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United State
Rashkin

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[54] APPARATUS FOR DETECTING, QUANTIZING AND DISPLAYING THE POSITION OF REGISTRATION MARK ON A SHEET

[72] Inventor: **Allyn S. Rashkin,** Ramsey, N.J.

[73] Assignee: **GAF Corporation,** New York, N.Y.

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[52] **U.S. Cl.**.....**356/172,** 250/219 DR, 250/227, 317/127

[51] **Int. Cl.**.....**G01b 11/26,** G02b 5/14, H01h 47/24

[58] **Field of Search**.....356/172; 250/219 DR, 227; 317/127

[56] **References Cited**

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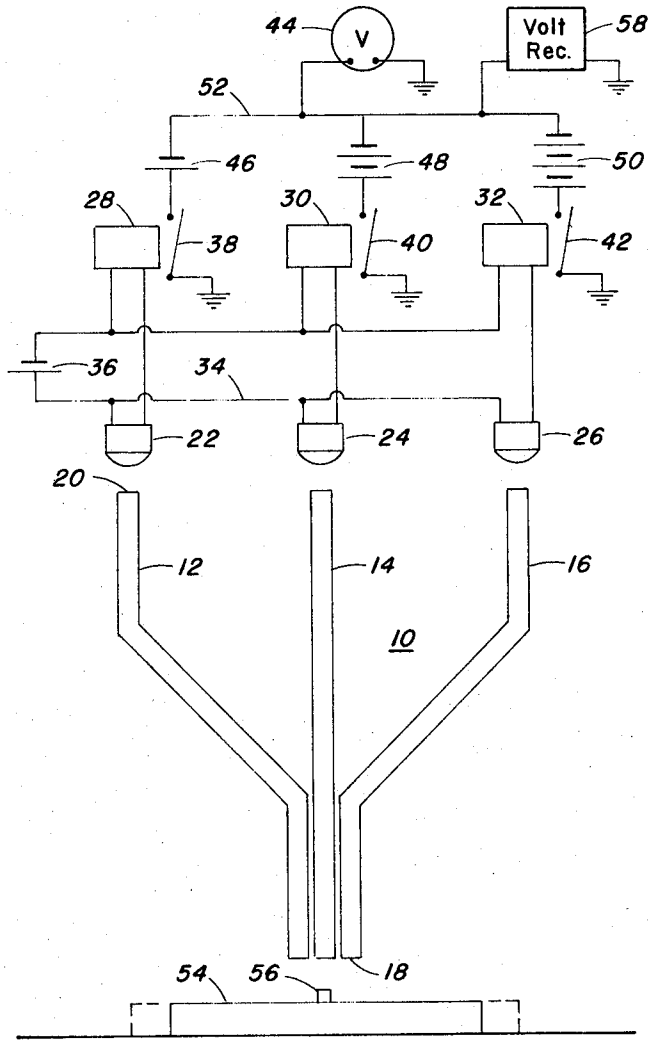
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Primary Examiner—James W. Lawrence
Assistant Examiner—T. N. Grigsby
Attorney—Walter C. Kehm, Samson B. Leavitt and Martin Smolowitz

[57] **ABSTRACT**

As the title sheet carrying an index registration stopping mark comes to rest, the surface of the sheet in the vicinity of the mark is viewed by a plurality of photocells, each through its individual fiber light guides having their objective ends located directly above the sheet. When the mark is viewed by one of the photocells, a corresponding relay is operated, applying a pre-selected voltage the valve of which corresponds to the relative position of the mark, to a voltage recorder, which thus provides a history of the several positions of rest of successive sheets in tile cutting for detecting and correcting any indexing errors.

6 Claims, 2 Drawing Figures



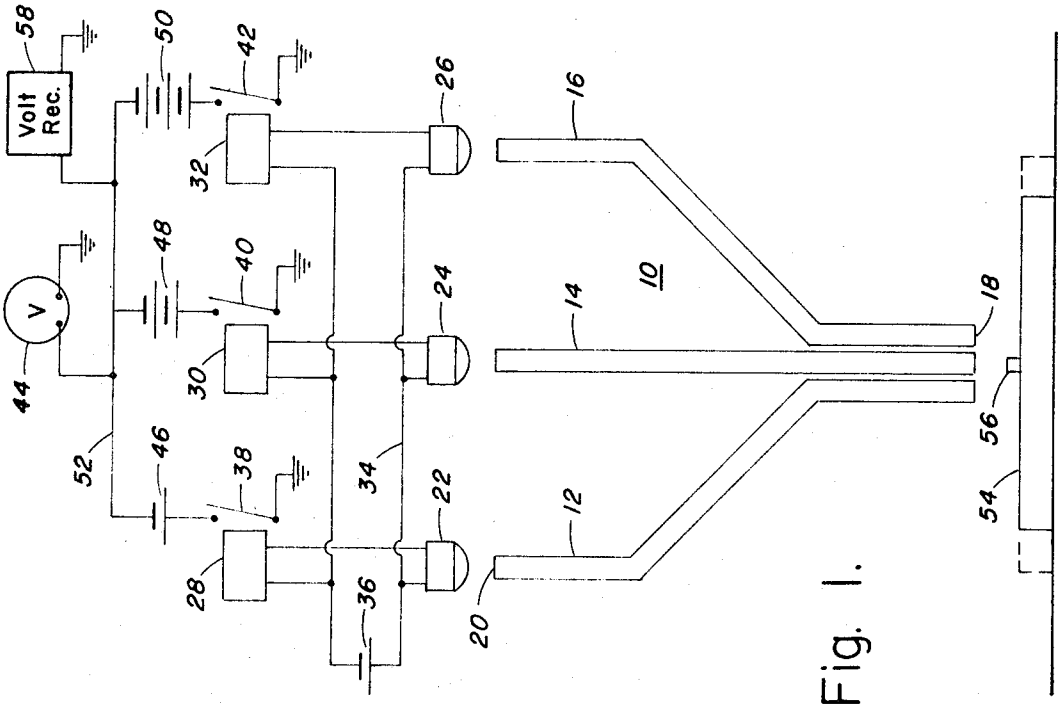


Fig. 1.

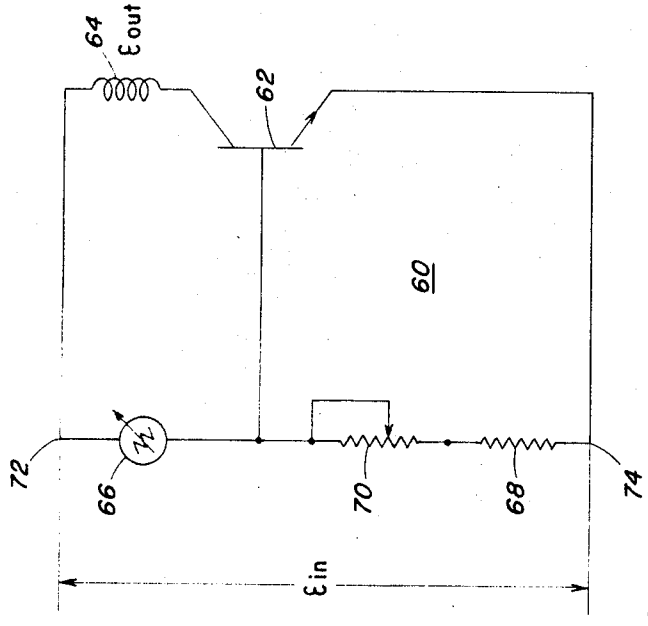


Fig. 2.

INVENTOR.
ALLYN S. RASHKIN

BY

Martin Smolowitz
ATTORNEY

APPARATUS FOR DETECTING, QUANTIZING AND DISPLAYING THE POSITION OF REGISTRATION MARK ON A SHEET

This invention relates to tile cutting, and more particularly to apparatus for detecting the exact index position of a registration mark on the tile sheet when the latter is at rest.

The overall aim of the device is to detect variations in stopping distance of the index mark. This is done by producing a voltage which is a function of the index mark position when the sheet has stopped. This is accomplished in the following manner:

a. A set of fiber optics light guides of substantially equal diameter are lined up side by side with their ends even and held fast in this position. On the other end the light guides are separated and a photocell attached to each one in a manner such that any and all light transmitted through the light guide is directed to the photocell receiving face.

b. An electrical circuit is provided with a relay coil, photocell and voltage supply in series. The photocell and relay coil resistances are selected such, that when light strikes the photocell the resistance goes down enough to allow the resulting voltage across the relay coil to activate the relay.

c. When the relay is activated and the contacts close, a preset voltage flows through the closed contacts to a voltage strip recorder. Each fiber optics light guide has its own assigned voltage according to the position of the lightguide. Thus, by noting the voltage on the strip recorder it is possible to tell at what position the sheet is stopping, what the past history has been, and if any sequential or cyclic error exists.

The invention is employed to record the accuracy with which prior index equipment is functioning that stops the tile sheet when the printed mark at the edge of the sheet is sensed by a photo-electric device which activates mechanical equipment to stop the sheet at the proper position under the tile cutting die.

In the drawing:

FIG. 1 is a diagrammatic view of apparatus illustrative of the invention.

FIG. 2 is circuit diagram of a transistorized relay circuit used in the invention.

As shown in FIG. 1, a set **10** of fiber optic light guides **12, 14** and **16** of equal diameter are lined up side-by-side, with their ends **18** and **20** even and held fast in this position. Ends **18** can be called the objective. The other ends **20** are separated and a photocell **22, 24** and **26**, respectively, is closely associated with each light guide **12, 14** and **16**, in such manner that all of the light is transmitted through the corresponding light guide to the photocell receiving face.

Each photocell **22, 24, 26** is connected to the coil of a relay **28, 30, 32** by a circuit **34** provided with a source **36** of electric power, so that when a photocell is activated, the corresponding relay coil is energized. This closes a corresponding relay switch **38, 40, 42**, and applies a preselected voltage to a voltmeter **44** from a voltage source **46, 48, 50** via circuit **52**. The voltage sources **46, 48** and **50** have different voltages, each voltage being different from the other: 2, 4 and 6 volts, for example.

Thus, assuming number **54** comes to rest with registration mark **56** in view of light tube **14**, photocell **24** is activated operating relay **30**, closing switch **40** and thereby applying the preselected voltage (4 volts) to voltmeter **40**. This indicates that mark **56** occupies the corresponding position in view of light tube **14**. Similarly, when the mark **56** is viewed by light tube **12**, 2 volts are applied to the voltmeter; and 6 volts when the mark **56** is viewed by tube **18**.

Referring to FIG. **2**, a transistorized relay photocell circuit **60** of the type which may be employed by this invention is illustrated which comprises a (3050) transistor **62** in the circuit with relay coil **64** and photocell **66**. The circuit also includes a fixed resistor **68** and an adjustable resistor **70**. Terminals **72** and **74** are connected to 13 volt source ϵ in. Thus, when light strikes the photocell **66**, the transistor **62** is triggered, and the resulting current through relay coil **64** increases and activates the corresponding relay switch.

The invention thus enables an operator to detect the stopping position of a registration mark with a resolution proportional to the width of one of its internally reflecting (fiber optic) light guides. Connecting a voltage recorder **58**, FIG. **1**, to the output allows a history of the registering process to be made which, in turn, aids in the analysis of registration system faults (detection of cyclic errors, etc.). This device will with a simple circuit change detect various types of registration marks such as a light mark on a dark background, a dark mark on a light background or a dimension change type mark such as a hole or lump in the strip or sheet being registered. It can be used as the basis for a system of measuring the distance between registration marks and detecting any error which might exist.

The following changes may be made in the specific example cited above in order to alter the device for various applications without losing its advantages:

a. The type of lightguide may be changed. Below are three examples

1. Plastic fibers
2. Glass fibers
3. Tube with highly reflective material lining the walls.

b. The type of detector may be changed for different electrical or optical characteristics (sensitivity, spectral response) in order to suit various situations.

c. The type of relay may be changed in order to vary electrical characteristics and sensitivity or response time.

The present invention has been specifically described with respect to a tile cutting operation; however, the scope of the invention is not intended to be limited by such illustrative description. It should be pointed out that the invention may be employed in any operation where precise detection of a mark on a moving sheet is required.

What is claimed is:

1. Apparatus for detecting the relative position of a registration mark on a movable member when said member is stationary, with respect to a preselected point of registration for such mark, comprising in combination:

a plurality of light guide means arranged to individually view the surface of said stationary member including such mark in the vicinity of such preselected point;

an individual photocell associated with each of said light guide means, whereby one is responsive to such mark when the member comes to rest, in view of the corresponding light guide means;

a relay circuit associated with said photocells comprising a separate relay coil connected to each photocell,

a different voltage source of voltage in circuit with each relay switch, and

a voltmeter connected to indicate the relative value of the voltage of the voltage source corresponding to the relay that is activated by energization of the particular photocell associated with the light guide means which views the registration mark on said member.

2. The invention as defined by claim **1**, in which said voltage circuit comprises a voltage recorder for providing a history of a succession of the relative registration positions of any desired member of the members provided with such marks.

3. The invention as defined by claim **1** in which said light guide means comprises plastic fibers.

4. The invention as defined in claim **1** in which said light guide means comprises glass fibers.

5. The invention as defined in claim **1** in which said light guide means comprises hollow tubes with a light reflective internal surface.

6. The invention as defined by claim **1**, in which the relay circuit comprises transistorized means for increasing the sensitivity of the photocell-light guide means to marks in the dark color spectrum.

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