Sept. 25, 1934. O. H. PIEPER ET AL 1,974,929

X-RAY APPARATUS

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Fig. 1

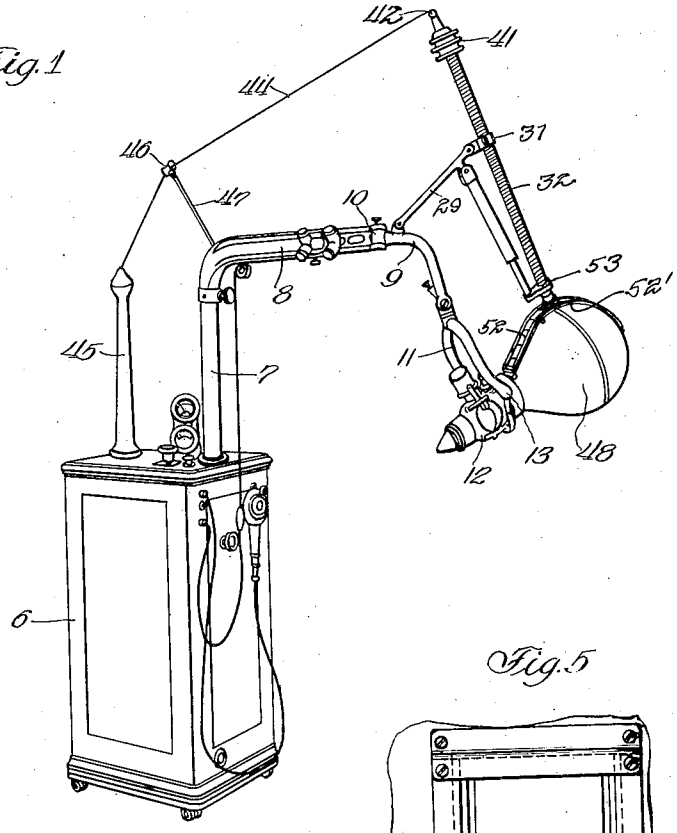


Fig. 4

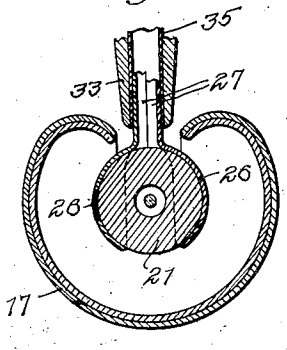
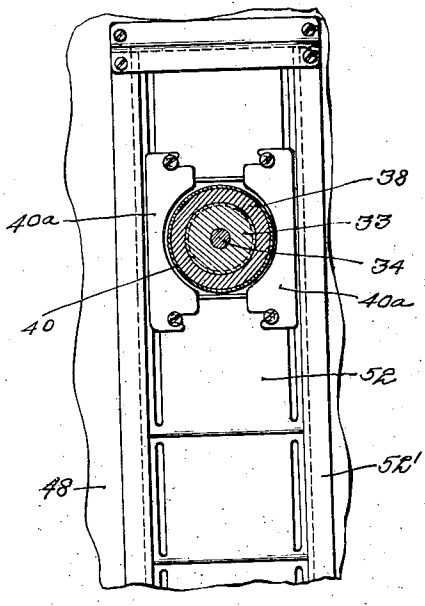


Fig. 5



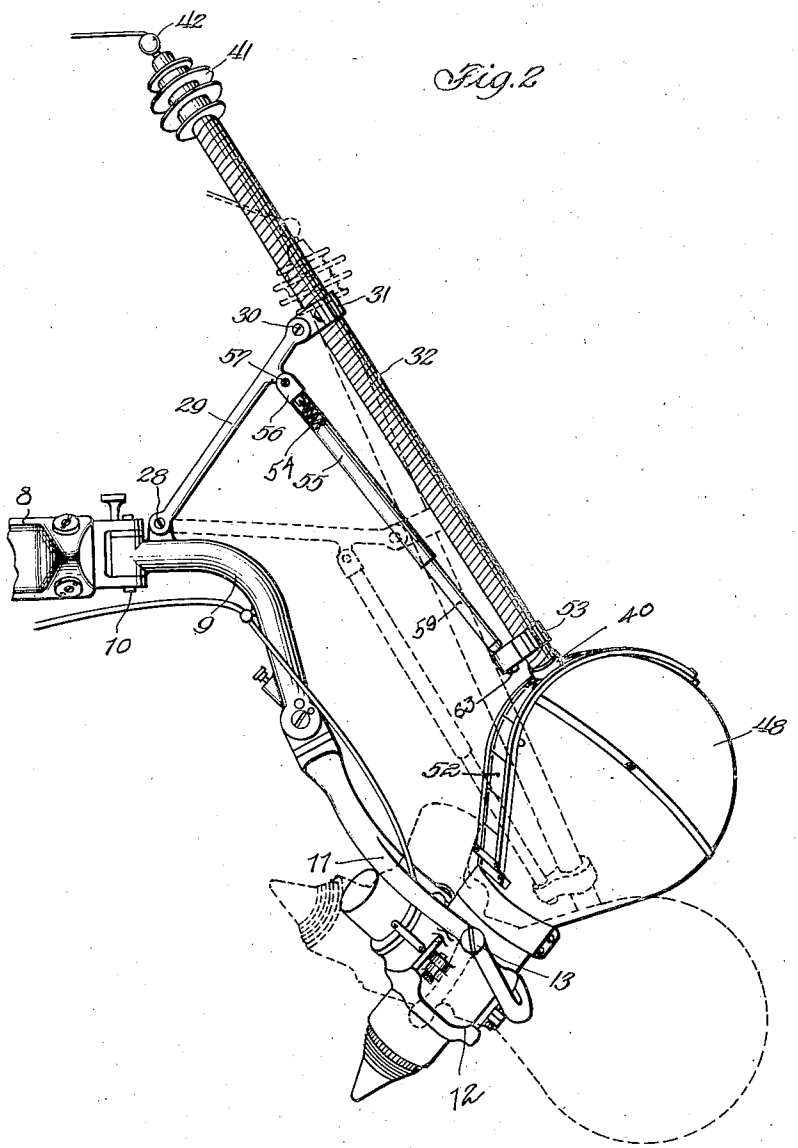
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Attys

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Fig. 2



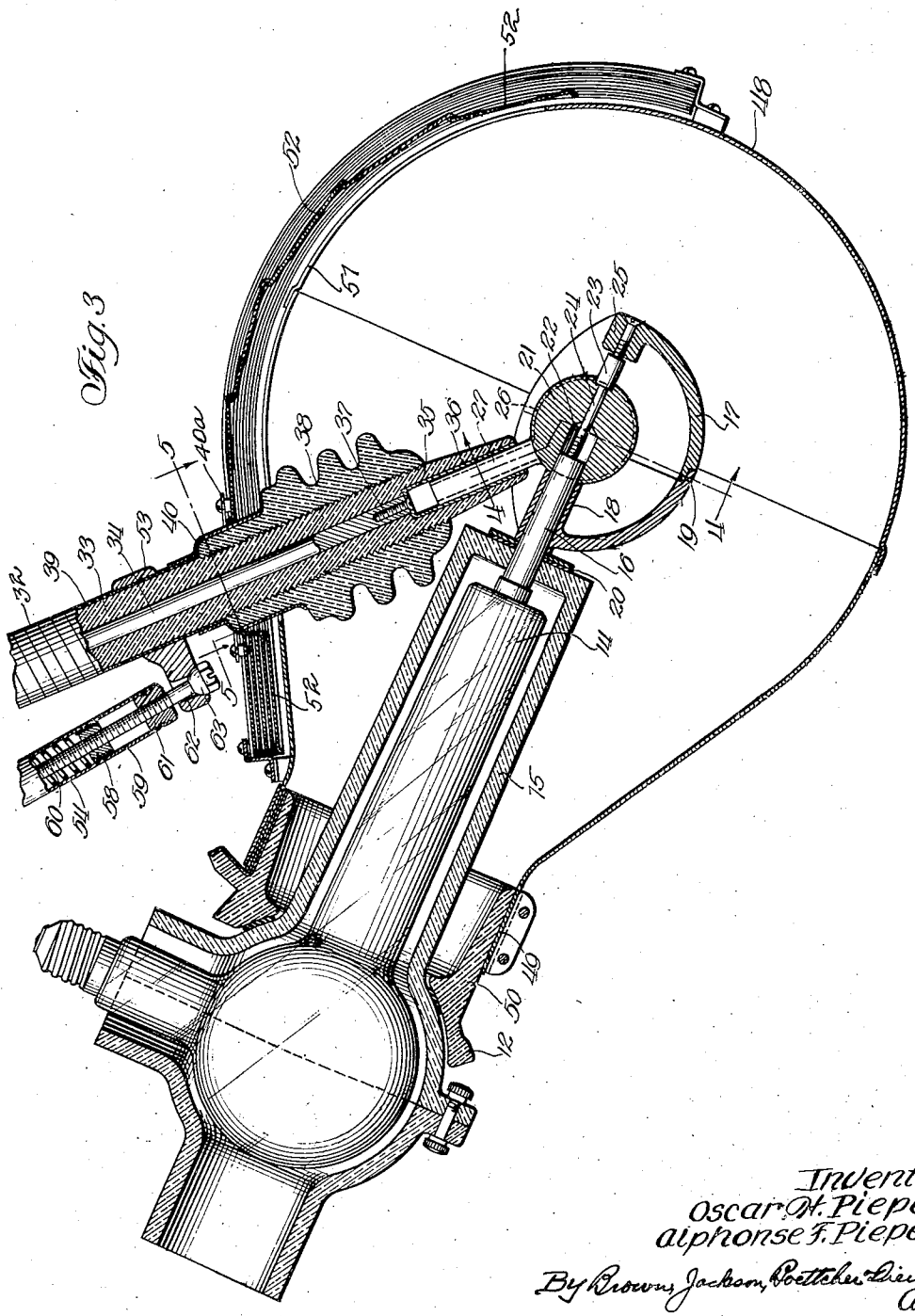
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Fig. 3



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Fig. 7

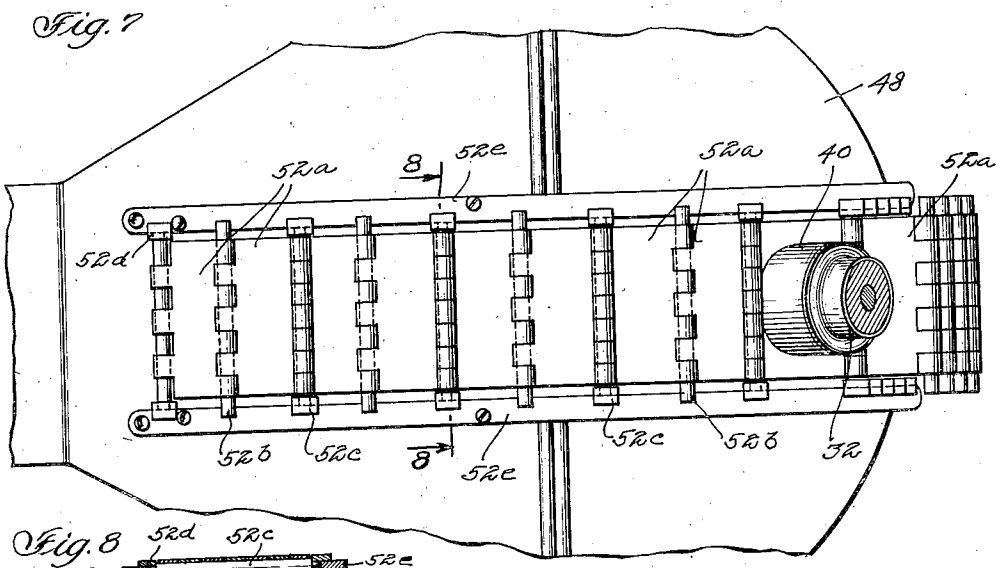


Fig. 8

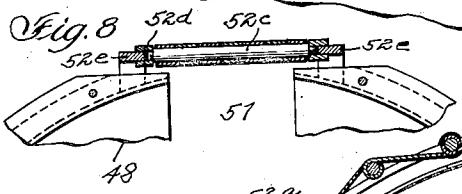


Fig. 6

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UNITED STATES PATENT OFFICE

1,974,929

X-RAY APPARATUS

Oscar H. Pieper and Alphonse F. Pieper,
Rochester, N. Y.

Application June 15, 1931, Serial No. 544,402

12 Claims. (Cl. 250—34)

Our invention relates to X-ray apparatus, particularly to the X-ray tube mounting, and contemplates improvements to the end of safety in handling while in operation.

In the apparatus of our invention, all metal parts which are at high potential are surrounded by grounded metallic parts, and it is important that we accomplish this and, at the same time, provide for the necessary manipulation of the tube in use.

Our invention is illustrated in the accompanying drawings in which:

Figure 1 is a perspective view showing an X-ray unit with our improved X-ray tube mounting;

Figure 2 is a perspective view of the mounting, showing the manner of manipulation of the X-ray tube;

Figure 3 is an axial sectional view of the anode end of the X-ray tube and the immediately associated parts;

Figure 4 is a sectional view taken on the plane of the line 4—4 of Figure 3;

Figure 5 is a view taken on the plane of the lines 5—5 of Figure 3;

Figure 6 is a view similar to Figure 3, illustrating a modification in part of the structure;

Figure 7 is a view similar to Figure 5, illustrating this modification, and

Figure 8 is a sectional view taken on the line 8—8 of Figure 7.

Referring first to Figure 1, we have illustrated, as an example, an X-ray unit in the form of a cabinet 6, within and upon which parts of the apparatus are mounted. A vertically adjustable standard 7 rises from the cabinet 6 and is provided at the top with a horizontal extension 8, to the free end of which the downwardly curved arm 9 is pivoted on the vertical axis 10. The arm 9 carries the bifurcated extension 11 in which the X-ray tube housing 12 is mounted to swing on the axis represented by the center point 13.

Referring now to Figure 3, 14 represents the X-ray tube, 15 represents its glass shield, and 16 is the anode stem. Mounted upon the anode stem 16 is a metallic shell 17 of spherical formation, open on the upper side, as best shown in Figure 4. This shell is provided with the integral tubular supporting portion 18 which is fitted tightly upon the stem 16, and it is centrally divided at 19, at right angles to the axis of the stem, for assembly purposes, as will be understood presently. Appropriate washers 20 are disposed between the tubular supporting portion 18 and the end of the shield 15.

Mounted on the end of the stem 16, concentrically within the shell 17, is a spherical member 21. The stem 16 enters the socket 22 in the member 21 and the member 21 is clamped against the inner end of the tubular supporting portion 18 by means of a collar 23 on screw 24 passing through a boss 25 on the shell 17 and through member 21, socket 22, and to the stem 16.

A bifurcated member 26 embraces the spherical member 21 so as to be capable of rotary movement relative to the member 21 on the horizontal axis intersecting the axis of the stem 16 at right angles. This bifurcated member 26 carries the radially extending stem 27 which will be referred to again presently.

Referring now to Figures 1 and 2, it will be seen that the arm 9 has pivoted thereto, at 28, a link 29, the free end of which is pivoted at 30 to a clamp 31 secured upon a conduit member identified as a whole by the reference character 32. This conduit member comprises a tube 33 of insulating material, shown in detail in Figure 3. The high tension conductor 34 is lodged in this tube, terminating in a socket 35 at the lower end thereof. The socket 35 is lodged in the increased bore 36 in the lower end of the tube 33 and is secured to the lower end of the high tension conductor 34 by means of the screw 37. The stem 27, previously referred to, extends into the socket 35 with a snug fit, being slidable therein for purposes which will appear presently.

An insulator 38 is threaded upon the tube 33, near the lower end thereof, as illustrated in Figure 3. The tube 33 is wrapped with a metallic binding 39 from said insulator 38 upwardly and the metallic sleeve 40 caps the top of the insulator 38 and engages over the lower end of the insulator binding 39. The purposes of this arrangement will be described presently.

The upper end of the high tension conduit 32 carries the high tension bushing 41 (Figures 1 and 2) and the metallic binding 39 is wound upon the tube 33 upwardly to this high tension bushing. The high tension conductor 34 terminates at the top in the high tension terminal 42 to which the high tension wire 44 is attached. This high tension wire 44 leads to the upwardly extending insulating tube 45 on the cabinet 6 and through it into the cabinet, being appropriately distanced from the standard 7 and extension 8 by being guided in an insulating ring or sleeve 46 supported on a strut 47 extending from the latter.

Completely surrounding the spherical member 21, the shell 17, and the anode end of the X-ray tube, is the thin metallic housing 48, this housing

being, in the main, concentric with the spherical member 21 and the shell 17 and being extended over the anode end of the X-ray tube, as shown in Figure 3, and terminating in a collar 49 secured upon the collar 50 formed on the X-ray tube housing 12. This housing 48 is suitably distanced from the shell 17 and is grounded. It is provided with a slot 51, the longitudinal center line of which lies in the vertical plane of the axis of the stem 16, this slot accommodating the lower end of the high tension conduit 32. It will now be seen that as the X-ray tube is manipulated about the axis 13 the high tension conduit 32 responds by the movement of the part 26 relative to the part 21 and by the movement of the link 29. In other words, the arm 9, the link 29, the conduit 32, and the X-ray tube structure constitute a parallelogram of linkages the action of which is indicated in dotted lines in Figure 2. In this action the lower end of the high tension conduit rides in the slot 51 and the insulator 38 and sleeve 40 are provided at the point where the high tension conductor is nearest the housing 48, these two elements in fact overlapping in the region of the slot. The insulator 38 is made in the form of a high tension bushing to prevent creepage of the high tension current from the anode stem to the grounded metallic housing 48 which is the other pole of the high tension circuit.

The slot 51 is covered, in all positions of the high tension conduit 32, by means of a series of metallic slides 52, operating in a curved rectangular frame 52', mounted on the housing 48 to surround the slot and consisting of a plurality of superposed tracks. These slides are made to interlock at the ends, as shown, and are provided with lengthwise narrow slots near their sides in order to facilitate flexing at the sides. The end slides are anchored at the ends of the frame. The two middle slides are attached to the sleeve 40, by means of the connecting plates 40*a*, as shown in Figure 5, the result being that as the conduit swings relative to the housing the slides are extended, one relative to the other, on one side of the conduit, and superposed, one relative to the other, on the other side of the conduit.

In Figures 6, 7 and 8 we have illustrated a modified form of the means for covering the slot 51. In this instance the cover comprises sections 52*a*, hinged together by means of pins 52*b* and 52*c*, the pins 52*c* carrying heads 52*d* guided on tracks 52*e* supported alongside the slot on housing 48. The end sections are anchored at the ends of the tracks. The middle section embraces the sleeve 40, as shown, and the result is that as the conduit swings relative to the housing the sections are unfolded, one relative to the other, on one side of the conduit, and folded, one relative to the other, on the other side of the conduit.

Toward the lower end of the conduit 32, just outside the housing 48, we provide a clamp 53 between which and the link 29 a spring, for counter-balancing the weight of the swinging structure, is connected. This spring 54 is lodged in a telescoping housing the upper part 55 of which terminates in a plug 56 pivoted to the link 29 at 57, the upper end of the spring being attached to this plug. The lower end of the spring 54 is attached to a collar 58 in the lower portion 59 of the telescoping housing which collar is engaged by a screw 60 extending through the plug 61 at the bottom of the housing and passing loosely through an opening 62 in the clamp 53, its head 63 engaging with the under side of said clamp. It will be clear that as the X-ray tube is manipulated this spring, in its action, counterbalances the weight of the tube and its associated parts.

As before stated, the housing 48 is grounded. Thus the metallic binding 39 is also grounded and represents the other side of the circuit or the cathode end of the tube. From the above description and the drawings it will be appreciated that all metal parts which are at high potential are surrounded by grounded metallic parts so that in the event the high tension current should spark across, either from the anode stem or from the high tension conductor through the insulation to the housing 48, there would be no danger incident to touching any of the metal parts. In the arrangement shown in Figure 1, the nearest exposed portion of the high tension circuit, that is nearest the patient or operator, is at the terminal 42 which, in practice, is approximately seven feet or more from the floor and thus entirely out of the way of the average person. The shield 17, from an electrical standpoint, is provided for the purpose of insurance against jumping of current from the spherical member 21, 26, to the housing 48. The chances of such a jump are comparatively remote, in view of the distancing of the housing, but to make assurance doubly sure, the shield 17 is provided. The larger area of the shield 17 greatly reduces the stress per unit area.

I claim:—

1. In combination, a supporting arm, a housing pivoted on said arm, an X-ray tube extending into said housing, a tubular insulating member extending from said housing and having angular movement relative thereto, means for supporting said tubular insulating member from said arm, and an electrical conductor in said tubular insulating member connected with said X-ray tube.

2. In combination, a supporting arm, a housing pivoted on said arm, an X-ray tube extending into said housing, a tubular insulating member extending from said housing and having angular movement relative thereto, a link for supporting said tubular insulating member from said arm, and an electrical conductor in said tubular insulating member connected with said X-ray tube.

3. In combination, a supporting arm, a housing pivoted on said arm, an X-ray tube extending into said housing, a tubular insulating member extending from said housing and having angular movement relative thereto, a link for supporting said tubular insulating member from said arm, an electrical conductor in said tubular insulating member connected with said X-ray tube, and a counterbalancing spring between said tubular insulating member and said link.

4. In combination, an X-ray tube, an anode terminal therefor, a metallic housing fixed with respect to and surrounding and spaced from said anode terminal and the anode end of said X-ray tube, said housing having a slot therein, an insulating tube extending from and pivoted at said terminal and out of said housing through said slot, and a high tension conductor in said insulating tube and connected with said terminal.

5. In combination, an X-ray tube, an anode terminal therefor, a metallic housing fixed with respect to and surrounding and spaced from said anode terminal and the anode end of said X-ray tube, said housing having a slot therein an insulating tube extending from and pivoted at said terminal and out of said housing through said slot, means for closing said slot and a high tension conductor in said insulating tube and connected with said terminal.

6. In combination, an X-ray tube, an anode terminal therefor, a metallic housing fixed with respect to and surrounding and spaced from said anode terminal and the anode end of said X-ray tube, said housing having a slot therein, an insulating tube extending from and pivoted at said terminal and out of said housing through said slot, slides connected with said insulating tube for closing said slot, and a high tension conductor in said insulating tube and connected with said terminal.

7. In combination, an X-ray tube, a metallic housing fixed with respect to and surrounding the anode end of said X-ray tube, an insulating tube pivoted at said anode end of said X-ray tube and extending through a slot in said housing, a high tension bushing surrounding said insulating tube in the region of said slot, a metal sleeve surrounding said insulating tube in the region of said slot, and a high tension conductor in said insulating tube connected to said X-ray tube.

8. In combination, an X-ray tube, a metallic housing fixed with respect to and surrounding the anode end of said X-ray tube, an insulating tube pivoted at said anode end of said X-ray tube and extending through a slot in said housing, a high tension bushing surrounding said insulating tube in the region of said slot, a metal sleeve surrounding said insulating tube in the region of said slot, a metallic sheath for said insulating tube, and a high tension conductor in said insulating tube connected to said X-ray tube.

9. In combination, an X-ray tube, a metallic housing fixed with respect to and surrounding the anode end of said X-ray tube, an insulating tube pivoted at said anode end of said X-ray tube and extending through a slot in said housing, a high tension bushing surrounding said insulating tube in the region of said slot, a metal sleeve surrounding said insulating tube in the region of said slot, a metallic sheath for said insulating tube, and a high tension conductor in said insulating tube connected to said X-ray tube, said metallic sheath and housing being grounded.

10. In combination, an X-ray tube having a terminal stem at its anode end, a spherical member mounted on said stem, a bifurcated supporting member pivoted to said spherical member and having a stem, a tubular insulating member, and a high tension conductor in said tubular insulating member, said high tension conductor terminating in a metallic socket receiving said stem of said bifurcated member.

11. In combination, a supporting arm, a housing member pivoted on said arm, an X-ray tube mounted in said housing member with the anode end of said tube extending therefrom, a metallic spherical member mounted on the anode end of said X-ray tube, a supplemental metallic housing supported on said tube housing and surrounding and spaced from said spherical member and said anode end of said X-ray tube, said supplemental housing having an arcuate slot therein, a contact and supporting member pivoted to said spherical member, an insulating tube mounted upon said contact and supporting member and extending outwardly through said slot, a high tension conductor in said insulating tube and connected with said contact and supporting member, a metallic sheath on said insulating tube, a high tension bushing and a metallic sleeve surrounding said insulating tube in the region of said slot, said supplemental housing and said sheath being grounded, a link between said insulating tube and said arm, and a high tension wire extending from the free end of said insulating tube and connected with said high tension conductor.

12. In combination, an X-ray tube, an anode terminal therefor, a metallic housing fixed with respect to and surrounding and spaced from the said anode terminal and the anode end of said X-ray tube, said housing having a slot therein, an insulating tube extending from and pivoted at said terminal and out of said housing through said slot, a conductor in said insulating tube connected to said anode terminal, a cover for said slot comprising a series of sections hinged together, and means for guiding the alternate hinges, said insulating tube extending through a middle section of said cover and the end sections being anchored, whereby said sections may fold one relative to the other, on one side of said insulating tube, as said tube is moved toward that end of said slot.

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