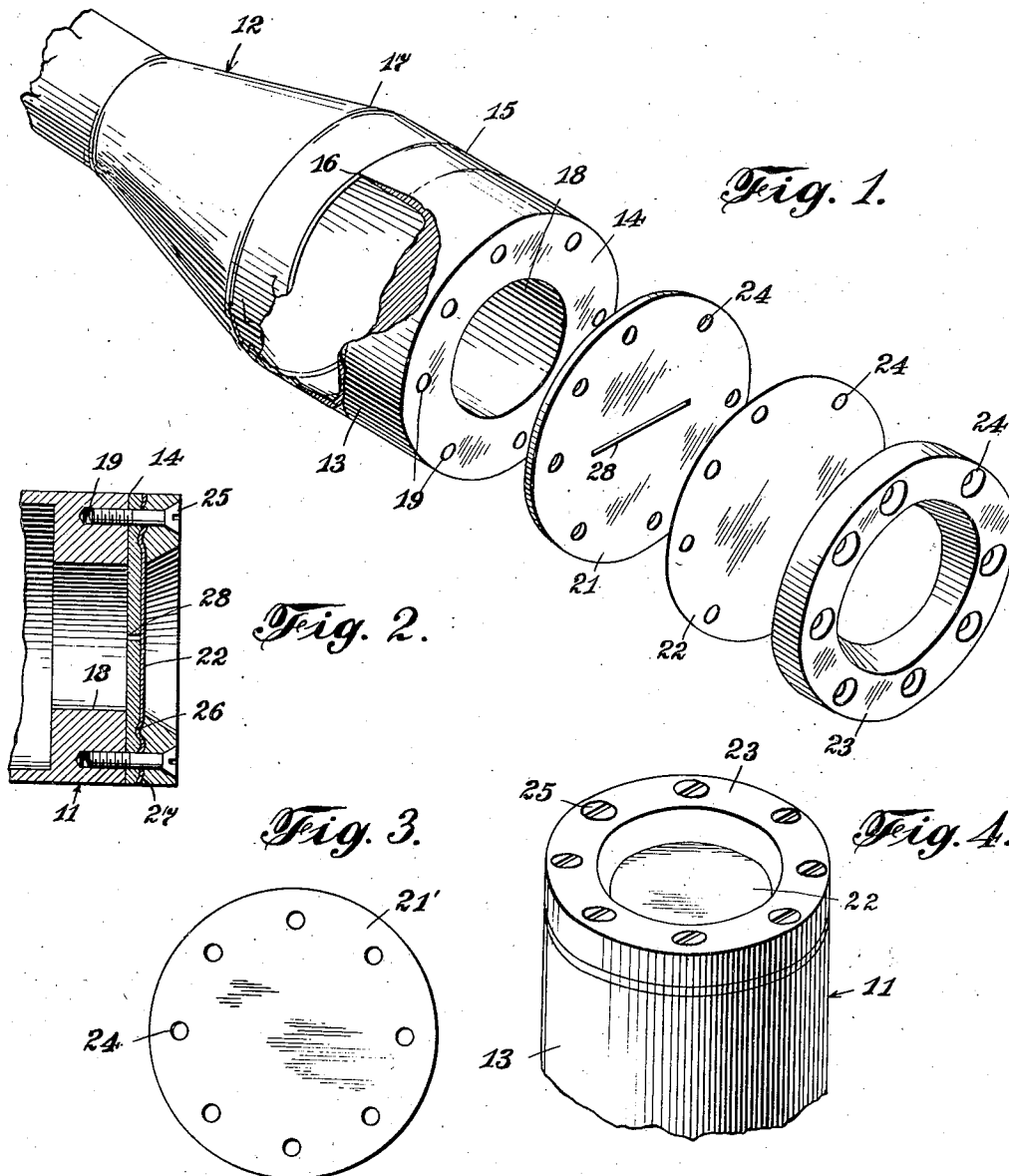


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LENARD RAY TUBE HEAD

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This invention relates to Lenard ray tubes and more particularly to an improved method of constructing Lenard ray tube heads.

As is well known, Lenard rays comprise streams of electrons projected into the atmosphere. The electrons are generated within a conventional cathode ray tube and are directed and accelerated as a beam through an electron-permeable window through which they emerge to the atmosphere as Lenard rays. It is often desirable to successively deflect the stream of electrons transversely so that the beam follows a substantially linear path. Such a beam when properly modulated and deflected finds utility when employed in conjunction with an oscillograph or a television apparatus.

The electron-permeable window through which the rays are projected is ordinarily of relatively thin and light material such as an aluminum sheet, or the like. In the construction of a Lenard ray tube it is customary to evacuate the vessel, and at some time during the evacuation to bake the entire tube so as to drive out occluded gases ordinarily retained in the structural elements of the tube. Since the heat employed in the baking process is ordinarily destructive to the delicate membrane or diaphragm forming the electron-permeable window, it has been a difficult problem to de-gas such tubes. One attempted method of solving this problem was to temporarily seal the vessel and to evacuate and bake the same before the window was put in position. After the baking of the tube was effected, the opening in the window was formed at the flared end of the tube and the window was then applied and hermetically sealed so that the tube might again be evacuated for use.

The foregoing procedure involved certain disadvantages in that the mechanical operations which were performed on the flared end of the tube after it had been baked, in order to form the aperture for the Lenard ray window, introduced foreign particles within the tube which were sufficient to release undesirable gases after the tube had been evacuated the second time. For example, Lenard ray tubes with an elongated aperture serving as the opening for the window, were formed by grinding or machining a slot in the flared end or head of the tube. The mechanical operations employed in forming the aperture introduced slight deposits of oil, foreign metal, or minute portions of the material forming the head of the tube, sufficient in quantity to render the tube gaseous after the tube was evacuated. In the foregoing method, the tube could not be

baked after the relatively fragile window was put in place because of the destructive action of the heat. Repeated evacuations of the tube in an attempt to eliminate the gaseous components was expensive and never entirely successful.

In the present invention through the use of an improved head for the Lenard ray tube, the electron-permeable window may be attached and hermetically sealed with the tube after baking without the introduction of foreign elements. Through the use of the improved device, window plates having apertures of various dimensions may be interchangeably mounted upon the tube. Furthermore, means is provided whereby, if desired, the window construction may be mounted in place at the first instance and the entire assembly baked as a unit.

Accordingly the principal objects of the present invention are: to provide a new and improved head for a Lenard ray tube; to provide means whereby a Lenard ray tube may be evacuated and baked, after which the window construction may be placed in position without introducing foreign material within the tube detracting from the operating efficiency; to provide improved means for holding the Lenard ray window in tightly clamped relation over the window aperture; and to provide means whereby the window may be protected from the ordinarily destructive action of the baking heat. These and other objects of the present invention will become more readily apparent from the following description in conjunction with the appended drawing, wherein:

Fig. 1 is an exploded isometric view showing the various components of the improved tube head;

Fig. 2 is a longitudinal cross-sectional view of the improved head construction taken along a diametrical plane;

Fig. 3 is an elevational view of a blank or disc; and

Fig. 4 is an isometric view of the assembled head.

Briefly, one form of the invention includes providing interchangeable members for the tube head so that the window construction may be quickly and conveniently placed into position after the tube has been evacuated a first time and baked. The invention also comprehends assembling the entire improved head and evacuating and baking the same as a unit by the provision of an annular flange for forming with the diaphragm a receptacle for containing a cooling medium during the baking process.

Referring again to the drawing, the invention comprises an improved head 11 hermetically sealed with the flared end of a Braun or cathode ray tube 12. The head comprises a tubular metallic cap or crown 13 having a flat end portion 14 provided with an integral depending skirt 15. The end of the skirt is ground or turned about a peripheral zone so as to form a feather edge 16, which edge adjoins and is sealed with the flared open end of the glass envelope 17 forming the outer casing for the tube 12. The wall of the end portion 14 is thickened and is provided with a relatively large opening 18 preferably of circular configuration. A plurality of drilled and tapped holes 19 extend longitudinally inward from the end portion 14 near the outer periphery.

A disc 21, an electron-permeable diaphragm 22, and a mounting ring 23 are successively mounted against the flat end portion 14, and are each provided with openings 24 corresponding in position and number with the drilled and tapped holes 19. The entire arrangement may be held in the assembled relation by means of a plurality of screws 25, as shown in Figs. 1 and 4. If desired, the disc 21 and the mounting ring 23 may be provided with interlocking annular grooves 26 and 27 between which the diaphragm 22 is compressed so that it may be stretched tightly against the disc 21.

An elongated aperture or slot 28 preferably with slightly rounded edges is formed in the disc 21 and defines the contour of the electron-permeable window. The slot 28 is preferably relatively narrow so that a thin sheet of aluminum or the like may be employed as a diaphragm without being ruptured by the atmospheric pressure. For example with a slot less than one hundredth of an inch in width a diaphragm 22 of .0004 inch thick may be safely employed. The length of the slot 28 is immaterial from the standpoint of strength, the dimensions being determined by the desired sweep or deflection of the electron beam. Obviously the opening 18 must be at least as large in diameter as the desired length of the slot 28. A blank or disc 21', shown in Fig. 3, is employed in some instances to temporarily replace the disc 21 as will more fully hereinafter appear.

In order to assemble the head, the end portion 14 is ground, planed, or otherwise formed in a smooth and flat condition. The blank 21' is then mounted against the end 14 with the openings 24 aligned with the holes 19. Preferably the disc 21' is sealed with the end 14 by a suitable cement or sealing compound preferably of a non-volatile nature. The mounting ring 23 is similarly positioned adjacent to the blank or disc 21' with a suitable cement if desired and the screws 25 are inserted and tightened so that the opening 18 is hermetically sealed. The tube 12 is then evacuated in the usual manner during which the head 11 may be baked as in an oven, by high-frequency bombardment, or by the application of localized heat about successive portions thereof. In the meantime the apertured disc 21 may be separately baked in any convenient manner so that a similar action takes place. In both instances occluded gases are driven out of the component parts by the baking. If desired, the diaphragm 22 may be moderately heated in an oven similar to that employed for the disc 21 so that a portion of the occluded gases may be driven off without exposing the delicate sheet to the destructive action which would ensue if it were ex-

posed to the same temperature as is employed for the remaining portions of the head. After the baking operation has been completed, the air pressure inside the tube is raised to normal, the screws 25 are removed and the apertured disc 21 and the diaphragm 22 are substituted for the blank 21', after which the screws 25 are inserted in their respective tapped holes and the parts reassembled. Upon evacuating the tube a second time only negligible amounts of gases are released within the tube because all of the parts have been separately baked and no mechanical operations have been performed which would introduce foreign matter within the tube or even to expose new surfaces of the original metal.

As an alternative method the parts disclosed in Fig. 1 may be assembled in the order shown and the entire combination clamped together with screws so as to hermetically seal the opening 18 and the slot 28. The mounting ring 23 forms a receptacle with the diaphragm 22 as shown in Fig. 4, which receptacle may be filled with water or other suitable cooling medium and the entire head may then be baked as a unit. Since the cooling medium is in direct contact with the diaphragm 22, the temperature of the diaphragm is continuously maintained below the destructive limit, even though the lower portions of the head are raised to red heat during the evacuation and baking process. It will be appreciated that the annular grooves formed in the supporting plate or disc 21 in cooperation with similar grooves in the ring 23 tightly engage the diaphragm 22, and in effect stretch it tightly over the slot 28. Since the diaphragm is preferably formed of aluminum or other similar relatively soft material the diaphragm acts as a gasket and cooperates with the grooves to hermetically seal itself against the disc 21 without the use of cement or other bonding agent. Because of the ease with which the various parts may be disassembled it is possible to easily substitute not only diaphragms of different compositions and thicknesses but also discs 21 provided with various proportioned slots 28. It is obvious that any such substitution necessitates reexhausting the tube.

Various other modifications will readily suggest themselves to those skilled in the art without departing from the scope of the invention or sacrificing any of its advantages.

We claim:

1. In an electron-discharge tube, the combination comprising a solid electron impervious disc for hermetically sealing said tube from the atmosphere; means for detachably securing said disc to said tube; and a Lenard ray window including a supporting plate having a slotted aperture therein, an electron-permeable diaphragm, and means for detachably but hermetically sealing said plate and said diaphragm with said tube when said disc is detached.

2. A method of preparing a Lenard ray tube comprising forming a smooth flat end on said tube; forming a central opening in said end; covering said open end with a blank; evacuating and baking said tube; replacing said solid electron impervious blank with a support having a slotted aperture therein and a superimposed electron-permeable diaphragm; and evacuating said tube a second time.

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