July 16, 1935. W. ENDE 2,008,066

GAS OR VAPOR DISCHARGE TUBE

Filed Feb. 16, 1934

Fig. 1

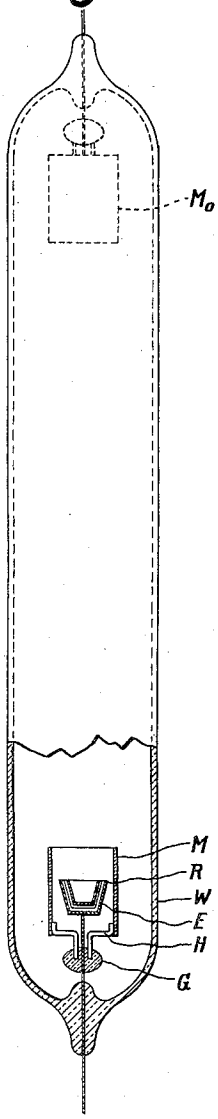


Fig. 2

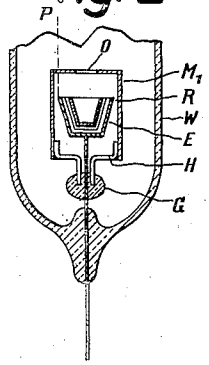


Fig. 3

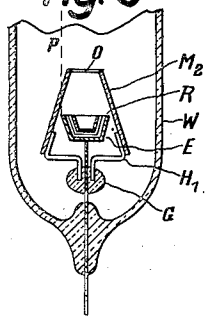


Fig. 4

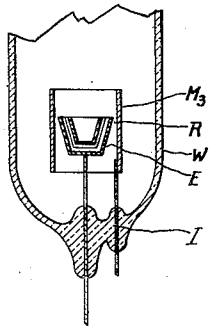
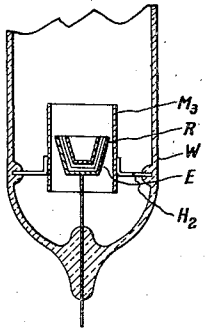


Fig. 5



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GAS OR VAPOR DISCHARGE TUBE

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In Germany February 17, 1933

2 Claims. (Cl. 176—126)

The invention relates to gas and/or vapor discharge tubes the electrodes of which are kept at high temperature when working, and more particularly to radiation tubes operated with a watt load which results in the discharge being a high-pressure discharge. Tubes of this class are provided with a rare-gas filling to which a metal susceptible of vaporization, such as mercury, is added, and equipped with activated hot cathodes which are preferably heated by the discharge itself.

In the case of tubes of this type the electrodes by radiation and conduction give off substantial amounts of heat which get into the wall of the tube and will, especially in case this wall is made of a material which is not very high-melting, e. g. ultra-violet glass or phosphate glass, cause the glass wall softened to bulge inward or to burst on account of the abrupt differences of temperature arising in the said wall.

In the case of such tubes operated a definite length of time there will be a more or less thick deposit due to the atomization of the electrodes. This deposit is on the one hand liable to absorb the filling gas and on the other hand undesirably reduces the permeability to radiation of the tube wall.

In order that these inconveniences are obviated, the electrodes, which according to the invention are kept at high temperature when working, are enclosed by a metallic guard jacket which is insulated against the electrodes and not connected to a fixed potential. Consequently, while the tube is being operated, the said guard jacket will have the potential of the particular point in the space without partaking of the conduction of the current and thus of the discharge. In this way the guard jacket is prevented from being atomized and the discharge from depositing on it. The guard jacket need not be sealed in separately.

The drawing shows several embodiments of the invention which will more clearly explain the latter, the several figures being sectional views of the discharge tube or a part of it respectively.

In the drawing, W designates the wall of a discharge vessel of which in Figs. 2–5 only the portion containing one electrode E is represented. The discharge vessel may e. g. be a long cylindrical tube and preferably be provided with two similar electrodes E (Fig. 1) at the opposite end of the tube so that the tube may also be susceptible of being operated with alternating current. Preferably the discharge vessel should contain a filling gas facilitating the ignition, e. g. argon, of some millimeters pressure and eventually may further be provided with an ignition strip arranged on the wall of the tube, connected with the electrodes and interrupted in the neighbourhood of the cathode so that the tube already ignites when connected to the usual voltage of the network. The tube further contains a metal susceptible of vaporization, such as mercury or cadmium. Preferably, the amount of vaporizable metal is so small that while the tube is being operated as a high-pressure discharge tube the whole amount of vaporizable metal has already vaporized.

The wall W of the vessel consists of glass permeable to the radiation desired, for instance, in case the tube is preferably used to emit ultra-violet rays, of ultra-violet or phosphate glass. The electrode is preferably designed as an activated electrode, viz. provided with a material highly electron-emitting. e. g. barium oxide, which is supported by a carrier made of a metal sufficiently high-melting, such as nickel. The carrier may have the pot-like shape shown in the drawing with two or more cups inserted in one another between which is placed the material emitting the electrons. This form affords particular advantages when it is the question of a tube the electrodes of which are to be heated by the discharge itself. In this instance, the glow discharge initially existent after the tube having been ignited will particularly readily start at the sharp edge R of the electrode E where it will soon produce such an amount of heat that within a short time it is converted into an arc discharge. During operation of the tube a sufficient quantity of electron emitting substance will be supplied from the space between the cups inserted in one another so that the tube will have a long useful life. Heating being accomplished by the discharge, the electrode E requires one current lead only.

The tube being operated, the discharge chiefly starts within a limited zone of the electrode, namely in that affording the most suitable conditions for this discharge. In the embodiment shown this zone is the top edge of the electrode E. Therefore this portion of the cathode is the hottest and transmits the maximum amount of heat to the adjacent portion of the glass wall so that this portion of the wall undergoes a substantial local increase of temperature which frequently results in the vessel bursting or in the glass wall softened being bulged inwards on account of the vacuum prevailing within the tube.

During operation of the tube and in dependence on the properties of the electrode material and the

temperature of the electrode, a more or less substantial vaporization or atomization of the electrode E will take place which phenomenon will produce a deposit adversely affecting the radiation of the tube.

Now, according to the invention, the electrode E is enclosed by a metallic guard jacket M. As Fig. 1 shows this guard jacket may have a cylindrical shape. Its effect may be explained in such a way that the highly concentrated amount of heat as radiated from the edge R of the electrode E is distributed over a large surface so that particular areas of the tube wall are no more subject to extreme heating.

This guard jacket also prevents the tube wall from being covered with the cathode material atomized or vaporized. In order that the glass wall is sufficiently protected against being so dusted, the protective cylinder M is, according to Fig. 1, so designed and arranged with respect to the electrode E that this electrode and particularly the starting points of the discharge are narrowly enclosed by the guard jacket which should also sufficiently project over the electrode on either side, especially on the side adjacent the path of radiation.

This is also good practice with regard to the thermal protection of the tube wall as, according to the measurements made on mercury arc discharge tubes, the temperature maximum extends as far as 3 mm. in front of the electrode. By the temperature being measured on the outside tube wall with the aid of a thermocouple it is readily determined how far the jacket should project over the electrode in any particular instance.

The effect of the guard cylinder M^1 may be further improved by the same being, according to Fig. 2, covered with a lid which is provided with an opening O in the direction of the path of discharge. The said opening should be so large that the discharge is not sensibly affected by the said lid. On the other hand however, the lid should project to such an extent that the rays emitted from the starting points of the discharge, viz. the edge R, towards the other electrode, and indicated by the dotted line P, are picked up. These conditions can readily be complied with by the arrangement referred to. It will be stated that then the glass wall is dusted to so small an extent that, practically, dusting is no more of any concern.

A similar advantageous effect, as afforded by the arrangement shown by Fig. 2, may be attained by the arrangement according to Fig. 3, where the guard jacket M^2 has the shape of a truncated cone which facilitates its manufacture.

For the operation of the tube it is an important requirement that the guard jacket be well degasified. To this end it is convenient to make the space between the said jacket and the electrode less than 5 mm., at least at one point. This being so, the guard jacket will in the case of a temporary increase of the load beyond the normal operative conditions be sufficiently heated up to incandescence so that it can be thoroughly degasified. This method of heating the jacket with a view to its degasifying is much more advantageous than e. g. heating the jacket by a discharge between the electrode and the guard jacket itself, as in this case the material of the latter is liable to be atomized and the glass wall to be covered with a deposit.

For fastening the guard jacket various possibilities are available. It may, for instance, be a separate sealing I on the side of the main electrode as Fig. 4 shows. A particularly practical and simple arrangement consists according to Figs. 1 to 3, in connecting the holding wires H or H^1 of the guard jacket M, M^1, M^2 with the holding wire of the main electrode by a glass bead G and to subsequently seal in this electrode unit. Finally the holding wires H^2 of the guard jacket may also be sealed in the interior of the glass wall as Fig. 5 shows.

The arrangement of a guard jacket according to the invention may also be applied to discharge vessels made of quartz, in which case the advantageous effect of the said arrangement against dusting plays the most important part, while nevertheless the guard jacket also favorably influences the distribution of the temperature along the tube wall.

I claim:——

1. A gas and/or vapor discharge tube with at least one electrode kept at high temperature when working, each electrode being within the tube enclosed by a metallic jacket electrically insulated from the electrode and deprived of a special lead, the metallic jacket having the shape of a truncated cone.

2. A gas and/or vapor discharge tube with at least one electrode kept at high temperature when working, each electrode being within the tube enclosed by a metallic jacket electrically insulated from the electrode and deprived of a special lead, the metallic jacket being within the discharge tube fastened by means of a glass bead to the lead of the main electrode but insulated from the latter.

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