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COLD CATHODE ELECTRON DISCHARGE DEVICE

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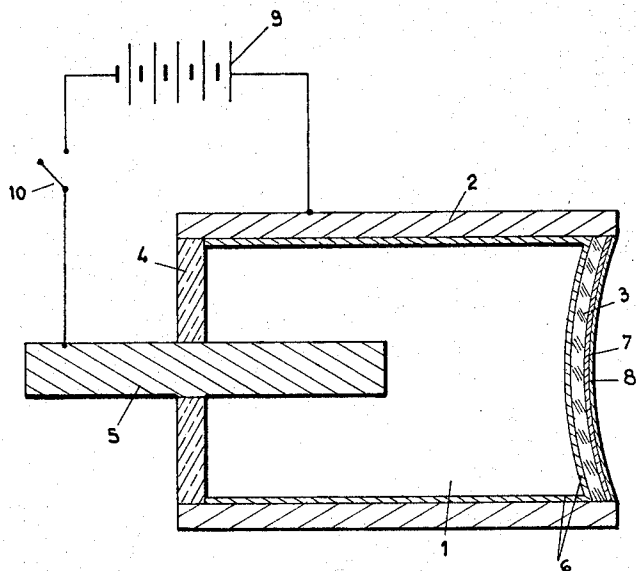
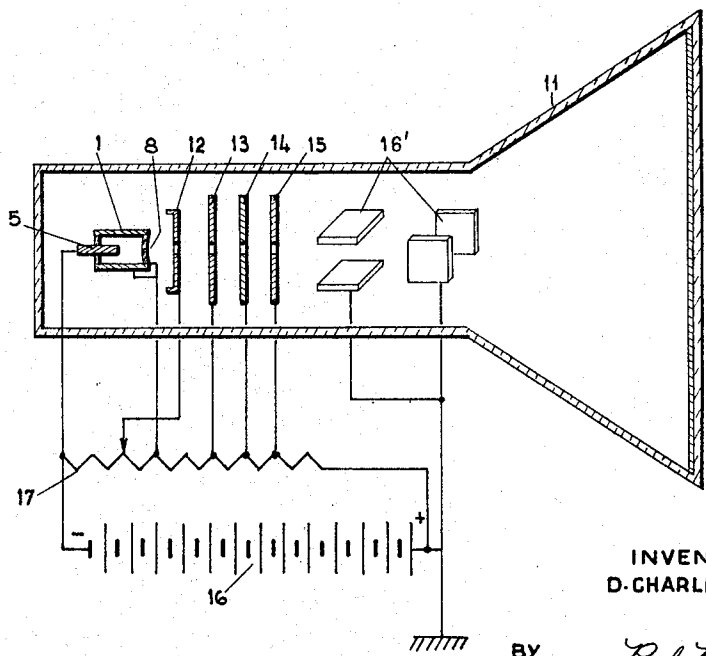


FIG. 1



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COLD CATHODE ELECTRON DISCHARGE DEVICE
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The present invention relates to electron discharge devices, and more particularly to electron tubes with cold-cathode structures.

In particular, it is an object of the present invention to provide a novel, improved cathode structure for this type of tube which effectively avoids the shortcomings and inconveniences of analogous prior art constructions by simple and relatively inexpensive means.

It is another object of the present invention to provide a cold cathode structure for electron tubes which requires less power for proper operation thereof than thermionic-emission type cathodes.

Still a further object of the present invention resides in the provision of a cold-cathode structure which lends itself especially to pulsed operation.

These and further objects, features and advantages of the present invention will become more obvious from the following description when taken in connection with the accompanying drawing which shows, for purposes of illustration only, one embodiment in accordance with the present invention, and wherein

FIGURE 1 is a cross sectional view through a cathode structure in accordance with the present invention, and

FIGURE 2 is a cross sectional view through an electron tube incorporating the cathode structure in accordance with the present invention.

According to the present invention, the cold-cathode structure for electron tubes is characterized in that it comprises a vacuum-tight envelope, provided with a transparent window and containing gas under low pressure, a transparent layer of photo-emissive substance deposited on said window on the outside of the envelope, and means to produce luminescent discharges on the inside of the envelope in such a manner as to excite the photo-electric emission of the said substance.

Referring now to the drawing wherein like reference numerals are used throughout the two views to designate corresponding parts, and more particularly to FIGURE 1, the cathode structure shown therein comprises a gas chamber 1 of which the vacuum-tight envelope is constituted by a metallic cylinder 2, closed by a wall or window of transparent glass 3 or analogous material and a piece 4 made of ceramic material or glass, traversed by a metal electrode in the form of a rod 5.

The chamber 1 encloses gas under slight pressure and its inner surface is covered by a fluorescent material 6.

A conductive layer or film 7, which is relatively thin and transparent, covers the outer face of the window 3, and this conductive film 7 is, in its turn, covered by a semi-transparent layer of photo-emissive material 8.

Finally, a voltage source 9 may be connected between the electrode 5 and the metallic wall 2 of the gas chamber 1 while an interruptor or switch 10 of any suitable construction permits opening and closing of the circuit.

In operation, when the voltage source 9 is operatively connected with the metallic member 2 and with the electrode 5 by closure of the switch 10, the gas within the chamber 1 is continuously ionized and the gaseous discharges excite or produce an emission of light from the fluorescent material 6. This light, which traverses the window 3, in turn excites the photo-emissive substance 8 and produces an electron emission in the latter.

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It is to be noted that a fluorescent cover such as cover 6 along the internal walls of the gas chamber 1 is not always necessary, as the choice of the gas and of the additives determine whether the gaseous discharge is or is not sufficiently luminescent in itself to excite the photocathode 8.

In the case in which the use of a fluorescent material is necessary, there is preferably utilized a product having a very short emission duration in order that the photocathode may operate as a system with very short pulses which obviously implies emissions of light also by means of pulses of short duration. Such a system permits, in effect, to withdraw from the photo-cathode currents which are much larger than in continuous emission operation, because the gaseous discharge adapts itself very well to a pulsed operation, under the condition that the intervals between pulses are not smaller than the time of de-ionization of the gas.

FIGURE 2 illustrates very schematically, and only as an illustrative example of the application of the present invention, a cathode ray tube 11 utilizing, as cathode, a structure 1 in accordance with the present invention whereby identical reference numerals designate again the same elements in FIGURE 2 as in FIGURE 1.

In addition to the cathode structure 1, there are provided within the tube 11 the usual electrodes, such as the Wehnelt electrode 12, anodes 13, 14, 15, deflection plates 16, etc.

The photo-emissive layer 8 of the cathode 1 and the other electrodes receive their respective potentials from a voltage source 16, connected to the terminals of the voltage divider 17.

It may be seen from FIGURE 2 of the drawing that the potentiometer assembly 16, 17 provides also the voltage which serves to produce the gaseous discharge within the chamber 1, that is, the direct-current voltage between the electrode 5 and the metallic wall of the envelope 1, this metallic wall 1 being connected to the photocathode 8. Thus, all of the voltages are provided by the source 16, including that determining the emission of the cold cathode.

The envelope of the tube 11 is evacuated as is usual but that of the cathode structure 1 contains a gas of any suitable known type as described hereinabove.

The electron tubes equipped with cold cathodes in accordance with the present invention present the following advantages:

(1) The power furnished to the photo-emissive cathodes is considerably smaller than that furnished to cathodes of the thermionic emission type.

(2) The cold cathodes are capable to emit electrons by short pulses, which is totally impossible with hot cathodes by reason of the thermal inertia.

(3) The output of a photo-emissive cathode according to the present invention may be readily modulated by applying the modulation signals to the discharge voltage of the gas.

(4) The cathode and control grid of a tube may be simultaneously modulated by distinct modulating sources.

While we have shown and described one embodiment in accordance with the present invention, it is understood that the same is not limited thereto, but is susceptible of many changes and modifications within the spirit and scope thereof. For example, the present invention lends itself readily to various modifications in its actual construction and realization, different from that shown in FIGURE 1. Thus, in particular, a structure may also be utilized in which the photo-cathode receives light reflected from reflective surfaces surrounding the cathode in any suitable manner. The photo-emissive layer, in that case, need not be transparent and its thickness might be substantially increased. The light which upon reflection

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tion is used to operate the cathode could thereby be produced in any suitable conventional manner.

Thus, it is obvious that the present invention is not limited to the details shown and described herein, but is susceptible of many changes and modifications within the spirit and scope thereof, and we therefore do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

We claim:

1. A cold cathode structure comprising a gas-tight envelope including a metallic portion and a window transparent to light, said envelope being filled with a rarified gas, a photo-emissive coating on the outer surface of said window, an electrode disposed within said envelope, and means for establishing a difference of potential between said inner electrode and said metallic portion of the envelope, thereby to produce luminescent electric discharges in said gas.

2. A cold cathode structure comprising a gas tight envelope including a metallic portion, a dielectric portion and a window transparent to light, said envelope being filled with rarified gas, a photo-emissive coating on the outer surface of said window, an electrode disposed within said envelope and traversing said dielectric portion, and means for establishing a difference of potential between said electrode and said metallic portion of the envelope thereby to produce luminescent electric discharges in said gas.

3. A cold cathode structure comprising a gas tight envelope including a metallic portion, a dielectric portion and a window transparent to light, said envelope being filled with a rarified gas, a photo-emissive coating on the outer surface of said window, a transparent metal-

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lic layer interposed between said window and said photo-emissive coating, an electrode disposed within said envelope and traversing said dielectric portion, and means for establishing a difference of potential between said electrode and said metallic portion of the envelope thereby to produce luminescent electric discharges in said gas.

4. A cold cathode structure comprising a gas tight envelope including a metallic portion, the inner surface of said envelope being coated with a fluorescent substance, a dielectric portion and a window transparent to light, said envelope being filled with a rarified gas, a photo-emissive coating on the outer surface of said window, a transparent metallic layer interposed between said window and said photo-emissive coating, an electrode disposed within said envelope and traversing said dielectric portion, and means for establishing a difference of potential between said electrode and said metallic portion of the envelope thereby to produce luminescent electric discharges in said gas.

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