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K. BISCHOFF
HIGH TENSION APPARATUS
Filed May 24, 1941

Serial No.
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2 Sheets-Sheet 1

Fig.1

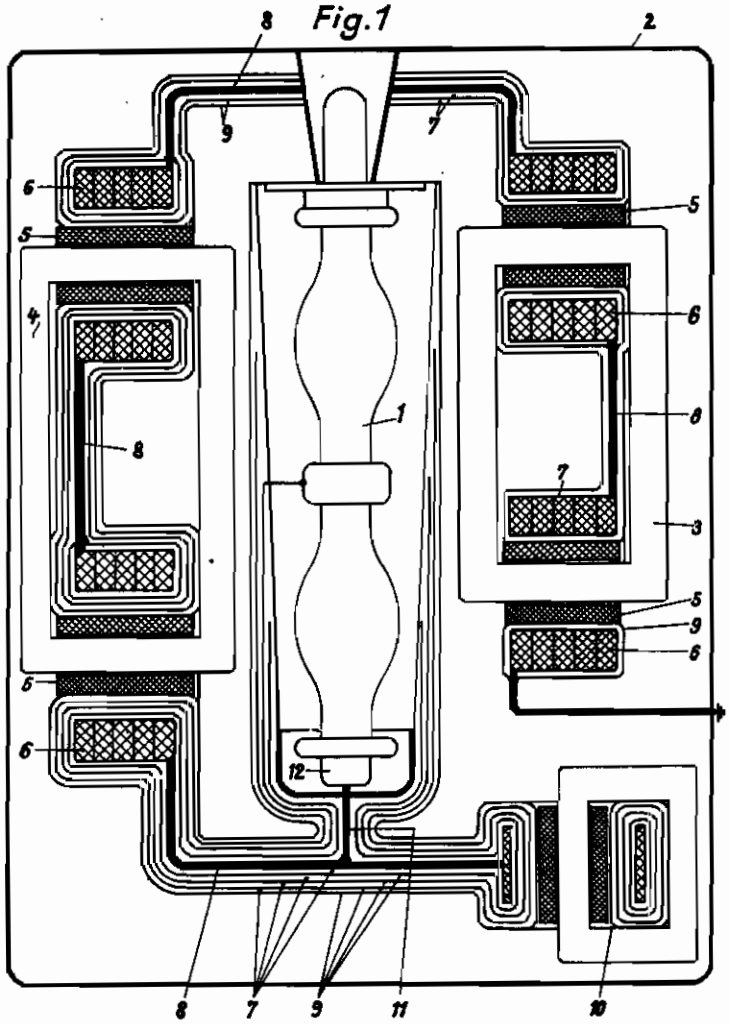

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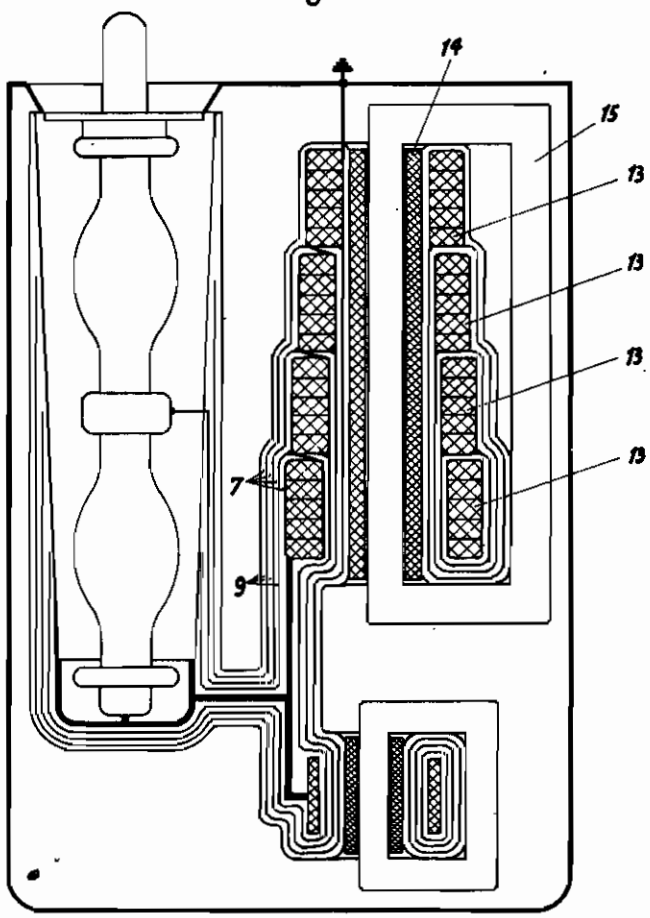
Fig. 2



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ALIEN PROPERTY CUSTODIAN

HIGH TENSION APPARATUS

Kurt Bischoff, Erlangen, Germany; vested in the Alien Property Custodian

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This invention relates to high tension apparatus, and is particularly concerned with arrangements or apparatus wherein an electrical discharge tube or a Roentgen tube is provided in a common housing or container together with a high tension generator.

The insulation of the windings and apparatus parts which are in such apparatus subjected to the high tension against ground causes considerable difficulties. The weight of such structures should be kept as small as possible, and this requirement increases the insulating difficulties very considerably.

In order to avoid these and other difficulties, a suggestion was made which, theoretically, appears to be correct, the realization of which is, however, extraordinarily difficult, particularly in the case of apparatus for very high tensions, (for example, tensions exceeding approximately 200,000 volts). This known suggestion is concerned with an apparatus including an electrical discharge tube built together with a high tension generator and having only a single high tension coil. The insulating layers arranged between the individual winding layers of this coil extend beyond the edge so that, upon cutting into the overlapping edges at uniform intervals, insulating flags or flaps are produced in radially extending layers, which are then lapped or folded over, for example, toward the middle of the outer side of the coil. The folding-over of these insulating flaps avoids flash-overs at the side walls of the coil. Built into the insulation at one point of the circumference of the coil is an electrical discharge tube which is subdivided into individual stages. In addition, a plurality of metallic potential control surfaces may be embedded in the folded insulating layers for the purpose of controlling the potential. These surfaces also control the potential along the discharge tube.

It should be assumed, from the point of view of insulating technique, that this suggestion would lead to a satisfactory solution of the insulating problem in the building of such apparatus. The production of structures according to this suggestion is, however, made unusually difficult and complicated in view of the fact that the high tension winding consists of a single coil, and that unequally wide insulating layers must be built into the structure during the winding of the coil. Particular difficulties are caused by the requirement that the metallic potential control surfaces must not act in the manner of shunt windings for the high tension transformer and that they must be approximated everywhere to the shape of the insulating body. It must also be considered that the structure of such a single coil high tension winding must not exceed a predetermined width in order to avoid an unfavorably high layer potential. The coil for very high tensions (about 1 million volts) must, therefore, be highly wound in order to accommodate the required number of turns, and this leads to an unfavorable condition regarding the straying which in turn affects the efficiency of the generator.

In accordance with the present invention, the building of such high tension apparatus is made easier, simpler, more economical and also more efficient by producing the high tension in a plurality of coils assembled or bandaged together; that is, the high tension is produced in individual windings (the insulation being in the manner of a bandage and one continuous bandage including all coils lying on a higher potential against ground, or rather including the individual windings of the high tension generator together with the connecting conductors up to a point of the tube housing or to a high tension conduit), each of these bandages which are successively attached being provided throughout with a conducting layer for the purpose of a complete potential control, thereby obtaining at every point approximately the same electrical load of the insulating material, and this conductive layer being connected with the lowest potential of the high tension generator which is included in the individual bandages.

The insulation of the individual coils, that is to say, the individual coils against ground, is at all points continuous by this introduction of the metallic layers extending over the entire surface of the individual bandages and being connected with the windings of the high tension coil, and the insulation is thus permeated by the conductive equipotential surfaces, the potential of which is controlled directly by the high tension generator up to the place where the high tension pole is conducted from the apparatus. The electrical load of the insulating material is in this manner accurately predetermined at all points. A minimum of insulating material will thus suffice, and material as well as space is saved without producing any undue stress that would go beyond the electrical value the material can stand.

The potential distribution within the insulation would be entirely different if the potential control surfaces would be omitted, assuming of course identical arrangement and strength of the individual bandages. The field strength would

increase very considerably from the outside to the inside according to the curvature of the surface elements which are to be insulated against ground. In the different parts of the high tension generator, as well as its connecting lines leading to a heating transformer and a tube housing that may be provided, we must consider entirely different radii of the curves. Therefore, the equipotential surfaces within the insulating bandages do not everywhere conform to the individual paper layers.

The production of the new high tension generator is considerably simpler than that of a single-coil high tension generator made in accordance with the previously mentioned prior suggestion. The winding parts which are individually made and individually bandaged, as well as the common bandaging of these parts, does not cause any difficulties. The metallic potential control surfaces can be produced, for example, by using for the uppermost layer of the insulating bandage a paper strip which is metallized on one side, or by using a thin metal foil which is introduced into the bandage, whereby short circuit windings through the metal layer are avoided. The control surfaces can also be formed by spraying the individual bandages with suitable metal whereby, in order to avoid short circuit windings, a strip-like surface piece is held free at the circumference of the coil, and this piece is provided with a thin intermediate insulating layer and is also covered with a metallic layer which is conductively connected with the first noted metallic layer.

The invention is schematically shown in the accompanying drawings, wherein

Figs. 1 and 2 illustrate two embodiments, partially in section and partially in plan view, of structures for producing very high tensions, and particularly of high tension generators built together with discharge tubes or Roentgen tubes.

In the embodiment shown in Fig. 1, the high tension generator consists of two transformers with iron cores 3 and 4. It is accommodated together with the two-stage Roentgen tube 1 in a common container 2. Each of these transformers has two primary windings 5 separated from each other and two secondary windings 6. The secondary windings again may consist of a plurality of coils each bandaged for itself. As shown in Fig. 1, the four secondary windings 6, which lie on a higher potential against ground, are bandaged together in such a manner that always one contiguous bandage 7 includes all individual windings 6 of the high tension generator together with their connecting lines 8. Each of these bandages 7, in accordance with the invention, is provided throughout with a conducting layer 9 which is connected at the corresponding points with the lowest potential of the parts of the high tension transformer that is embedded in the individual bandages. In the case of a total tension of the generator, which is grounded at one side, of, for example, 500 kV, the individual control surfaces 9 therefore receive the potential 0.125, 250 and 375 kV.

In accordance with another feature of the invention, the heating transformer 10 provided for the heating of the Roentgen tube 1 can be covered throughout in the same manner with the conductive control surfaces 9.

The Roentgen tube 1 is built into the stepped bandage of the high tension line 11 in such a manner that its cathode side 12 is in connection therewith. The insulating bandages 7 and the control surfaces 9 terminate, as viewed from the cathode side of the Roentgen tube, from the inside to the outside in a stepped or staggered manner, and the control surfaces 9 thus serve for controlling the potential of the Roentgen tube.

In case the high tension should be conducted not to a Roentgen tube, which is provided with the generator in a common container, but, for example, to an apparatus outside of the container, the insulating bandages 7 and the control surfaces 9 may end or terminate in corresponding manner in a high tension conduit.

Another example of the invention is shown in Fig. 2. The high tension is produced in a winding which is subdivided into several parts 13. We have again shown this second embodiment for the sake of simplicity in connection with a high tension generator which is grounded on one side. The arrangement of the bandages 7 and the control surfaces 9 is here very similar to that in the first example. By the use of a single winding consisting of four part windings 13, which is arranged together with the primary winding 14, upon the iron core 15, the building of the entire structure is considerably simplified and made more accessible, and weight as well as space can be saved as compared with the embodiment discussed in connection with the first example.

KURT BISCHOFF.