

[54] FOLDING PHOTO-ELECTRIC DETECTING
DEVICE

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250/561; 356/199

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[58] **Field of Search** 250/571, 221, 224, 239,
250/557, 559, 560, 561; 356/138, 172, 199

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[57] **ABSTRACT**

A detecting device capable of being strapped around and positionally mounted on a variety of sizes of document guide channels in a self-adjusting manner. The light transducing units of the devices can be pre-aligned and configured to face each other through apertures in the guide channel in such a manner as to be relatively impervious to ambient light.

18 Claims, 3 Drawing Figures

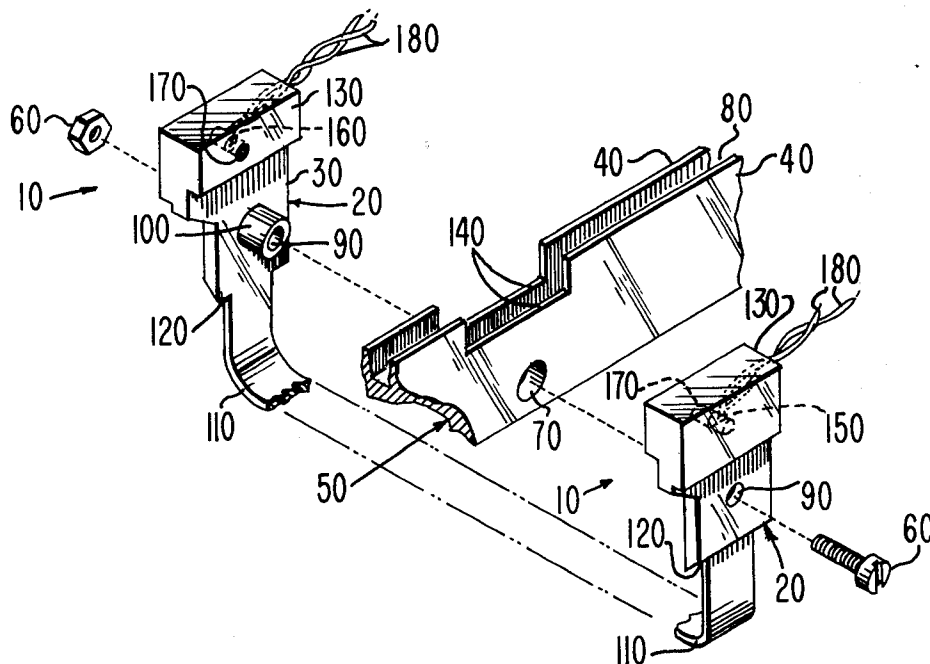


FIG. 1.

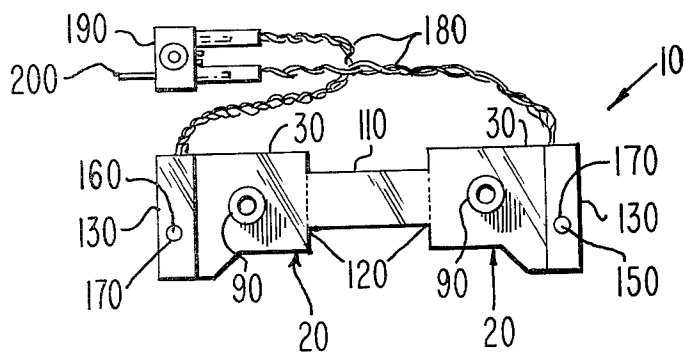


FIG. 2.

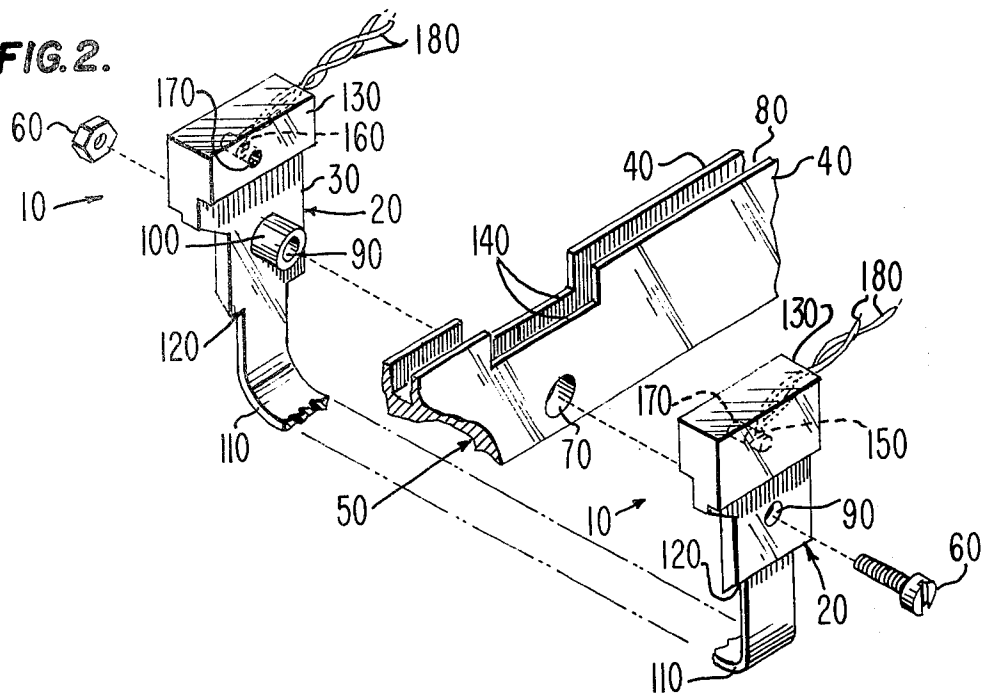
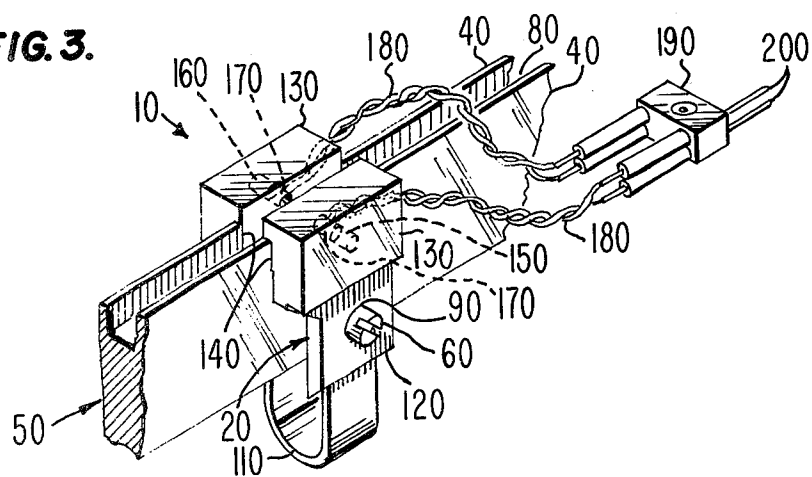


FIG. 3.



FOLDING PHOTO-ELECTRIC DETECTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to sensing devices in general and particularly to light sensors used for document detection in a guide channel.

2. Prior Art

Previously, light emitters and detectors as used for detecting documents in a guide channel were relatively large as to their beam strength and physical size, and the speed of the documents in the channel was relatively slow. As such, even if the light emitter and detector were slightly misaligned relative to each other, detection could still be made since the light source would also radiate side light greater than the ambient light and thus still be detectable. Any time lags incurred by using side light could be easily compensated for since the side light was easily detectable and the documents were moving at a relatively slow speed.

With the advent of high-speed document guide channels and the desire to use economical emitter-detector devices that were relatively physically small and low powered as to beam strength, the tolerances for misalignment of the beam thus became smaller.

The reason being that in a misalignment situation, the relatively low powered side light beam could not be readily distinguished from ambient light thus increasing the probability of miscueing the detector. As high speed document environments became more common, the distinguishing problem became even more acute since time lags could not be as easily compensated for. As such, there existed a need for detection of precisely aligned direct beaming of light when using low powered sources.

SUMMARY OF THE INVENTION

Accordingly, it is an important object of the invention to provide an improved means of accurately sensing documents in a high speed document guide channel when using relatively low-powered emitter-detector units.

It is another important object of the invention to provide an emitter-detector unit capable of being bench tested and accurately set as to alignment prior to assembling the unit on the guide channel.

Yet another object of the invention is to provide an emitter-detector unit whose very act of assemblage on the guide channel will automatically align it to the same tolerances as set by the bench test alignment.

Another object of the invention is to provide an emitter-detector unit that will automatically align itself to a variety of guide channel depths.

A further object of the invention is to provide an emitter-detector unit that will set into an apertured side wall of the guide channel thereby auto-aligning the emitter relative to the detector.

Another further object of the invention is to strap the emitter and detector components of the emitter-detector unit together from the time of prealigning until they are mounted for the purpose of keeping together the bench aligned components prior to assembly.

A final object of the invention is to provide tunnel-like apertures for the aligned sensing and emitting com-

ponents thereby acting to block out ambient light that would otherwise miscue the sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view of the emitter-detector unit in a flat state before assembly;

FIG. 2 is an exploded perspective view of the emitter-detector unit of FIG. 1 as it would appear just prior to its assembly on the guide channel; and

FIG. 3 is a perspective view of the emitter-detector unit of FIG. 1 in its actual assembled state on the guide channel.

DETAILED DESCRIPTION OF THE INVENTION

In the preferred embodiment of the invention as shown in FIGS. 1, 2 and 3, the body of the detector device 10 comprises a pair of blanks 20 with flat mounting sides 30 to fit the respective pair of sidewalls 40 of the guide channel 50 upon which the blanks 20 are to be mounted. Each blank 20 is cut in the form of a square with an area corresponding to the mounting side 30 sufficient to provide an adequate friction surface once mounted.

The blanks 20 made of molded plastic are fastened to the sidewalls 40 of the guide channel 50 by means of a screw and nut combination 60 traversing the blanks 20 and guide channel 50. Specific components of the fastening means include a locating hole 70 provided in the sidewalls 40 below the actual document channel 80, the locating hole 70 being operative to traverse the guide channel 50 from sidewall 40 to sidewall 40. Additional holes or locating journals 90 traverse each of the blanks 20 and have a diameter equal to the locating hole 70. A screw and nut combination 60, as mentioned supra, or similar fastening means is used to traverse these holes 70, 90 and bind each blank 20 on its mounting side 30 to its respective sidewall 40. An alternative embodiment of the fastening means comprises a collar 100 with an inner diameter equal to the normal sized locating journal 90 hole diameter of the previous embodiment and an outer diameter equal to the now enlarged diameter of the locating hole 70. The collar 100 would protrude from one of the blanks 20 and insertably traverse the locating hole 70 and abut up against the normal sized journal locating hole 90 of the other blank 20. This embodiment would enable one blank 20 to be screwed directly up against the other when using the screw and nut combination 60 thus giving a more secure binding effect.

Once the detector device 10 is prealigned, as will be explained infra, it is necessary to keep the associated pair of blanks 20 physically bound to each other at least until permanently mounted. This is accomplished by providing a strap 110 composed of a flexible material such as rubber where each bottom end 120 of the blanks 20 is physically secured to opposite ends of the strap 110. This strap 110 as mentioned supra, binds the blanks 20 together for aligning purposes and also due to its flexibility allows the detector device 10 to be molded and stored in a flat state as shown in FIG. 1. When it is time to assemble the detector device 10, the detector device 10 by virtue of its flexible strap 110 can be bent back on itself and slipped onto the guide channel 50 from underneath as shown in FIG. 2. By giving the strap 110 a length as long as needed for the guide channel 50 having the greatest depth, the detector device 10 automatically becomes independent of the

guide channel's 50 height for fitting purposes. Once the detector device 10 is so mounted to its given guide channel 50 as shown in FIG. 3, the strap 110 may be cut off or otherwise disposed as its function of keeping the aligned blanks 20 together will have been completed.

At the top ends of each of the pair of blanks 20, are lips 130 protruding out in such a way that once the blanks 20 are fitted to the guide channel 50, the lips 130 will be directed toward one another to form extensions of the inner surfaces of the sidewalls 40 of the actual channel 80. Corresponding in position to the protruding lips 130 are apertures 140 formed into and traversing the sidewalls 40 of the guide channel 50. These apertures 140 serve as snug receptors for the protruding lips 130 which in turn act to guide the placement of the blanks 20 relative to their respective sidewalls 40. It is preferred that both the lips 130 and associated apertures 140 be placed on the top ends of their respective blanks 20 and sidewalls 40 for ease of mounting and most importantly to make the detector device self-adjusting and thus independent of the actual channel's 80 depth. This is analogous to the logic for using the relatively long strap 110 which is to make the detector device 10 fittingly universal as to the height of the guide channel 50 that it may be mounted on.

Prior to mounting the detector device 10 on a guide channel 50, an emitting 150 and sensing means 160 are molded into the lips 130 of the blanks 20 when the detector device 10 itself is molded. In the process of molding the emitting 150 and sensing means 160 to their respective lips 130, they are concurrently prealigned as to each other. Once so prealigned and molded on a test bench that simulates a guide channel 50, the units 150 and 160 are kept together by the strap 110 and when mounted, will oppositely face each other through their sidewall apertures 140 so that a document passing through the channel 80 will interrupt the light beam passing directly from the source-emitter 150 to the detector-sensor unit 160. Although the preferred embodiment consists of a light transducing unit 150, 160 comprising a light emitting diode (L.E.D.) as the emitter 150 and a photo-transistor as the sensor 160, it would also be possible to use other types of light transducing units 150, 160 or even a sound transducing unit 150, 160 in place thereof to sense interruptions of various phenomena such as sound.

Although the emitter 150 and sensor units 160 may be merely secured to the sides of their respective lips 130 protruding into the apertures 140, they also may be recessed into a tunnel-like aperture 170 in the lips 130 thereby allowing only light beamed directly from the emitter 150 to the sensor 160 to be detected. This enables side light and ambient light in general to be eliminated as a source of miscueing of the sensor 160 as to the proximity of a document when a low power emitter 150 such as a L.E.D. is used.

Carrying signals to and from the light transducing units 150, 160 is obtained by separate lines 180 going to each of the units 150, 160. The lines 180 are connected at their opposite ends to a common block 190 having distinct multi-plugs 200 for the different signals carried on the lines 180. The purpose of this being to allow the lines 180 to easily slip under the guide channel 50 when mounting in a manner similar to the way the strap 110 is used, while at the same time only neces-

sitating the plugging into an external connector of a single block 190.

The primary features of the invention are thus the ability to prealign the detector device 10 and keep the components thereof together until mounted, to be able to universally mount the detector device 10 over a wide range of guide channel 50 heights and actual channel depths 80, and the novel securing of the emitter 150 and sensors 160 in tunnel-like apertures 170 that will minimize ambient light thus enabling lower-powered emitters 150 to be used.

What is claimed is:

1. An emitter-detector unit for sensing the movement of documents along a guide channel having a pair of apertured sidewalls comprising:

- a. a pair of interconnected blanks oppositely abutting the outside surfaces of the apertured sidewalls,
- b. a pair of lips protruding from said blanks and into corresponding ones of the sidewall apertures for aligning said blanks in relation to one another,
- c. means for emitting secured to one of said pair of blanks and snugly positioned relative to the aperture of its associated sidewall,
- d. means for sensing secured to the other of said blanks and snugly positioned relative to the aperture of its associated sidewall so as to be aligned with said emitting means, and
- e. means for fastening said blanks to the apertured sidewalls whereby the movement of documents along said guide channel is detected by said emitting means and said sensing means.

2. The emitter-detector unit according to claim 1 wherein a tunnel-like aperture is formed in each of said pair of blanks and said lips for snugly positioning said emitting and sensing means relative to said apertures in said sidewalls whereby the effect of ambient phenomena in detecting documents is minimized.

3. The emitter-detector unit according to claim 1 wherein said emitting means is a light source.

4. The emitter-detector unit according to claim 3 wherein said light source is a light-emitting diode.

5. The emitter-detector unit according to claim 1 wherein said sensing means is a light detector.

6. The emitter-detector unit according to claim 5 wherein said light detector is a photo-transistor.

7. The emitter-detector unit according to claim 1 wherein said fastening means comprises:

- a. a pair of locating journals formed in and traversing said blanks and positioned to be axially aligned with each other and with a locating hole formed in the guide channel, and
- b. a screw and nut combination axially traversing said locating journals and the locating hole for securing said blanks to the guide channel.

8. The emitter-detector unit according to claim 1 wherein said pair of blanks are interconnected by means of a flexible strap fixed to and extending from the inboard extremities thereof, said strap being disposed underneath the guide channel.

9. The emitter-detector unit according to claim 1 wherein said emitting and sensing means are each provided with separate signal leads that are joined to a remote common block having separate plugs for respective signal functions.

10. The emitter-detector unit according to claim 1 wherein said pair of lips are located on the outboard ex-

tremities of said blanks and serve to form extensions of the inner surfaces of said pair of sidewalls.

11. The emitter-detector unit according to claim 7 wherein one of said locating journals comprises a collar extending outwardly from its respective blank and into the locating hole formed in said guide channel to thereby provide a guiding and securing medium for said screw of said screw and nut combination.

12. A unitary photo-sensing device effective for convenient assembly onto a pair of sidewalls of a guide channel for detecting the movement of documents therealong, said pair of sidewalls having a pair of coaxial U-shaped apertures formed therein and said guide channel having a locating hole disposed underneath said U-shaped apertures, said device comprising:

- a. a pair of flexibly connected blanks having a pair of first side surfaces for parallelly abutting the outer surfaces of said sidewalls,
- b. a pair of lips fixed to the outboard extremities of said blanks and extending outwardly from said pair of first side surfaces, said lips and particularly the extensions thereof being dimensioned to be received by said U-shaped apertures of said sidewalls,
- c. a pair of locating journal apertures formed in said pair of blanks so as to coaxially align with said locating hole of said guide channel when the extensions of said pair of lips are received in said U-shaped apertures of said sidewalls, and
- d. a light source secured to the extension of one of said lips and a light detector secured to the extension of the other of said lips such that the operative ends thereof are coaxially aligned and inwardly directed when said lips are received in said U-shaped apertures, whereby upon the assembling of said device relative to said guide channel by fastening means associated with said pair of locating journal apertures of said blanks and said locating hole of said guide channel said light source and said light detector are rendered effective to detect the movement of documents along said guide channel.

13. The photo-sensing device defined in claim 12 wherein the flexible connection between said pair of blanks is comprised of a pliable strap effective for prealignably maintaining the relationship between said pair of blanks, said pair of journal apertures, and said light source and light detector prior to the assembly of said device onto said guide channel, and for yieldably accommodating the assembly of the device thereonto by fastening means in association with said pair of locating journal apertures of said pair of blanks and said locating hole of said guide channel.

14. The photo-sensing device defined in claim 12 wherein said light source and said light detector are secured in tunneled apertures formed in the extensions of said pair of lips such as to minimize the effect of ambient light when said device is assembled onto said guide channel and thereby rendered effective for detecting the movement of documents therealong.

15. The photo-sensing device defined in claim 12 wherein a collar is secured to the first side surface of one of said blanks and in coaxial relationship with the locating journal aperture thereof, said collar traversing said locating hole of said guide channel to abut against the first side surface of the other of said blanks in coaxial relationship with the locating journal aperture

thereof when said device is assembled onto said guide channel by the fastening means.

16. The photo-sensing device defined in claim 12 wherein said light source and said light detector are each provided with signal leads fixed thereto and remotely joined to a common block, said block being provided with function plugs connectible to extraneous document detection circuitry.

17. The photo-sensing device defined in claim 12 wherein the assembly thereof onto said guide channel may be accommodated by a bolt and nut combination comprising said fastening means, said bolt being transversably receivable by said locating journal apertures of said pair of blanks and by said locating hole of said guide channel such that the head of said bolt is abutted retainably against a second side surface of one of said blanks opposite its said first side surface and said nut of said bolt and nut combination is abutted retainably against a second side surface of the other of said blanks opposite its said first side surface.

18. A method for conveniently assembling a light source and a light detector relative to the sidewalls of a guide channel such that the movement of documents therealong may be detected with minimal effects from ambient light, said method comprising the steps of:

- a. providing a pair of flexibly interconnected identical blanks with a pair of identical outboard lips extending outwardly from first side surfaces thereof, and with a pair of locating journal apertures that bear an identical predetermined relationship relative to said lips and to the edges of said blanks normally disposed of said lips,
- b. providing a pair of tunneled apertures in said pair of lips on the side surfaces thereof corresponding to said first side surfaces of said pair of blanks, said tunneled apertures being identically disposed relative to the extending edges of said pair of lips,
- c. secureably installing a light source having a signal lead into one of said tunneled apertures and a light detector having a signal lead into the other of said tunneled apertures, and connecting said signal leads to a common block having plug connections,
- d. forming a pair of coaxially aligned U-shaped apertures in said sidewalls of such dimension as to snugly receive said pair of lips,
- e. forming a locating hole in said guide channel underneath said pair of U-shaped apertures and bearing an identical relationship therewith as the relationship of said locating journal apertures to said pair of lips,
- f. assembling said pair of flexibly interconnected blanks onto the sidewalls of said guide channel such that said pair of lips are snugly received within said pair of U-shaped apertures,
- g. installing a bolt through said pair of locating journal apertures of said pair of blanks and said locating hole of said guide channel and tightening a nut onto said bolt such that the head of said bolt is secureably abutted against a second side surface of one of said blanks and said nut is secureably abutted against a second side surface of the other of said blanks, and
- h. connecting the plug connections of said common block to extraneous document detection circuitry.

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