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E. H. FREIBURGHOUSE

1,783,837

HIGH VOLTAGE APPARATUS

Filed Oct. 1, 1927

Fig.1.

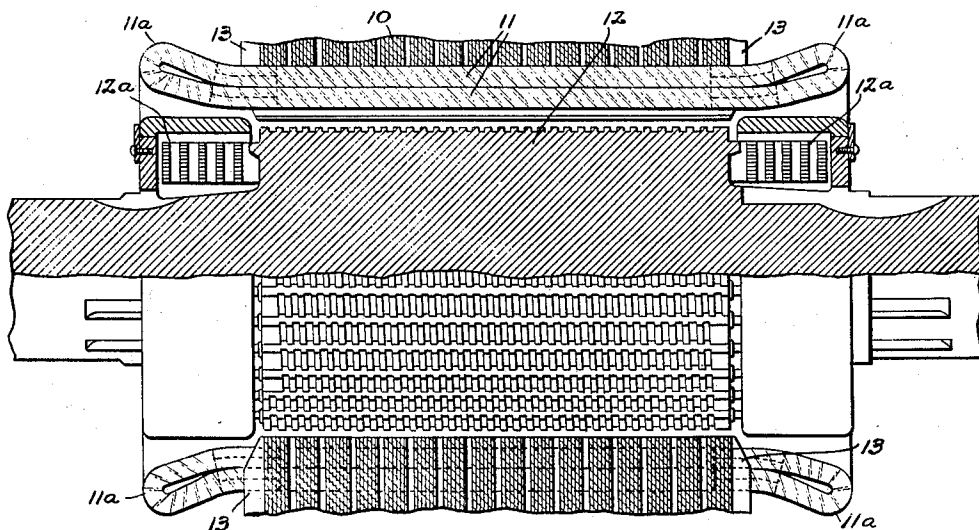


Fig.2.

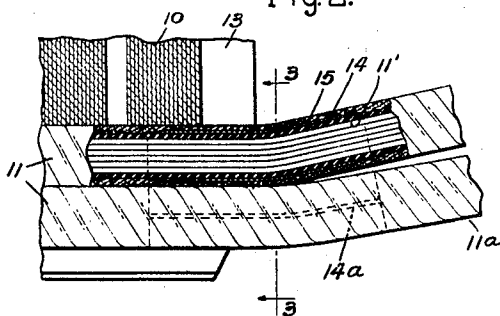
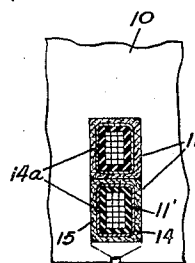


Fig.3.



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UNITED STATES PATENT OFFICE

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HIGH-VOLTAGE APPARATUS

Application filed October 1, 1927. Serial No. 223,417.

My invention relates to high voltage apparatus and more particularly to an arrangement for protecting the insulation of the windings thereof against corona discharge.

It has been proposed heretofore to protect the winding insulation adjacent the core structure of high voltage apparatus by providing a grounded covering of conducting material on the insulation so as to make the potential on the surface thereof the same as that of the core structure. This avoided corona discharge at the portion of the winding covered by the conducting material but it caused a high voltage gradient at the ends of the conducting material resulting in discharges which damaged the insulation. For this reason the effect of using such a grounded covering was to move the zone of high voltage gradient from the clamping covers outwardly on the winding and the arrangement did not protect the winding insulation adjacent the ends and extending beyond the shield.

The object of my invention is to distribute the dielectric stress around the portion of the winding adjacent the parts of the apparatus at widely different potential, such as the core structure and the other portions of the winding, so that the building up of zones at a high voltage gradient which would cause corona discharge is avoided. I prevent electrical discharge at the portion of the winding adjacent other parts of the apparatus by providing a winding shield thereon which varies in resistance from one portion to another so that the voltage gradient at the surface of the same varies gradually from one portion to another and is maintained low enough to prevent corona discharge between the shield and another part of the winding or the core structure.

My invention will be more fully set forth in the following description referring to the accompanying drawing and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In the drawing, Fig. 1 is a longitudinal section of a high voltage generator having a winding shielded against corona discharge

in accordance with my invention; Fig. 2 is an enlarged view of a portion of the winding projecting from the core structure of the machine; and Fig. 3 is a sectional view on the line 3—3 of Fig. 2.

Referring to the drawing, the high voltage apparatus in connection with which I have shown my invention is a dynamo-electric machine comprising a slotted core structure 10 having a high voltage winding 11 thereon and a rotor 12 provided with an exciting winding 12a. The core structure is supported in the frame of the machine by clamping covers having clamping fingers 13 extending between the end connections 11a of the winding 11. It is well understood that the sharp edges of the core structure and the presser fingers cause a concentration of dielectric flux adjacent thereto resulting in a voltage gradient which often rises above the dielectric strength of the surrounding air so that sparks jump from the end portions of the winding to the core structure and corona discharge forms about this part of the winding resulting in breaking down of the insulation. The concentration of dielectric stress and resulting sparks or corona discharge is avoided in accordance with my invention by arranging a shield on the winding insulation 11' comprising a conducting layer 14 of conducting material such as copper or metal foil extending from within the slots in the core structure outwardly therefrom as far as necessary to reduce the voltage gradient below the breakdown point of the surrounding air, the conducting layer being split longitudinally at 14a to avoid circulating current therein. A layer of high resistance material 15 such as asbestos or the like is superimposed on the conducting layer 14 in contact with the core structure and extends beyond each end of the conducting layer 14. This layer of high resistance material has a resistance intermediate that of copper and the ordinary insulation employed in high voltage machines. In the particular construction shown asbestos tape is used to form the layer of high resistance material which has a resistance of about 7 megohms per inch square mil, which is intermediate that of copper having a resistance

of approximately 6.5×10^{-10} megohms per inch square mil, and the ordinary insulation, such as micanite or mica-tape, having a resistance of from 300,000 to 500,000 megohms per inch square mil. In the present instance the high resistance material is shown covering the entire winding, but it is only necessary that it extend over that portion of the winding where it is desired to avoid concentration of the dielectric flux.

In this construction the leakage of current from the surface of the insulation of the end portion of the winding outside of the core through the layer of high resistance material to the core structure reduces the voltage gradient remote from the core structure below the dielectric strength of the surrounding air. Although the leakage through the high resistance material does not of itself reduce the dielectric stress adjacent the core structure sufficiently to avoid electrical discharge, the leakage current through the conducting layer is in parallel with the high resistance layer in the slot to the core structure further reduces the dielectric stress so that the voltage gradient is low enough to prevent sparks between the end portions of the winding and the core structure or corona discharge around and over the winding adjacent the core structure.

It will thus be seen that I have produced an effective shield for the windings of high voltage apparatus which will protect the same against electrical discharges.

Although I have shown my invention applied to a high voltage dynamo-electric machine, I do not desire to be limited to this particular application of my invention or to the form of my invention shown except as defined in the appended claims.

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

1. In a high voltage apparatus having a slotted core structure, an insulated winding extending through the slots in said core structure and projecting therefrom, and means comprising a shield arranged on the projecting portion of said winding for distributing the dielectric stress around the projecting portion of said winding adjacent said core structure for protecting the insulation of said winding against electrical discharge, said shield comprising a layer of low resistance material extending from within said slot outwardly beyond said core structure and a layer of high resistance material having a resistance intermediate that of copper and the winding insulation, and entirely covering the layer of low resistance material, said shield extending from within said slot outwardly from said core structure beyond said layer of low resistance material.

2. In a high voltage apparatus having a slotted core structure, an insulated winding extending through the slots in said core struc-

ture and projecting therefrom, and means for distributing the dielectric stress around the projecting portion of said winding for protecting the insulation of said winding against electrical discharge, said means comprising a shield having a layer of ungrounded low resistance material arranged on the projecting portion of said winding and a covering of asbestos on said shield extending beyond each end thereof, said asbestos covering being in contact with said core structure.

In witness whereof, I have hereunto set my hand this 30th day of September, 1927.

EDWARD H. FREIBURGHOUSE.