Oct. 20, 1936. E. POHL 2,058,105

RONTGEN TUBE

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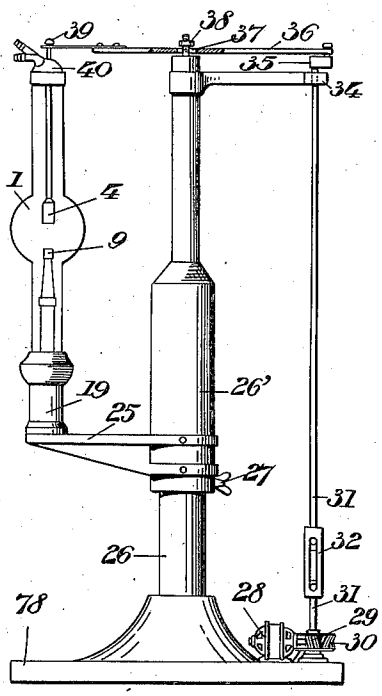


Fig. 2.

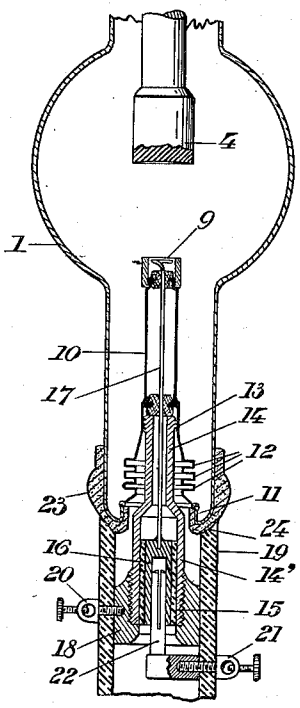


Fig. 1.



Fig. 3.

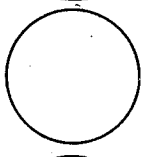


Fig. 4.



Fig. 5.



Fig. 6.

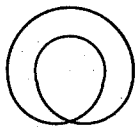


Fig. 7.

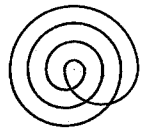


Fig. 8.

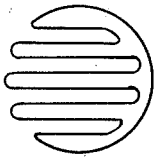


Fig. 9.

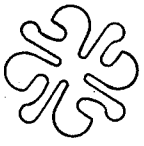


Fig. 10.

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RONTGEN TUBE

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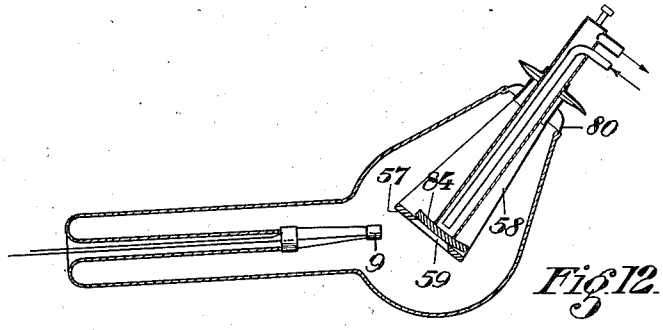


Fig. 12.

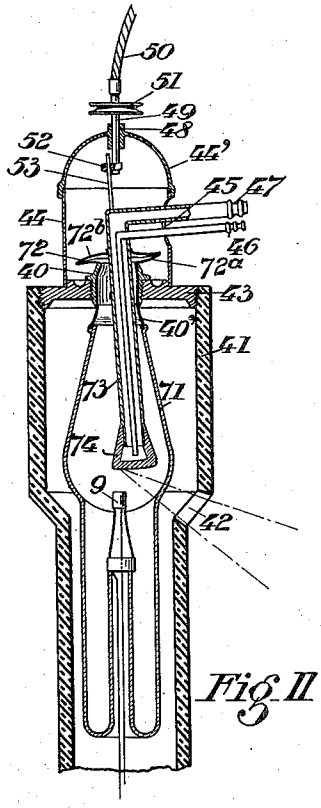


Fig. II

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Patented Oct. 20, 1936 2,058,105

UNITED STATES PATENT OFFICE

2,058,105

RÖNTGEN TUBE

Ernst Pohl, Kiel, Germany

Application March 26, 1929, Serial No. 350,084
In Germany March 31, 1928

4 Claims. (Cl. 250—35)

My invention relates to improvements in Röntgen tubes, and more particularly in Röntgen tubes of the type described in my United States Patent No. 1,790,073, dated January 27, 1931, for improvements in Röntgen tubes, and the object of the improvements is to provide a suitable flexible connection between the body of the Röntgen tube and the movable electrode, and with this object in view the said flexible connection includes one or more diaphragms. Other objects of the improvements will appear from the following description of the invention.

For the purpose of explaining the invention several examples embodying the same have been shown in the accompanying drawings, in which the same letters of reference have been used in all the views to indicate corresponding parts. In said drawings,

Fig. 1 is a partial sectional elevation showing the Röntgen tube having the anticathode fixed to the body thereof and having the cathode yieldingly connected therewith,

Fig. 2 is an elevation showing the Röntgen tube illustrated in Fig. 1 mounted on a suitable support including mechanism for imparting rocking movement to the body of the tube,

Figs. 3 to 10 are diagrammatical views illustrating various forms of cams for operating the body of the Röntgen tube,

Fig. 11 is a sectional elevation showing a Röntgen tube having the anticathode movably connected therewith and comprising means for imparting rocking movement to the said anticathode,

Fig. 12 is a similar sectional elevation showing a Röntgen tube having a movable anticathode, the said anticathode being equipped with a stationary annular member.

In the example shown in Figs. 1 and 2 the Röntgen tube comprises a glass bulb 1, an anticathode 4 fixed to the bulb, and a cathode 9 yieldingly connected with the bulb. The cathode is mounted on a metal pipe 10 fused to the body 1 and including a plurality of flexible diaphragms 12. The said diaphragms have a function similar to that of the corrugated metal pipe carrying the anticathode shown in my aforesaid patent, but they are more effective by having higher flexibility by reason of their greater radial dimension, so that the number of the said diaphragms may be reduced, and a single diaphragm may be sufficient.

The metal pipe 10 is provided with internal screw-threads 13 having a tubular member 14 screwing therein, which tubular member is formed at its bottom part with an enlarged portion 14' receiving an insulating bushing 15 and a sleeve 16 disposed within the said bushing and connected by a lead 17 with one terminal of the heating wire. Further, the enlarged portion 14' is provided at its bottom part with outer screw-threads having a metal sleeve 18 screwing thereon, the said metal sleeve 18 being fixed within an insulating pipe 19 and being provided with a binding screw 20 adapted to be connected with one terminal of a source of electric energy for heating. To a second binding screw 21 secured to the insulating pipe 19 a pin disposed concentrically within the sleeve 16 is electrically connected. To the neck of the bulb a spherical cap 23 is secured which is in engagement with the end face of the pipe 19, the said end face being for this purpose formed with a spherical seat 24. By thus supporting the body of the tube an excessive deformation of the diaphragms by the air pressure acting therein is avoided.

In Fig. 2 I have shown a frame for supporting the Röntgen tube illustrated in Fig. 1 and provided with means for imparting rocking movement to the body of the Röntgen tube. As shown, the said frame comprises a base plate 78 having a pillar 26 rising therefrom, and a tubular member 26' slidable on said pillar 26 and adapted to be fixed in the desired position vertically by means of a clamp screw 27. The tubular member 26' is made integral with a bracket 25 supporting the pipe 19.

On the base plate an electric motor 28 is mounted which is connected by a worm gearing 29, 30 with a vertical shaft 31 supported at its top end in a bracket 34 carried by the top end of the member 26', the said shaft 31 being made in two sections connected with each other by a coupling member 32 fixed to one section and permitting longitudinal displacement of the other section. Thus, when changing the position of the tubular member 26' the shaft 31, 31 is automatically extended or reduced in length. To the top end of the shaft 31 a crank 35 is secured which is jointed to a lever 36 formed with an elongated slot 37 engaged by a bolt 38 fixed to the member 26'. The outer end of the lever 36 is jointed to a pin 39 secured to the cap 40 of the anticathode of the Röntgen tube. Therefore, when imparting rotary movement to the shaft 31 circular movement is transmitted to the pin 39, so that gyratory movement is imparted to the body of the Röntgen tube. Thus the point of the emission of the Röntgen rays is moved substantially through a circle relatively to the stationary cathode 9.

According to the driving mechanism for the Röntgen tube, the path of the point of the emis-

sion of rays can be varied. For example, when providing cam disks in lieu of the crank 35 or the slot 37 having any one of the forms represented in Figs. 3 to 10, similar paths are imparted to the said point of the anticathode.

In Fig. 11 I have shown a Röntgen tube 71 provided with a movable anticathode 74, the metal pipe 73 carrying the said anticathode being connected to the body of the tube by means of a diaphragm 72 comprising two flexible or a flexible and an elastic annular disk 72*a*, 72*b* connected at their margins by welding. The said disks are provided with central openings, the opening of the disk 72*a* being larger in diameter than that of the disk 72*b*. The disk 72*a* is soldered to the margin of the tubular anticathode cap 40, and the disk 72*b* is soldered to the pipe 73 carrying the anticathode 74. The pipe 73 has sufficient play within the opening of the disk 72*a* and the tubular cap 40 to permit rocking movement of the anticathode. The Röntgen tube is confined within a protective housing 41 having only one aperture 42 for the passage of the rays therethrough. At its top end the housing 41 is closed by a disk 43 screwing therein and having the cap 40 screwing therein, the said cap 40 being formed with an extension 40' fused into the body of the glass bulb of the tube. The disk 43 carries a hood 44 having a lid 44' and enclosing the cap 40 and the diaphragm 72 and formed with a single opening 45 through which pipes 46 and 47 are passed into the housing for supplying cooling water to the anticathode. The lid 44' is formed with a sleeve 48 providing a bearing for a shaft 49 adapted to be rotated by means of a flexible shaft 50 or a rope pulley 51. At its bottom end the shaft carries a crank 52 engaging a pin 53 for imparting gyratory movement to the pipe 73. The flexible shaft 50 may at the same time serve to supply the current to the anticathode.

In the modification shown in Fig. 12 in front of the rockable anticathode 84 an annular movable plate 57 is located which is likewise connected to the positive terminal, and which is rigidly connected with the ring 86 carrying the anticathode 84 by a member 58. The central opening 59 of the said disk 57 is smaller in diameter than the diameter of the anticathode, so that it is always completely covered by the anticathode when rocking the same. Therefore, notwithstanding the gyratory movement of the anticathode there is always a metallic surface of even size in front of the cathode which surface does not change its position relatively to the cathode, which results in an unvariable field of forces. Thus the position of the point of the emission of the Röntgen rays on the movable anticathode is not changed relatively to the stationary cathode and relatively to the surrounding space, while the said position would be varied by reason of the variation of the electric field of forces if the plate 57 were not provided. In this case as well as in the examples shown in Figs. 1 to 11 the concentric situation of the surface of the anticathode relatively to the centre of oscillations is important.

The diaphragms 12, 72, etc. may be different in construction according to the object aimed at.

I claim:

1. A Röntgen tube, comprising a receptacle, an electrode fixed to one end thereof, a sleeve fixed to the other end thereof, a tubular carrier extending through said sleeve into the receptacle, a second electrode fixed to the inner end of said tubular carrier, a diaphragm comprising a pair of elements connected with each other and connected in an air-tight manner respectively with said carrier and the outer end of said sleeve, a housing enclosing said diaphragm, and circulation pipes for a cooling medium extending into said housing and connected to said tubular carrier.

2. In X-ray apparatus, the combination of an envelope containing a cathode structure rotatably mounted within the envelope, an anode fixedly mounted within the envelope, means for rotating the tube and anode as a unit, and means cooperating with said cathode structure for holding fixed in space the cathode beam thereby to focus the beam on the anode at a position removed from the center of rotation of said anode.

3. The combination of an X-ray device comprising an envelope containing a cathode rotatably mounted within said envelope, an anode fixedly mounted within the envelope, means for focusing rays from said cathode on the anode, means cooperating with said device for causing a continuous motion of the cathode rays relative to the envelope thereby distributing the heating effect of said rays over an area on the anode greater than the focal spot.

4. In X-ray apparatus, the combination of an X-ray tube containing a source of electrons and an electron receiving member, said source being rotatably mounted within the tube, said member being secured to the tube, means for rotating the tube and the said member, and means cooperating with said source of electrons for maintaining the source stationary whereby a relative movement is obtained between the source of electrons and the anode thereby to increase the X-ray output of the apparatus.

ERNST POHL.