

W. D. COOLIDGE.
THERMIONIC DISCHARGE APPARATUS.
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1,394,145.

Patented Oct. 18, 1921.

Fig. 1.

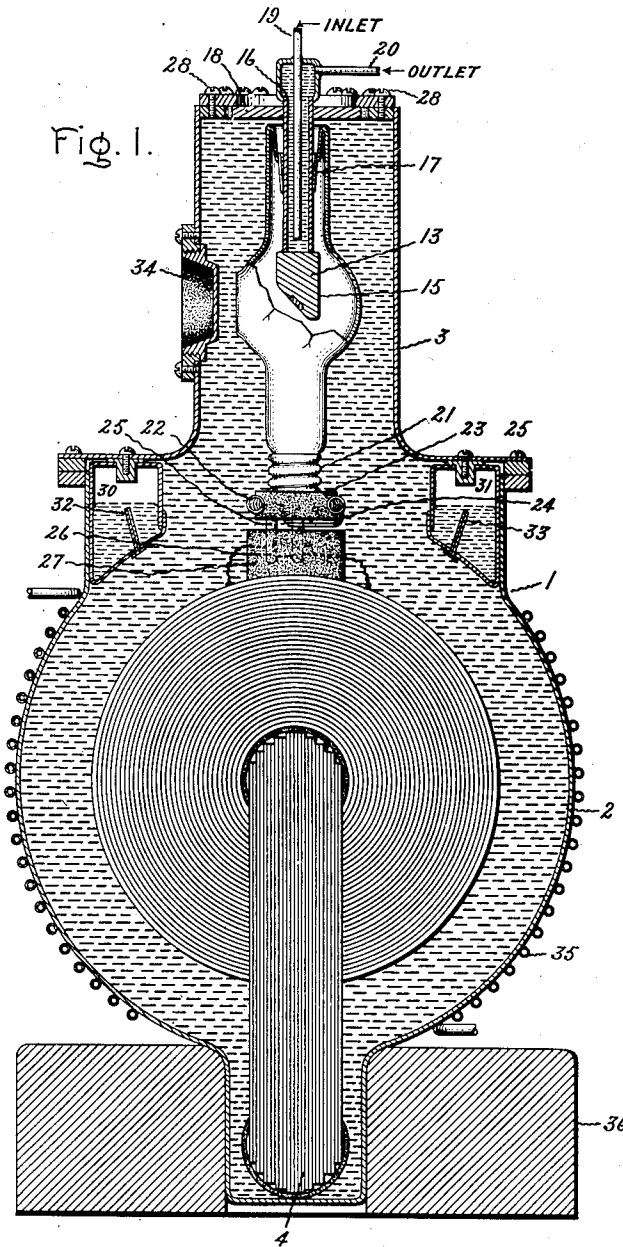
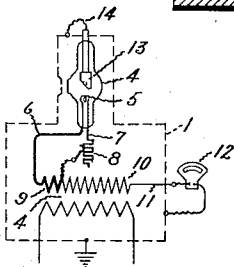


Fig. 2.



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THERMIONIC DISCHARGE APPARATUS.

1,394,145.

Specification of Letters Patent.

Patented Oct. 18, 1921.

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To all whom it may concern:

Be it known that I, WILLIAM D. COOLIDGE, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Thermionic Discharge Apparatus, of which the following is a specification.

The present invention comprises an improved electric discharge device—such, for example, as X-ray devices—which is particularly suitable for continuous operation with a high energy input.

When it is desired to operate X-ray devices for protracted periods and with a relatively high energy input, it is necessary to effectively cool the anode of the tube. When it is desired to use water for this purpose complications are introduced by the necessity of insulating the water supply to avoid danger of short-circuit and injury to the operator from electric shock.

In accordance with my present invention an apparatus is provided in which an anode adapted to be water cooled is maintained at substantially ground potential and the cathode terminal is buried in oil to insulate the same and preclude electrical injury to the user of the X-ray apparatus. My new device also embodies certain advantageous structural features which will be pointed out with particularity in the appended claims. For a detailed description of my invention reference may be had to the following specification taken in connection with the accompanying drawings in which Figure 1 is a longitudinal section of an apparatus embodying my invention, and Fig. 2 is a diagram of electrical connections.

Referring to the drawing, the device comprises an inclosing tank or container 1, consisting of iron or other suitable metal. This container preferably consists of two separable parts or sections 2, 3 conforming respectively to the general contour of the transformer and tube and being adapted to be bolted together. The larger bell-shaped chamber 2, contains a transformer 4 adapted to deliver high potential currents adapted to generate X-rays of desired penetrability. The tubular chamber 3 contains an X-ray tube, the wall of the tube being in part broken away and the anode end of the tube being shown in section.

As shown diagrammatically in Fig. 2, the

X-ray tube has an incandescent cathode 5 which is connected by conductors 6, 7, in series with an adjustable resistance 8 to a transformer secondary 9. The low potential secondary 9 is conductively connected with the high potential secondary at one of its terminals. A conductor 11 connects the opposite terminal of the transformer secondary 10 in series with an ammeter 12 to the container 1. The anode 13 is also conductively connected to the grounded tank 1 by the conductor 14.

As shown in Fig. 1, the anode 13 is preferably joined to the container 1 by a solid metallic connection which does not require any separate conductor. As illustrated in Fig. 1, the anode 13 comprises a mass of good heat conductivity, for example, copper, in which is embedded a button of refractory metal 15, preferably consisting of tungsten. The anode 13 is joined to a tube 16 consisting of copper or other suitable metal which is in turn sealed into the glass envelop of the tube through intermediate section 17 consisting of platinum or other suitable metal having a coefficient of expansion adapted to form a permanent seal with glass. The flange 18 joined to the tube 16 is bolted to the container 1, suitable gaskets being provided to make an oil-tight joint.

Water or other suitable cooling fluid is introduced into contact with the anode by an inlet tube 19 and removed by outlet tube 20. The cooling water may be introduced from an ordinary water tap without any special precautions to provide insulation, thereby effectively grounding the anode.

The cathode end of the X-ray tube is provided with a base 21 similar to an incandescent lamp base to which electrical connection to the two cathode conductors is made in the usual manner. The resistance 8 shown diagrammatically in Fig. 2 is mounted as a helix 22 upon a block 23 of insulating material, electrical connection to the cathode being made by an adjustable finger 24 to include the desired amount of resistance in the cathode circuit.

The X-ray tube is electrically connected to the transformer by metal pins 25, 26, fitting into metal sockets in a suitable insulating block 27 mounted on the transformer. Thus by removing the screw bolts 28, it is possible to remove the X-ray tube from the apparatus without difficulty.

In order to suitably provide electrical insulation, a body of oil is provided within the container which surrounds both the transformer and X-ray tube, and thus precludes
 5 electrical short circuits and corona. In order to enable the oil to expand and contract with changes of temperature while at the same time maintaining the inclosing tank entirely filled with oil, two expansion
 10 chambers 30, 31 are provided communicating with the main chamber through capillary tubes 32, 33. A sufficient quantity of oil is provided within these expansion chambers to cover at all times the ends of the
 15 tubes 32, 33, to prevent passage of air from the expansion chambers to the main chamber.

A depressed window 34 is provided in the X-ray chamber to decrease the thickness of
 20 the oil layer through which the X-rays pass. In order to facilitate cooling of the oil in the X-ray chamber the cooling coil 35 external to the envelop is provided. The apparatus is mounted upon a base 36 in order to enable it to stand upright.

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

1. An electron discharge apparatus comprising a metal tank, a high potential current source therein, an electron discharge
 30 device connected to said source and having one terminal connected to and projecting outside of said tank.

2. An X-ray device comprising a conductive tank, a transformer therein, an X-ray tube also within said tank connected to the terminals of said transformer, the anode terminal being electrically connected to said
 35 tank, and means for conducting a cooling fluid to said anode.

3. An electric discharge device comprising a metal tank, a body of oil therein, a transformer in said tank, a current conducting tube having an anode terminal projecting
 45 through the wall of said tank, and connections between the secondary terminals of said transformer and the terminals of said tube and a ground connection for said anode.

4. An electric device comprising a metal tank, a tube therein having a cathode operable at incandescence and a cooperating

anode, means for conducting a cooling fluid to said anode, a transformer also within said tank, connections between the secondary
 55 terminals of said transformer and said tube, the anode terminal being electrically in contact with said tank, and a body of oil in said tank.

5. An X-ray apparatus comprising the
 60 combination of a transformer, an X-ray tube mounted at the cathode terminal upon said transformer and projecting away therefrom, a metal envelop for said transformer and tube conforming to their general con-
 65 tour, a closure for said envelop joined to the anode terminal of said tube, and electrical connections between said transformer and X-ray tube.

6. An X-ray apparatus comprising the
 70 combination of a container having a tubular chamber and a main chamber communicating with each other, a transformer in said main chamber, an X-ray tube in said tubular chamber, an electrical connection be-
 75 tween a secondary terminal of said transformer and the adjacent terminal of said X-ray tube, and a common connection between said tank and the opposite terminals of said transformer and X-ray tube.

7. A device comprising the combination of a tank having a main chamber and a tubular chamber communicating with said main chamber, a transformer in said main chamber, an electric device tube in said tubular chamber having one terminal mechanically connected to the closed end of said tubular chamber, an electrical connection between one terminal of the secondary winding of said transformer and said tank, and a
 85 disengageable connection between the opposite terminal of said transformer and the free terminal of said device.

8. An electron discharge apparatus comprising a high potential source, an electron
 95 discharge device connected thereto, a housing therefor containing an insulating fluid, a ground connection for the anode of said device, and means for circulating a cooling fluid into effective thermal relation to said
 100 anode.

In witness whereof, I have hereunto set my hand this 12th day of November, 1919.

WILLIAM D. COOLIDGE.