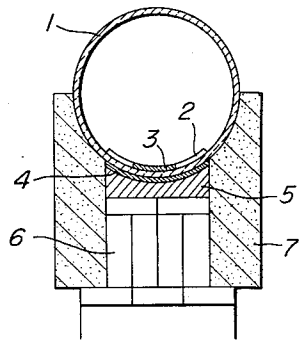
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APPARATUS FOR COOLING PHOTO-DETECTORS

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APPARATUS FOR COOLING PHOTO-DETECTORS

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1 Claim. (Cl. 250—238)

The present invention relates to apparatus for cooling photo-detectors such as phototubes or photoconductive cells.

It has been generally known that photo-detectors such as phototubes or photoconductive cells, when cooled during use, show improved performances such as decrease of dark current, increase of sensitivity, and reduction of noise. Conventional methods for cooling the photo-detectors include application of a coolant such as Dry Ice or liquid air and installation of a refrigerator for the purpose. As these methods, however, have been attended with defects such as cumbersome equipment, interference by vibration, and troublesome operation in supplying coolant thereto, the desired effect of practical use has not been attainable.

Accordingly, the primary object of the invention is to provide an excellent cooling apparatus for photo-detectors so that the photo-detectors can work at a good performance while being free from said disadvantages of the prior art devices.

According to the invention, there is provided an apparatus for cooling photo-detectors comprising a glass vessel having a photo-detecting portion consisting of electrodes and a photo-detector element coated on an inner surface of the glass vessel, said glass vessel being evacuated to maintain a vacuum thereinside, a block of thermal insulator disposed to surround the outside surface of said glass vessel except the portion of an incident light window for providing thermal insulation against external heat, a semiconductor cooling module disposed opposite the vessel wall corresponding to the photo-detecting portion for cooling said coated photo-detector element, and a layer of soft metal and a mass of thermal conductor interposed between said photo-detecting portion and semiconductor cooling module for providing good conduction of heat therebetween.

There are other objects and particularities of the invention which will be obvious from the following description with reference to the accompanying drawing, which schematically illustrates a longitudinal sectional view of a preferred embodiment of a cooling apparatus according to the invention.

In the sole figure, there is shown a glass vessel **1** which is evacuated thereinside and contains a lead sulfide photoconductive cell. Reference numeral **2** designates an electrode for the cell. The photo-conductive cell comprises a lead sulfide photo-conductive film **3** which is coated on a portion of the inside surface of the glass vessel **1**. At the portion of the outside surface of glass vessel **1** opposite the photoconductive film **3**, there is provided a layer of soft metal **4** such as indium or Wood's metal of low melting point which fills the space formed between the glass wall and the substantially complementary surface of a mass of a thermal conductor **5** such as copper or aluminum for providing good conduction of heat therebetween. Disposed below the thermal conductor **5**, there

is a semiconductor module **6**, for example, bismuth telluride (Bi_2Te_3) semiconductor elements of p- and n-types connected in series by means of a high-conductive metal electrode such as of copper or aluminum. A block of a thermal insulator **7** such as foamed polyethylene or moltoprene may be provided about a portion of the vessel wall so as to surround the photo-detecting portion to thereby provide thermal insulation from external heat, the portion of the glass wall uncovered by the thermal insulator being used as an incident light window. It will therefore be understood that, when a current is made to flow from the n-type semiconductor element towards the p-type semiconductor element of said semiconductor module **6**, heat absorption is developed at the junction plane by the Peltier effect. Thus, any heat generated at the portion of the lead sulfide photoconductive film **3** is absorbed into the junction plane through the mass of the thermal conductor **5**, and the photo-detecting portion can therefore be subjected to cooling. This cooling effect is further improved by the block of the thermal insulator **7**. Since, in this case, the internal space of the glass vessel **1** is evacuated to form a vacuum therein, the glass vessel per se acts as a good thermal insulator.

From the foregoing description, it will be apparent that the photo-detecting portion alone of the photo-detector can be cooled locally to provide good performance, and the photo-detector can therefore develop a more excellent performance than with the conventional detecting means. Further, it will readily be understood that the cooling apparatus according to the invention may be used equally effectively for the cooling of other photo-detectors such as a photo-detecting plane of phototubes.

What is claimed is:

An apparatus for cooling photo-detectors comprising a glass vessel having a photo-detecting portion consisting of electrodes and a photo-detector element coated on an inner surface of the glass vessel, said glass vessel being evacuated to maintain a vacuum thereinside, a block of thermal insulator disposed to surround the outside surface of said glass vessel except one portion to provide a window for incident light for providing thermal insulation against external heat, a semiconductor cooling module disposed adjacent the outside surface of the glass vessel opposite the photo-detecting portion for cooling said photo-detector element, and a layer of soft metal and a mass of thermal conductor interposed between said photo-detecting portion and semiconductor cooling module for providing good conduction of heat therebetween.

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