

Dec. 23, 1941.

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2,267,128

AIR COOLED TUBE

Filed Sept. 14, 1939

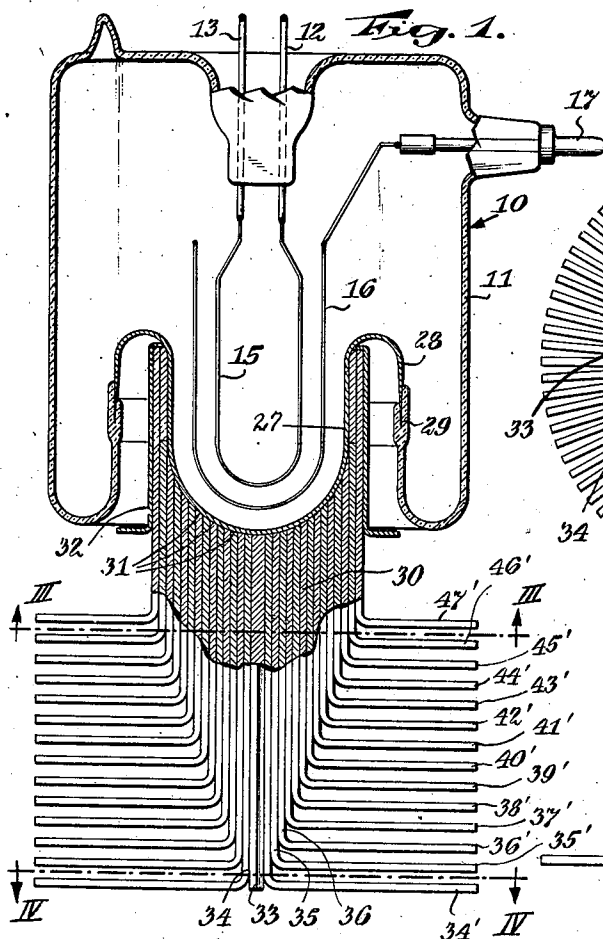


Fig. 2.

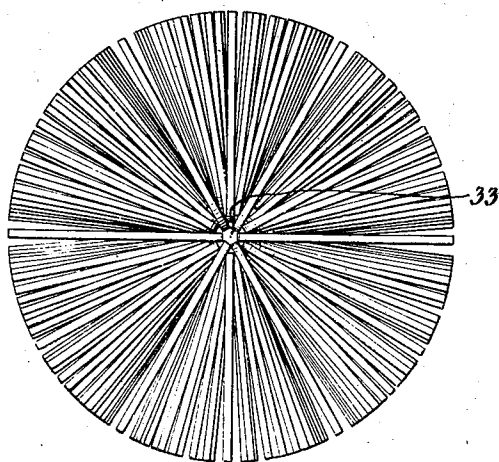


Fig. 3.

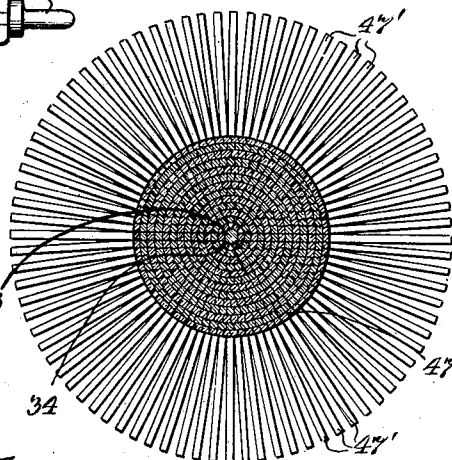


Fig. 4.

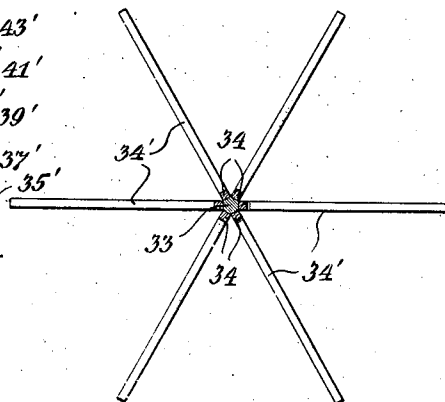
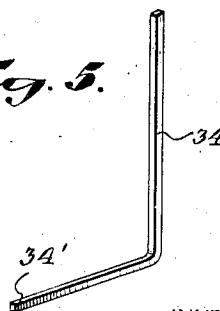


Fig. 5.



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AIR COOLED TUBE

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Application September 14, 1939, Serial No. 294,844

7 Claims. (Cl. 250—27.5)

Our invention relates to discharge tubes and especially to a cooling device for an external anode of such a discharge device.

An object of the invention is to provide a large cooling surface for the exterior anode of a discharge tube.

Another object of the invention is to provide effective cooling of exterior anodes having a large diameter in respect to the length of such an anode.

Other objects and advantages of the invention will be apparent from the following description and drawing in which:

Fig. 1 is a view partly in elevation and partly in cross-section of a discharge tube and a preferred embodiment of the cooling device applied thereto.

Fig. 2 is a bottom elevational view of the device of Fig. 1.

Fig. 3 is a view on lines III—III of Fig. 1.

Fig. 4 is a view on lines IV—IV of Fig. 1.

Fig. 5 is a perspective view of one of the wires in Fig. 1.

The exterior anode tubes of the prior art are generally elongated anode types to provide effective liquid cooling of the anode. For some installations, however, such as airplanes, it is desirable to economize on the space occupied by such tubes and to substitute air cooling for the liquid cooling of these prior art discharge tubes. In shortening the anode length and substituting air cooling for liquid cooling, a very acute problem is presented of effectively radiating the heat from the anode and dissipating it to the outside atmosphere.

The drawing illustrates a tube 10 in Fig. 1 designed to occupy a minimum of space in comparison with the present type of exterior anode tubes. This tube has, of course, the glass casing 11 with a plurality of cathode leads 12 and 13 entering through a press seal 14. These cathode leads extend to one or more cathode filaments diagrammatically illustrated at 15. The grid 16 is also diagrammatically illustrated connected to an exterior lead 17. The cathode and grid are only diagrammatically illustrated as they may take many varied shapes which do not affect the invention.

The anode is formed of dome-shaped copper 27 and has a reentrant outer curved portion 28 sealed to the glass casing by means of the feather edge seal 29. It will be noted that the diameter of the dome is very large in comparison with its length and that the dome is substantially surrounded laterally by the glass insulating por-

tion of the tube. Such a device presents a difficult problem in effectively cooling the anode in view of its enclosure by the rest of the device.

The preferred embodiment of the invention is illustrated in the drawing. The invention contemplates forming a bundle of wires 30 having an indentation 31 at one end to fit closely about the dome-shaped exterior anode 27. The wires may be pre-formed as to length for this indentation at one end, but we prefer to place them in a copper collar 32 and machine this end to the desired shape for fitting closely to the exterior anode 27. The bundle of wires may be formed in several ways, but our preferred type which is especially advantageous is disclosed in the various figures of the drawing.

We preferably select a central rod 33 as the axis of the bundle. This central rod may have various cross-sectional configurations, but we prefer to shape it in the form of a regular polygon having the same number of sides as the number of wires forming the first layer on this central core. In the preferred embodiment illustrated we have selected six wires as forming the first layer, and accordingly the core is preferably, but not necessarily, a hexagon in cross-section.

The wires themselves are preferably square or rectangular in cross-section, although they may take other cross-sections if desired. We prefer to increase the number of wires in each succeeding layer or radius increase by a fixed numerical amount, although it is apparent that adding or subtracting an additional wire to one of the inner layers or more to the outer layers will not seriously affect this mathematical arrangement.

In this preferred embodiment illustrated we have illustrated in Fig. 3 the central core 33 having its first layer thereon formed of six wires 34. The next layer 35 we prefer to increase by the same number of wires, making a total of twelve in this radius. Each succeeding increase in radius has added to it the six additional wires so that as the bundle increases in diameter, the number of wires, at the particular layer or radius, increases accordingly and from eighteen wires in the third layer we go respectively to 24, 30, 36, 42, 48, 54, 60, 66, 72, 78, 84, etc., to the desired diameter of the bundle.

We prefer to bend the outer ends of the first layer 34 at a right angle to the axis of the bundle so that the outer ends 34' of this layer are located in a plane perpendicular to the axis of the bundle, as illustrated in Fig. 4. The next layer of twelve wires 35 does not extend quite as far as the first layer when they are also bent at right angles

into a plane at right angles to the axis. The same process is performed with the third layer 36 with its ends 36' and this is continued until there is progressively a series of planes formed by the ends 34' to 47', as illustrated in Fig. 1.

With this particular arrangement the bottom has six wires and the number gradually increases until the ends 47' comprise eighty-four wires. The progressively staggered arrangement of these wires from the bottom of the tube is illustrated in Fig. 2, and this figure gives an approximate idea of the enormous enlarged surface that is exposed to the cooling breeze of positive means such as a fan directed upon these wires, as illustrated in Fig. 2.

The tube and cooling means could, of course, be located so that the wires, as illustrated in Fig. 2, would be directly aimed in the same direction as the airplane, for example, so that the air would be forced through this myriad of wires. It will be noted that the shape and arrangement provides for effectively dissipating the heat from the anode into quite an enlarged volume of the atmosphere occupied by the spaced ends of these wires.

In Fig. 5 we have illustrated one of the wires 34 with its outer end 34' bent at right angles, as disclosed in Fig. 1. While we prefer the right angle bend, it is apparent that the layers may have their ends bent at other angles to the axis than that of 90°, either acute or obtuse with a line from the axis of the anode. Such a shape may be such as to form conical surfaces of revolution instead of the planes as disclosed. The spacing between the various planes or cones of revolution may be varied, but we prefer to space them an equal distance apart, as disclosed in the drawing.

It is apparent that many other modifications may be made in the preferred embodiment, and accordingly we desire only such limitations imposed upon the invention as are necessitated by the spirit and scope of the appended claims.

What is claimed:

1. A cooling device for a discharge tube having an exterior anode comprising an elongated bundle of wires having an indentation at one end of said bundle adapted to contact the exterior anode of said discharge tube in intimate engagement therewith and with each other thereat, said wires at the other end of the bundle bent away and terminating in the atmosphere spaced from each other at various locations along the longitudinal axis of said bundle.

2. A cooling device for a discharge tube comprising a bundle of wires axially aligned with an

indentation at one end adapted to contact the exterior anode of said discharge tube, the wires at the other end being progressively bent away from the axis of said bundle.

3. A cooling device for a discharge tube comprising a bundle of wires axially aligned with an indentation at one end adapted to contact the exterior anode of said discharge tube, the other ends of most of said wires being bent at right angles to the axis of said bundle.

4. A cooling device for a discharge tube comprising a bundle of wires having an indentation at one end adapted to contact the exterior anode of said discharge tube, the other ends of most of said wires being bent at right angles to the axis of said bundle, the wires located radially the same distance from the axis of said bundle having their outer ends substantially in the same plane.

5. A cooling device for a discharge tube comprising a bundle of wires having an indentation at one end adapted to contact the exterior anode of said discharge tube, said bundle being substantially symmetrical about the longitudinal axis thereof, the number of wires increasing substantially in arithmetical progression along the radius of said bundle, some of said wires being bent away at one location along said axis, other wires at other locations.

6. A cooling device for a discharge tube comprising a bundle of wires having an indentation at one end adapted to contact the exterior anode of said discharge tube, said bundle being substantially symmetrical about the longitudinal axis thereof, the number of wires increasing substantially in arithmetical progression along the radius of said bundle, the wires located at substantially the same radius from the axis of said bundle having their outer ends bent at substantially the same angle to the axis of said bundle.

7. A cooling device for a discharge tube having an exterior part which normally becomes hot in use, comprising a bundle of wires with one end of said bundle in intimate contact with said part throughout substantially the entire end surface of the bundle and with the side surfaces of the wires of the bundle next to said end in intimate contact with each other, the other ends of said wires more remote from the tube bending away from said bundle and spaced from each other, and each entirely surrounded by air space throughout the extent of the remote end portion thereof beyond the bend.

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