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ELECTRON DISCHARGE DEVICE

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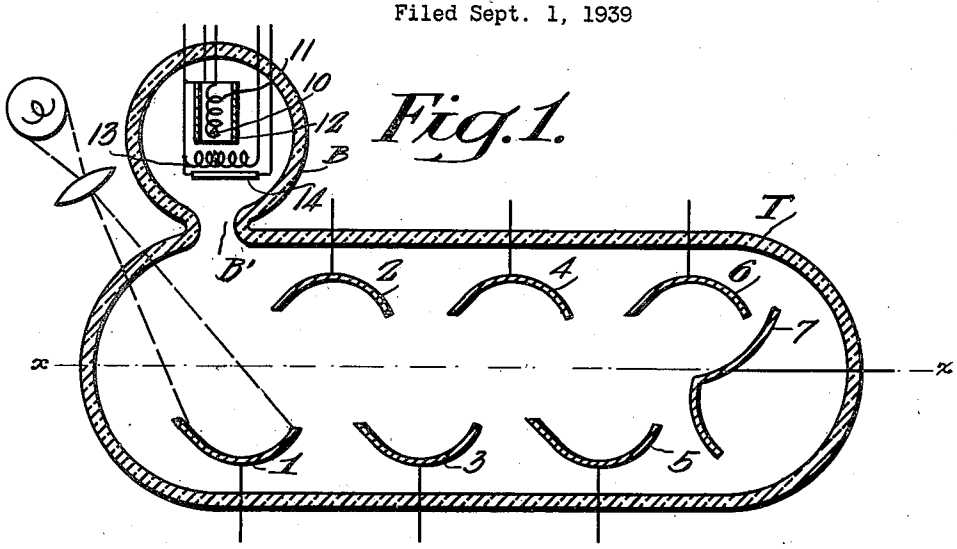
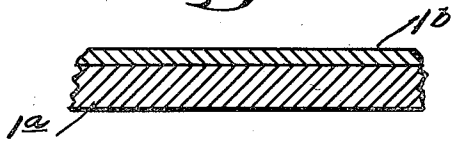


Fig. 1.

Fig. 2.



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ELECTRON DISCHARGE DEVICE

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3 Claims. (Cl. 250—165)

This invention relates to electron discharge devices, particularly to photo-actuated discharge tubes and has special reference to the provision of improvements in photosensitive cathodes.

One problem encountered in the operation of photo-actuated discharge tubes is that of reducing "dark current" (i. e., current which flows due to the emission of thermionic or other electrons from a photosensitive or secondarily emissive surface when the electrodes are energized but the cathode not illuminated). This problem is especially troublesome in the case of multistage photosensitive electron multipliers since, in such devices, the emission of even a minute quantity of electrons when the cathode is dark may result in an enormously multiplied undesired current in the output circuit.

Accordingly, the principal object of the present invention is to provide a phototube wherein dark current is minimized.

Another object of the invention is to provide a photosensitive cathode possessing a substantially zero emissive characteristic in the absence of light.

Another object of the invention is to provide a simple, and trouble-free method of making a cathode of the type described, and one the practice of which inhibits spreading of the emissive material to surfaces other than the surface to be activated.

Other objects and advantages together with certain details of construction will be apparent and the invention itself will be best understood by reference to the following specification and to the accompanying drawing wherein

Figure 1 is a longitudinal sectional view of an electron multiplier containing a photosensitive cathode and constructed in accordance with the principle of the invention, and

Figure 2 is an enlarged fragmentary sectional view of a photosensitive cathode within the invention.

In Fig. 1 the invention is shown embodied in an electron multiplier of the type disclosed in U. S. Patent No. 2,125,750 to Edward G. Ramberg. In this drawing T designates a highly evacuated glass envelope containing a plurality of cylindrical multiplying electrodes 2 to 6, inclusive, mounted in staggered relation on opposite sides of a median line x—x which may be said to bisect the electron path which extends between the photosensitive cathode 1 and the collector electrode or anode 7.

The envelope T is preferably provided during the manufacture of the device with a vacuous bulbous portion B containing certain apparatus (later described) which is employed in activating the cathode.

The multiplying electrodes 2 to 6, inclusive, are preferably constituted of an alloy of gold or silver or copper and magnesium united in a thermodynamically stable alloy such as disclosed in copending application Serial No. 197,994 of Zworykin, Leverenz and Ruedy, filed March 25, 1938. Such alloys while capable of a copious emission of secondary electrons when subject to electron bombardment emit substantially no electrons (in the absence of such bombardment) during normal use. Thus the possibility of the emission of dark current from these electrodes is substantially obviated.

The cathode 1 may be of a contour similar to that of the multiplying electrodes 2—6 but is constituted in accordance with the invention of a clean metal base 1*a* (Fig. 2) having a surface 1*b* formed of a salt of an alkali metal or, alternatively, of a binary compound of a halogen with a metallic element selected from the first group of the periodic system, or, (to describe the alternative embodiment in another way) of a halide of an alkali metal.

The emissive surface of the cathode may be formed of any halide of any of the alkali metals. Evaporated caesium chloride (CsCl) is preferred, at present, since cathodes treated with this halide have been found to exhibit a sensitivity of the order of six microamperes per lumen when tested with a standard tungsten filament. The dark current from a cathode surface constituted of evaporated caesium chloride was found to be only about one-one-thousandth of that of a standard caesium activated surface. Among the other alkali metal salts or halides which may be successfully employed are caesium bromide, potassium chloride, sodium chloride, and lithium chloride.

The coating material may be applied to the cathode plate in situ, in which case the envelope T is preferably provided with a bulbous vacuous extension B having an opening B' which is in line with the surface to be treated and which may be sealed when the activation process has been completed.

The base of the cathode may be formed of any suitable conductive material, such, for example, as aluminum, barium, calcium, beryllium and chromium. The surface of the metal should be as clean as it is possible to get it and to this end it is preferable to provide it with a new surface after the base has been mounted in place and

subsequent to the evacuation of the envelope. This may be accomplished simply by evaporating or distilling a small piece of aluminum 10 which may be mounted in a coiled filament 11 surrounded by a shield 12 in the bulbous extension B of the envelope T. The selected halide of one of the alkali metals is mounted in a second coiled filament 13 in the bulb B and will be deposited by evaporation upon the clean surface of the plate when the filament is energized.

After the salt or halide has been deposited upon the cathode plate it is preferable to bombard the surface with electrons from a third filament 14 for a short time, say, one minute more or less, as determined by the intensity of the bombardment. Such bombardment apparently causes a chemical reaction between the coating material and the metal of which the surface of the base is constituted and in any event enhances the ability of the surface to emit photoelectrons without affecting its low dark current characteristic.

When the aperture B' has been sealed off and the bulbous portion B of the envelope removed the device can be used for any of the purposes for which it is adapted.

What is claimed is:

1. Method of manufacturing a photo-tube which comprises mounting a cathode plate in an envelope, evacuating said envelope, subsequently applying a clean surface to said cathode plate, evaporating a halide of an alkali metal upon said clean surface and then bombarding said halide surface with electrons.

2. Method of manufacturing a photo-tube which comprises mounting a cathode supporting surface in an envelope, evacuating said envelope, depositing a metallic film upon said cathode supporting surface, then depositing a salt of an alkali metal upon said metallic film and subsequently bombarding said alkali metal salt with electrons.

3. Method of manufacturing a photo-tube which comprises mounting a cathode supporting surface in an envelope, evacuating said envelope, depositing a film of aluminum upon said cathode supporting surface, subsequently depositing a halide of an alkali metal upon said aluminum film and then bombarding said halide deposit with electrons for approximately one minute.

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