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(54) Label detector

(57) A media detector detects the presence of a printed label in a printer which is designed to pause after printing each label, and resume printing only after the printed label has been removed. The detector uses reflected light from an LED, which strikes the print media and is reflected onto a light sensor. The ambiguity caused by ambient light striking the light sensor is avoided by using a two-step detection process. The output from the light detector is read both with the LED on and with the LED off. The status of the light sensor under both conditions is repeatedly analyzed until it is unambiguously determined that the printed label has been removed and the printer can therefore resume printing.

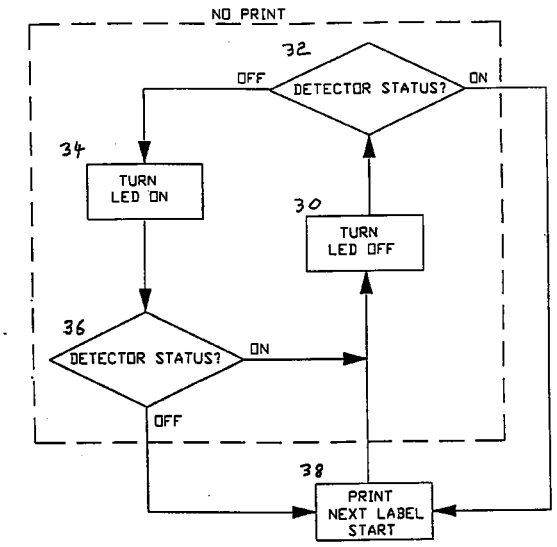

FIG. 4

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention pertains to a detector for sensing the presence of the print media in a printer. More particularly, it pertains to a detector for sensing the presence of a printed label in a label printer which only prints a new label after the previously-printed label has been removed.

2. Description of the Related Technology

[0002] Most printers have a detector for sensing the presence or absence of the print media (i.e., the paper). Most such sensors are used to determine if new printer paper is installed and correctly positioned for printing. After printing, the printed paper is ejected from the printer and stacked. New documents are normally printed without regard to how many printed documents have already been ejected and stacked in this manner.

[0003] However, some types of printers, such as portable label printers, have another paper-sensing function which is designed to allow further printing only when the absence of print media is detected. After printing each label, these printers are designed to advance the label until it partially protrudes from the printer, and then pause until the printed label has been removed by the operator or by some other force. The printer will not print a second label until the first has been removed. This prevents the need for a stacking operation by allowing the printer to produce labels at ante which matches the operator's speed in using those labels. This feature is especially important for portable label printers which are designed to be hand-carried or attached to the operator's belt. In such printers, small size and weight are paramount, and the weight/bulk of a stacker would be unacceptable.

[0004] Since the label to be detected protrudes at least partially from the printer, the sensor which detects the label must be near the label exit port, potentially exposing the sensor to unpredictable levels of ambient light. For light-based detectors, this can be a problem.

[0005] The most common form of paper detector uses a light source such as a light emitting diode (LED) to direct light onto a light-sensitive sensor. In the transmission form of detector, light from the LED is emitted directly towards the sensor. When the label is located between the LED and sensor, the label will block light from the LED and the sensor will not detect any light. Thus the presence of a signal from the sensor indicates the absence of a label. In the reflectance form of detector, the LED and sensor are located on the same side of the label. When a label is present, light from the LED is reflected off the label to the sensor. Thus the presence of a signal from the sensor indicates the presence of a label. The reflectance form of detector has the advantage of allowing the LED and sensor to be built into a single unit, which reduces parts count and assembly costs and eliminates the need to run separate wiring to two different parts of the printer.

[0006] With either type of detector, ambient light can be a problem. If ambient light is allowed to fall upon the light sensor, the resulting signal may be mistaken for light from the LED. Even when the light sensor is tuned to the particular frequency of the LED, the ambient light may contain that frequency in sufficiently strong quantities to be detected by the sensor. This problem is especially acute with printers which may frequently be used outdoors, where ambient light can be very strong.

[0007] Conventional printers using the transmission form of detector have tried to address this problem by placing an LED in the body of the printer, with a sensor in the hinged lid facing downward. Although this positioning does provide some shielding from ambient light, the protection is often not great enough in extremely bright environments. Since the media exiting the printer tends to fall downward, this increases the space between the sensor and the media, allowing ambient light to be reflected from the media into the sensor and further exacerbating the problem. In addition, placing the sensor in the hinged lid requires additional wiring and wire routing difficulties.

[0008] Using the reflected light approach, placing the LED and light sensor in the hinged lid also causes problems. As the media exits the printer, it tends to curve downward, which provides a poor angle of reflection so that less light from the LED falls on the sensor.

[0009] What is needed is a media-sensing system for a printer which accurately detects the presence of the print media, reliably excludes the effects of ambient light, and eliminates the need to route separate wiring to the light source and light sensor in different parts of the printer.

SUMMARY OF THE INVENTION

[0010] The invention includes a detector for sensing the absence of a print media from a predetermined location in a printer. The detector has 1) a light source having a control input and an optical output, 2) a light sensor having an optical input and a sensor output, and 3) a logic unit having a logic unit input coupled to the sensor output of the light sensor. A first logic unit output is coupled to the control input of the light source. A second logic unit output is coupled to additional circuitry to enable a print function. The first logic unit output alternately turns the light source on and off, and the logic unit determines after each transition whether light is sensed by the light sensor. The light sensor and light source are on the same side of the print media. If light is sensed when the light source is turned off, it is determined that the print media is not in place over the sensor, indicating that further printing can be enabled. If

light is not sensed when the light source is turned on, it is also determined that the print media is not in place over the sensor, also indicating that further printing can be enabled. All other sensor/source combinations will result in further printing being inhibited.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a perspective view of a printer containing the label detector.

FIG. 2 is a schematic of the connections between major components of the detector.

FIGs. 3A and 3B are schematics of the optical operation of the detector.

FIG. 4 is a flow chart of the media sensing logic.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] The present invention solves the aforementioned problems with a combination of strategic positioning of the LED and sensor and an intelligent interpretation of the light detected by the sensor. The invention uses the reflected light technique and positions both the LED and the sensor in the body of the printer underneath the media. Because gravity causes the ejecting media to curve downwards toward the printer body, the curvature of the media will aid in blocking ambient light from the sensor. This positioning also eliminates the need to run wires into the hinged lid for either the LED or the sensor.

[0013] Fig. 1 shows a printer 1 with detector 2 located in the ejection port 11 area at which print media 3 exits printer 1 after printing. Fig. 2 shows the major components of detector 2, including light source 6, light sensor 8 and logic unit 14. Logic unit 14 is electrically coupled to light source 6 and light sensor 8, and also provides output 16 to indicate whether printing of a new label is enabled or not. Light sensor 8 is positioned to receive light 10 from light source 6 under certain conditions, and may also receive ambient light 12. Figs. 3A and 3B show how light source 6 can detect ambient light 12 when no printed label is in place, and can also detect light from light source 6 when a label is in place over the light source/light sensor combination.

[0014] Fig. 4 shows how logic unit 14 can sequence through a series of steps to eliminate the ambiguity caused by ambient light. Logic unit 14 can alternately switch light source 6 on and off, checking the light sensor for detected light after each switching operation.

[0015] Any ambient light which does reach the sensor is accounted for by taking two readings. The first reading is taken with the LED turned off. Since an in-place label will sufficiently block ambient light, if the detector does detect light, it will be because no label is present and the detector is reading ambient light. If the detector does not detect light, then the LED is turned on and the detector checks a second time. If the detector does not detect light this time, it is because there is neither ambient light nor a label in place to reflect light, and the printer is allowed to print the next label, after which the newly-printed label is advanced into position over the LED/sensor and the detection cycle resumes. On the other hand, if the detector does detect light with the LED on, it can either be ambient light or light from the LED. This is checked by turning the LED off and reading the detector again. The detector logic can repeatedly cycle through these steps of turning the LED on and off and checking the sensor. The printer will be allowed to print a new label only when either 1) it senses no light with the LED on, or 2) it senses light with the LED off. Both conditions indicate the absence of a label over the detector, indicating the previously printed label has been removed.

[0016] The LED and sensor may be part of one component, tough slightly spaced apart, so that the light from the LED can be directed at an angle, such as a 45° angle, and be reflected back by the print media at a similar angle to the sensor. Such combination LED/sensors are commercially available.

[0017] FIG 1. shows a printer 1 with a body 4 and a hinged lid 5. Print media 3 can be in the form of a paper roll, which feeds out the front of printer 1 at media ejection port 11. Ejection port 11 is typically a slot formed between lid 5 and body 4 when lid 5 is closed, but could also take other configurations. Print media 3 can use tear-off or peel-off labels, or can be in any other form that allows each label to be individually removed from the printer after it is printed. Label detector 2 is located near the front of body 4 and is positioned so each label will cover detector 2 after the label has been printed, but will leave detector 2 uncovered after the printed label is removed from the printer. Printer 1 may also contain electrical and electronic components for advancing media 3 forward and for controlling the printing function. These functions are known in the art and are not described herein.

[0018] FIG. 2 shows a schematic of the optical and electrical connections between major components of the detector. Light source 6 has an optical output 22 which can emit light 10 under the control of electrical input 20. A preferred embodiment uses a binary signal at input 20 to switch an LED light source on or off at output 22, thus creating a switchable light source. Light sensor 8 has an optical input 24 which can sense the presence or absence of light 10, but optical input 24 typically cannot distinguish between ambient light 12 and light from light source 6. Electrical output 26 indicates the presence of light at input 24, but output 26 also generally does not distinguish between ambient light and light from light source 6. The sensed light can therefore be generically called detection light. In a preferred embodiment, output 24 produces a binary signal that indicates whether or not the detection light at input 24

exceeds a predetermined intensity threshold. Since it is unfeasible to screen out all unwanted light, this predetermined intensity threshold allows the light sensor to avoid false triggers caused by the small amounts of stray light which may inadvertently reach optical input 24. An LED is the preferred choice for light source 6 because of its wide commercial availability, low cost, and use of visible light which allows visual verification of its operation. However, other light sources could also be used, provided sensor 8 is properly chosen to detect the type of light thus produced.

[0019] The signal from output 26 is coupled to input 28 of logic unit 14. Logic unit 14 includes two outputs. Output 18 is connected to input 20 of light source 6, where it can be used to control the output of light 10. The signal on output 18 can be a binary signal which is used to switch light 10 on and off under control of logic unit 14. Logic unit 14 also has a second output 16, which provides an enablement signal to the printer control circuit (not shown). This signal can be a binary signal that indicates whether printing of the next label is permitted or not.

[0020] FIGs. 3A and 3B show the optical operation of a preferred embodiment of detector 2. Light source 6 and light sensor 8 can be incorporated into a single detection assembly 7. When turned on, light source 6 emits light beam 10. Light source 6 can be placed at the bottom of an angled, recessed cavity in assembly 7, so that light beam 10 emanates in a substantially uniform direction. FIG. 3A shows the optical operation with no label in place. Light beam 10 is not reflected to light sensor 8, but rather emanates outwardly and is eventually disbursed or absorbed by whatever materials it encounters. However, ambient light 12 may reach light sensor 8. Depending on the characteristics of light sensor 8 and ambient light 12, this condition may trigger a signal at sensor output 26 that is equivalent to that generated when a label is in place.

[0021] FIG. 3B shows detector 2 with a printed label 9 in place. Label 9 represents a part of print media 3 which has been partially ejected and is ready for removal from printer 1. In this configuration, ambient light 12 strikes label 9 and is reflected away, so that it does not reach light sensor 8. When light source 6 is turned on, light beam 10 strikes the underside of media 9 and is reflected back onto light sensor 8, which can be located in an angled, recessed cavity in assembly 7 to minimize the reception of ambient light by sensor 8. When light source 6 is turned off, neither light from light source 6 nor ambient light reaches sensor 8. Of course, it is not entirely correct to say that no light reaches light sensor 8. With a label in place, a small amount of ambient light might pass through the label into sensor 8, or somehow reach the underside of the label where it will be reflected into sensor 8. With no label in place, a small amount of light from light source 6 might reflect off various internal printer parts and reach sensor 8. These small amounts of stray light are considered 'noise level' light. However, most commercial light detectors are designed to indicate the reception of light only when the sensed light exceeds a predetermined threshold. In a preferred embodiment, this predetermined threshold will be greater than the noise level light, so that noise level light will be ignored by sensor 8.

[0022] Comparing FIGs. 3A and 3B, it can be seen that when light source 6 is turned on and ambient light 12 is strong, light sensor 8 can produce a similar output signal whether print media 9 is in place or not. It is this ambiguity which must be overcome.

[0023] FIG. 4 shows the detector logic used to resolve this ambiguity. Readings are taken from light sensor 8. If sufficient light strikes light sensor 8, it will produce an electrical signal corresponding to a detector ON status. Two readings are taken. One is taken with the LED light source turned off, as shown in blocks 30 and 32. Since a label that is in place will sufficiently block ambient light, if the detector does detect light it will be because no label is present and the detector is reading ambient light. The logic will then branch to block 38, which permits printing of a new label. However, if the detector does not detect light at block 32, the LED is turned on at block 34 and the detector status is read again at block 36. If the detector does not detect light, it is because the detector is not receiving ambient light and there is no reflected light from the LED, a combination that indicates no printed label is covering the detector and ambient light is too weak to be detected. The logic will then branch to block 38, which permits printing of a new label. On the other hand, if light is detected at block 36, it could be either ambient light or LED light reflected from a printed label. This is checked by turning the LED off at block 30 and reading the detector again. If the detector senses light at block 32, it is ambient light and the algorithm advances to block 38 to permit printing of a new label. As can be seen, blocks 30, 32, 34 and 36 form a continuous loop, indicating printing is not to be enabled. It is only when light sensor 8 detects light with the LED turned off or detects no light with the LED turned on that the print media is in a suitable configuration for printing, and the logic will advance to block 38 to permit printing of the next label. Once this printing takes place, the logic enters the loop again at block 30.

[0024] The aforementioned logic eliminates the ambiguity caused by ambient light by using a two-step process which checks the light sensor with the LED on and again with the LED off. This two-step process allows the logic to determine when a signal from the light sensor is being caused by ambient light and when it is caused by reflected light from the LED. Since ambient light is no longer a problem, there is no need to take special precautions in printer design to prevent any ambient light from reaching the sensor. This simplifies printer design and makes it feasible to operate the printer outdoors in sunlight, where ambient light is always present and is frequently intense.

[0025] The aforementioned logic may be incorpo-

rated trough any standard form, such as a microprocessor or microcontroller, programmable gate array, state machine, or hard-wired circuitry. It may be implemented in a logic unit dedicated to the label detection function, or may be incorporated into a logic unit which also performs other functions.

Claims

1. A detector for detecting the absence of a print media from a predetermined location in a printer, the detector comprising:

a light source having:

a control input;
an optical output;

a light sensor having:

an optical input;
a sensor output; and

a logic unit having:

a logic unit input coupled to the sensor output;
a first logic unit output coupled to the control input; and
a second logic unit output.

2. The detector of claim 1, wherein the light sensor is disposed in a position for detecting the presence of light from the optical output only when the media is in a predetermined location.

3. The detector of claim 2, wherein the predetermined location is a media ejection port.

4. The detector of claim 1, wherein the optical output is a light emitting diode.

5. The detector of claim 1, wherein the first logic unit output includes a first binary electrical signal.

6. The detector of claim 1, wherein the second logic unit output includes a second binary electrical signal.

7. The detector of claim 6, wherein the second logic unit output is coupled to a function control circuit.

8. The detector of claim 7, wherein the second logic unit output is coupled to a print control circuit.

9. The detector of claim 1, wherein the logic unit is a microcontroller.

10. The detector of claim 1, wherein the light source and the light sensor are a single integrated unit.

11. A detector for detecting the absence of a print media from a predetermined location in a printer, the detector comprising:

means for generating controllable light;
means for sensing the controllable light and for sensing ambient light; and
a logic unit having:

means for responding to the means for sensing;
means for controlling the controllable light; and
means for indicating enablement of a function.

12. The detector of claim 11, wherein the means for sensing includes:

means for sensing the controllable light only when the media is in a predetermined location; and
means for sensing the ambient light only when the media is not in the predetermined location.

13. The detector of claim 12, wherein the predetermined location is a media ejection port.

14. The detector of claim 11, wherein the means for generating is a light emitting diode.

15. The detector of claim 11, wherein the means for controlling includes means for turning the controllable light on and off.

16. The detector of claim 11, wherein means for sensing includes:

means for determining when at least one of the controllable light and the ambient light exceeds a predetermined threshold at the means for sensing; and
means for determining when both the controllable light and the ambient light are less than the predetermined threshold at the means for sensing.

17. The detector of claim 11, wherein the means for indicating includes a means for indicating enablement of a print function.

18. A method for detecting an absence of a print media from a predetermined location in a printer, comprising the steps of:

alternately turning a light source on and off;

sensing a presence of light with a light sensor;

sensing an absence of light with a light sensor;

detecting the absence of the media from the predetermined location when the light source is off by sensing the presence of light; and

detecting the absence of the media from the predetermined location when the light source is on by sensing the absence of light.

19. The method of claim 18, wherein the step of sensing a presence of light includes the step of sensing light from the light source reflected by the media to the light sensor.

20. The method of claim 18, further comprising the step of enabling a function when the absence of the media is detected.

21. The method of claim 20, wherein the step of enabling includes the step of enabling a print function.

22. The method of claim 18, wherein the step of sensing a presence of light includes the step of sensing ambient light.

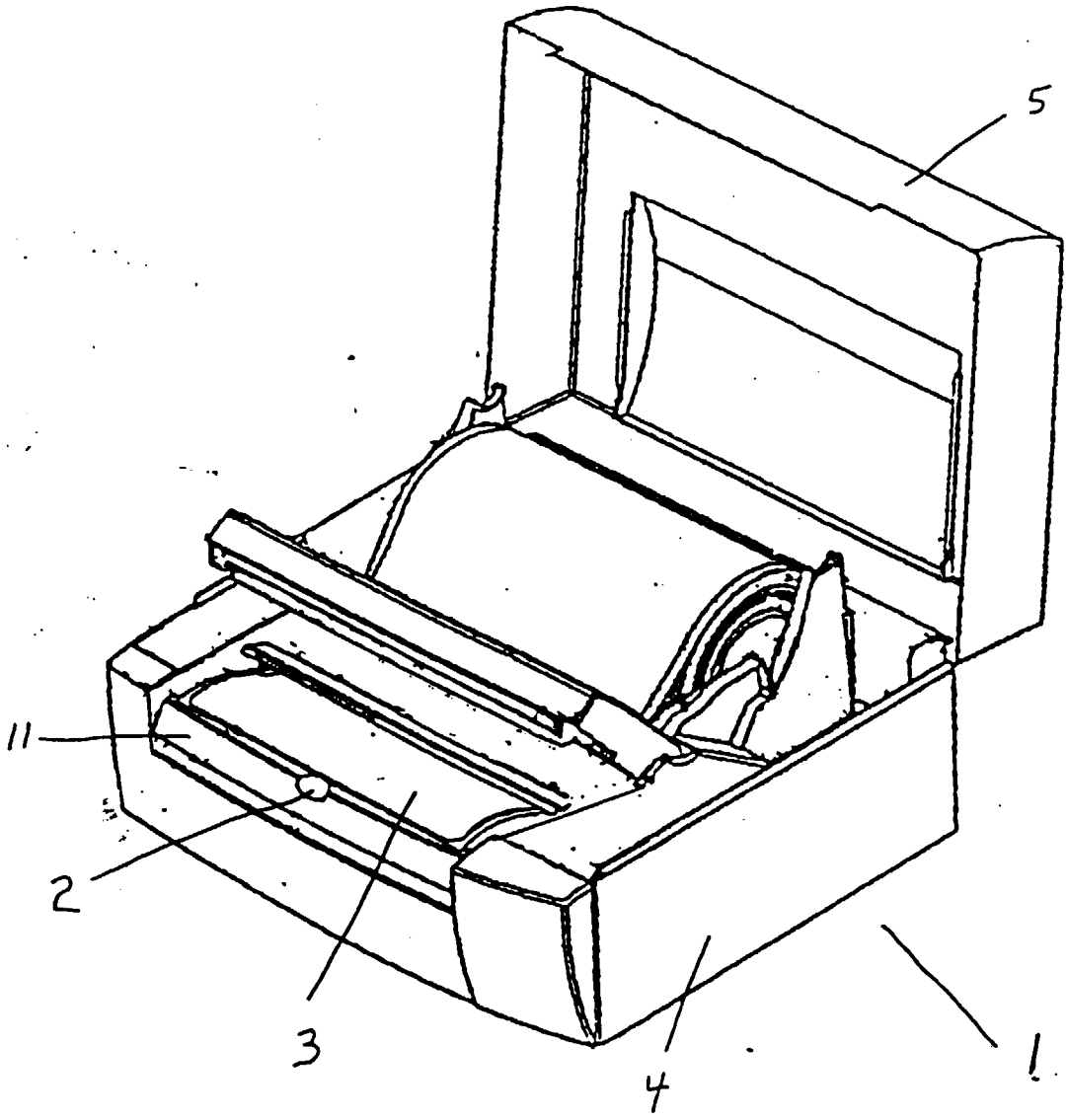


FIG. 1

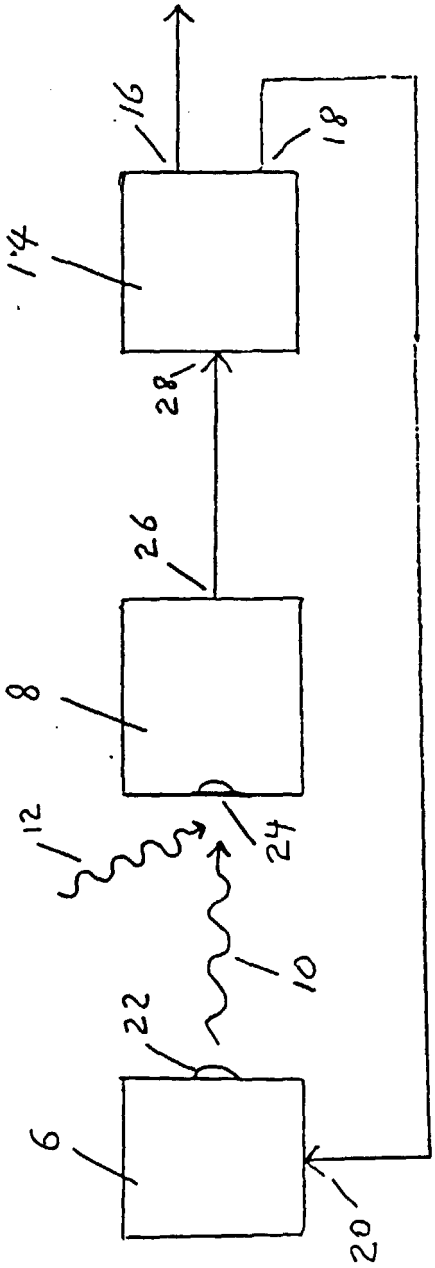


FIG. 2

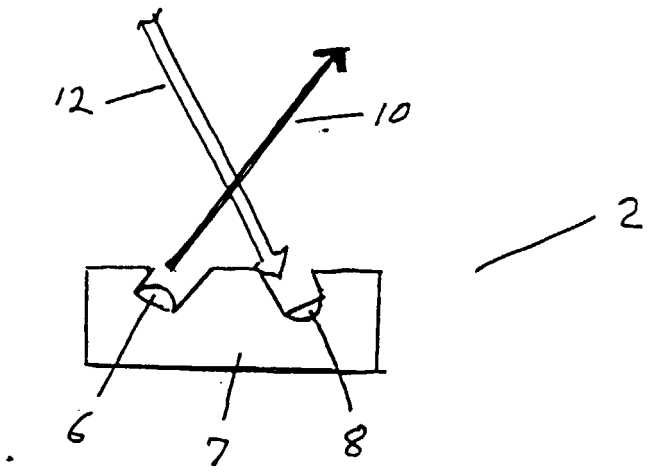


FIG. 3A

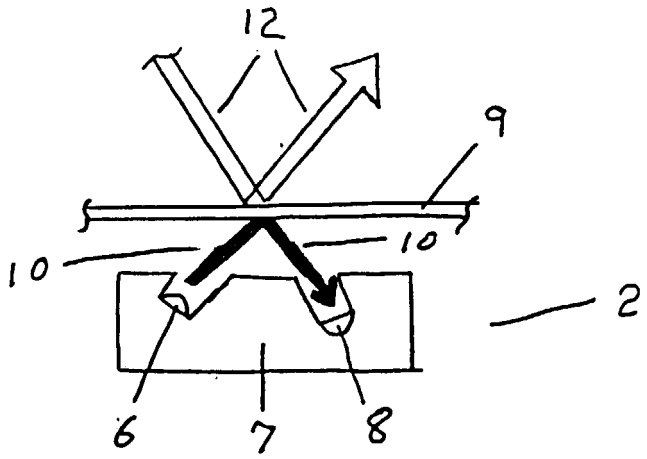
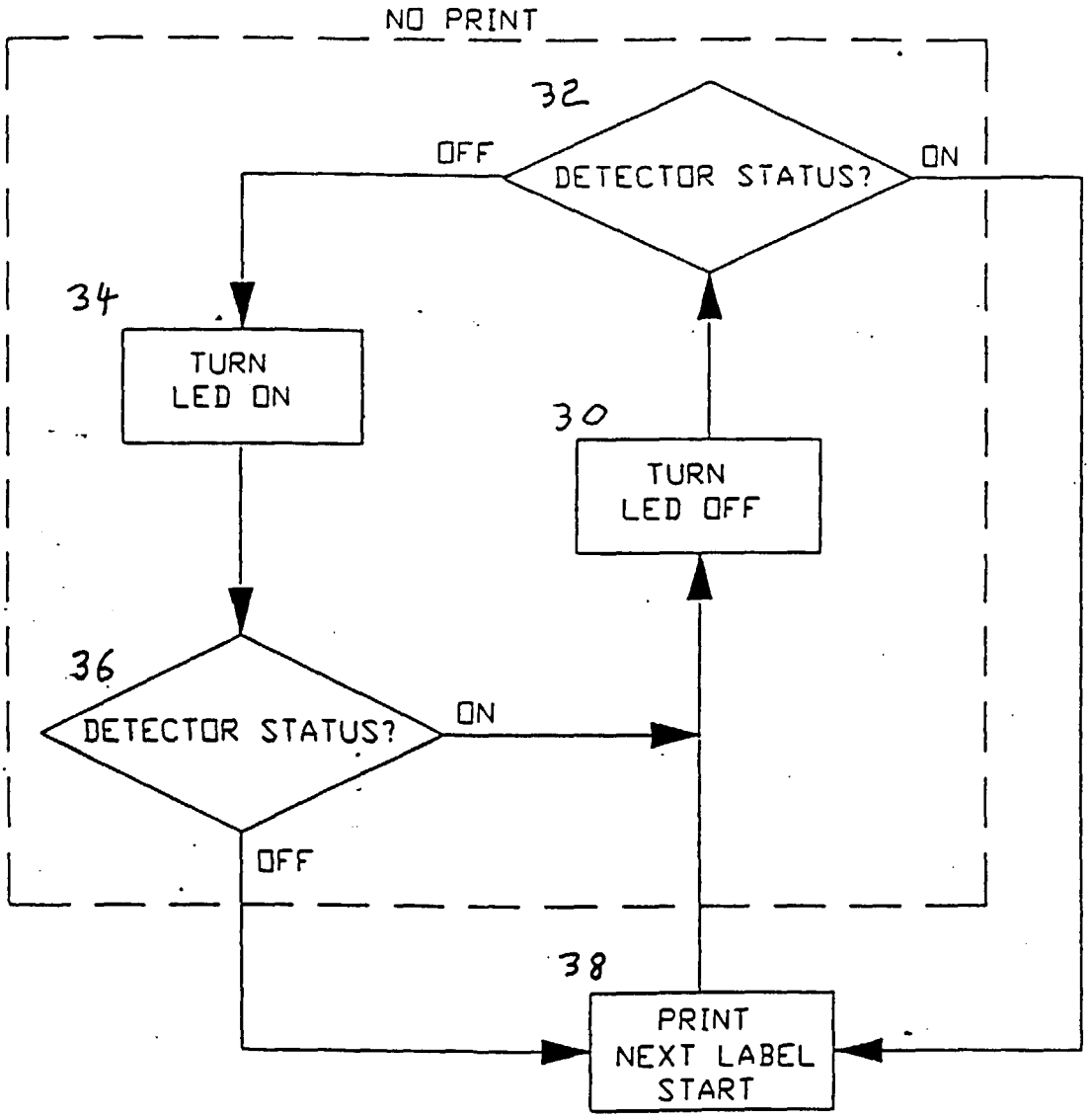


FIG. 3B


NO PRINT
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30
TURN
LED OFF
36
DETECTOR STATUS?
ON
OFF
38
PRINT
NEXT LABEL
START

FIG. 4