June 17, 1952 L. W. MARKS 2,601,042

TRANSFORMER

Filed Sept. 17, 1949

Fig. 1

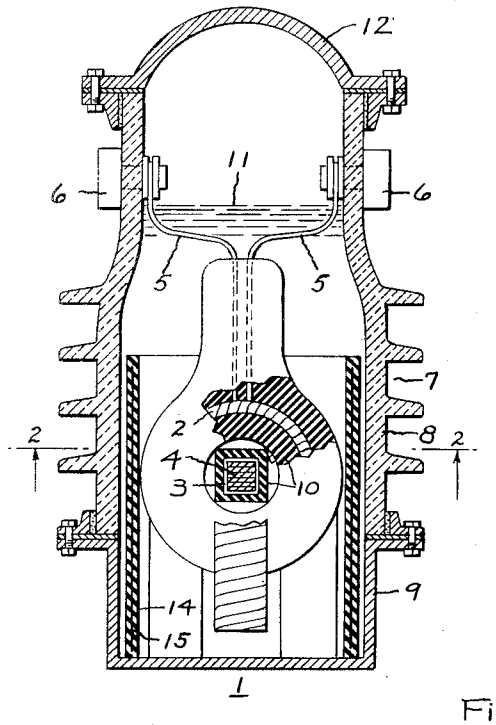


Fig. 2

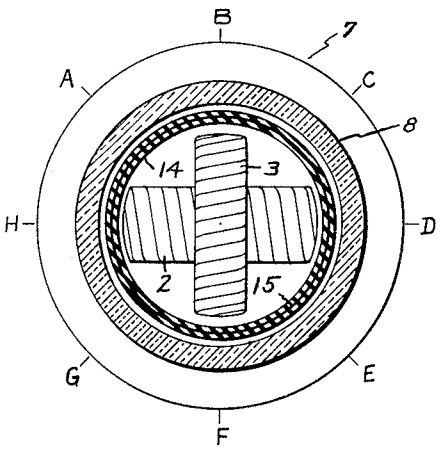
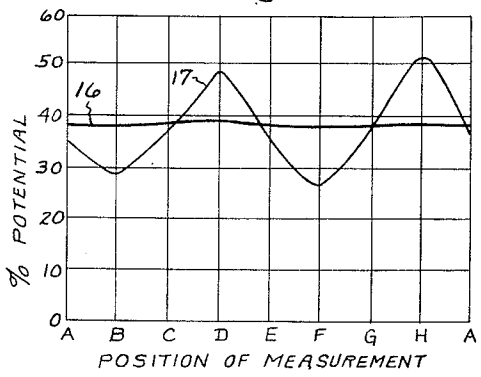


Fig. 3



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TRANSFORMER

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4 Claims. (Cl. 175—358)

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My invention relates to transformers and, although not limited thereto, it has particular application to high voltage instrument transformers.

Heretofore, high voltage current transformers have been made with high voltage winding and core structures which are wound with their axes perpendicular to the axis of the cylindrical enclosing casing. The casing which is usually used is of porcelain or other insulating material. Due to the above mentioned positioning of the coil and core, certain portions of these components are much nearer to the interior surfaces of the enclosing casing than are other portions. This circumstance gives rise to an uneven peripheral voltage distribution around the exterior of the casing, and the resulting existence of local areas of high voltage stress concentrations increases the incidence of corona effects. These corona effects and the accompanying ionization of the surrounding air are very undesirable since they increase the probability of an actual fault condition and subsequent breakdown of the entire insulation system.

It is, therefore, an object of my invention to eliminate the uneven peripheral voltage distribution around the exterior of a high voltage transformer.

My invention consists essentially of a high voltage transformer structure including a cylindrical equi-potential conducting surface which may be embedded within a suitable insulating material and inserted between the coil and core of the transformer and the interior of the transformer enclosing casing.

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 in the claims annexed to and forming a part of this specification.

In the drawing Fig. 1 is a side elevation, in partial section, of a high voltage instrument transformer embodying my invention; Fig. 2 is a bottom view in partial section of the transformer illustrated in Fig. 1; and Fig. 3 is a graph showing the uneven peripheral potential distribution which exists in the absence of the structure of my invention and the comparatively even voltage distribution which occurs with the structure of my invention.

Referring to the drawing, in Fig. 1, I have illustrated a high voltage instrument transformer designated as a whole as 1, which includes a primary winding 2 and a secondary winding 3 which

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is distributed around a suitable core 4. Windings 2 and 3 are each annular-shaped, with the axes of the respective windings being aligned mutually perpendicularly to each other and to the axis of the casing in which the windings are positioned. The two annular-shaped windings are structurally interlinked with each other, due to the fact that each winding passes through the hollow portion of the other winding. Extending from the primary winding and connected thereto, I provide suitable lead members 5 whose ends are connected to the connectors 6 which are in turn connected in the high voltage lines whose current or voltage is to be measured or controlled. The winding core and terminal leads are suitably housed in a casing 7 which is comprised of a tubular porcelain bushing 8 and a steel casing end member 9. Windings 2 and 3 are surrounded by insulation 10 of any suitable type such as crepe paper which may be applied in any suitable manner such as by winding in tape form to the desired thickness. The same type of insulation may also be wound around the leads 5. The casing 7 may be filled with a suitable dielectric fluid, such as oil, to the level 11 and a conservator 12 is provided at the top of the bushing 8 to allow for thermal expansion and contraction of the fluid.

Surrounding the coils 2 and 3 and the core 4 is an equi-potential cylinder 14, which may be of any suitable insulating material such as a resin bonded paper laminate, within which a cylindrical conducting surface 15 is embedded which may consist of a graphite phenolic resin varnish or other suitable conducting material. Surface 15 need not be a perfect conductor, but may have considerable resistance and still perform the function described below. The cylinder 14 with its embedded conductor 15, therefore forms an equi-potential surface which surrounds the coils and core within casing 7 and the potential distribution around the exterior of this equi-potential cylinder and therefore around the exterior of the casing 7 is practically constant.

In Fig. 2 is shown a bottom view of my transformer with the casing and equi-potential cylinder shown in section. This view shows how certain portions of the transformer coils are spaced much more closely to the transformer casing than are other portions of the transformer coils. Around the periphery of my transformer, as shown in Fig. 2, potential measurement positions have been marked with letters, A through H, at 45° intervals. When potential measurements are taken from these respective positions to ground,

the circumferential potential distribution curve at section 2—2 on Fig. 1 such as curve 16 shown in Fig. 3 may be plotted. In contrast, curve 17 in this same figure shows how uneven the voltage distribution is in a corresponding transformer which is not equipped with the equi-potential cylinder of my invention.

It will be obvious of course that conducting surface 15 could be positioned around the exterior of equi-potential cylinder 14 instead of embedded therein.

My invention, therefore, virtually eliminates unequal peripheral voltage distribution around the exterior of high voltage instrument transformers in the vicinity of the transformer coils, thus eliminating dangerous corona discharge and fault producing tendencies without appreciably increasing the size, weight or cost of the transformer.

Although I have shown and described a particular embodiment of my invention, I do not desire to be limited to the particular embodiment described and I intend in the appended claims to cover all modifications which do not depart from the spirit and scope of my invention.

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

1. In a high-voltage instrument transformer, a first annular-shaped electrical winding and a second annular-shaped electrical winding, one of said windings being positioned on an annular-shaped magnetic core structure, said first and second windings being structurally interlinked with each other, the axis of said first winding being perpendicular to the axis of said second winding, a hollow insulating casing surrounding and enclosing said first and second windings, the longitudinal axis of said insulating casing being perpendicular to the respective axes of said first and second windings, an insulating liquid within said casing, said windings being immersed in said liquid, a conductively isolated hollow cylindrical conductor member contained within said casing, said hollow cylindrical conductor member being coaxial with said casing, said hollow cylindrical conductor member surrounding said windings and core structure.

2. In a high-voltage instrument transformer, a first annular-shaped electrical winding and a second annular-shaped electrical winding, one of said windings being positioned on an annular-shaped magnetic core structure, said first and second windings being structurally interlinked with each other, the axis of said first winding being perpendicular to the axis of said second winding, a hollow insulating casing surrounding and enclosing said first and second windings, the longitudinal axis of said insulating casing being perpendicular to the respective axes of said first and second windings, an insulating liquid within said casing, said windings being immersed in said liquid, a conductively isolated hollow cylindrical conductor member contained within said casing, said hollow cylindrical conductor member being coaxial with said casing, said hollow cylindrical conductor member surrounding said windings and core structure, said hollow cylindrical conductor member being completely embedded in a solid insulating material.

3. In an instrument transformer comprising a hollow insulating enclosing casing, a first annular-shaped electrical winding positioned within said casing, a second annular-shaped electrical winding positioned within said casing and structurally interlinked with said first winding, one of said windings being wound about an annular-shaped magnetic core, the axes of said first and second windings and of said enclosing casing all being mutually perpendicular to each other, an insulating liquid within said casing, said windings being immersed in said liquid, a conductively isolated open cylindrical equipotential conductor member positioned within said casing substantially coaxially with said casing, said cylindrical conductor member surrounding said first and second windings and said magnetic core.

4. In an instrument transformer comprising a hollow insulating enclosing casing, a first annular-shaped electrical winding positioned within said casing, a second annular-shaped electrical winding positioned within said casing and structurally interlinked with said first winding, one of said windings being wound about an annular-shaped magnetic core, the axes of said first and second windings and of said enclosing casing all being mutually perpendicular to each other, an insulating liquid within said casing, said windings being immersed in said liquid, a conductively isolated hollow cylindrical equipotential conductor member positioned within said casing substantially coaxially with said casing, said cylindrical conductor member surrounding said first and second windings and said magnetic core, said cylindrical conductor member being completely embedded in a solid insulating material.

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