Dec. 22, 1925. 1,567,012

H. P. PILON

ELECTRON DISCHARGE APPARATUS

Filed April 27, 1922

Fig. 1.

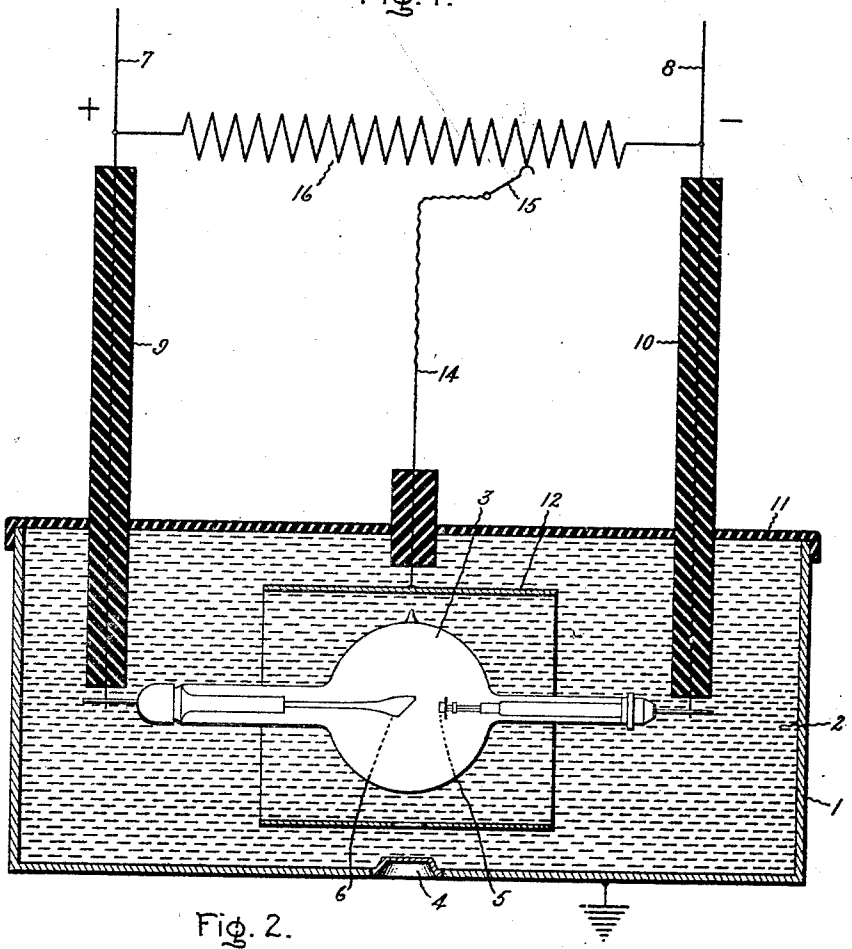
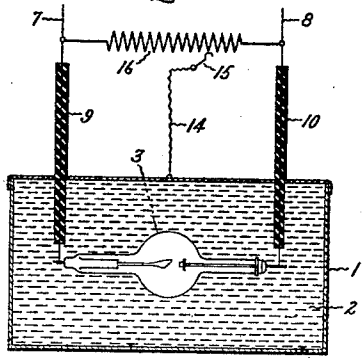


Fig. 2.



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UNITED STATES PATENT OFFICE.

HECTOR PAUL PILON, OF PARIS, FRANCE, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRON-DISCHARGE APPARATUS.

Application filed April 27, 1922. Serial No. 556,917.

To all whom it may concern:

Be it known that I, HECTOR PAUL PILON, a citizen of the French Republic, residing at Paris, France, have invented certain new and useful Improvements in Electron-Discharge Apparatus, of which the following is a specification.

The present invention relates to electronic devices, as for example, X-ray tubes, and its object is to obviate conditions tending to cause damage or destruction of these devices when at high voltages.

The practice of radiology requires to an increasing degree, the employment of high operating voltages. Hence, it becomes necessary to modify the construction of X-ray apparatus. Increasingly high operating voltages require such dimensions in glass X-ray bulbs that these tubes become cumbersome and because of their fragility are transported with difficulty.

Certain advantages may be obtained by immersing electrical devices in an insulating solid, paste, or liquid. Twofold advantages are thereby realized.

1. The insulation is increased considerably and therefore high operating potentials may be employed.

2. Cooling is more efficient, especially if the insulation is liquid and therefore greater amounts of power can be absorbed than in air.

The generation of X-rays of short wave length requires a high voltage which increases with the shortness of wave length of X-rays desired. Immersing X-ray tubes in a cooling fluid, therefore, permits of the reduction of the dimension of these tubes, but experience has shown that under these conditions the operation of the tubes is modified. Serious trouble is experienced by the formation on the two surfaces of the glass wall of the tubes of electric charges of opposite sign which cause sparks to pass through and puncture the glass. Hence, when the applied voltage is very high the tubes may be rendered useless in a short time. This phenomenon is particularly marked when the tubes are operated with alternating current.

The present invention has for its object the provision of electron discharge devices operable at high potentials without risk of puncture by sparks passing through the walls of the enclosing envelope.

My invention is embodied in an apparatus comprising an electron discharge device operated in an insulating liquid or paste and provided with means for modifying the electrostatic field about this device.

In the accompanying drawing I have shown in Fig. 1 a vertical section of a preferred embodiment of my invention in an X-ray apparatus and in Fig. 2 I have shown a modification.

Fig. 1 shows a sealed tank 1 containing oil or other suitable insulating liquid 2 in which is immersed an X-ray tube 3, a suitable window 4 consisting of hard rubber, bakelite or the like for the transmission of X-rays. The tube 3 provides a highly evacuated space in which an electron discharge is produced between a cathode 5 adapted to emit electrons from a heated filament (not shown) and an anode 6. The conductors 7, 8 supply current to the X-ray tube from a source of current (not shown), preferably direct current. These conductors preferably are surrounded by insulating sheaths 9, 10. The cover 11 of the tank may consist of insulating material as shown in Fig. 1 or of metal as indicated in Fig. 2. Surrounding the X-ray tube 3 is a cylindrical conductive body 12, which preferably is provided with a window as indicated, although the X-rays can be transmitted directly through the metal.

The conductor 12 is connected by a conductor 14 to the slider 15 of a potentiometer 16 conductively mounted between the conductors 7, 8. The conductor 14 can be brought by moving the slider to a suitable potential intermediate the potential between the terminals of the X-ray tube. In this way the electric field inside and outside of an electron discharge tube may be equalized to prevent puncture.

In some cases, as shown in Fig. 2, the tank 1 may be connected to a point of intermediate potential, for example, the potentiometer 16, in order to modify the electric field about the electron discharge device. To avoid the possibility of shocks to the patient the tank 1 may be grounded as indicated in Fig. 1 or surrounded by a grounded cage.

In both Figs. 1 and 2 I have indicated by way of example a potentiometer for obtaining a point of intermediate potential but other means for sub-dividing potential may

be employed as for example a transformer, electric pile, or dynamo.

I have also shown an X-ray tube by way of example as an electron discharge device, but I wish it to be understood that the advantages of my invention are not limited to X-ray tubes. It extends to other forms of electron discharge devices, operable at high voltage.

To reduce the superficial conductivity of the glass envelope, these devices also may be coated to advantage with an insulating body, such as a resin, applied by varnishing the surface with an alcoholic solution of the resin, for example, shellac. The application of this insulating coating modifies the electric field created about the tube in the tank and decreases the risk of puncture of the glass wall of the tube.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. An electron discharge apparatus comprising the combination of a tank, an electron discharge device mounted therein, means for operating the same, a conductor spaced away from said tank and surrounding said device and means for charging said conductor to an electrostatic potential intermediate the potential of said operating means.

2. An X-ray apparatus, comprising the combination of a tank, an X-ray bulb mounted therein, a body of insulating liquid surrounding said bulb, a conductive body surrounding said bulb in contact with said liquid, and means for charging said conductive body to an electrostatic potential.

3. An X-ray apparatus comprising the combination of a tank, a glass enclosed X-ray device having a surface coating of resinous material and being located in said tank, a body of oil surrounding said device, a conductive body within said tank spaced about said X-ray device, insulating means for supporting said body, current supply conductors connected to said device, and means for charging said body to an electrostatic potential which is intermediate the potential of said supply conductors.

In witness whereof, I have hereunto set my hand this 11th day of April, 1922.

HECTOR PAUL PILON.