Aug. 2, 1938. L. VÖLKEL 2,125,700

HIGH TENSION DISCHARGE VESSEL

Filed Nov. 16, 1933

Fig. 1.

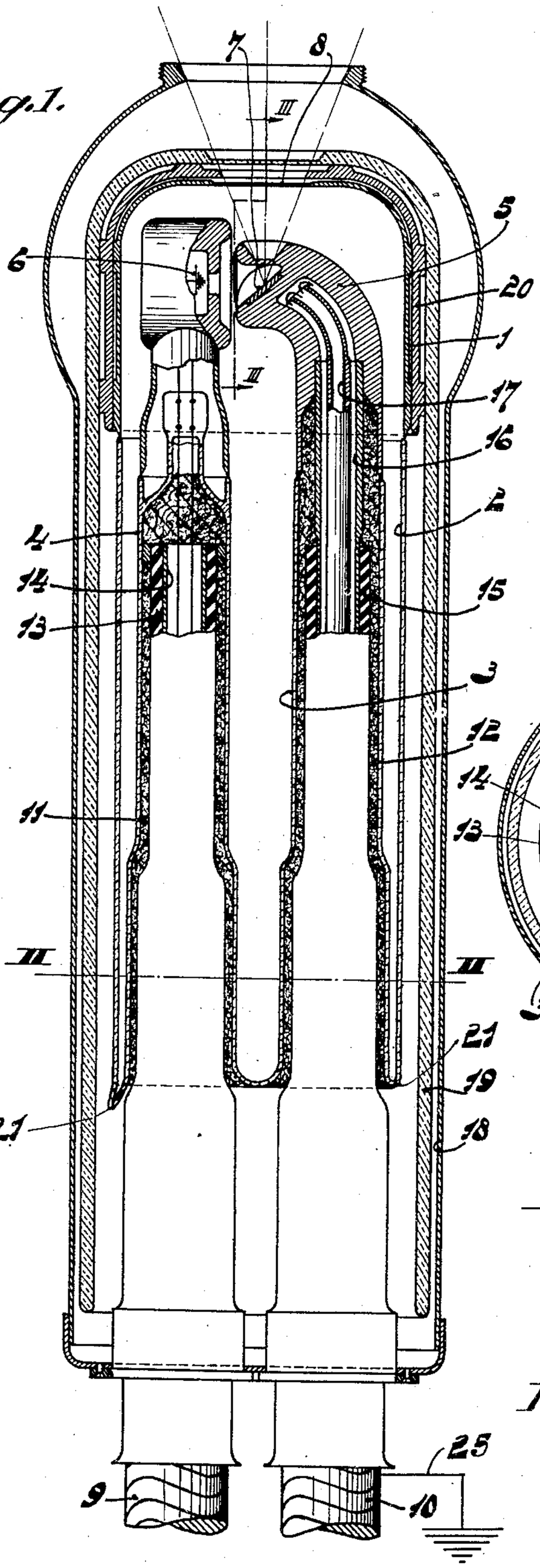


Fig. 3.

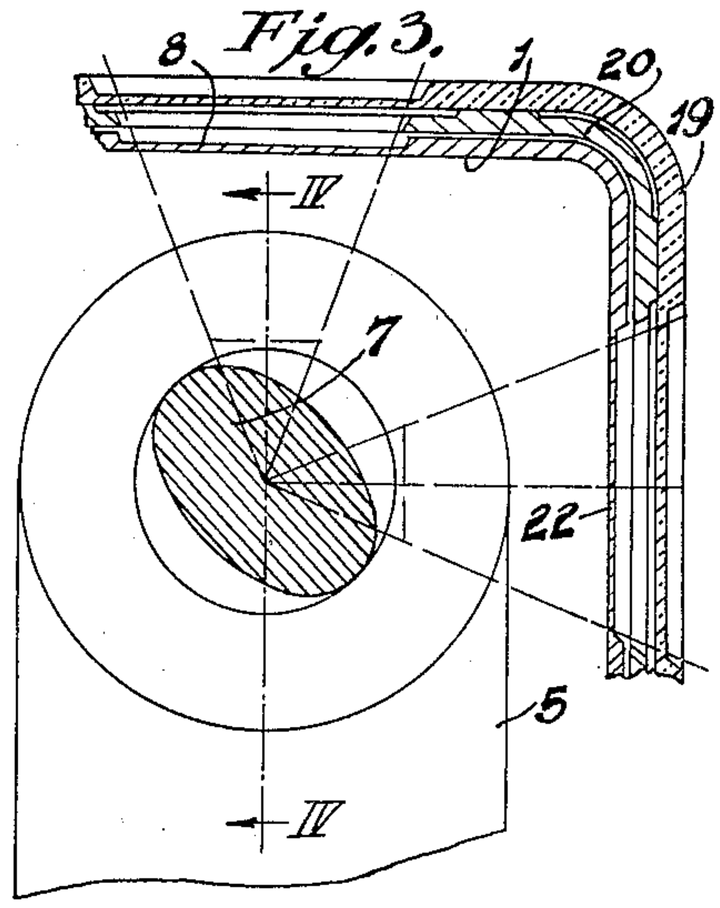
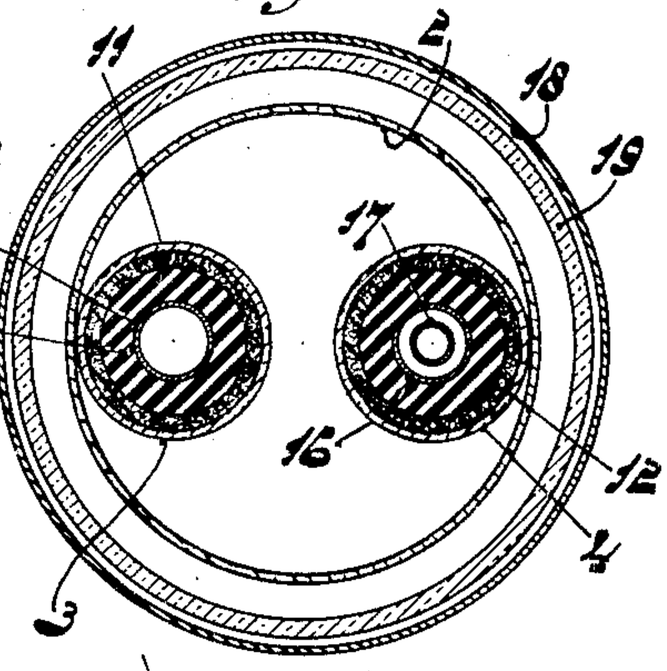


Fig. 2.



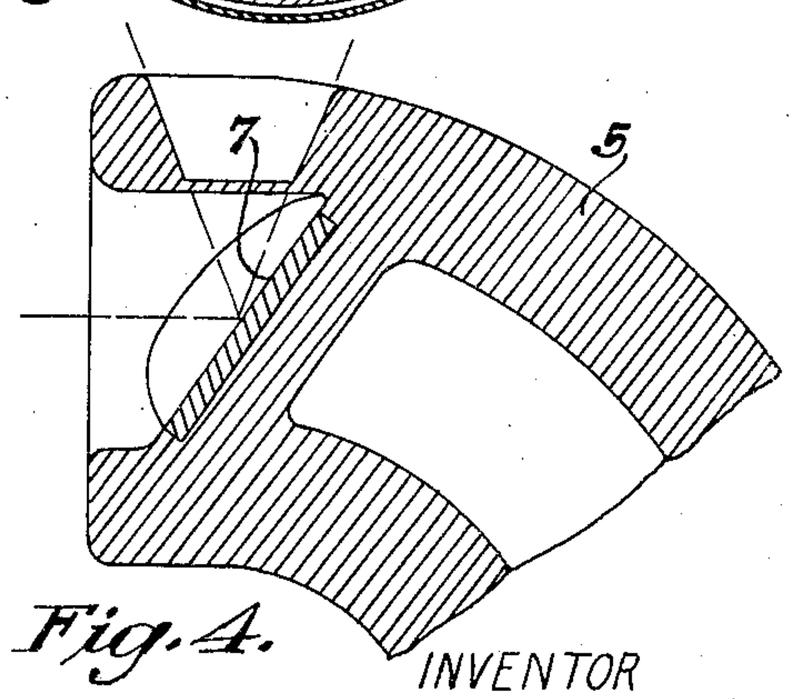


Fig. 4.

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HIGH TENSION DISCHARGE VESSEL

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In Germany December 2, 1932

4 Claims. (Cl. 250—35)

This invention relates to high tension discharge devices comprising supply conductors which are insulated against high tensions, and more particularly to X-ray tubes.

In the high tension discharge device according to the invention the cables are introduced into the device from one end thereof. The device comprises two reentrant parts consisting of insulating material and extending parallel to the longitudinal axis of the device, each part carrying one of the electrodes of the discharge device. The supply conductors are led into these reentrant parts so as to be insulated for the full tension which may occur and are connected to the electrodes within said re-entrant parts. The discharge path between the electrodes extends laterally to the reentrant parts.

By leading in the two cables from one end of the device they can be kept together up to their entrance into the tube. In the case of an X-ray tube the further advantage is obtained that the cable junctions are located as far as possible from the window serving for the passage of the rays. In order to avoid ionization of the air between the insulation of the conductors and the wall of the tube, the spaces into which the insulated conductors are led may be filled with a compressed gas or with a liquid or solid insulating material.

The invention will be more clearly understood by reference to the accompanying drawing representing, by way of example, a discharge device in the form of an X-ray tube.

Fig. 1 is a longitudinal section taken through the device including the reentrant parts.

Fig. 2 is a cross-section of the device of Figure 1 taken at II—II.

Fig. 3 is a sectional view on an enlarged scale along line III—III of Fig. 1 with certain parts omitted, and

Fig. 4 is a sectional view along line IV—IV of Fig. 3.

The tube shown in Figure 1 has an envelope comprising a metal cap 1 to whose edge a glass member 2 is sealed. This glass member surrounds two glass tubes 3 and 4 which rearwardly increase in diameter and which are sealed to the glass member 2 at 21 to thus form reentrant parts of the discharge tube. The glass tubes 3 and 4 carry at their front end the anode 5 and the cathode 6, respectively. The anode 5 is shaped in such a manner that the cathode rays, emitted by the cathode in a direction normal to the axes of the reentrant parts, strike the frontal surface of the anode. As more clearly shown in Figs. 3 and 4, the anode 5 is provided with a cavity whose bottom surface forms an impact or target surface 7. Surface 7 is inclined to form equal angles with the axes of the glass tubes 3 and 4 (see Fig. 1) and with a line normal to the plane passing through these axes. This surface also forms an angle of 45° with the direction of the cathode rays. The metal cap 1 is provided with a window 8 for the passage of the rays. A second window, shown at 22 in Fig. 3, serves for the beam of rays emerging in a direction perpendicular to the axis of the discharge device. In order to avoid the occurrence of glow discharges in the air space between the supply conductors and the wall of the reentrant parts, because of the high tension set up between the conductors, this space may be filled with a material which is highly resistant to electrical breakdowns, for instance, with compressed air, oil or with a solid cast material. On the cathode side a separate insulating tube 13 is provided which has an internal metal coating 14 for avoiding corona effects of the current carrying conductors. On the anode side an insulating tube 15 is provided which surrounds two concentrically arranged metal tubes 16 and 17 for the circulation of a cooling medium. For instance, a liquid or gaseous cooling medium can be supplied, through the tube 17, and carried off through the annular space existing between the tubes 16 and 17 after it has absorbed the heat produced at the anode. The insulating tubes 13 and 15 preferably constitute the outer envelope of the connecting devices corresponding to the cables. The cables themselves are provided with an outer metal coating which can be grounded, as indicated at 25, during the operation of the X-ray tube. This coating is electrically connected to a metal hood 18 which surrounds the whole X-ray tube and is provided with necessary apertures for the passage of the X-rays. A hollow member 19 of insulating material is provided between the wall of the discharge device and the metal hood 18. Preferably a metal coating, instead of a separate metal hood 18, may be provided on the insulating member 19 which coating is electrically connected to the grounded coating of the cables 9 and 10. This insulating member bears on the metal hood 1 with the interposition of a lead layer 20.

The end of the member 1 may be shaped substantially as a hemisphere whose center point falls in the focal spot of the X-ray tube. If desired, the aperture through which the rays emerge may be shaped as a slit having rounded corners and extending through a quarter of a circle so that a fan-shaped beam of X-rays is obtained.

In this case by providing screens, it is possible to limit the beam of rays in a known manner both as regards its position and its size, so as to adapt it to the prevailing requirements.

Portions 1 and 2 of the tube wall may be formed as a single metal member thereby increasing the mechanical strength of the tube, and at the same time providing an equipotential surface. If the portion 2 is of metal and portion 1 of glass, the surface of the latter portion can be made equipotential by means of electrostatic screening.

What I claim is:

1. A high-tension discharge device comprising an elongated envelope having two re-entrant parts of insulating material forming hollow tubular members, and a cylindrical portion surrounding said members, said members extending side by side into said portion from one end thereof, and being symmetrically disposed with respect to the axis of said portion, two electrodes within said envelope and mounted one on one end of each of said members, said electrodes being spaced apart to form a discharge gap, current leads passing through the hollow of said members and electrically connected to the electrode of their respective member, and means to electrically insulate said leads from each other, said means comprising insulating sleeves surrounding said leads and extending into the hollow of said tubular members, said insulating means being adapted to withstand the full voltage occurring between said electrodes.

2. A high-voltage discharge tube comprising, an elongated envelope having two re-entrant parts of insulating material forming hollow tubular members, and a portion surrounding said members, said members being of substantially equal length and extending into said portion from one end thereof with their axes symmetrical with respect to the axis of said portion, said members having diameters which are equal and at least one-quarter the inner diameter of said portion, electrodes within said envelope and mounted one on one end of each of said tubular members, current leads passing through the hollow of said tubular members and connected to the electrode mounted thereon, insulating sleeves surrounding said leads and extending from outside the tube into said tubular members, said sleeves having a combined dielectric strength capable of withstanding the full voltage occurring between said electrodes, a protective hood surrounding the elongated envelope and provided with a metallic surface, and high-voltage cables having a metallic coating electrically connected to the metallic surface of said protective hood.

3. An X-ray tube having an elongated enclosing envelope comprising two tubular re-entrant members and a tubular portion surrounding said members, said members extending side by side into said portion from one end of the envelope with their axes symmetrical to the axis of said portion, a cathode structure supported from one of said members, an anode structure supported from the end of the other member, said cathode structure and anode structure being spaced apart to form a discharge gap extending laterally to the axes of said members, said cathode structure being adapted to produce a cathode-ray beam having an axis substantially perpendicular to the axes of said tubular members, said anode construction comprising a target surface forming equal angles with the axes of the tubular members and with a line normal to a plane passing through said axes, current leads connected to said cathode structure and anode structure respectively, said tubular members surrounding said leads with an intermediate space, and insulating sleeves extending from outside the envelope into the space between the leads and said members.

4. A high-tension discharge tube comprising an elongated envelope substantially symmetrical about a longitudinal axis and having tubular re-entrant members of insulating material and a metal portion surrounding said members, said members being of substantially equal lengths and extending into said portion from one end thereof with their axes symmetrical with respect to the longitudinal axis of said envelope and each having an outside diameter greater than ¼ the inside diameter of the envelope, electrodes within said envelope and mounted one on each of said members, lead wires surrounded by said members and connected to said electrodes, and insulating sleeves surrounding said current leads and extending from the outside of the tube into said members and completely filling a considerable portion of the space between said leads and said members.

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