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Walter et al.

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[54] **LIGHT BARRIER APPARATUS**

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[52] **U.S. Cl.** **250/239,** 29/25.2, 240/8.16

[51] **Int. Cl.** **H01j 5/02**

[58] **Field of Search** ..... 250/239, 552; 339/176 L, 339/59 L, 60 R; 240/2 R, 8.16

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Attorney, Agent, or Firm—Watts, Hoffmann, Fisher & Heinke Co.

[57] **ABSTRACT**

A light barrier system including a light source in a first enclosure and a photosensitive element in a second enclosure. The enclosures are of like structure and each defines a chamber which communicates optically with its exterior. Each enclosure has a housing with a cylindrical bore through it, and a sleeve slidable into the bore. The sleeve has a flange about one end which is engageable with a step on the inside of the bore. The light source and photosensitive element are each mounted on a sleeve in a different enclosure at the sleeve end opposite the flange. The ends of the bores to which the light source and photosensitive element are exposed are each covered with a lens. Each sleeve has an aperture in its flanged end through which an electrical conduit carries leads to the light source and photosensitive element. The sleeves are sealable in the housings by packing material adherent to the electrical conduit and a sealing ring, all of which are held in place by beading around the end of the bore.

16 Claims, 5 Drawing Figures

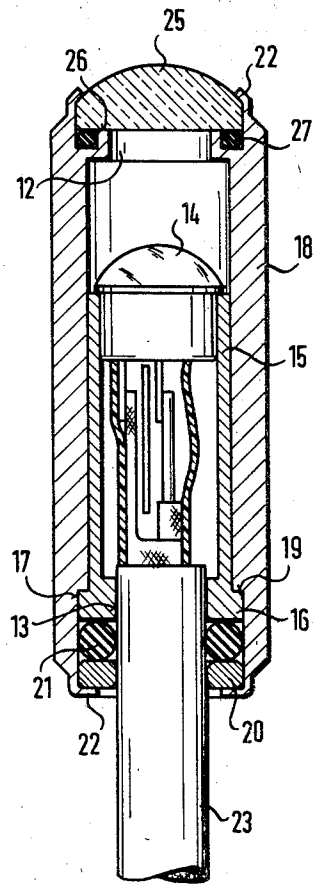


Fig.1

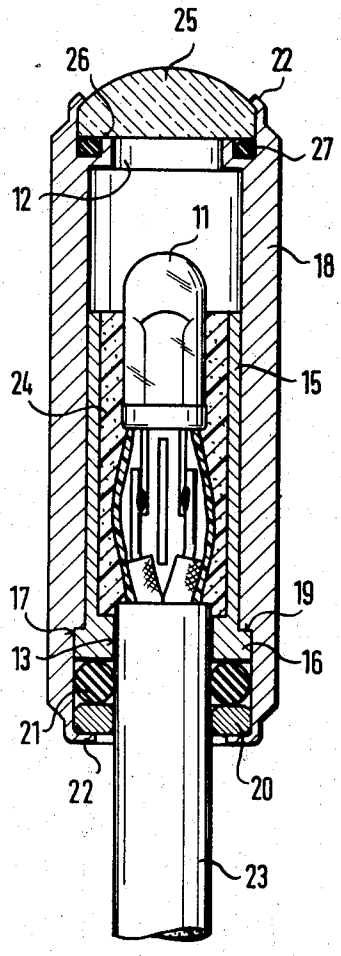

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Fig.2

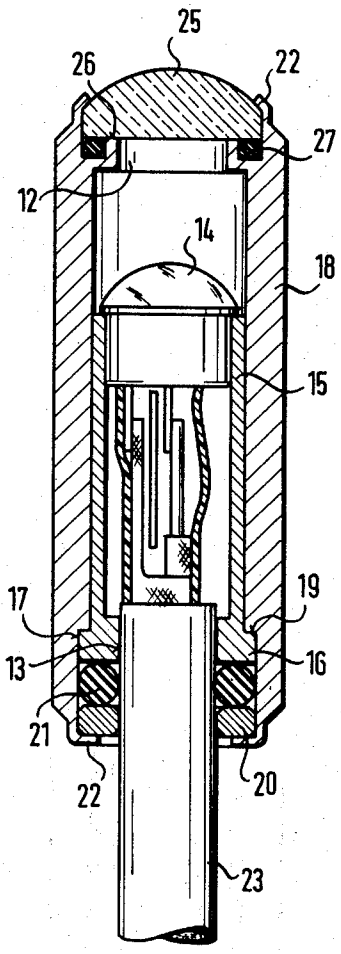

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Fig.3

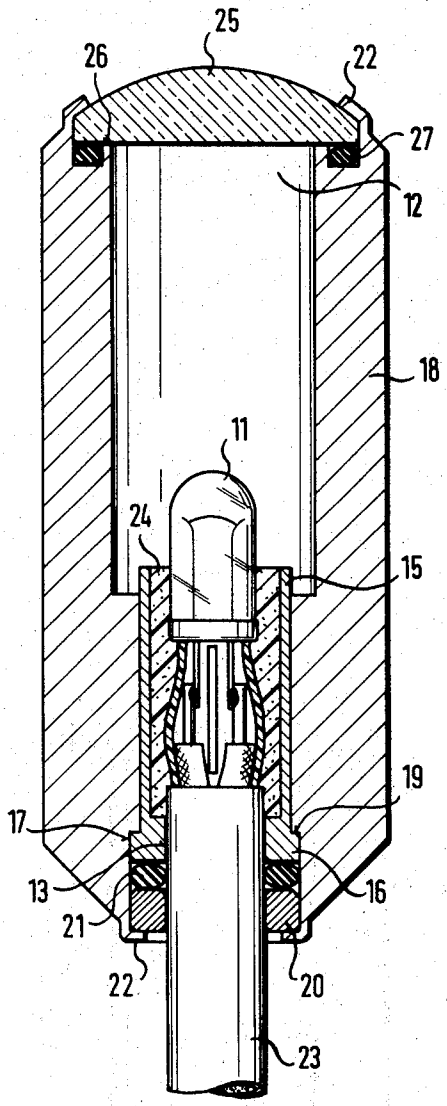

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Fig.4

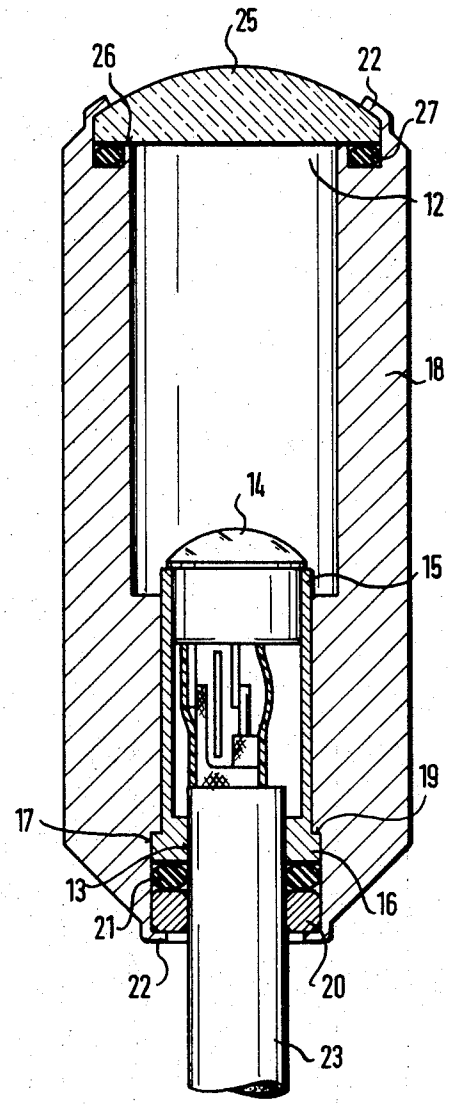
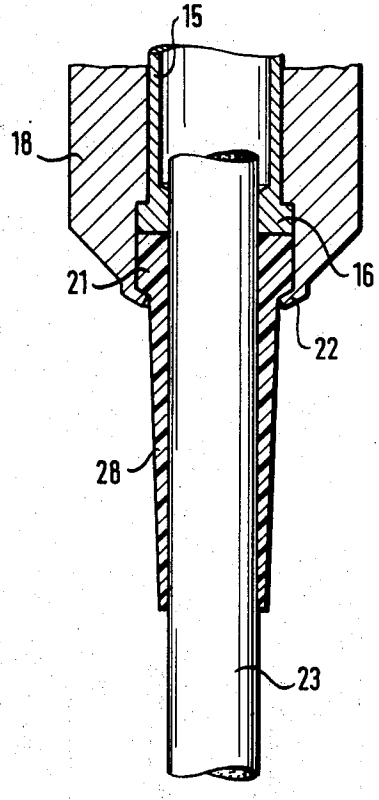

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Fig. 5



LIGHT BARRIER APPARATUS

The invention relates to a light barrier consisting of a lamp disposed in a first housing and a photo-receiver disposed in a second housing, both housings having respective exit and entry apertures for light and an aperture for the electrical connections to pass through.

The lamp and photo-receiver are each generically referred to in this application as "active optical elements".

Light barriers of this type are employed nowadays extensively in all fields of technology and so there is a need for a form of construction which can be manufactured economically, has a high function value and is also tightly sealed.

The object of the invention is, accordingly, to create a light barrier of the abovementioned type which can be manufactured simply and economically but at the same time has a high function value by virtue of its robust construction and small dimensions.

As a solution of the problem the invention provides that both the housing for the lamp and the housing for the photo-receiver are of the same design. In this way only one single type of housing has to be produced for both parts of the light barrier, which represents a substantial saving in manufacturing costs.

Manufacture is further simplified by the fact that each housing is cylindrical and the passageway for the electrical connections is at one end face and the aperture for the entry or exit of light is at the other end face. Because of the size of the cylinder both parts of the light barrier are also easily handled and can be fixed at any desired points. The form of the cylinder also has the advantage that round lenses can be fixed relatively simply and no difficulties are presented by the fitting of the lamp, which is generally cylindrical or round, and of a cylindrical photo-receiver. Furthermore the cylindrical shape favours the hermetic sealing of the housing.

In a specially preferred form of construction each housing surrounds a cylindrical sleeve, pushed in with a press fit, in which the lamp, or photo-receiver is inserted at the end facing the aperture for the exit and entry of light and which has at the other end the passageway for the electrical connections. As a result of this measure the sensitive parts, that is the lamp and the photo-receiver, together with the electrical connections, can be adjusted and installed in the sleeve before assembly of the housing. This protects the sensitive components during the final assembly of the housing.

A further form of construction provides for the sleeve to have, at the end containing the passageway, a flange which rests in a press fit in a cylindrical expansion of the internal bore of the housing provided at the end on the connection side and which makes contact with the shoulder between the expansion and the housing bore. Because of this construction as soon as the flange comes up against the shoulder the correct adjustment of the lamp, or the photo-receiver, is ensured and maintained.

It is preferable if the flange is pressed against the shoulder by a ring, a sealing ring being conveniently disposed between the ring and the flange, which ring seals both the contact surface between the sleeve and the housing and also the lead-through bushing of the conduit holding the connections.

In accordance with a further form of construction the housing has, on both end faces, beading directed substantially inward, by means of which all the components are held and the hermetic seal is secured. By this measure, which can be carried out very simply, the production of the light barrier according to the invention is made still more economical. At the same time the precise adjustment which is necessary for the sensitive components is guaranteed.

To facilitate the fixing of the parts contained in the housing the thickness of the housing wall is, according to another form of construction, substantially less in the region of the flanges than in the other regions. This ensures good stability for the housing, on the one hand, but at the same time a relatively easy fixing operation is made possible by bending over the beading and there is also a guaranteed hermetic seal.

In another form of construction there is taken through the passage for the connecting cable, in a sealed manner, a nozzle which surrounds the latter in a tight manner. As a result, in addition to providing a good seal, any kinks which might appear in the area of cable entry into the housing are prevented.

A very good guiding of the sleeve in the housing is ensured if the sleeve is guided in the housing over approximately its entire length.

If, in the case of a somewhat bigger construction, a greater distance is required between the lamp, or photo-receiver and the light exit or entry aperture, the housing may also extend substantially beyond the sleeve, the internal bore of the housing widening out in the region of the end of the sleeve in such a way that the cone of light from the lamp, or to the photo-receiver, is not impeded.

The photo-receiver conveniently takes the form of a component which can be inserted into the end of the sleeve, which again simplifies production. The lamp is advantageously cast integral with the sleeve after adjustment, whereby the maintenance of the adjustment during assembly and operation is ensured and on the other hand the possibility of damage to the lamp is largely eliminated.

A further form of construction provides for a lens to be disposed at the aperture for the exit or entry of light and for the lamp, or photo-receiver, to be located at the focal point of the lens. In this arrangement it is preferable if a plane side of the lens makes a tight contact with a step projecting inwardly from the flanging and the curved side of the lens is embraced at the edge by the flanging. It is convenient if a ring packing is inserted in the step. In this way, on the opposite side of the housing also, there is ensured not only exact installation of the lens but also a perfect seal of the housing.

Instead of a lamp it is possible, according to the invention, to employ a gas-diode; lamps or gas-diodes with a very long life are preferred.

Although fixing by means of flanging makes for particularly economic production, it is also possible, instead of this method of fixing, to provide for the the various components of the light barrier to be screwed in. In this connection it is preferable for the lamp or gas-diode to be removable, for example capable of being plugged in.

The invention will now be further described by way of illustration with reference to the accompanying drawings in which

FIG. 1 is a longitudinal section of the lamp part of a light barrier according to the invention;

FIG. 2 is a longitudinal section of the photo-receiver part associated with the lamp part shown in FIG. 1;

FIG. 3 is a longitudinal section of a second form of construction of the lamp part;

FIG. 4 is a longitudinal section of the photo-receiver part associated with the form of construction shown in FIG. 3;

FIG. 5 is a partial longitudinal section of a further form of construction.

As shown in FIGS. 1 and 2, both the lamp part and the photo-receiver part have a cylindrical housing 18 into which a cylindrical sleeve 15 is pushed from one end with a press fit. At its lower end, in the drawing, the sleeve 15 has a flange 16 which engages in widening 17 at the end of the bore of the housing 18. The sleeve 15 is pushed into the housing 18 to such a distance that the flange 16 rests against the shoulder 19 formed by the widening 17.

The firm application of the flange 16 to the shoulder 19 is brought about by a ring 20 which presses against the flange 16 through a beading 22 on the end of the housing 18 by way of a packing 21. According to the invention the packing 21 is stuck round a connecting cable 23 before assembly, which cable extends through the ring 20, the packing 21 and the flange 16 as well as the sleeve 15 and contains the electrical leads to the lamp 11 or the photo-receiver 14. The packing 21 not only seals the sleeve 15 from the housing 18 but also the lead-in bushing of the conduit 23 through the aperture 13 for the passage of the electrical connecting cable, this being assisted by the aforementioned sticking which also gives advantages from the manufacturing point of view.

Inserted in the upper end, as shown in the drawing, of the sleeve 15 is the lamp 11 or photo-receiver 14. Here, after adjustment, the lamp 11 is rendered integral, for example by means of a cast synthetic resin 24, so that the adjustment which has been made is then maintained. The element 24 may otherwise be an elastic socket.

The aperture 12 for the entry or exit of light situated opposite the aperture 13 for the electrical connecting cable 23 is covered by a lens 25 which rests with its lower, plane side on a step 26 projecting inwardly from the housing 18. In the annular step 26 there is accommodated a ring packing 27 which seals the contact surface between the lens 25 and the step 26. A beading 22 ensures a tight application of the lens 25 to the step 26 so that a tight seal of the housing is also guaranteed at this end.

As a result of the design according to the invention practically all the parts of the associated housings, except for the lamp 11 and the photo-receiver 14, are of like construction and capable of being manufactured in the same way, which makes possible an extremely economic production.

In the form of construction shown in FIGS. 3 and 4, in which the same references designate the same parts as in FIGS. 1 and 2, the housing 18 is substantially longer in relation to the length of the sleeve 15. The housing also has a bigger diameter so that a broader light barrier beam is obtained. Fundamentally, however, the construction of the light barrier in FIGS. 3 and 4 is the same as in the first example of construction. Here it is very important that in order to obtain light barriers of different magnitude it is only necessary to produce the housing 18 and lenses 25 in different dimensions, whereas the sleeve 15 with the fixing parts and the elements contained therein are of the same construction for all types. As a result light barriers with different ranges can be manufactured extremely economically.

The outer wall of the housing 18 may be provided with a screw thread for fixing purposes, thus facilitating its installation.

FIG. 5 shows a portion of a further form of construction in which, according to the invention, the packing 21 is joined to an anti-kinking nozzle. The fixing ring is also omitted, for purposes of simplification, and the beading 22 makes direct contact with a widening of the nozzle 28 corresponding to the packing 21.

What we claim is:

1. An enclosure for defining a chamber optically communicating with an environment external to said chamber, for housing an active optical element, said enclosure comprising:

a. a housing having an elongated bore extending therethrough, said bore having first and second ends communicating to the exterior of said housing and a first step peripheral to said first end of said bore;

b. a lens sealed over said second housing end; and

c. an integral optical element-bearing assembly comprising:

i. a sleeve slidable into said bore, and having first and second ends;

ii. an active optical element comprising one of a lamp and a photocell mounted proximate said second end of said sleeve;

iii. an electrical connector for connecting said active optical element to an electrical circuit for enabling operation of said active optical element; and

iv. said sleeve having a flange around the periphery of a first end thereof, said flange being engageable with said first step for establishing a press fit relation of said sleeve in said bore defining the maximum extension of said sleeve into said bore at which maximum extension said active optical element is located substantially at the focal point of said lens.

2. The enclosure of claim 1, further comprising:

a portion of packing material adherent to said electrical connector and extending therearound, said packing material being engageable with said flange of said sleeve when said electrical connector is extended through said sleeve.

3. The enclosure of claim 2, further comprising:

a. a sealing ring disposed about the exterior of said electrical connector, said sealing ring being located adjacent said packing material on the opposite side of said packing material from said flanged portion of said sleeve when said connector is inserted into said aperture, and

b. a first bead portion extending about said first end of said housing for at least partially enclosing and holding in place said sealing ring in order to maintain said electrical connector, said sleeve and said packing material rigidly disposed with respect to said housing when said sleeve is slid into said bore.

4. The enclosure of claim 1, further comprising:

a. said housing having a second step extending about the periphery of said second end of said housing, said lens being engageable in said second step of said housing;

b. a second sealing ring engageable in said second step between said second step and said lens, and

c. a second bead portion about the periphery of said second end of said housing and engageable with the exterior surface of said lens for holding said lens rigidly against said sealing ring in said second step of said housing.

5. The enclosure of claim **1,** wherein said bore and said sleeve possess circular cross-sections.

6. The enclosure of claim **1,** wherein:

said active optical element in said sleeve is mounted in a quantity of cast synthetic resin extending about said active optical element between said active optical element and said sleeve.

7. The enclosure of claim **1,** wherein:

said active optical element is mounted proximate said second end of said sleeve.

8. The enclosure of claim **4,** wherein:

the thickness of said housing is less in the regions of said first and second beads than in the other regions of said housing.

9. The enclosure of claim **1,** wherein said sleeve extends approximately two-thirds of the length of said bore when said sleeve is inserted into said bore so that said flange of said sleeve engages said first step of said housing.

10. The enclosure of claim **1,** wherein:

a. said sleeve extends approximately to the midpoint of the length of said bore when the flange of said sleeve is engaged with said first step of said bore, and

b. the inside diameter of said bore is greater in the region of said bore proximate to said second end of said housing than in the region of said bore proximate to said first end of said housing.

11. The enclosure of claim **1,** wherein said active optical element is press fitted into said second end of said sleeve.

12. The enclosure of claim **1,** wherein said active optical element is mounted in a threaded socket in said second end of said sleeve.

13. The enclosure of claim **1,** wherein said active optical element is a gas diode light source.

14. A light barrier system comprising:

a. a light source disposed in a first assembly;

b. a photosensitive element disposed in a second assembly;

c. each of said first and second assemblies comprising:

i. a housing having an elongated bore extending therethrough, said bore having first and second ends each communicating to the exterior of said housing, and a first step peripheral to said first end of said bore, and

ii. a lens sealed over said second end of said bore, and

iii. an integral optical element-bearing assembly comprising:

1. a sleeve slidable into said bore and having first and second ends,

2. an active optical element comprising one of a lamp and a photocell mounted on said sleeve,

3. an electrical connector fixed to said sleeve for connecting said active optical element to an electrical circuit for enabling operation of said active optical element, and

4. said sleeve having a flange around the periphery of its first end, said flange being engageable with said first step for establishing a press fit relation of said sleeve in said bore defining the maximum extension of said sleeve into said bore, at which maximum extension said optical active element is located substantially at the focal point of said lens.

15. A method for constructing an assembly for containing an active optical element operatively positioned therein with precision, said assembly including a housing having an elongated bore extending therethrough, and having first and second ends communicating to the exterior of said housing, said method comprising the steps of:

a. constructing an integral optical element-bearing assembly by

i. mounting said active optical element proximate one end of a sleeve slidable into said bore.

ii. operatively connecting an electrical connector to said active optical element, extending said electrical connector through said sleeve and through the end of said sleeve opposite said active optical element,

iii. fastening said electrical connector in place in said sleeve,

b. inserting said element bearing assembly into said bore to an extension at which said active optical element is located substantially at the focal point of said lens;

c. maintaining said element bearing assembly fixed at said extension in said bore, and

d. covering one end of said bore with a lens.

16. The enclosure of claim **15,** said bore having an enlarged section in the region of said packing material and said sealing ring.

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