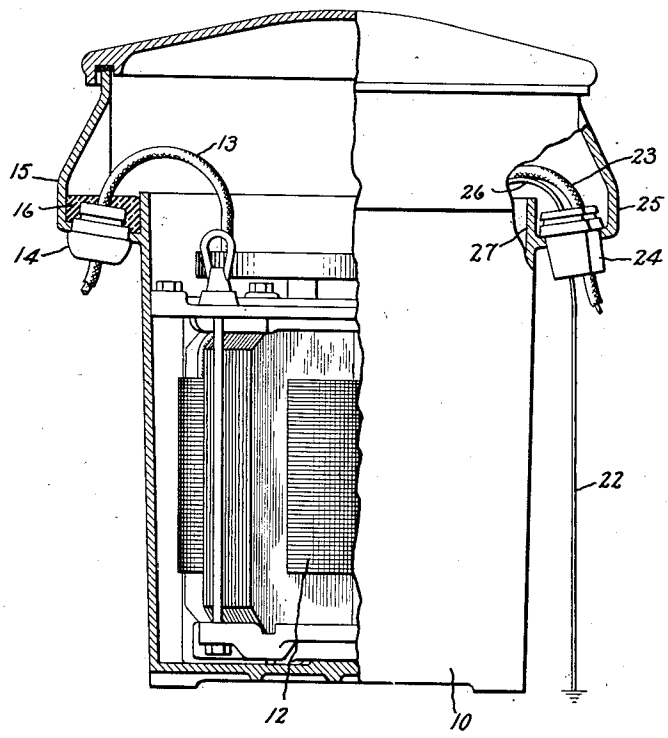



Fig. 2.

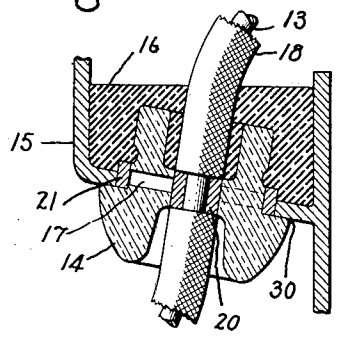
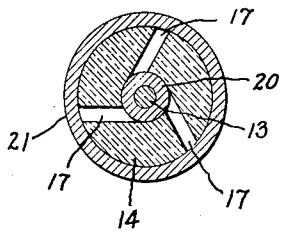



Fig. 3.




Inventor:
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by Albert G. Davis
His Attorney.

# UNITED STATES PATENT OFFICE.

LEWIS R. BROWN, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## PROTECTIVE DEVICE FOR ELECTRICAL APPARATUS.

1,310,054. Specification of Letters Patent. Patented July 15, 1919.

Application filed December 9, 1918. Serial No. 265,851.

*To all whom it may concern:*

Be it known that I, LEWIS R. BROWN, a citizen of the United States, residing at Pittsfield, in the county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Protective Devices for Electrical Apparatus, of which the following is a specification.

My invention relates to a protective device for incased electrical apparatus such as transformers and the like.

It has been recommended for standard practice that transformers and like apparatus always be installed with adequate protecting devices such as lightning arresters, etc., to take off safely to ground the peak voltages which may arise during surges or other transient phenomena.

This recommendation, however, cannot in all instances be effectively carried out because of the difficulty in obtaining a good ground connection for the arresters. Furthermore, the protection originally afforded by lightning arresters not infrequently becomes substantially inoperative by reason of deterioration in the quality of the ground connection.

It is, therefore, desirable that apparatus which is installed where such conditions obtain should itself be protected against those maximum values of the peak voltage which would break down the insulation of the apparatus or otherwise injure it.

The object of my invention is then to provide a cheap, safe and efficient device which is a part of the apparatus for affording this measure of protection; and to this end I provide the bushings for the incoming leads, to the apparatus which it is desired to protect, with one or more interior passages or perforations of sufficient length to permit a breakdown or arc-over therethrough to the tank only when critical maximum voltage is reached; such passage or passages in the bushing leading from a bare metallic portion of the lead to a like metallic body in conducting relation with the tank or casing of the apparatus. To protect against short circuits passing from lead to lead through the tank when bushings of this type are employed, I provide a ground connection which is not in permanent conducting relation with the tank but which offers less resistance to the passage of current from the tank to ground when an arc-over occurs in one bushing, than from lead to lead through the tank.

This is most readily effected by bearing a portion of a grounded neutral outgoing lead in such proximity to the conducting structure of the tank as to provide a path having this reduced resistance.

For a more complete understanding of the nature and objects of my invention reference should be had to the following detailed description when taken in connection with the accompanying drawing in which Figure 1 is a view partly in section and partly in elevation of an incased electrical apparatus having my invention applied thereto. Fig. 2 is an enlarged sectional view of a bushing employed in the practice of my invention; and Fig. 3 shows a section thereof.

Referring now to Fig. 1 of the drawing, 10 denotes the tank or casing inclosing an electrical apparatus, here indicated as a distributed core type transformer 12 adapted to be submerged in oil.

The incoming high voltage leads 13 each pass through an insulating bushing 14, which may be made of molded porcelain and are formed to embody my invention; all of which is clearly indicated in Fig. 2. Each bushing 14 is preferably inserted in a downwardly projecting pocket, as shown at 15, and sealed therein by some readily molded insulating material such as pitch or other suitable compound, indicated at 16.

The bushing 14, in the drawing, has three interior passages 17 passing in a tangential direction from the central opening to the outer periphery; the tangential direction being employed in preference to a radial direction because it affords a path for the arc having the required length with less insulating material. Obviously though, instead of the tangential disposition of the passages 17, they might have been given a tilt in an axial plane with the same effect, or a combination of both arrangements of passages 17 may be used where a still longer passage is desired within a given amount of insulating material.

The lead 13 is stripped of its insulating coverings 18 where it traverses the bushing opposite the openings 17. In order, however, to avoid having an arc pass from copper to iron (which are the materials generally employed in the manufacture of the leads and casings for apparatus of the type

here disclosed), the lead 13 has swaged or otherwise secured to it a collar 20 of non-arcing metal of sufficient size to snugly fit the central opening in the bushing.

The casing 10 is also preferably provided with a narrow collar 21 of non-arcing material bounding the margin of each opening formed in the casing for a bushing.

The collar 21 is in conducting relation with the casing and has sufficient width to entirely cover the openings 17 in the bushing 14. In this manner disintegrating sparks are prevented between metallic surfaces across the passages 17, when the critical arc-over voltage occurs in a lead 13.

As hereinbefore remarked, it is desirable to make provision against the occurrence of a short circuit from one high voltage lead to another high voltage lead through the tank; this I accomplish by stripping the insulation from the grounded neutral lead 22 which is preferably connected to the secondary windings of the transformer 12, whose service secondary leads are shown at 23. These secondary leads are provided with bushings 24 of any standard type, which may also be located in a pocket 25 near the top of the casing 10.

The stripped portion 26 of the neutral lead 22 is bent down to pass very near a portion 27 of the casing 10 which is in conducting relation with the collars 21 surrounding the high voltage bushings 14. The distance between conducting portions 26 and 27 is such that the arc-over voltage necessary to strike an arc thereacross is at all times less than that necessary to strike an arc across the length of a passage 17.

In operation: Should a surge or other transient phenomenon cause the voltage on the leads 13 to exceed the critical peak value which the air gap along a passage 17 is designed to withstand, the resistance of this gap would break down permitting a discharge of the peak voltage through a passage 17 to the tank which is at a materially lower potential. By reason of the use of non-arcing metal at each end of the passages 17 substantially no metallic vapors are present during an arc to condense subsequently in the passage and possibly alter the resistance of such passage. What hot gases are present during the arcing period in one of these passages may expand and escape to the atmosphere between the bushing 14 and the casing 10 through the capillary space indicated at 30 in Fig. 2.

A short circuit from one lead 13 to another lead 13 will not occur through the casing 10, when an arc occurs across a passage 17 in the apparatus shown because the resistance of each of these passages to arc-over voltage is greater than that required to arc from the tank 10 to conductor 22. Consequently if the tank 10 by a discharge from lead 13 becomes sufficiently highly charged before such charge can leak away, the air gap between conducting portions 26 and 27 will break down permitting the charge to escape safely to ground.

It will, of course, be understood that where a good leakage path from tank to ground is to be had the use of ground connection such as I have shown at 26 is not essential to the practice of my invention.

While I have here shown an embodiment of my invention which is at present the best means known to me for carrying the same into effect, I would have it understood that this is merely illustrative and that I do not mean to be limited thereby to the precise details here disclosed since obvious alterations thereof will appear to those skilled in this art, nor in the choice of recognized equivalents except as defined in my claims hereunto annexed.

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

1. The combination with an incased electrical apparatus having a lead opening in its casing, of a bushing for the lead secured in said opening, said bushing being provided with another passage extending from its lead passage to a conducting part of said casing.

2. The combination with an inclosed electrical apparatus having a lead opening in its casing, of a bushing for the lead secured in said opening, said bushing being provided with another passage arranged to extend from its lead passage to a conducting part of said casing and bushed interiorly and exteriorly with non-arcing metal placed over the openings of said elongated passage.

3. The combination with an incased electrical apparatus having a lead opening in its casing, of a bushing for the lead secured in said opening, said bushing being provided with a plurality of perforations entering at points adjacent the wall forming said opening and penetrating into the lead passage.

4. The combination with an incased electrical apparatus having a lead opening in its casing, of a bushing for the lead secured in said opening, said bushing being provided with a plurality of perforations entering at points adjacent the wall forming said opening and penetrating into the lead passage, and metallic collars of like material lining said wall and said lead passage opposite said perforations.

5. The combination with an incased electrical apparatus having a lead opening in its casing, of a bushing for the lead secured in said opening, said bushing having a bared metallic lead traversing its central passage, another passage extending in a generally radial direction away from said central passage to the wall forming said opening, and a restricted egress to permit an escape of hot

gases which may be formed during the arc-over period in said second named passage.

6. The combination with an incased electrical apparatus having a lead opening in its casing, of a bushing for the lead secured in said opening, said bushing being provided with another passage extending from its lead passage to a conducting part of the casing, and a bare grounded outgoing lead for said apparatus placed in such juxtaposition to said conducting part of the casing that the intervening space has less resistance to arc-over voltage than the space in said elongated passage.

7. The combination with a casing having oil immersed electrical apparatus therein, of a plurality of incoming leads for said apparatus passing through individual openings in said casing, bushings for said leads secured in said openings, said bushings having perforations extending from a bared portion of the lead traversing it to the conducting wall forming the opening in which the bushing is secured, and a grounded neutral outgoing lead having a bared portion spaced a less distance from said casing than the depth of one of said perforations.

8. A bushing for incased electrical apparatus, comprising a substantially cylindrical insulating body portion provided with a lead passage parallel to the axis thereof, and a perforation in the insulating wall entering adjacent the exterior point of support and extending into said lead passage.

9. A bushing for incased electrical apparatus, comprising a substantially cylindrical insulating body portion provided with an axial lead passage, and a plurality of perforations penetrating said axial lead passage tangentially and opening exteriorly at points adjacent the region of support for the bushing.

In witness whereof, I have hereunto set my hand this 6th day of December, 1918.

LEWIS R. BROWN.