United States Patent [19]

Husome

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[54] **OPTICAL LABEL INSPECTING APPARATUS**

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[52] **U.S. Cl.**..... **250/223**, 209/111.7, 356/240

[51] **Int. Cl.**.. **B07c 5/342**, G01n 21/16, G06m 7/00

[58] **Field of Search** ..... 250/223 B, 223; 356/240; 209/111.5, 111.7

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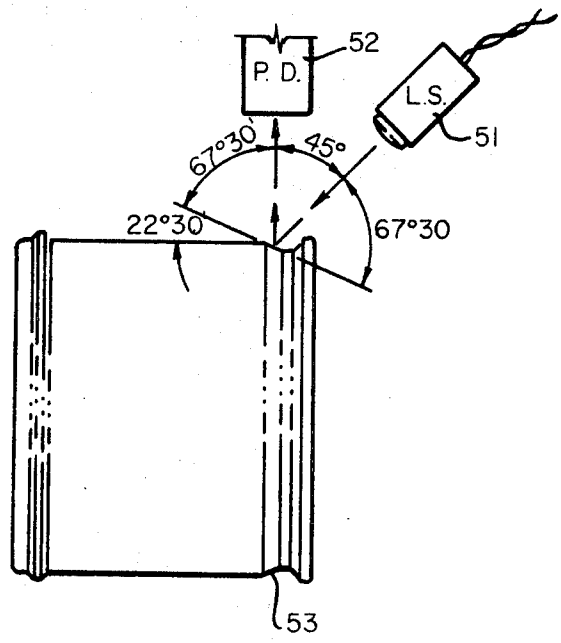
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[57] **ABSTRACT**

A container label inspector apparatus utilizing light reflected from the container to detect a missing or misapplied label on tin, aluminum, glass, or other reflective containers and serving to reject containers having missing or misapplied labels.

2 Claims, 4 Drawing Figures



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SHEET 1 OF 3

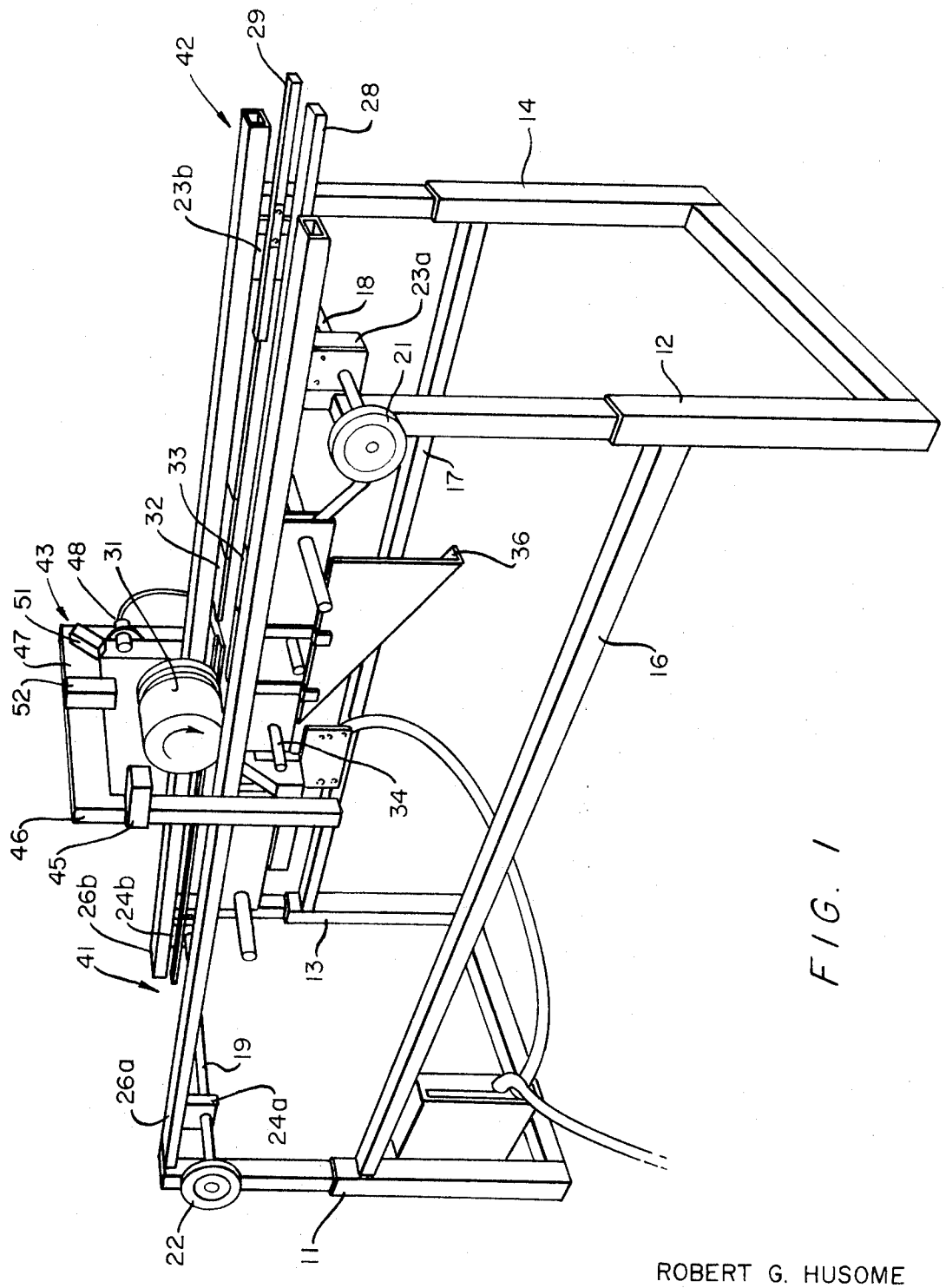


FIG. 1

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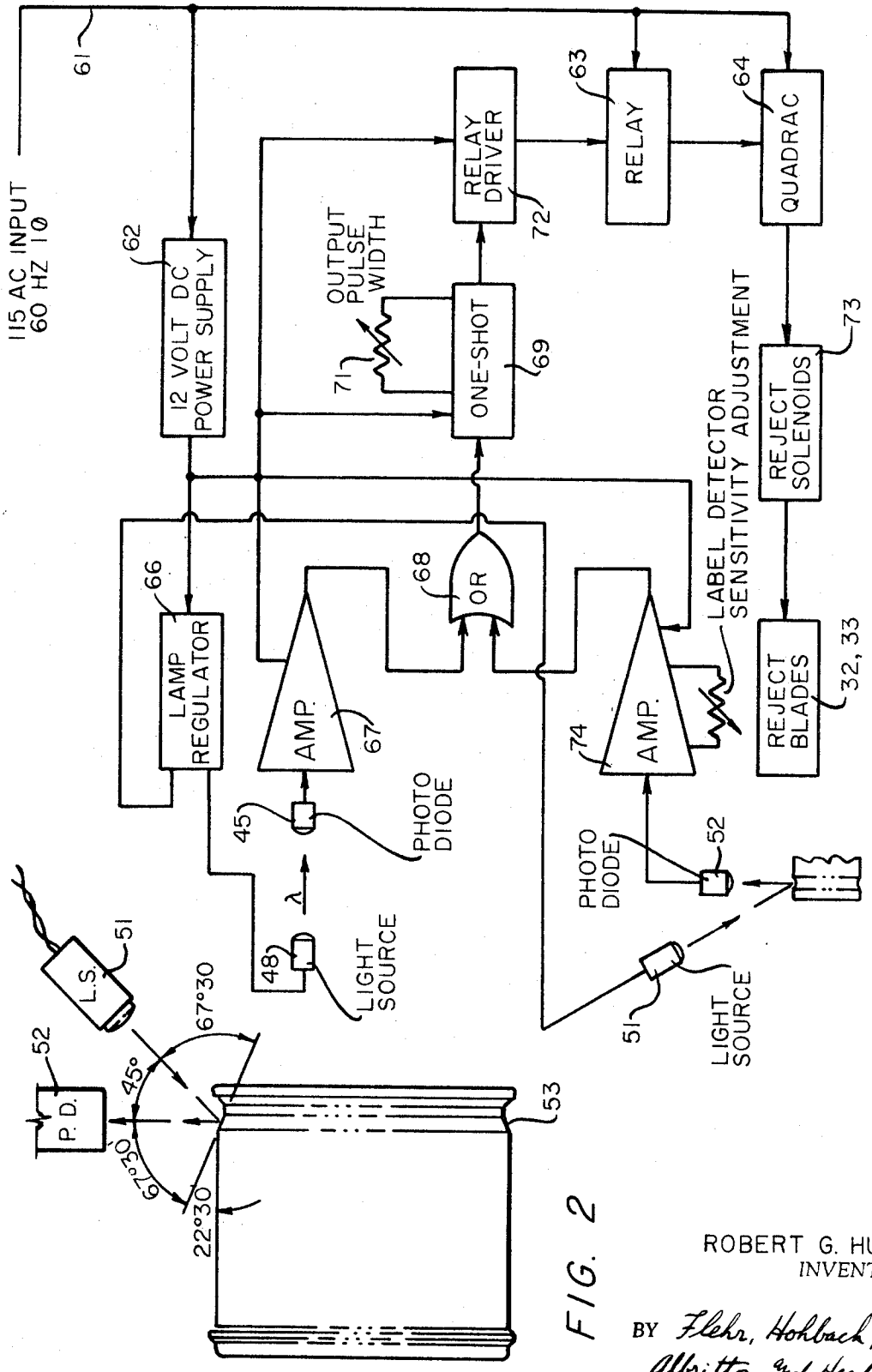


FIG. 3

FIG. 2

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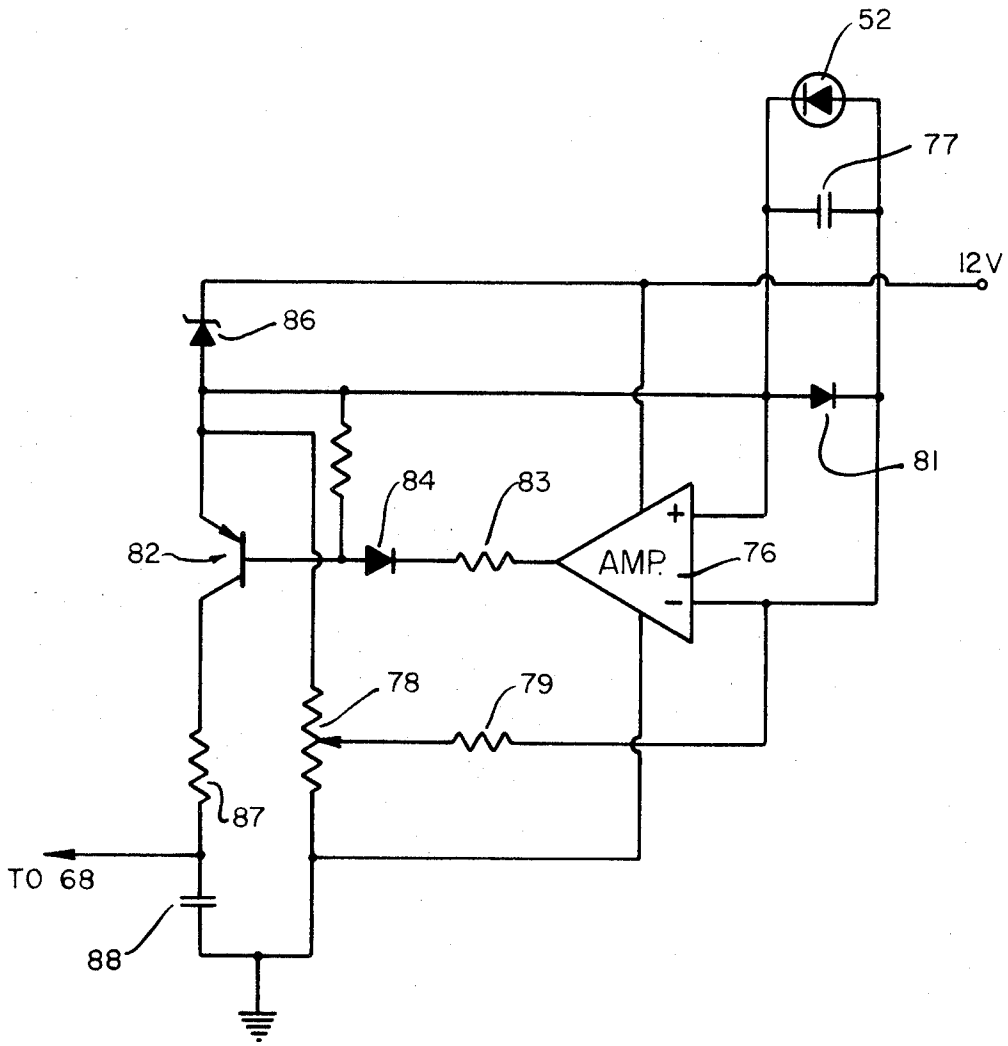


FIG. 4

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OPTICAL LABEL INSPECTING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates generally to label sensors and more particularly to optical label sensors. In the canning industry, labels are generally placed on glass, tin and aluminum containers by a labelling machine. The containers leaving the labelling machine are inspected to assure that the labels have been properly applied. When a misapplied or missing label is detected, the container is rejected.

Prior art devices for inspecting containers have depended upon the conductivity of the container to thereby either provide a circuit between a feeler disposed to engage one end of the can and the container, or no circuit, indicating that a label is present and properly applied.

Such apparatus has not been useful in connection with anodized aluminum containers wherein the surface coating forms an insulating layer, or with glass containers.

OBJECTS AND SUMMARY OF THE INVENTION

It is a general object of the present invention to provide a label inspecting apparatus which can be used in connection with containers having conductive and nonconductive surfaces.

The foregoing and other objects of the invention are achieved by a label inspection machine in which the container is guided by guide rails past an inspection station disposed along said lay rail. A light source projects a light beam parallel to the surface of the container towards a detector and serves to detect end flaps which have not been properly secured to the can. Furthermore, the machine includes a second light source which projects a beam of light onto the container near one end and a photoelectric cell disposed to receive the reflected light beam and provide an increased output signal when a label is not present or is misapplied.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic diagram of a label inspection machine in accordance with the present invention.

FIG. 2 is an enlarged view of the label inspection device used in connection with an aluminum container.

FIG. 3 is a block diagram showing the electrical circuit which is responsive to an increase in reflected light from the container or interrupted light by the label.

FIG. 4 is a detailed circuit diagram of the amplifier associated with the reflected light photodiode.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the apparatus includes two pairs of spaced support legs **11, 12** and **13, 14.** The legs include telescoped sections to provide a height adjustment. Stabilizing members **16** and **17** are disposed longitudinally on the apparatus and secured to the spaced legs **11, 12** and **13, 14,** respectively. Lead screws **18** and **19** are supported by the legs **12, 14** and **11, 13,** respectively. Wheels **21** and **22** are associated with the lead screws **18** and **19** to rotate the same. The lead screws threadably receive support members **23*a*, 23*b*** and **24*a*, 24*b*** which support spaced longitudinal rails **26*a*, 26*b***, respectively. The lead screws include oppositely threaded sections whereby rotation in one direction serves to move the rails **26*a*** and **26*b*** apart and in the opposite direction thereby moving the rails together. The rails are adapted to abut the two ends of the containers to guide them as they roll on the spaced longitudinal support rails **28** and **29.** The rails **28** and **29** are supported on the rails **26**a and **26**b. The support rails **28** and **29** include blade portions **32** and **33** which are moved by a solenoid **34.** When the solenoid is energized, the rail portions **32, 33** move outwardly and the container **31** is no longer supported and falls into reject chute **36.**

In operation, the container **31** is applied at the end **41** of the apparatus. With the rails being slightly inclined, the container rolls downwardly toward the end **42** past inspection station **43.**

The inspection station **43** includes arms **46** and **47** supported from the rails **26**a and **26**b. The arm **46** serves to support a photodetector **45.** The height of the detector is adjustable along the arm **46.** The arm **47** supports a light source **48** which projects a beam parallel to the top edge of the can towards a detector **45.** The height of the light source is adjustable whereby it can be aligned with the photodetector. The light source and the photodetector serve to detect whether the ends of the label have been suitably secured. If the label ends have not been suitably secured, they intercept the light beam and generate an electrical signal which is employed, as will be presently described, to generate a reject signal.

A second light source **51** and photodetector **52** are placed whereby the detector **52** receives light reflected from the surface of the container **31.** Making reference particularly to FIG. **2,** the container shown is an aluminum container with a reinforcing ring or indenture **53.** The light source projects a light beam on the surface **54** which reflects the light upward to the photodetector **52.** The photodetector is mounted in a lens tube assembly which provides a field of view which is clearly defined and limited to a narrow segment of the conical surface of interest whereby extraneous light and the like is rejected. It is preferable to employ specularly reflected light. Consequently, the light source and photodetector are located so that the angle of incidence of the light from the source and the viewing angle of the detector are equal.

If a label is properly applied, the reinforcing ring is covered and very little light is reflected by the label into the photodetector, whereas if the ring is missing, substantial light is reflected. When the amount of light striking the photodetector exceeds the level represented by light reflected from a label, a reject signal is generated.

Referring to FIG. **3,** the electrical circuitry associated with the lamps and photocells is shown in block diagram. The input from the supply line **61** is applied to a d.c. power supply which converts 60 hertz single phase voltage to a **12** volt d.c. voltage. The supply line is also connected to relay **63** and quadrac **64.**

The output from the 12 volt d.c. supply is applied to lamp regulator **66** which regulates the voltage and applies a voltage to the light sources **48** and **51** previously described. The photodetector or photodiodes **45** and **52** are shown receiving the direct and reflected light respectively. The output from the photodiode **45** is applied to an amplifier **67** which includes filter means for filtering out noise pulses which might be present in the industrial environment. This prevents the noise pulses from causing spurious operation. The amplifier pro-

vides a negative output pulse whenever the light path is interrupted. The negative pulse is applied to the OR gate **68**. The output from the OR gate drives one-shot multivibrator **69**. The pulse width of the one-shot multivibrator is adjusted by width adjustment **71**. The output of the multivibrator is applied to relay driver circuit **72** to drive the relay **63** which controls quadrac **64**. The quadrac controls the application of power to the reject solenoid **73**. When the solenoid is energized, the reject blades **32, 33** are withdrawn to reject the mislabelled container. Thus, a negative pulse from photodiode **45** due to loose flaps on the label forms a negative pulse which controls the reject solenoid to reject the container.

The amplifier circuit **74** receives the signal from the photodiode **52** and processes the positive signal to give a negative output pulse when the label is misapplied. The negative pulse is applied to the OR gate to thereby operate the solenoid in the manner just described to reject the container. The amplifier **74** includes a sensitivity control for controlling the sensitivity of the circuit to thereby provide a means for differentiating between light reflected from labels and that reflected from the surface of the container.

FIG. **4** is a detailed circuit diagram of the amplifier **74** which provides the negative output pulse when there is a misapplied label, which pulse is then employed to reject the container. Photodiode **52** is connected to the input terminals of an integrated circuit operational amplifier **76**. Capacitor **77** is connected across the input terminals of the amplifier **76** and filters out noise pulses which might be present in the industrial environment, preventing them from causing spurious operation. The cathode lead of the photodiode **52** is connected to the non-inverting input of amplifier **76** and also a d.c. voltage produced by Zener diode **77** and resistor **78** is connected to this terminal. The anode of the photodiode **52** is connected to the inverting input of the amplifier **76** and via a resistor **79** connected to potentiometer **78**. The voltage on the arm of the potentiometer **78** is adjustable between zero and a plus voltage regulated by Zener diode **86**. This arrangement supplies a reverse bias current to the diode **52** adjustable from zero to a current corresponding to the voltage. For example, the voltage might be adjustable from zero to +7 volts and the current would vary from zero to 7 microamps, if resistor **79** was 1 megohm.

When the diode **52** is not illuminated by reflective light, the bias current causes a voltage drop across the amplifier **76** inputs. Diode **81** limits the voltage drop to about 0.6 volts maximum. The polarity of this voltage drop is minus at the inverting input of the amplifier **76** with respect to the non-inverting input, causing the output of the amplifier to become positive.

When diode **52** is illuminated, its photocurrent opposes the bias current supplied through the resistor **79**. With sufficient illumination, its photocurrent will exceed the bias current causing a reversal of polarity at the input of the amplifier **76**. When this occurs, the output of the amplifier **76** goes negative (towards ground). Since resistor **78** adjusts the bias current, it also sets the photocell light level required to change the polarity of the input of the amplifier **76**. When setting up the machine, the resistor **78** is adjusted so that amplifier **76** output remains positive when a labelled can is present but goes negative when an unlabelled container is centered under the photocell lens tube assembly. The output of the amplifier **76** drives the base of transistor **82** via resistor **83** and diode **84**. As long as the output of the amplifier **76** is positive, diode **84** is reverse biased and the transistor **82** remains turned off. When the output of the amplifier **76** goes negative indicating the presence of an unlabelled or mislabelled can, diode **84** conducts current to the base of the transistor **82** turning it on. The collector of the transistor **82** is coupled to the timing circuits, resistors **87** and capacitor **88** of the machine and conduction of transistor **82** results in a pulse to the OR gate **68**, which pulse then activates the reject mechanism previously described.

Thus, it is seen that there has been provided a label inspection machine which serves to reject the containers having no labels or misapplied labels or containers in which the end flaps of the label are not firmly affixed. The system is simple in operation and is adaptable for use with not only cans which have conductive surfaces, but also with aluminum cans having an insulating film on their surface and with glass containers.

I claim:

1. In a container label inspection machine including guide rails for receiving and guiding containers, an inspection station disposed along said rails for inspecting a container having a reinforcing ring in the form of a V-shaped groove, said container adapted to move past said station and rejection means responsive to a reject signal for rejecting defectively labelled containers, the improvement comprising a light source for projecting a light beam onto one surface of said groove, means including a photoresponsive device mounted in a lens tube assembly to provide a defined, limited field of view whereby to reject extraneous light and receive light reflected from said surface of the groove, said means including said photoresponsive device and said light source located so that the angle of incidence of the light and the angle of the field of view are equal whereby said photoresponsive device receives specularly reflected light, said photoresponsive device serving to provide an electrical output signal when the reflected light exceeds a predetermined level to provide a reject signal to said rejection means to reject a defectively labelled container.

2. A container inspection label machine as in claim **1** wherein said container is an aluminum container having a reinforcing rim and said light source projects a light beam onto one surface of said rim and said photoresponsive device is disposed to receive specular reflections from said surface and provide the electrical signal for the control means.

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