Dec. 4, 1956 T. E. MYERS 2,773,158

HOUSING STRUCTURE FOR PHOTOCELL OR THE LIKE AND METHOD OF MAKING THE SAME

Filed Jan. 27, 1953

Fig. 1.

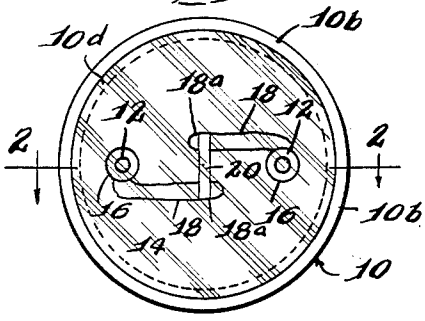


Fig. 3.

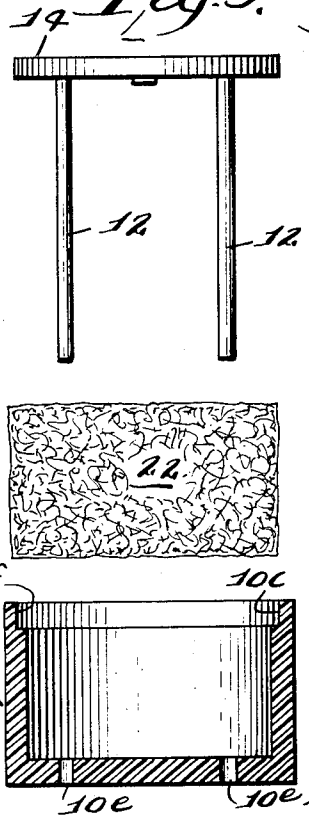


Fig. 2.

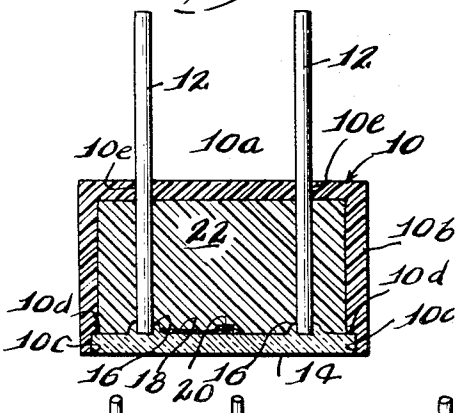


Fig. 8.

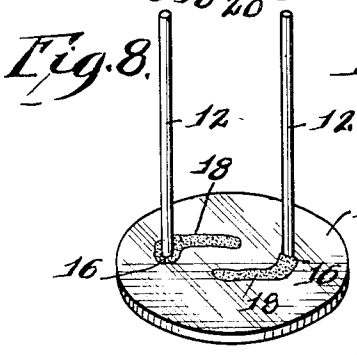


Fig. 7.

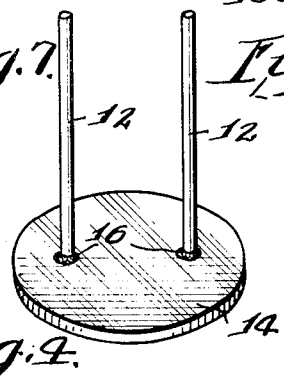


Fig. 6

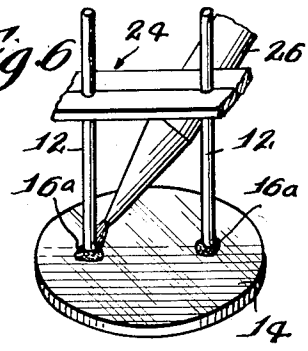


Fig. 4.

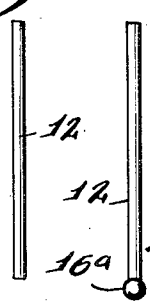


Fig. 9.

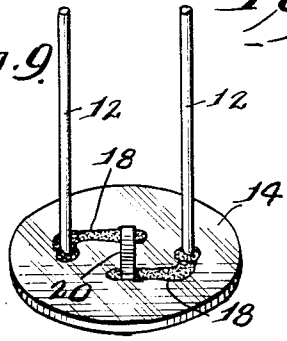


Fig. 5.

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HOUSING STRUCTURE FOR PHOTOCELL OR THE LIKE AND METHOD OF MAKING THE SAME

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10 Claims. (Cl. 201—63)

My invention relates to an improved housing construction for a photocell or the like, characterized by simplicity, inexpensiveness, resistance to shock, heat etc., hermetic sealing, and other desirable features, and to a method of making the same.

In one type of photocell a cadmium sulfide or lead sulfide crystal is exposed to the light or other rays. Crystals of this type have the characteristic of undergoing a variation in resistance in accord with the intensity and the nature of the rays so that devices responsive to the resistance change may be used to measure the character and intensity of the incident rays.

In accordance with the present invention, an improved enclosure and mounting is provided for a photosensitive resistance element of the above type. Briefly, the unit consists of a plate of glass or like transparent substance to which a pair of spaced upright conducting rods are attached. A pair of beads of conducting cement extend along the glass from the conducting rods to spaced positions relative to each other and the radiation-sensitive crystal is laid on the glass to bridge the space between the beads of cement. The unit is then placed in a housing cup having holes at its bottom to receive the conducting rods and through which they protrude to form socket pins. The housing also has a shoulder or wall to receive the glass so as to completely encase the same. The space within the housing is filled with a plastic material prior to assembly and the entire unit heated to cure this plastic after assembly.

It is, therefore, a general object of the present invention to provide an improved housing structure for a photocell or similar device.

A more specific object of the present invention is to provide an improved housing structure for a photocell or the like in which the parts are supported from a plate and are held snugly in position.

Another object of the present invention is to provide a housing for a photocell or the like using a cup-shaped part from which suitable contact-making prongs extend and in which the electrical element is positively supported against the closure member provided for the cup part.

Still another object of the present invention is to provide an improved method of making a photocell or the like embodying the housing of the present invention.

It is yet another object of the present invention to provide an improved method of making a photocell or the like in which the light-sensitive element is placed in position and temporarily secured in proper location and thereafter positively supported from both sides.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention, itself, however, both as to the features of construction and the steps of the process, together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a top plan view of a completed photocell in a housing constructed in accordance with the principle of the present invention;

Figure 2 is a cross-sectional view through axis 2—2, Figure 1;

Figure 3 is an exploded view of the unit shown in Figure 2 with the plastic filler omitted;

Figure 4 is a view of one of the conductor rods used in the structure of Figures 1–3;

Figure 5 is a view like Figure 4, but showing the conductor rod with a globule of glass thereon;

Figure 6 is a view in perspective showing how the conductor rod is affixed to the glass plate;

Figure 7 is a view like Figure 6 showing the unitary structure formed by the glass plate and conducting rods;

Figure 8 is a view like Figure 7 but showing the beads of conducting cement in position on the glass plate; and

Figure 9 is a view like Figure 8 with the photosensitive resistance crystal in place.

The housing structure

Referring now to Figures 1 and 2, there is shown generally at **10** a cup-like part having a bottom **10***a* and a cylindrical side wall **10***b*. The side wall **10***b* has an enlarged portion **10***c* defining an annular shoulder or seat **10***d*. This housing may be of any suitable insulating material. Preferably a plastic material is used, such as a phenolformaldehyde condensation product.

The bottom portion **10***a* of the cup or housing **10** has a pair of holes **10***e* which receive the conducting pins or rods **12**. These pins are fused to the glass window **14** by the beads of the glass **16** as is hereafter described in detail. The glass **14** is circular and of such size as to fit snugly within the enlarged portion **10***c* of the cup **10**. It seats on the annular shoulder or seat **10***d*.

As shown in Figure 1, a pair of beads **18** of a conducting cement extend from the pins **12** along the inner face of the glass **14** to spaced points **18***a*. A photo-sensitive resistance crystal, such as cadmium sulfide or lead sulfide, is embodied in the conducting beads, thus forming a complete circuit which may be traced from one pin **12**, through the contiguous conducting bead **18**, the photo-sensitive resistance **20**, the other conducting bead to the other pin **12**.

The space within the housing or cup **10** is filled with a plastic filler **22**. This filler is of suitable resin having good dielectric strength, low moisture absorption, adhesion to the glass and other materials in the housing, and a low dielectric loss factor. In addition, this material must be capable of curing at a temperature below that which adversely affects the crystal **20** or the other components of the unit. It has been found that ethoxyline resins are suitable for this purpose. If desired, particles of glass may be incorporated in the filler, the particle size being sufficiently small to avoid any tendency to settle out prior to curing the filler.

The photo-sensitive resistance **20** may be any one of the materials well known in the art for this purpose. If radiations in the visible range are to be detected, for example, a cadmium sulfide crystal is suitable for this purpose. On the other hand, if ultra violet radiations are to be detected, lead sulfide may be used. In practice the crystal may be in the neightborhood of a 2 cm. long and .02 cm. in diameter, although the dimensions are not critical and can be varied in accordance with the desired resistance and other characteristics.

The prongs or leads **12** are made of metal having a coefficient of thermal expansion approximating that of the glass **14**. Many alloys having this characteristic are well known in the art, some of the commercial ones being Sylvania No. 4 alloy or Carpenter No. 46. The glass **14** and the glass globule **16** are preferably of a relatively low melting point glass. While the same type of glass

need not be used for each, it is desirable that their coefficients of thermal expansion be approximately the same so that the unit can survive wide temperature variations without damage. A commercial glass that has been used for the globule 16 with success is known as Corning No. 7570 and may be rendered plastic at a temperature of slightly over 500° C. Other glasses having similar characteristics may be used if desired.

Manufacture of the housing

In the manufacture of the unit the wire stock used for the prongs 12 is first cut in suitable lengths, as seen in Figure 4. An end of each wire is then dipped into melted glass to form the glass globule 16*a*, Figure 5. This glass, as described above, is of a low melting point composition and has approximately the same coefficient of thermal expansion as the glass which is used as the window 14.

A pair of prongs or rods 12 is then supported in parallel spaced relationship by a suitable jig 24, Figure 6. This jig, shown as a two-part split jig positively supports the prongs 12 parallel to each other and with the desired spacing. The jig is supported by suitable means (not shown) so as to locate the two prongs with their glass tipped ends resting on the glass 14, as shown in Figure 6. A suitable glass melting burner 26 is then applied successively to the glass globules 16*a* to melt them and fuse them to the window 14. In the view of Figure 6, the left hand globule is shown in the state of fusion, whereas the right hand globule 16*a* is shown in the unfused condition.

After the fusing operation, the prongs are removed from the jig 24 leaving the unitary structure shown in Figure 7. As shown, this structure consists of the glass window 14 with the spaced parallel prongs 12 extending upwardly therefrom and secured thereto by the globules 16 which are fused to and form a unitary part of the glass window pane 14.

Alternatively, the jig 24 with the prongs 12 in position, as shown in Figure 6, may be placed in a furnace and heated to the melting point of the globules 16*a*. This melts the globules 16*a*, causing them to fuse with and form a unitary structure with the glass window pane 14, as shown in Figure 7.

The next step in the process is to paint the beads 18 on the face of the pane 14, as shown in Figure 6. The materials used for this purpose may be any one of many conducting paints. Preferably a conducting silver paste is employed. This silver paste consists of particles of metallic silver suspended in a plastic carrier and is characterized by ability to conduct an electric current and impose small resistance thereto. It will be observed from Figure 8 that the two beads 18 extend to conducting relationship with the prongs 12, respectively, and that they extend generally toward the seat of the glass 14 but are in spaced relationship as stated.

As shown in Figure 9, the light-sensitive resistance 20 is then placed over the conducting beads 18 to bridge the space between them. This is preferably done with the unit in the inverted position of Figures 8 and 9 and by positioning the material 20 while the beads 18 are in an undried condition. The unit is held stationary thereafter until the cement or paste 18 has dried and cements the conducting material 20 in position.

The last step in the assembly operation is best understood by reference to Figure 3. Filler material 22 and the unit of Figure 9 are placed in the cup 10, this being accomplished by first putting the filler in and then pushing the prongs 12 through the filler and the openings 10*e* of the cup to obtain the asembled unit of Figure 2. At this state, the filler 22 is in an uncured state and is powdery in form. Thus the prongs 12 can easily be pressed through it.

The assembled unit, which at this stage is in the form shown in Figures 1 and 2, is then placed in a suitable oven and heated to the curing temperature of the filler 22. Using ethoxyline resins, I have found that curing can be effectively carried out at temperatures well below any temperatures that affect the light-sensitive body 20. Upon completion of this curing operation, the unit is cooled and ready for use. Practical resins have been cured at 40° C. for two or more hours and an effective cure obtained.

As above described, I prefer to use an ethoxyline resin as the filler 22 and to include in it powdered glass. One ethoxyline resin that has been used is sold under the trade name Araldite by the Ciba Company. This material has been used in the form of yellow-brown crumbs which begin to melt at 120° to 140° F. and flow freely at 260° to 270° F. The resin makes a strong bond capable of withstanding heat and exhibiting no excessive brittleness at temperatures down to minus 76° F.

I prefer to add approximately 25% by weight of powdered glass to the resin. This powdered glass is of micron size and can be obtained by ball milling 100 mesh powdered glass. It aids in achieving characteristics of the resin similar to those of the glass window 14.

It will be observed that the photocell structure described above is of simple construction and yet is effectively sealed against contamination. Tests have indicated that immersion in water for as long as 90 days has no noticeable effect on operation and that the device itself may be cooled by Dry Ice and then immediately placed in boiling water without effecting its electrical or physical characteristics.

While I have described the above device as applied to a photoelectric device, it may also be used as a mounting for other electrical units such as germanium crystals in the form of diodes and junction triodes. In the case of a triode, an additional terminal post 12 is used.

When the unit of the present invention is used for a purpose other than a photocell, it is, of course, unnecessary to use a transparent window 14. In general, however, I prefer to use glass for the pane 14, since it has good insulating characteristics and lends itself to the formation of an effective unitary structure.

If desired, a plurality of elements 20 may be arranged in a single housing 10. Suitable prongs 12 are provided for each of the elements. This feature permits very close spacing of independent photo-sensitive elements which may, if desired, be of different types, such as cadmium sulfide and lead sulfide, so as to provide in a single unit a response to radiation extending from the X-ray to the infra-red range.

In the present claims I have used the term "sensing resistance" to refer to a photo-sensitive resistance, a rectifying resistance, or other device mounted in the housing of the present invention. I have used the term "non-conducting plate" to refer to the plate 14 which may be of glass, plastic, or other material as well as the glass specifically described above.

While I have shown and described specific embodiments of the present invention, it will, of course, be understood that various modifications and alternative structures as well as alternative steps in the process of manufacture, may be used without departing from the true spirit and scope of the invention. I, therefore, intend by the appended claims to cover all modifications and alternative constructions falling within their true spirit and scope.

I claim:

1. A housing for a sensing resistance comprising in combination: a cup-like member having a pair of spaced holes in its bottom and defining an annular seat adjacent its lip; a glass plate seated on the seat and having a pair of conducting rods extending inwardly of the cup-like member and through the holes; a sensing resistance on the inner face of the glass and located generally between the rods; beads of conducting adhesive extending along the inner face of the glass from the rods to the ends of

the resistance, respectively; and a plastic filling within the housing and filling substantially the entire space therein.

2. A housing for a sensing resistance comprising in combination: a cup-like member having a pair of spaced holes in its bottom and defining an annular seat adjacent its lip; a glass plate seated on the seat and having a pair of conducting rods extending inwardly of the housing and through the holes; a sensing resistance on the inner face of the glass; means defining conductors extending between the rods and the ends of the resistance respectively; and a plastic filling within the housing and filling substantially the entire space therein.

3. A housing for a sensing resistance comprising in combination: a cup-like member having a pair of spaced holes in its bottom and defining an annular seat adjacent its lip; a non-conducting plate seated on the seat and having a pair of conducting rods extending inwardly of the cup-like member and through the holes; a sensing resistance on the inner face of the plate and located generally between the rods; beads of conducting adhesive extending along the inner face of the plate from the rods to the ends of the resistance, respectively; and a plastic filling within the housing and filling substantially the entire space therein.

4. A housing for a sensing resistance comprising in combination: a cup-like member defining an annular seat adjacent its lip; a non-conducting plate seated on the seat; a sensing resistance on the inner face of the plate; means defining conductors upstanding from the inner face of the plate extending from the ends of the resistance, respectively, to the exterior of the housing, and a plastic filling within the housing and filling substantially the entire space therein.

5. A housing for a sensing resistance comprising in combination: a cup-like housing; a glass plate positioned on the open face of the housing; a pair of spaced conducting pins affixed to one face of the glass plate; a sensing resistance on said face of the glass plate located generally between the pins; beads of conducting cement extending from said pins to the ends of the resistance, respectively; and a filler within the housing, the filler being composed of a plastic material carrying powdered glass.

6. A housing for a sensing resistance comprising in combination: a cup-like housing; a glass plate positioned on the open face of the housing; a pair of spaced conducting pins affixed to one face of the glass plate; a sensing resistance on said face of the glass plate located generally between the pins; beads of conducting cement extending from said pins to the ends of the resistance, respectively; and a filler within the housing, the filler being composed of a plastic material carrying approximately 25 percent by weight of powdered glass.

7. The method of making a sensing resistance unit comprising the steps of: filling a cup-shaped housing with a plastic material; closing the open face of the housing with a non-conducting plate carrying a photosenstive resistance and electrical connections thereto, the resistance being located on the inside face of the plate; and heating the entire unit to the curing temperature of the plastic material to form a unitary structure.

8. The method of making a sensing resistance unit comprising the steps of: affixing a globule of glass to one end each of a pair of conducting pins; heating the globules to melting temperature while holding the same against the face of a glass plate, thus forming a unitary structure with the rods extending upright from the glass plate; laying a conducting cement in the form of beads extending from each of the rods to spaced positions on the glass; and placing a light sensitive resistance on the face of the glass and in bridging relation to the beads of conducting cement.

9. A housing for a sensing resistance comprising in combination: a cup-like member having a pair of spaced holes in its bottom and adapted to receive a cover over its lip; a cover received over the lip of the cup-like member and having a pair of spaced upstanding conducting rods passing through the holes of the cup-like member; a sensing resistance on the inner face of the cover and located generally between the rods; beads of conducting adhesive extending along the inner face of the cover from the rods to the ends of the resistance, respectively; and a plastic filling within the housing and filling substantially the entire space therein.

10. A housing for a light sensing resistance comprising in combination: a cup-like member having a pair of spaced holes in its bottom and adapted to receive a cover over its lip; a transparent cover received over the lip of the cup-like member and having a pair of spaced upstanding conducting rods passing through the holes of the cup-like member; a light sensing resistance on the inner face of the cover and located generally between the rods; beads of conducting adhesive extending along the inner face of the cover from the rods to the ends of the resistance, respectively; and a plastic filling within the housing and filling substantially the entire space therein.

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