

July 13, 1948.

P. J. CADE

2,444,915

ELECTRON DISCHARGE DEVICE

Filed Feb. 22, 1945

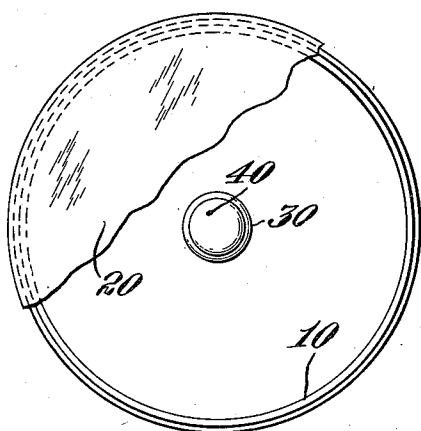


Fig. 1

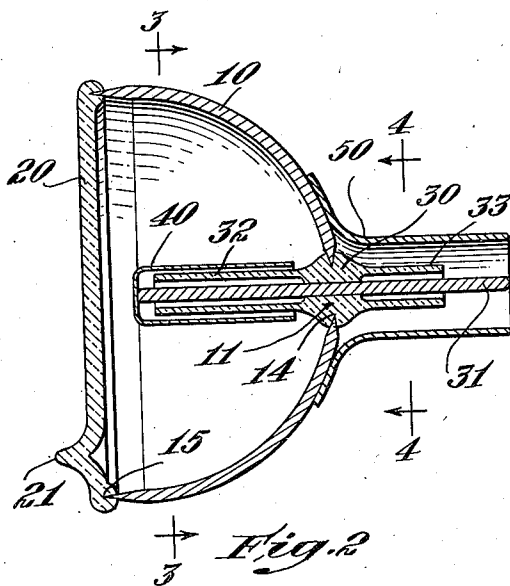


Fig. 2

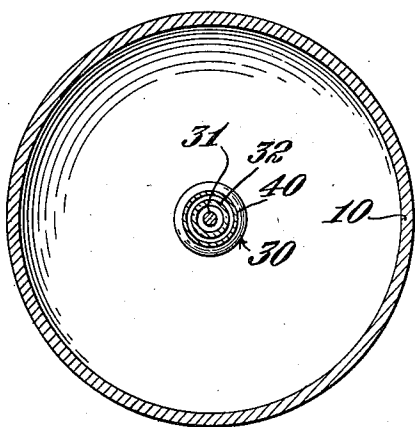


Fig. 3

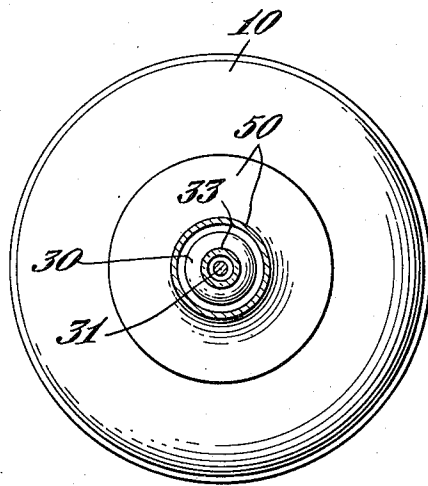


Fig. 4

INVENTOR.

Phillip J. Cade
BY Andrew J. Amann
Attorney

UNITED STATES PATENT OFFICE

2,444,915

ELECTRON DISCHARGE DEVICE

Phillip J. Cade, Cambridge, Mass., assignor to
Photoswitch, Incorporated, Cambridge, Mass.,
a corporation of Massachusetts

Application February 22, 1945, Serial No. 579,210

3 Claims. (Cl. 250-165)

1

The present invention relates to electron discharge devices and more particularly to such devices part of whose evacuated envelope is made of metal and serves as an electrode.

It is one of the main objects of the present invention to provide an electron discharge device which has a minimum of parts and which is nevertheless very effective and reliable in performance. Other objects are to provide a phototube which has a minimum overall size but a maximum area of conductive and emitting material for a given window area; to provide a phototube which, due to its hemispherical construction, makes maximum use of the light impinging thereon; to provide an electron discharge tube of this type which has a long leakage path inside and outside between cathode and anode or parts conductively connected thereto, which in the case of a phototube results in a low dark current; to provide an electron discharge device whose construction inherently provides a shield for its electrically sensitive components; and to provide an electron discharge tube with moisture-proof terminals which can be used even for work under water.

While the construction according to the present invention lends itself especially well for phototubes, it is understood that some of its features are applicable to other types of electron discharge devices.

These and other objects and aspects of the invention will be apparent from the following description of a specific embodiment of the invention which illustrates its general character. The description refers to a drawing in which

Fig. 1 is a front elevation of a phototube according to the invention, with part of the window broken away;

Fig. 2 is a longitudinal cross section through a phototube according to Fig. 1;

Fig. 3 is a cross section on line 3-3 of Fig. 2; and

Fig. 4 is a cross section on line 4-4 of Fig. 2. In the figures, 10 is a hollow, or cup-shaped, in the present instance hemispherical, cathode portion made of a metal which has a coefficient of thermal expansion approximating that of glass or other material used for the insulating or transparent plate to be described below. Such metal is available for example in the alloy known under the trade name "Kovar."

The cathode cup has a central opening 11. The edge 14 of this opening as well as the edge 15 of the mouth of the cathode cup are sharpened in order to provide a better seal. The mouth

2

of the cathode cup is covered with a window or cover plate 20, made of suitable glass or other insulating and transparent material. This window is sealed to edge 15 by conventional means, for example high frequency induction apparatus. During manufacture the plate 20 may be provided with a tube for evacuating the vessel, as indicated by seal-off 21 of Fig. 2.

Fused to edge 14 is a seal 30 of insulating material, which may be the same as that of window 20. Through the center of seal 30 leads a pin 31 made of material similar to that of cathode cup 10. The seal 30 is provided with inner and outer leakage sleeves indicated at 32, 33, respectively.

Suitably fastened, for example welded, to the inner end of pin 31 is a metallic anode body 40 which is drawn over the outside of sleeve 32 toward the supporting portion of seal 30. Suitably fastened, for example welded, to cup 10 is a tubular cathode connection and anode shield 50.

The cathode 10 is on the inside covered with a sensitive coating of suitable composition. The inside of the window may be covered with a transparent conductive and sensitized coating, to add to the photoelectric current.

The outer end of pin 31 and the sleeve 50 may be plugged into a concentric receptacle of known type; if sleeve 50 is soldered to a socket of sealed design a waterproof connection is provided which permits immersion of the tube in water.

The operation of a phototube of this type is as follows.

Light is admitted through window 20, and the electrons released from the coating of cathode 10 are collected at anode 40. Due to the hemispherical construction of the cathode, a maximum of the light flux entering through the window is utilized, the light being incident upon all parts of the cathode. The cathode cup, the conductive coating of window 20 if such is provided, and cathode connection sleeve 50 provide a complete shield for the anode assembly 31, 40. Anode tube 40 protects sleeve 32 against accumulation thereon of conductive material, and sleeves 32 and 33, extending freely around conductor 31, therefore constitute a very effective extension of the leakage paths between anode and cathode.

It will be evident that, since the cathode is part of the evacuated housing and borders directly on the window without any light obstructing supporting elements, a tube according to the invention necessarily has the smallest possible overall size for the given area of the window; in other words, the outer contour of the tube is

practically equal to the sum of light-admitting and light-sensitive surface areas. At the same time, the inner supporting, shielding and conducting elements are so constructed that they are practically not larger than the one absolutely necessary internal element, namely the anode.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. A phototube comprising a hollow substantially hemispherical cathode having a substantially centrally located opening opposite its mouth, a substantially flat transparent cover plate sealed to the rim of said cathode, an anode structure including a connector rod and a tube-like member fastened to the tip of and extending substantially coaxially over said rod, an insulating seal in said opening fastening said rod to, and leading it through said cathode, said seal having a sleeve extending between said rod and said member, and a connector sleeve fastened to said cathode substantially concentric to said rod.

2. An electron discharge device comprising a substantially hemispherical electrode member having an opening in addition to its mouth, a

cover plate of insulating material sealed to the rim of said electrode member, a second electrode member including a stem and a tubular member around said stem, and an insulating seal in said opening fastening said stem to, and leading it through said first electrode member, said seal having a sleeve extending between said stem and said tubular member.

3. An electron discharge device comprising a substantially hemispherical electrode member, a cover plate of insulating material sealed to the rim of said electrode member thus completing a vessel which can be evacuated, a second rod-like electrode member leading through and being insulated from said first electrode member and forming a connector pin, and a connector sleeve fastened to said first electrode member substantially coaxially with said pin.

PHILLIP J. CADE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
755,840	Bose	Mar. 29, 1904
2,306,376	Beuchon	Dec. 29, 1942
2,351,028	Fearon	June 13, 1944