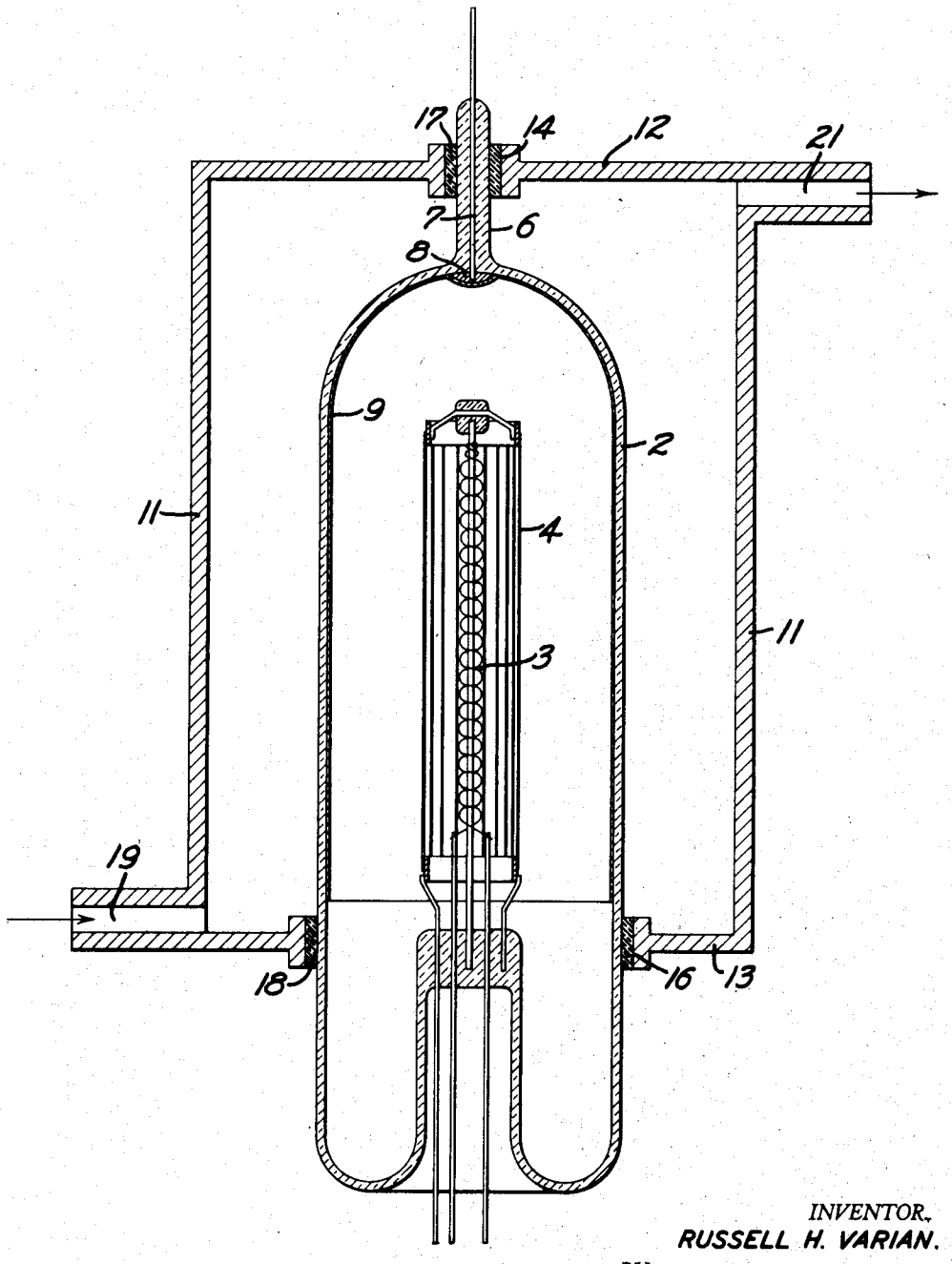
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FLUID COOLED TUBE

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FLUID COOLED TUBE

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1 Claim. (Cl. 250—27.5)

My invention relates to the construction and apparatus for the cooling of thermionic tubes.

Among the objects of my invention are: to provide a simple and improved construction for fluid cooled tubes; to provide a tube wherein tubular metal to glass seals in the construction of the envelope therefore are avoided; to avoid degassing difficulties inherent in fluid cooled tubes of the type in which one of the electrodes forms part of the tube envelope; to provide a fluid cooled tube, capable of handling high power, which compares, in size and manufacturing cost, with air cooled tubes of lesser capacity; to provide a fluid cooled tube wherein the electrode carrying high potential may be insulated from the cooling means; and to provide an improved anode construction for fluid cooled tubes.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claim.

Referring to the drawing:

The figure is a vertical sectional view of a thermionic device embodying my invention.

Broadly, my invention comprises a space discharge tube, or other thermionic device, having a vitreous envelope with an electrode formed on an area of the inner surface thereof, by the deposition of a conductive film, which is in atomic contact with the envelope. Means are provided, circumjacent the envelope and overlying and preferably insulated from the area covered by the conductive film, for permitting the dissipation of heat from the film.

In thermionic tubes capable of handling high power, in the order of one or two k. w., considerable heat is generated, in the tube, due to the heavy electronic bombardment of the anode. It is necessary, in order to prevent damage to the tube, to dissipate this heat; this usually being done by forming the anode as a cylindrical part of the tube envelope and providing a jacket thereabout, through which water, or other cooling fluids, may be circulated. Due to its high heat conductivity, copper is generally used for the anode material.

Several difficulties arise in the construction and use of tubes of this type, one of these being the difficulty in obtaining, and maintaining, a proper seal between the metal and glass parts of the envelope due to the wide difference in the rates of expansion and contraction of the two materials.

Another difficulty experienced is in the evacuation of the tube. In order to drive occluded gases from the copper anode, the temperature of this electrode must be raised to a high degree, causing expansion in the metal, which, if it does not rupture the seal, will cause minute cracks therein. These, in time, will allow sufficient leakage of air, into the envelope, to destroy the usefulness of the device.

In the use of these tubes, another undesirable feature presents itself, in that, to prevent serious radio frequency losses, or current leakage due to the difference in potential between the anode and the water supply, which is usually at ground potential, banks of coiled water circulating conduit are interposed in the inlet and outlet leads to the water jacket to provide a high resistance path from the anode to the water source, or ground.

I have provided an improved means for cooling the tube whereby the size and space required for the resistance coils, mentioned above, may be reduced.

In greater detail, the structure of my invention comprises an evacuated vitreous envelope 2 having a cathode 3 and a control element or grid 4 mounted therein. The envelope is provided, at its upper end, with an extension 6 into which a lead 7, terminating in a button 8, is sealed.

An anode 9 is provided, and comprises a metallic film deposited on the inner surface of the envelope. This film may be produced by one of several methods, such as the method employed in silvering mirrors, or by the process of evaporation of metals in vacuo.

I prefer, however, to produce the metallic film by depositing a thin layer of platinum, by the use of a platinizing solution, on the interior surface of the envelope, and burning this layer into the vitreous material so that it is actually in atomic contact therewith. Successive layers of metal may then be deposited on the base layer to build up the film to the desired thickness. As a result, the finished anode is welded to the envelope, and of course, to the button 8.

Means are provided circumjacent the envelope, and overlying the area covered by the metallic film anode, for permitting dissipation of heat from this electrode. A housing 11 is provided, having end walls 12 and 13, in which apertures 14 and 16 are formed. These apertures, respectively, are slightly larger than the extension 6 and the lower portion of the envelope, so that resilient gaskets 17 and 18 may be placed therein to provide water tight connections between the jacket and the projecting portions of the envelope. An inlet passage 19 and a discharge passage 21 are provided, communicating with the

interior of the water jacket, to which suitable conduits may be attached to permit circulation of cooling water from an external source, such as the building mains, through the housing 11 to cool the tube.

Due to the large capacity between the insulated anode and the surrounding water, the use of cooling water direct from any source at ground potential is not practical when the tube is used at radio frequencies. Consequently, it is advisable to provide the usual banks of water conduit, such as used in connection with the tubes described above, wherein the anode is formed as part of the envelope. However, due to the insulation afforded the anode by the envelope, these coils, for use with the present tube, need not be as large as those used with the previously described tube. It has been found, also, that in certain instances, where the tube is used for low frequency work, that the capacity between the anode and the water will not seriously affect the operation of the tube when the cooling water is taken direct from the supply mains.

I may prefer to use a dielectric fluid as the cooling medium, in which event it is obvious that, due to the anode being insulated from the fluid, a further reduction in the size, and consequently the space required for the resistance coils, may be effected.

The tube just described is far superior to the water cooled tubes in present use, in that all tubular seals between vitreous and metal parts, in the envelope construction, are avoided; the rates of expansion of the envelope and the metallic film anode are so nearly alike that rupture of the envelope, due to uneven expansion of these two parts, is improbable; and the insulated feature of the anode greatly simplifies the construction of the cooling water system and allows it to be materially compacted. The cooling efficiency is good, and higher powers can be handled than with any air cooling systems.

I claim:

A fluid cooled electrical discharge device, comprising an insulating, heat conducting envelope, an electrode disposed within said envelope in atomic contact with the interior surface thereof and a cathode, a housing for liquid disposed about said envelope to enclose the area covered by said electrode, a lead wire from said electrode passing through the space enclosed by said housing, and means forming an extension of said envelope for insulating said lead wire from contact with the liquid in said housing.

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