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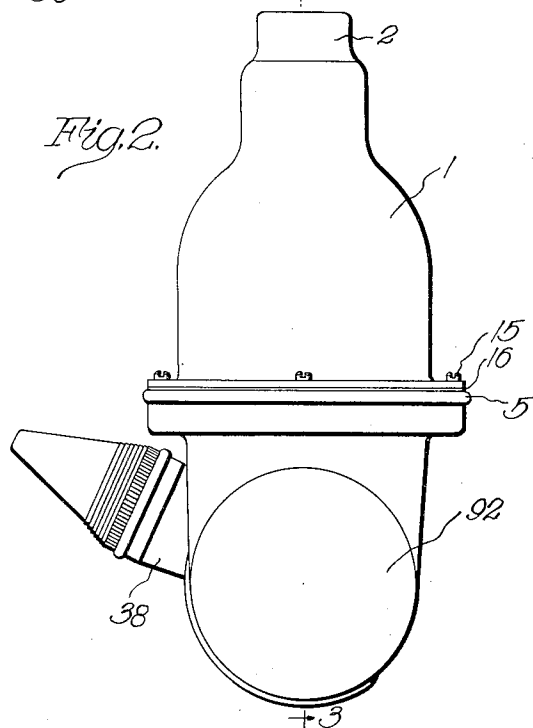
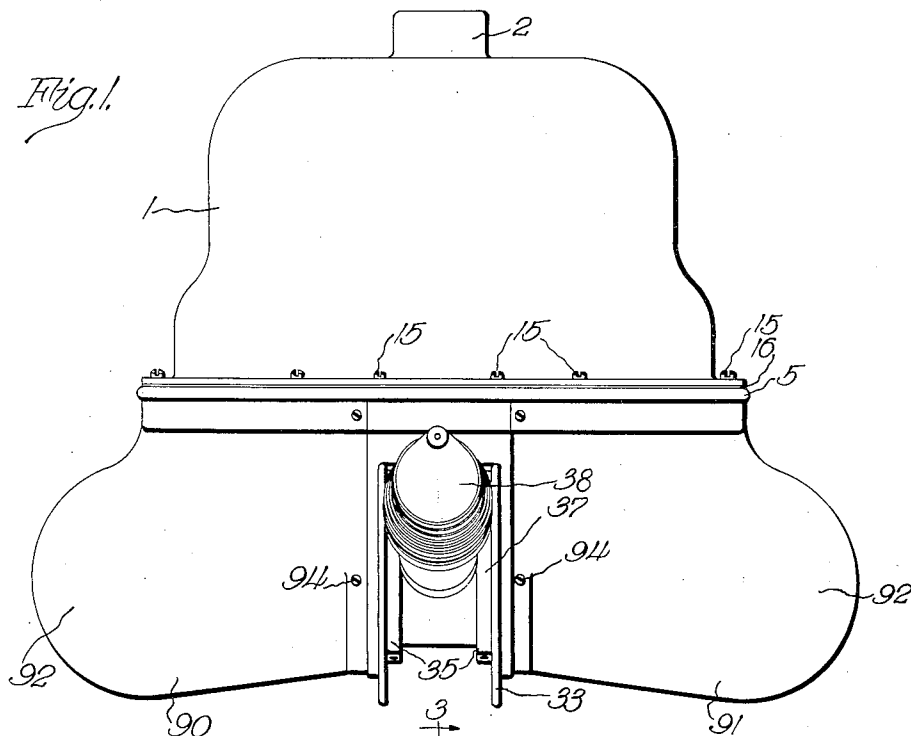
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1,979,997

X-RAY MACHINE

Filed April 4, 1932

4 Sheets-Sheet 1



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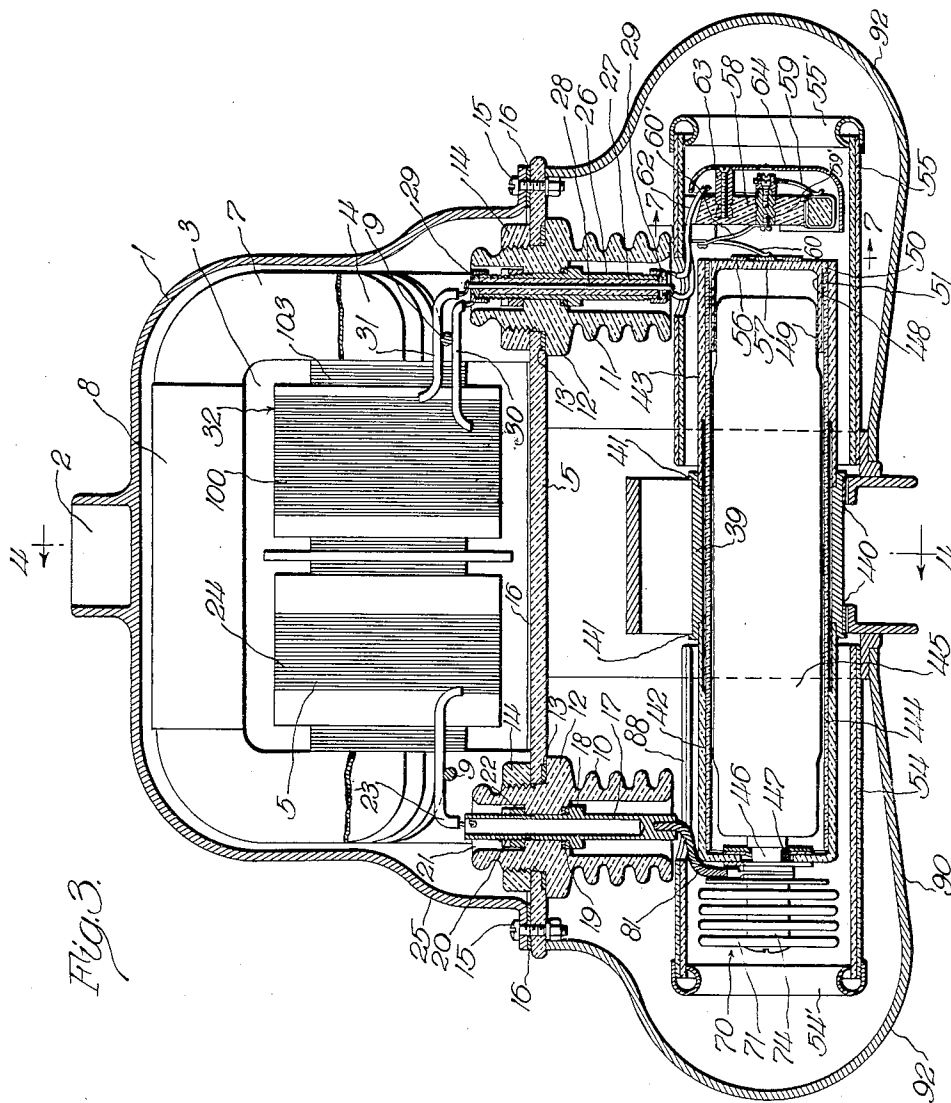


Fig. 3.

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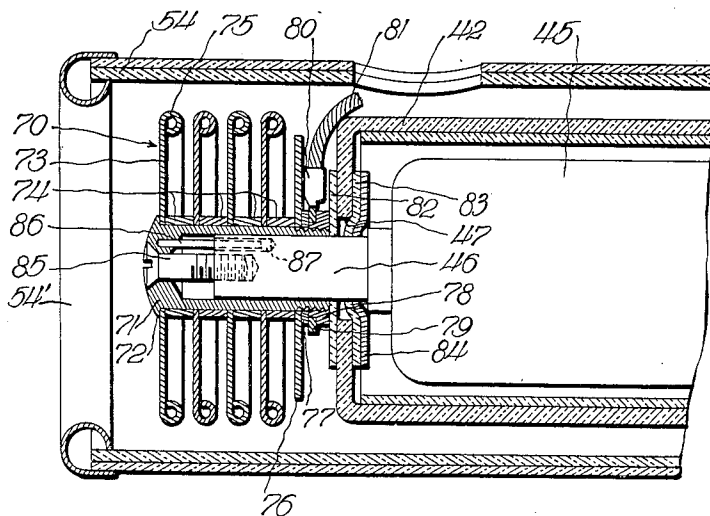
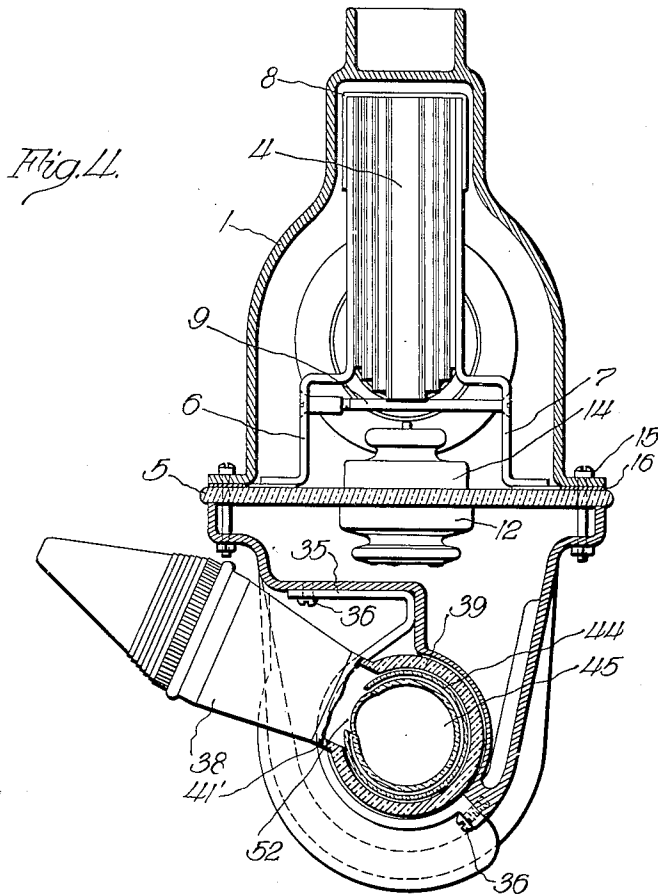


Fig. 6.

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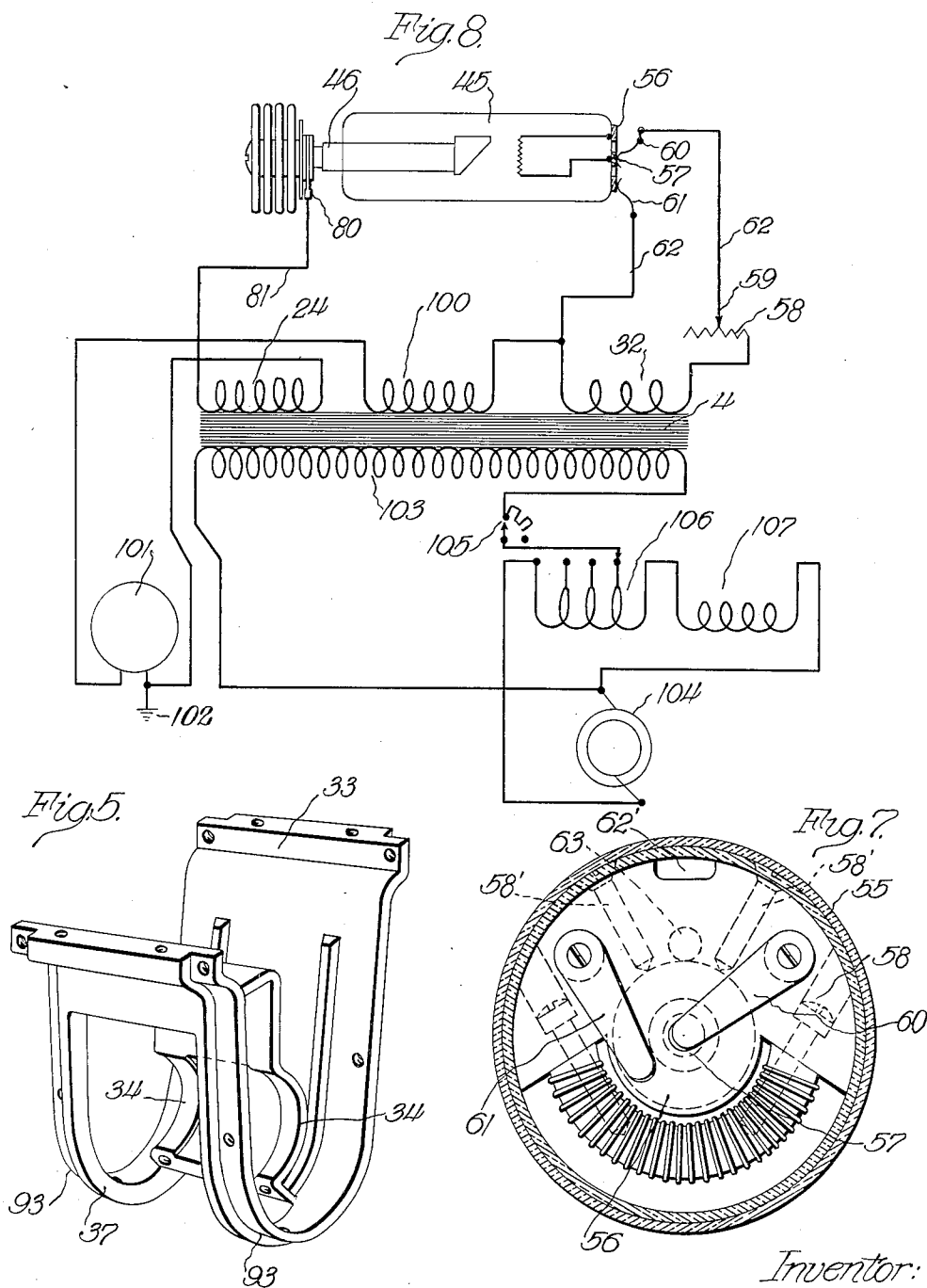
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UNITED STATES PATENT OFFICE

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X-RAY MACHINE

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Application April 4, 1932, Serial No. 602,989

9 Claims. (Cl. 250—34)

My invention relates to X-ray tube mountings and contemplates improvements which simplify the construction of the mounting, add to the convenience and safety in handling the tube in operation, and increase the reliability of the tube and transformer therefor in operation.

In my copending application Serial No. 502,366, filed December 15, 1930, of which the instant application is an improvement, I disclose a mounting for X-ray tubes comprising a casing which is divided into two compartments, the upper one of which is hermetically sealed and contains the high tension transformer by which the tube is operated. This compartment is filled with oil. The second and lower compartment contains the tube which is mounted at its mid-section for rotation about its longitudinal axis. The lead in wires by which certain connections are made to the terminals of the tube itself are contained within this second compartment. The casing is grounded and the tube may be used without danger of the operator coming into contact with the high tension circuit.

The present invention provides a new mounting arrangement of the same general type as disclosed in my above mentioned copending application. The sealed compartment in which the transformer is housed is made smaller and of slightly different shape so that it more closely embraces the transformer structure. Near the bottom of the casing are outwardly extending flares or bosses of generally spherical configuration, and the terminals by which the electrical connections are led from the transformer to the tube are located in close proximity to the center of these spherical bosses. By this arrangement the clearance between the current carrying parts of the assembly and the grounded casing is ample to insure that the current will not bridge the gap between the same, and at the same time the casing is compact in structure and of pleasing contour.

Located at the central portion of the lower compartment is a mounting bracket containing a saddle for receiving the central portion of the tube to mount the same for rotation about its longitudinal axis. Attached to the bracket are protective cylinders which surround the tube and extend beyond the ends thereof. At the cathode end of the tube a rheostat is mounted in this concentric cylinder, this rheostat carrying also the spring brushes by which the cathode circuit is extended to the tube. The tube contains a ferrule of insulating material which carries collector rings with which the brush springs make contact,

and over which the springs slide as the tube is rotated.

The anode terminal of the tube comprises a post extending concentrically from the end of the tube and upon which I have mounted an improved radiator by which the heat of the anode is dissipated from the tube. This radiator is attached rigidly to the tube and turns with it, and contains a contactor with which a connector is engaged. The connector terminates a wire leading from the transformer and is arranged to remain stationary as the tube is rotated.

The tube compartment of the casing is closed by metallic members attached to the mounting bracket and to the casing member forming the transformer compartment, these members being of substantially spherical form adjacent the ends of the tube to minimize the dimensions of the same without unduly reducing the clearance between the current carrying portions of the tube and the casing.

Attached to the mounting collar of the tube is a focusing cone by which the rays emanating from the tube are directed to a particular location, this cone being rendered movable through a wide arc by the mounting arrangement of the tube.

My invention will be best understood by reference to the accompanying drawings in which a preferred embodiment of it is shown by way of example, and in which:

Figure 1 is a front elevational view of the completely assembled unit;

Figure 2 is an end view of the unit shown in Figure 1;

Figure 3 is a cross sectional view taken along the line 3—3 of Figure 2 looking in the direction of the arrows and showing the arrangement of the parts within the unit;

Figure 4 is a cross sectional view through the unit taken substantially along the line 4—4 of Figure 3 looking in the direction of the arrows;

Figure 5 is a perspective view of the tube mounting bracket;

Figure 6 is a fragmentary cross sectional view through the end of the tube showing the details of construction of the radiator;

Figure 7 is a fragmentary cross sectional view taken substantially along the line 7—7 of Figure 3 looking in the direction of the arrows and showing the arrangement for establishing connection with the cathode end of the tube; and

Figure 8 is a schematic wiring diagram showing the circuit connections between the transformer and tube.

Referring now to the drawings in more detail, the unit comprises an upper casing member 1 having a mounting collar 2 located centrally of its top surface. The casing is supported upon a suitable bracket by means engaging this mounting collar 2. The details of this mounting arrangement are not of the essence of the present invention and are more fully described in my above mentioned copending application. Located within the casing member 1 is a transformer indicated generally at 3 and comprising a core 4 and windings 5. The casing member 1 is shaped to snugly fit around the transformer 3.

The bottom face of the casing member 1 is open, and across it is disposed an insulating plate 5 upon which the transformer is mounted by U-shaped mounting brackets 6 and 7 which lie against the laminations 4 of the transformer and are held together at the upper side thereof by a U-shaped metallic clamp 8 which is fitted tightly over the same. Bolts 9 clamp the bottom portions of the brackets 6 and 7 together and serve as supports upon which the lower edge of the transformer core 4 rests. By this arrangement the laminations of the core are tightly clamped so that they will not vibrate and become noisy when the transformer is energized.

Mounted in the plate 5 between the feet of the transformer mounting brackets 6 and 7 are fluted insulating bushings 10 and 11, each of which is provided with a shoulder 12 engaging the lower surface of the plate. A sealing washer 13 is interposed to form a tight seal against the plate. A nut 14 threaded upon the upper end of the bushing clamps the same against the plate to form an oil tight joint therewith.

The plate 5 is securely held upon the casing 1 by bolts 15 with a suitable washer 16 interposed therebetween to form an oil tight joint.

The bushings 10 and 11 contain terminal means similar to the terminals disclosed in my above mentioned copending application. The terminal located within the bushing 10 is a single hollow metallic member 17 having a shoulder 18 engaging the end wall of the lower recess in the bushing with a washer 19 interposed therebetween. A suitable nut 22 is threaded upon the upper end of the terminal 17 within the recess 21 of the bushing and serves to clamp the terminal in the bushing. The washer 19 serves to form an oil tight connection between the terminal and bushing. The nut 22 is slotted at 20 to receive the spanner wrench by which the nut is tightened.

Terminal member 17 is hollow so that the oil contained in the transformer chamber of the casing can fill and cool the terminal. An electrical connection 23 is suitably attached to the upper end of the terminal 17 and extends to the secondary winding 24 of the transformer.

It will be noted that the nut by which the terminal is clamped in the bushing is located well within the bushing and that the upper end of the terminal is located at the approximate center of the arcuate portion 25 of the casing member 1.

The terminal contained in the bushing 11 is of the same general construction except that the outer cylindrical member 26 carries an insulator 27 within which is located a second terminal member 28. The insulator is held in the member 26 by suitable nuts 29 threaded on the ends of that member. Terminal wires 30 and 31 extend from the transformer winding 32 to the ter-

minal members 26 and 28, respectively, being attached thereto in any preferred manner.

The tube is mounted in a generally U-shaped bracket 33, Figures 3, 4 and 5, which is attached to the plate 5 by bolts 15. Located in the bracket 33 is an arcuate saddle 34 in which the tube casing rests and is held by a clamp 35, Figure 4, attached thereto by screws 36. The bracket 33 is slotted as at 37 to permit the focusing cone 38 of the tube to move from the position in which it is shown in Figure 4 downwardly into a substantially vertical position.

The tube contains a metallic collar 39 which engages the saddle member 34 and clamp 35 and is held therein by springs 40 which serve to cushion the tube. The edges of the metallic collar 39 are flanged as at 41, Figure 3, to prevent longitudinal movement of the tube in the bracket, these flanges engaging the outer surfaces of the saddle members 34.

The collar 39 carries a radially disposed cylinder 41' to which the focusing cone 38 is suitably attached.

As will be seen in Figures 4 and 5, the tube assembly comprises in addition to the collar 39 an insulating cup 42 and cylinder 43 which are fitted into and suitably held in the opposite ends of the collar. Located within the cylinder thus formed is an insulating liner 44 and the tube 45, the anode terminal 46 of which projects through an opening 47 in the end of the cup member 42.

The opposite end of the tube 45 carries an insulating ferrule 48 which is cemented thereto as shown at 49 and which fits snugly against the insulator 44 to hold the same in place. A boss 50 projecting outwardly from the surface of the ferrule 48 registers with a slot 51 in the insulator 44 to prevent the same from turning with respect to the tube. As will be seen in Figure 4 the insulator 44 contains a perforation 52 adjacent the focusing cone 38, and the tube is suitably located in the cylinder 43 so that the rays generated by it are directed through this opening into the cone.

The tube is surrounded by insulating cylinders 54 and 55, which may be single piece cylinders composed of a suitable insulating material such as bakelite, or two-piece cylinders as shown. These cylinders are disposed concentrically of the tube and extend beyond the ends thereof. Metal protective caps 54' and 55' are carried and suitably attached to the ends of the cylinders 54 and 55 respectively. These caps are preferably formed of sheet copper shaped in the manner best shown in Figure 6, and serve to prevent flash-over between the current carrying parts of the tube and the grounded casing in which the tube is housed.

Located upon the ferrule 48 is a metallic ring 56 and a metallic disc 57 concentrically located within it. Both the ring and disc are preferably brass or bronze and are located concentrically of the ferrule.

The cylinder 55 carries a rheostat assembly 58 upon the front or outer side of which are rheostat instrumentalities indicated generally at 59. The rheostat is mounted by suitable means, such as screws 58' which project through one or both of the members comprising the cylinder 55. On the back side of the rheostat assembly are springs 60 and 61, Figure 7, which engage the disc 57 and ring 56, respectively, of the tube to establish an electrical connection therewith. A centrally located bushing 59' extends through the base of the assembly 58. This bushing is drilled and tapped.

The contact arm of the rheostat is attached to one end of the bushing by a suitable screw. A wire 60' is attached to the opposite end of the bushing by a suitable screw and to the contact spring 60. The rheostat arm is thus electrically connected to the contact spring. Suitable wires 62 extend from the rheostat through the opening 62' in the same to the terminal members 26 and 28 to extend a circuit from the spring 60 and 61 to the transformer winding 32.

A post 63 projects from the front or outer face of the rheostat 58 and on this is mounted a metallic cup-shaped member 64 which serves as a cover for the rheostat mechanism. This cover is preferably a sheet metal punching and extends into close proximity to but does not touch the inner wall of the cylinder 55. This cover serves to partially close the end of the cylinder and aids in preventing discharges between the current carrying parts of the rheostat and the grounded metallic casing.

As will be best seen in Figure 6, the anode terminal 46 of the tube is equipped with a radiator indicated generally at 70 and preferably comprises a metallic ferrule 71 which embraces the terminal member 46 and is flanged as at 72 on the outer edge of its closed end. A plurality of metallic discs 73, preferably copper, are disposed over the ferrule and spaced apart therealong by metallic spacing rings 74. The outer edges of the disc 73 are turned over to form a bead 75 which is preferably of generally circular section.

Adjacent the tube end of the ferrule is a smaller disc 76 which is not beaded. A washer 77 bears against this disc and a collared nut 78 is threaded upon the ferrule and bears against the washer to thereby clamp the assembly tightly together. The washer 77 and nut 78 together form a groove in which the terminal 79 is disposed.

This terminal 79 comprises a ring disposed in the groove and split to permit its faces to bear against the side walls of the groove. A suitable wire receiving means 80 is formed integral with the ring and adapted to receive the wire 81 by which the anode is connected to the terminal 17. The wire may be clamped by the receiving means 80 or otherwise suitably attached thereto.

Insulating washers 82 and 83 surround the anode terminal 46 of the tube and a metallic washer 84 bears against the washer 83. Preferably the washer 84 is cupped at its central portion to thereby locate the anode terminal 46 concentrically in the opening 47 in the insulating cup 42. A screw 85 projects through the end of the ferrule 71 and is threaded into the anode terminal 46 to draw the radiator assembly tightly in the cup 42. A pin 86 located in the ferrule projects into an opening 87 in the anode terminal and prevents turning of the ferrule and radiator assembly with respect to the anode terminal.

As will be seen in Figure 3, the insulating cylinder 54 which surrounds the tube is slotted at 88 so that it may be passed over the terminal wire 81.

Preferably the terminal wire 81 is a flexible heavy copper wire, which, in addition to serving as an electrical connection for the anode, serves also to conduct heat from the radiator to the terminal 17, from which it is carried and dissipated by the oil in the transformer compartment of the casing. The wire 81 is made flexible to compensate for any eccentricity which may occur in the mounting of the tube anode 46.

The tube compartment is closed by metallic members 90 and 91 which are generally cylindrical in shape and provided with generally spherical ends 92 adjacent the ends of the tube. These members engage the flanged rings 93 of the mounting bracket 33 and are held thereagainst by suitable screws 94.

As will be seen in Figure 8, the cathode of the tube 45 is connected through the ring 56 and disc 57 and springs 60 and 61, through the rheostat 58 and wires 62 to the secondary winding 32 of the transformer. One terminal of this winding 32 is connected to the end of the secondary winding 100 of the transformer, the opposite end of which winding is connected through a suitable milliammeter 101 to ground at 102. The anode of the tube is connected through a connector 80 and wire 81 to one terminal of the winding 24 of the transformer, the opposite end of which winding is grounded at 102. By this arrangement the opposite ends of the tube 45 are at the same potential with respect to ground, since the voltage induced in windings 24 and 100 of the transformer is the same.

One terminal of the primary winding 103 of the transformer is connected to one terminal of the alternator 104, and the opposite terminal of the winding 103 is connected through a suitable resistance 105 to the variable reactance 106 connected to the opposite terminal of the alternator. A second reactance 107 is connected to the first terminal of the alternator and to the reactance 106, forming with it a potential divider or auto transformer by which the voltage impressed upon the primary winding 103 is varied. The milliammeter 101, rheostat 105, transformer and alternator are mounted externally of the casing 1 and form no essential part of the present invention.

What is claimed is:

1. In an X-ray machine, a casing containing two compartments one of which is hermetically sealed, a transformer mounted in said sealed compartment, a tube mounted in the other compartment and rotatable about its own axis, a stationary cylinder surrounding said tube, a rheostat mounted in said cylinder adjacent the end of said tube, collector means on the end of said tube, a pair of leaf springs attached to the tube side of said rheostat and engaging said collector means, an electrical connection extending from said springs through said rheostat to said transformer, and an electrical connection from the other end of said tube to the transformer.

2. In an X-ray machine, a mounting saddle, a tube embraced at its mid-section by said saddle, means for holding said tube on said saddle, an insulating cylinder mounted on said saddle concentrically of said tube, a rheostat mounted within said cylinder adjacent the end of said tube, a ferrule on said tube, a disc and an annulus concentrically mounted on said ferrule, and a pair of leaf springs mounted on said rheostat and engaging said disc and annulus, respectively, to thereby establish electrical connections between the rheostat and the tube.

3. In an X-ray machine, a mounting saddle, a tube embraced at its mid-portion by said saddle and mounted therein for rotation about its longitudinal axis, means for holding said tube on said saddle, an open end cylinder attached to said saddle and surrounding one end of said tube and extending therebeyond, a rheostat mounted in said cylinder adjacent the end of said tube, collector means on the end of the

tube, leaf springs mounted on the tube side of said rheostat and engaging said collector means and wiping over the same as the tube is rotated to thereby establish electrical connections with the tube, and a metallic cup mounted on said rheostat but insulated therefrom and extending thereover to form a shield for the rheostat.

4. In an X-ray machine, a tube mounted for rotation about its axis, anode terminal means projecting from one end of said tube, cathode terminal means projecting from the opposite end of the tube, cylinders of insulating material disposed concentrically around said tube and extending beyond said terminal means, a grounded metallic casing surrounding said tube and cylinders, and metallic rings disposed on the free ends of said cylinders in spaced and substantially concentric relation to the end portions of said casing for preventing flash-over between said terminal means and said casing.

5. In an X-ray machine, a tube mounted for rotating about its axis, anode terminal means projecting from one end of said tube, cathode terminal means projecting from the opposite end of the tube, cylinders of insulating material disposed concentrically around said tube and extending beyond said terminal means, a grounded metallic casing surrounding said tube and cylinders and extending about the outer end portions of the latter substantially concentrically therewith, and metallic rings disposed on the free ends of said cylinders and insulated from said terminal means and casing for preventing flash-over therebetween.

6. In an X-ray machine, a tube mounted for rotation about its axis, an anode terminal projecting concentrically from the end of the tube, a radiator on said terminal, said radiator comprising a ferrule embracing and secured to the terminal and a plurality of fins spaced on the ferrule and held thereon by a nut and washer which together form an annular groove of predetermined width, a connector comprising a split ring disposed in said groove and slidably engag-

ing the walls thereof, and means formed integral with said ring and extending therebeyond for clamping a wire by which an electrical connection is extended to said anode terminal.

7. In an X-ray machine, a tube mounted for rotation on its axis, an anode terminal projecting concentrically from the end of the tube, a radiator comprising a ferrule fitting upon and secured to said terminal concentrically therewith, a member on said ferrule adjacent the inner end thereof and held against outward movement therealong, a shouldered nut secured upon the inner end of the ferrule with its shoulder in contact with said member and defining therewith a groove of fixed and predetermined width extending about the ferrule concentrically therewith, and a terminal connecting member extending into the groove and having wiping contact with the side walls thereof while permitting turning of the ferrule with the tube and relative to said connecting member.

8. In an X-ray machine, a metallic casing, an X-ray tube mounted within said casing, cylinders of insulating material extending around and beyond the ends of the tube concentrically therewith, said casing having end portions of spherical curvature enclosing the outer end portions of said cylinders and extending concentrically therearound, and metallic rings secured upon the outer ends of said cylinders in concentric spaced relation to said surrounding end portions of said casing.

9. In an X-ray machine, a metallic casing, an X-ray tube mounted within said casing, cylinders of insulating material extending around and beyond the ends of the tube concentrically therewith, said casing having end portions of spherical curvature enclosing the outer end portions of said cylinders and extending concentrically therearound, and metallic rings of substantially circular cross-section fitting upon the outer ends of said cylinders.

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