

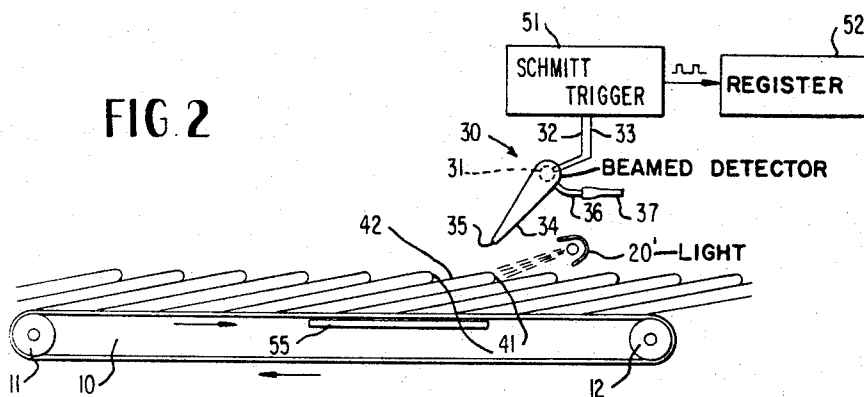
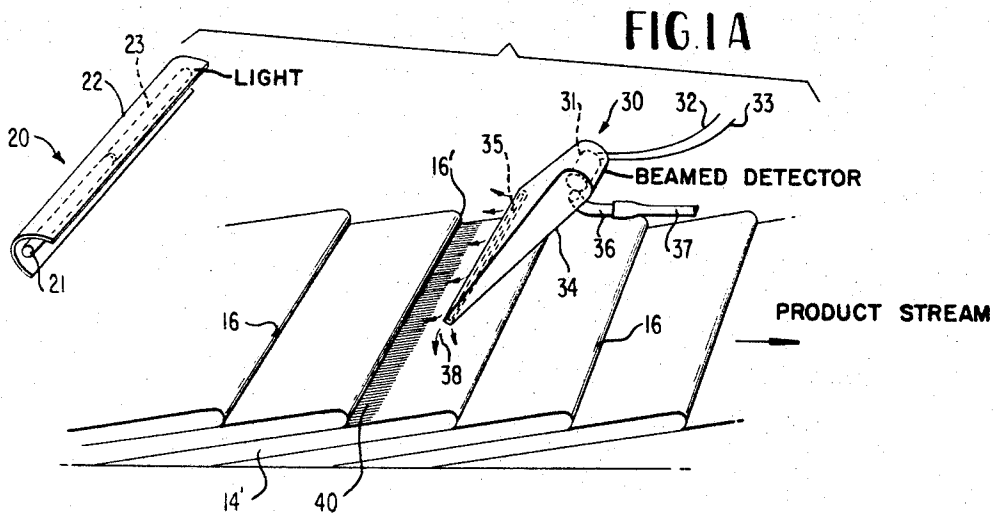
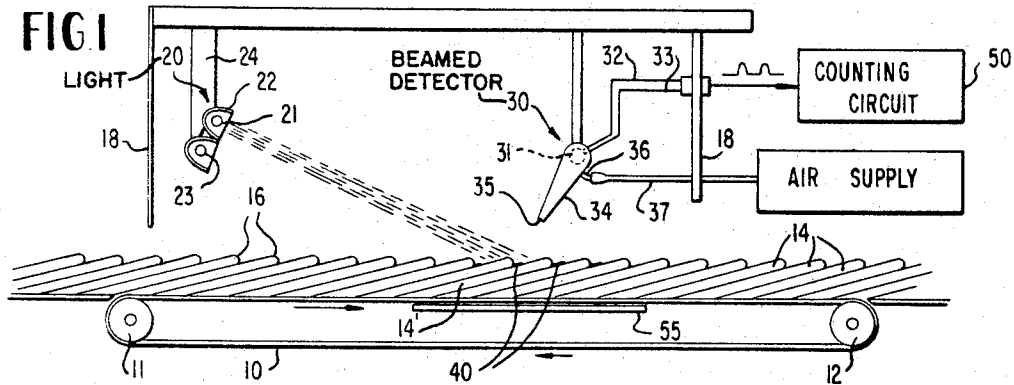
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3,414,732

COUNTER FOR FOLDED PAPER OBJECTS

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ATTORNEYS

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COUNTER FOR FOLDED PAPER OBJECTS

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ABSTRACT OF THE DISCLOSURE

This invention provides a highly directive photocell detector unit employed in a counting circuit to register passage of edge lighted newspapers, and the like, moving in a stream on a conveyor illuminated from above to create a shadow advancing ahead of each folded paper or from the direction of the detector to present a brightly lighted leading edge, in either case operating a counting circuit. A separate housing for the lamp permits a high intensity illumination and a slit opening for a housing enclosing the cell provides high directionality and at the same time permits use of an airstream cleansing the slit aperture to prevent loss of light transmissivity.

This invention relates to improvements in object counting on a conveyer and more particularly to photoelectric counting of folded paper objects such as newspapers moving in a stream on a conveyer.

Printed products produced at rates of 50,000 per hour or higher must normally be counted by automatic means either as they are delivered from the press to a conveyer or batcher or must be counted in transit on a conveyer. A number of prior art devices have been used for this purpose, and in particular it has been attempted to provide photoelectric counting while in a continuous stream but with certain inherent difficulties which have made such methods of counting unsatisfactory. One prior art means is to employ a lamp which illuminates each item at an acute angle along the direction of motion, to provide a shadow which may be detected by a photocell or like detector of light. Some such prior art devices have been arranged to ride on or above the stream and have been enclosed in a windowed housing, giving protection for both lamp and cell from floating dust, fiber, ink spots, and fragments which would otherwise obstruct the light passage between the lamp and the photocell. A cabinet housing the light and the photocell may have a glass window placed immediately above the product stream so that the housing can be in riding contact to wipe the window clean of such obstructing material. This arrangement leaves much to be desired for the reason that printer's ink is not a rapidly drying material and quickly covers such a window with the result that the counting operation is in error or interrupted too frequently for practical use in high production rate operations. If the window is omitted, flying particles enter the cabinet, but if the window is used, it becomes quickly clouded. If the cabinet holding the lamp and cell are not caused to rub against the moving stream of products, dust settles on the window, and it is not self-cleaning. These reasons have prevented the practical employment of a source of illumination casting a shadow at one edge of a product in a stream to provide contact for detection by a photocell, since counts were too often in error.

Photoelectric counting is advantageous if these difficulties can be overcome, and this invention achieves such a result partly by the enhancement of the light and shadow effect as light is projected over the edge of each article in the stream using a photocell limited to an entrance slit parallel to the leading edges of the objects for detecting

light and shadow effects. No contact is made with the stream, and this arrangement is made possible since the slit and cell are kept clean and effective by a flow of air circulating past the photocell and emerging from the slit to prevent entry therein of any of the usual obstructing agents, thus to avoid the need for a wiping action. A light source is mounted to give a directed beam pointing diagonally downward and forward along the line of flow of the product stream to cast a shadow at and beyond the leading edge of each product in one form. It may alternatively be slanted backwardly toward the leading edge at an angle such that only the leading edge of the object is strongly lighted, and the photocell is then arranged to respond positively to the light on the leading edge and negatively to the lesser light on the face of each object. In either case, the photocell and light source may be mounted substantially above the moving stream within a housing, or without the use of an overall housing, critical regions being continuously flushed with an air stream to avoid settling out of obstructing material.

Features of the invention are illustrated in the drawings in two embodiments wherein:

FIG. 1 is a side elevational view of a conveyer for a printed product stream showing apparatus according to one embodiment of the present invention;

FIG. 1A is a perspective view showing details of an arrangement according to FIG. 1; and

FIG. 2 is a side elevational view of an alternate arrangement of the apparatus according to a second embodiment.

Referring now to FIG. 1, there is illustrated at 10 a conventional conveyer supported or driven by rolls 11 and 12 carrying thereon a stream of printed products shown at 14 characteristically having a folded edge extending forwardly in overlapping relationship to the immediately preceding product, as in the case of newspapers and magazines. The leading edge, whether of folded or other type, is illustrated at 16, ordinarily overlapping the next preceding product to define a continuous stream, although interruptions may cause the stream to be non-uniform or even discontinuous.

A counter according to this invention is generally supported above the moving stream of products 14 and may be enclosed in light shielding housing 18, as illustrated in FIG. 1. Such a housing, if used, differs from housings of the prior art in that it is not closed at the bottom and is supported by means (not shown) well above the stream of products, its purpose being to prevent stray illumination from affecting the light and shadow effects adjacent to leading edges 16 of products 14 when they are suitably illuminated for detection of edge movement pass the detector.

A light shield or housing 18 may form a mounting for a high intensity lamp 20, which may comprise one or more linearly arranged bulbs or a linear light source, here illustrated as a tubular bulb 21 of high intensity mounted in reflector 22 and supported at 24 from housing 18, or other supporting structure adjacent the stream (not shown). A spare bulb as at 23, in the same or a different reflector, permits shifting from 21 to 23 without stopping the press in the event of failure of light 21 during a run. Such shifting may be accomplished manually or preferably by an automatic circuit responsive to the failure of the detector to receive adequate illumination to keep the counting circuit activated, as by a suitable threshold switching circuit according to well known electronic circuitry.

A photoelectric detector is shown generally at 30 comprising a photocell 31 having leads 32 and 33 mounted within a specially designed housing 34 and having an opening directed toward a particular counting location

along the stream. In the counting of printed products such as pamphlets and thin newspapers which are relatively thin, shadows cast from leading edges 16 of the products, as illuminated by the forward slanting rays from lamp 21, will have a very narrow shadow region 40 comprising the unilluminated portion of leading edges 16 and the shadow portion on the products 14 subadjacent thereto. Housing 34 has a narrow slit 35, preferably adjustable, arranged perpendicularly to the stream motion. Furthermore, best results are obtained when the housing 34 is disposed at an angle substantially 90° or more from the direction of the light beam as it impinges upon products 14. This is better illustrated in the arrangement shown in FIG. 1A wherein the darkened portion of the leading edge at 16' is shown adjacent to the shadow 40 lying on the subadjacent product 14'.

An arrangement as described permits mounting focused lamp 20 well above the product stream, and detector 30 also well above the product stream, each facing the stream along a slanting path of which the light is sloped downward in the direction of travel and the detector is sloped downward against the direction of travel, as illustrated in FIG. 1.

To prevent the entry of ink particles and lint, fibers or dust normally prevalent in considerable quantities in a high speed printing room, housing 34 has an air duct 36 supplied from an air pressure line 37, and is arranged to have a jet of air entering the housing 34 in a direction to circulate past the photocell 31 to emerge from the slit 35 as air stream 38 diverging in all directions from slit 35. This air flow prevents entry of airborne fogging and clogging materials and keeps the slit and the photocell clear for long periods of time. By this means it is feasible to maintain a narrow slit which may be adjusted to approximately the width of the shadow cast by the leading edge 16 as each product passes through the focused beam from lamp 20, and actuates cell 31 according to the illuminated or shadow effect projected through the slit upon the detector cell.

An alternative arrangement as shown in FIG. 2 uses a reversed relationship between light and shadow in that a focused light 20' is directed oppositely to the direction of motion of the product stream. Light 20' is located low enough to be nearly in line with the extended plane of the individual product being lighted thereby thus to produce a brightly lighted leading edge 41 on each product as it approaches the counting position for detector 30, and to leave unlighted adjacent portions of edge 41 or face 42 corresponding to the shadow of FIGS. 1 and 1A. The detector may be in the same plane as the light or may be directed toward the objects from a higher angle. The detector is otherwise similar to that of the previous embodiment, although it may be mounted at a different angle, and responds to variations over a narrow area to detect the unlighted faces 42 or portions adjacent edges 41 as dark areas and the lighted edges 41 as bright areas.

In either example of apparatus according to this invention it has been observed that a light of relatively high intensity may be employed so as to make unimportant the use of the housing as at 18 since ambient light is then relatively insignificant. Illumination of the products 14 is effective to provide reflected light detectable by the cell 31 when properly oriented with respect to slit 35 so that the lighted area even of the darkest printed portions encountered still returns reflected light far greater than the nonilluminated but unprinted areas of a white paper. In the area of intense illumination, the solid black values of a printed picture passing the detection region returned to the cell 31 sufficient light to indicate a lighted area while an immediately adjacent shadow beyond edge 16 on the product 14' therebelow returned and not more than about 10% of the light intensity of the illuminated black areas, thus to provide at least a 10:1 difference for detection by the cell 31. In addition to this contrast be-

tween the illuminated black portions and the unlighted white portions there is the further advantage of a detector as illustrated in FIG. 1A in that the slit 35 is made long enough to cover a substantial portion of the width of product 14, and thus averages the light over at least a substantial portion of the width of the product, although a relatively short slit is often adequate. In either form of the invention it is readily possible to employ a trigger circuit having an on or off type of output reliably determinative of exact counts of product edges passing the region seen by the cell.

While the details of the counting mechanism according to this invention may be varied in accordance with any of several well known techniques, there is illustrated at 50 a counting circuit connected by leads 32 and 33 to the cell 31 of a type to respond to a particular light value with a voltage developed in cell 31 which triggers a positive signal when illumination is greater than the set minimum, and a negative signal when the illumination is less than that value. Conventional binary circuitry may be employed for this purpose in counting circuit 50, including, for example, a trigger circuit connected to provide output pulses of a positive type each time a brightly illuminated strip passes beneath slit 35. Alternatively, a Schmitt trigger 51 may be employed for operating a register as at 52 connected to respond as shown in FIG. 2 or oppositely to that illustrated and to provide either a positive or negative pulse when a shadow passes the slit 35. Since these relationships are variable according to well known practice to effect registry of counting pulses, they need no further discussion in connection with this invention.

During the printing of a run of products it frequently happens that the stream is interrupted momentarily, or stopped for some reason, so that a circuit responding to changes of illumination in the area beneath the slit 35 might cause spurious counts. In the embodiment of FIG. 1 it will be noted that failure of illumination upon a product 14 beneath the slit 35 might cause the same effect as a shadow, thus to give rise to a spurious count whenever the stream is broken and no product 14 is in position to reflect light to the slit 35. To overcome this difficulty there is arranged subadjacently to the stream a reflecting panel 55, which may be supplied with a light-colored generally diffusing surface. If the conveyor 10 is of solid material, the light from source 20 would fall thereon, and sufficient light will return to the detector to maintain the counting circuit in the same way as a product illuminated while passing slit 35. If the conveyor is of the spring belt type surface 55 prevents the registration of a shadow, to trigger an extra count. Absence of a product in apparatus according to FIG. 2 returns no spurious pulse. It will also be appreciated that when conveyor 10 is stopped a trigger circuit such as 51 will either be actuated in the positive or the negative signal condition and will so remain until the stream is again started on its way to provide changes above and below the minimum signal necessary to trigger the circuit for producing an output pulse to counter 52.

As illustrated in FIG. 1, the thickness of the paper stream is somewhat exaggerated to more clearly show the shadow effect. However, papers are normally much thinner and reflector 55 lies within the beam of illumination and within the angle of vision defined by slit 35 and the cell 31. Housing 34 and light 20 are made adjustable in an installation where a variety of products are to be counted so that optimum angles of incidence of the light and of reception of reflected light will be obtained, details of adjustment being omitted since they are variable according to need.

While the invention has been described with particular reference to an example and to modes of operation, it will be appreciated that the invention may be otherwise practiced within the scope of the appended claims.

What is claimed is:

1. A counter for products moving in a stream along
a conveyer comprising
a source of beamed light directed obliquely along an
area in said stream, 5
elongated detector housing means having an open slit
transversely disposed to said stream, being of a
length-to-slit width ratio to define an aperture cor-
responding to the product thickness,
photocell means positioned in said housing to define a 10
transverse light detection band corresponding to said
product thickness, and
means causing continuous flow of gas from said hous-
ing through said slit toward said area for preventing
entry thereto of foreign matter. 15
2. A counter according to claim 1 wherein said slit
and cell define a line at a large angle to the beam of
light, being directed downwardly toward the approaching
stream.
3. A counter according to claim 1 wherein both said 20
light and said photocell means are directed toward the
approaching products in said stream.
4. A counter for products moving in a stream along
a conveyer, comprising
means for illuminating said products on the upper 25
surfaces thereof in a direction to cast forwardly
shadows according to the thickness of the leading
edge thereof,
photocell means for detecting differences of light in-
tensity in said shadows and on said surfaces, said 30

means including an enclosure having a transverse
light slit admitting light to said photocell means
along the plane extending from said stream at an
angle differing from the angle of illumination,
means converting said differences of light intensity to
binary pulses corresponding to light and shadow
regions as said products pass through said plane,
means counting said pulses of like sign,
said enclosure being open to the atmosphere along slit
and including air supply means for causing a continu-
ous flow of air from said slit during operation of the
counter, and
said means for illuminating upper surfaces including
plural light sources alternatively operable to main-
tain said illumination and shadows at the intersec-
tion of said plane with said stream.

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