Dec. 4, 1956 H. J. DAILEY 2,772,861

RADIATOR FOR ELECTRON DISCHARGE DEVICE

Original Filed June 29, 1951

Fig. 1.

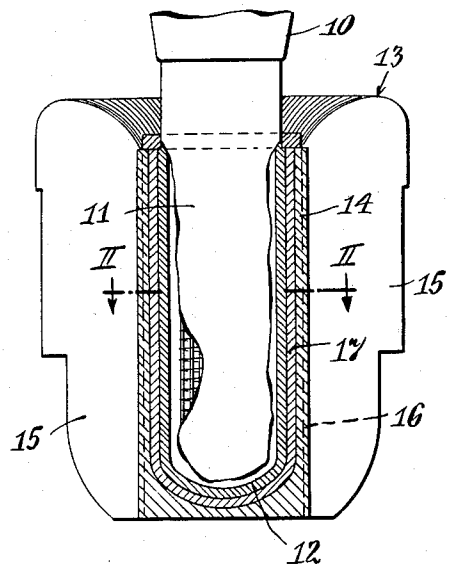


Fig. 2.

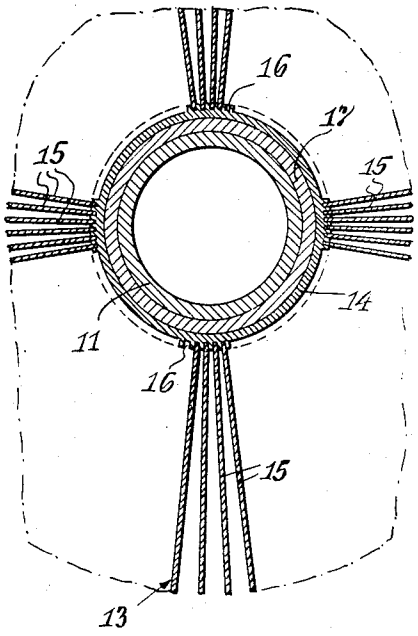
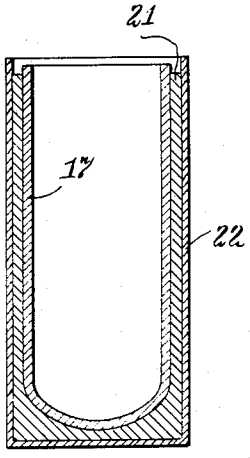


Fig. 3.



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RADIATOR FOR ELECTRON DISCHARGE DEVICE

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Original application June 29, 1951, Serial No. 234,216. Divided and this application September 28, 1953, Serial No. 382,538

2 Claims. (Cl. 257—263)

This invention is a division of application S. N. 234,216, filed June 29, 1951, now abandoned, and relates to radiators and more particularly, to radiators for electron discharge devices.

Present day transmitting tubes included in the general classification of electron discharge devices, are the source of intense heat during operation, and require radiators of good thermal conductivity and adequate surface area to disperse the generated heat. Radiators employing copper fins have been commonly used. While the tubes alone are relatively light, not usually exceeding twenty-five pounds, the copper radiators may be several hundred pounds, and thus require a crew of several men or a crane to handle and to make tube replacements as needed from time to time. If it were possible to merely substitute aluminum or other light-weight metal or alloy for the copper in fabrication of the radiators, great saving of weight would be accomplished as density of aluminum is approximately 168 pounds per cubic foot as compared with 555 pounds for copper. However, until now, the fabrication of a radiator of aluminum, magnesium or alloy thereof and assembly with a transmitting tube has been found to have substantial limitations. A prerequisite for a successful radiator is that it must have a secure bond with the copper anode of the transmitting tube, but aluminum, for example, when fabricated, quickly forms a very stable oxide surface to which it is, for all practical purposes, impossible to make a good solder joint. This lack of adequate bond with the anode has prevented adoption of aluminum radiators for transmitting tubes, and similarly has prevented adoption of radiators of other light-weight metals and alloys.

Accordingly, the fundamental purpose of the present invention, is to provide a practical radiator of light-weight material, such as aluminum, for an electron discharge device and particularly for a transmitting tube in that classification.

Also, in general terms, an object of the invention is to provide an improved radiator of light-weight material such as aluminum adaptable to attachment to a copper anode of an electron discharge device with a secure bond therewith.

More specifically, an object of the invention is to include within the radiator a means by which secure attachment between radiator and anode may be obtained.

Another object of the invention is to provide a liner for the radiator which can be soldered to the anode.

Yet another object of the invention is to obtain a complete bond between the liner and the radiator hub or body.

A further object of the invention is to provide an improved method of fabrication.

Still other objects of the invention will appear to those skilled in the art to which it appertains as the description proceeds, both by direct recitation thereof and by implication from the context.

Referring to the accompanying drawings, in which like

numerals of reference indicate similar parts throughout the several views:

Fig. 1 is a longitudinal section of a radiator fabricated in accordance with the present invention and shown applied to an anode, which is depicted partly in section and partly in elevation;

Fig. 2 is a transverse section on line II—II of Fig. 1; and

Fig. 3 is a mid-sectional view of the central hub of the radiator shown in Figs. 1 and 2 at one step in the course of its fabrication.

In the specific embodiment of the invention illustrated in said drawings, the reference numeral **10** designates an electron discharge device in general, having usual triode or other electrodes of which the anode **11** shown herein is formed as part of the envelope with which it is appropriately sealed so as to be evacuated, the lower end of said anode being closed as by an integrally formed dome **12**. The anode is usually made of copper and in the construction shown is an exterior part of the tube so as to be available for heat dissipation.

The radiator, designated in general by numeral **13**, comprises a hollow body or hub **14** from which, in radial planes, project a plurality of fins **15**. The present invention contemplates use of light-weight metal, such as aluminum, magnesium or alloys thereof, as the material of which said hub **14** and fins **15** are fabricated. The exterior cylindrical surface of the hub is milled with a plurality of longitudinal grooves **16**, one for each fin, and the inner edges of the fins are applied in the grooves and brazed or otherwise securely attached throughout their engaging portions with the hub.

The interior of the radiator body or hub is provided with means for enabling the body to be securely attached to the anode throughout the juxtaposed surfaces after telescoping the said body upon the anode. According to the present invention, a metallic liner **17** is made integral with the said hub and constitutes the inner surface of the radiator body. Said liner is integrated with the hub so as to transmit heat by conduction from the anode to the hub and fins, and is of copper like the anode. The lower end of the liner **17** is hollowed to substantially conform to the curvature of dome **12**.

In carrying out the method of fabrication, the liner is submerged to a point just below its rim in a pot of molten aluminum **21** or equivalent metal, kept in its fluid state by inclusion in an electrically heated pot **22**. In view of the direct contact of the outer surface of the liner with the molten aluminum, an excellent bond will form at the outer surface of the liner **17** because copper is soluble in molten aluminum. The liner may be kept cooler than the surrounding aluminum by any appropriate means (for instance insertion inside it of a massive slug of cooled copper) whereupon a shell of solidified aluminum will form, growing radially outward from the liner **17**. When the desired wall-thickness of solidified aluminum has formed, the unit may be withdrawn from the molten bath; or alternatively the heat may be shut off from the molten aluminum when the liner **17** is first immersed in it, and the whole mass of the molten aluminum be allowed to solidify. Solidification from the core radially outward insures against the formation of pores and blow-holes in the casting.

When the unit thus formed has cooled, it is machined to the desired size, and suitable slots to engage the inner edges of the fins are milled on its exterior surface. The fins may then be brazed into position.

After cleaning, solder is then introduced into the hollow of the radiator and heat applied until the solder is liquefied, flux is added, and the anode is then pressed into the hollow of the radiator until solder extrudes at

the top of the radiator cavity and the parts have desired relation. The solder will harden and tenaciously adhere to the liner and to the anode and provides an excellent heat-conductive path from the anode to the radiator. The solder performs the function of providing a secure bond which will not deteriorate by oxidation.

By providing a structure enabling the radiator to be fabricated from aluminum or equivalent metal, a relatively light-weight radiator is obtained, and as comparative weights, it may be pointed out that where a prior art copper radiator weighed 225 pounds, an equivalent aluminum radiator in accordance with the present invention weighs only 98 pounds, thereby enabling one man to make a tube replacement in service. Since handling can be done by one man, the apparatus may be more compactly arranged, thus saving space in the transmitter station. Furthermore, providing lighter weight radiators of the present invention reduces shipping costs considerably.

I claim:

1. An electron discharge device comprising a copper anode, an aluminum radiator mounted on said anode, a liner of copper interposed between the anode and radiator, with a fused copper-aluminum bond integrating said liner and radiator as a unit, and solder interposed between said anode and liner securing the said liner on the anode.

2. A hollow radiator for an electron discharge device comprising an aluminum hub, fins projecting from said hub, a liner of copper within said hub and providing an inner surface for the hollow of the radiator to which solder will adhere, and a coating of copper-aluminum alloy interposed between and adherent to both the liner and the hub inseparably integrating the liner and hub as a unit.

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