The present invention relates to high tension electrical inductive apparatus, and more particularly to extra high tension transformers and improvements in the effectiveness of insulation between the transformer windings and transformer housing.

It is known to provide sufficient space between metallic housings, and the windings of electrical apparatus to provide a potential gradient of the electrical field which is compatible with the insulating effectiveness of the insulation material in the space, and further to provide for sufficient separation so that the stray magnetic field does not cause excessive stray losses. In concentric windings, equal potential lines are not perpendicular to the axis of the concentric windings at the ends thereof; in other words, the equipotential lines will not be parallel to the metallic masses at the ends of the axis but rather will present a different distribution.

It is an object of the present invention to provide a high tension electrical apparatus in which the effectiveness of insulating materials is improved.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, concentric windings are surrounded, at the outside, by cylinders formed of metallic armatures so arranged as to form an electrostatic image of the windings themselves, the image being arranged and located with respect to an imaginary cylinder having an axis congruent with the axis of the concentric winding, and a diameter slightly larger than the external diameter of the largest winding. The term "electrostatic image" as used in this specification may be defined as an arrangement of location of such metallic armatures, or metal sheets such that the capacity between the armatures will, itself, cause a potential gradient distribution in that space outside of the winding, which is symmetrical, and a mirror image of the potential gradient distribution between the layers of the winding itself.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a cross sectional view through half of a toroidal-type winding, arranged in accordance with the prior art, and illustrating equally potential lines;

FIG. 2 is a view similar to FIG. 1, in which metallic armatures are placed in accordance with the present invention, also showing the resulting equipotential lines.
The electrical field distribution can further be improved by combining auxiliary armatures $B_1, B_2 \ldots B_5$ with the armature elements $A_1, A_2 \ldots A_5$. The auxiliary elements $B_1, B_2 \ldots B_5$ are arranged radially and axially between the outer ends of the winding layers $C_1, C_2 \ldots C_5$ and housing $M_5$. Armatures $B_2, B_3 \ldots B_5$ are carried at the potential of the outside turn of the next adjacent winding layer $C_1, C_2 \ldots C_5$ by interconnections, which are not shown in the drawings.

By providing a structure in which the equipotential lines of the electrostatic shield are essentially parallel to the metallic parts of the apparatus, so that the insulation will be loaded transversely thereto, the distances between the electrical windings and the metallic housings may be reduced, without simultaneously increasing losses due to stray magnetic fields in the metallic elements which surround the windings, and in particular within the generally substantial vertical wall of the housing surrounding the transformer.

I claim:

1. Electrical high tension inductive apparatus having concentric layer of windings ($C_1, C_2 \ldots C_5$) said windings having a common circle of concentricity, insulating material surrounding the windings, and a housing located outside of said insulating material, comprising a plurality of radially spaced, concentric metallic armatures ($A_1, A_2 \ldots A_5$) equal in number to the number of winding layers, said armatures being concentric with said windings ($C_1, C_2 \ldots C_5$), and being located outside of the circle of concentricity of said windings and positioned in said housing at diameters, with respect to the center of said circle of concentricity, to form an electrostatic image of the windings with respect to an imaginary cylinder (E) having its axis at the center of the circle of concentricity, said cylinder having a greater diameter than said circle of concentricity.

2. Apparatus according to claim 1 wherein said metallic armatures consist of magnetic material having high permeability and of sufficient cross-section to operate in unsaturated state during operation of the apparatus.

3. Apparatus according to claim 1 wherein the layers of said windings are cylindrical and have progressively different axial length.

4. Apparatus according to claim 3 wherein said metallic armature comprises cylindrical sheet metal elements symmetrically located with respect to said windings and forming mirror images thereof with the length thereof matching the length of said layers of windings.

5. Apparatus according to claim 3 including metal inserts located transverse to the axis of said windings at the ends thereof and forming magnetic guides for magnetic flux from said layers of windings to said sheet metal element.

6. Apparatus according to claim 1 wherein said metallic armatures are equal in length to their corresponding winding layers.