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Weber et al.

[11] **3,854,661**

[45] **Dec. 17, 1974**

[54] **EMBOSSED CHARACTER SENSING DEVICE**

[75] Inventors: **Charles F. Weber; Carl W. Sherman,** both of Euclid, Ohio

[73] Assignee: **Addressograph-Multigraph Corporation,** Cleveland, Ohio

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[52] **U.S. Cl.** ..... **235/61.11 E,** 235/61.11 C

[51] **Int. Cl.** **G06k 7/10**

[58] **Field of Search**...235/61.11 B, 61.11 C, 61.11 E, 235/61.7 B; 250/555, 566

[56] **References Cited**

UNITED STATES PATENTS

3,612,832	10/1971	Goldstein et al.	235/61.11 E
3,627,991	12/1971	Beall et al.	235/61.11 E
3,627,994	12/1971	Sallach et al.	235/61.7 B
3,714,398	1/1973	Brock	235/61.11 E

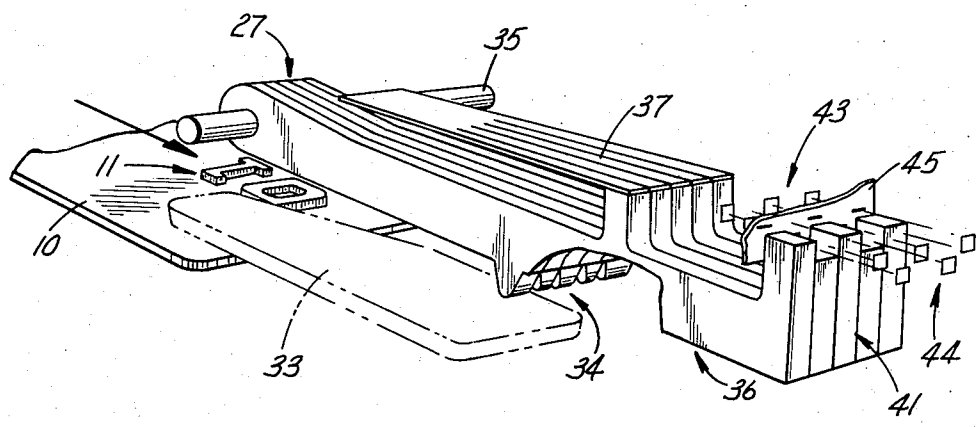
Primary Examiner—Daryl W. Cook

Attorney, Agent, or Firm—Ray S. Pyl

[57] **ABSTRACT**

An improvement in sensing indicia embossed on the surface of data cards. The sensing head frame is designed to ride the surface of the card and thereby position the sensing elements with respect to the card surface at all times. Also, the sensing head frame is designed to align itself with the top and bottom of characters embossed on the surface of the card. The design of the sensing elements allows the reading of small characters.

8 Claims, 7 Drawing Figures



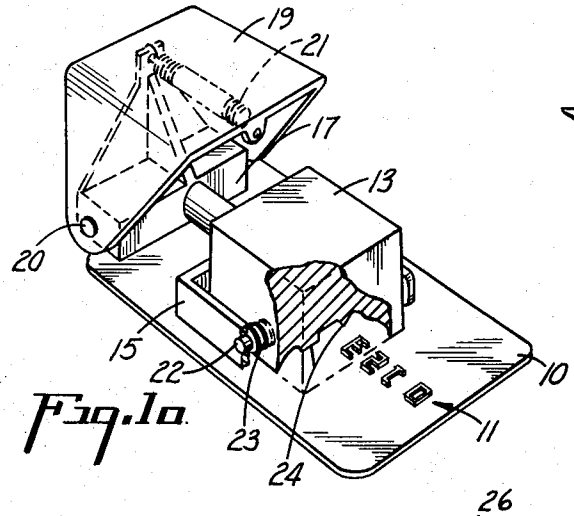


Fig. 1a

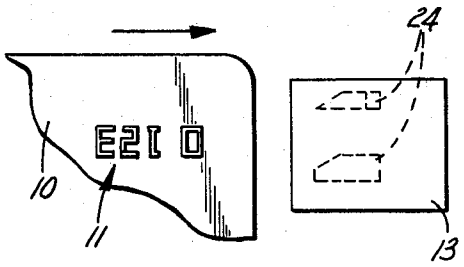


Fig. 1b

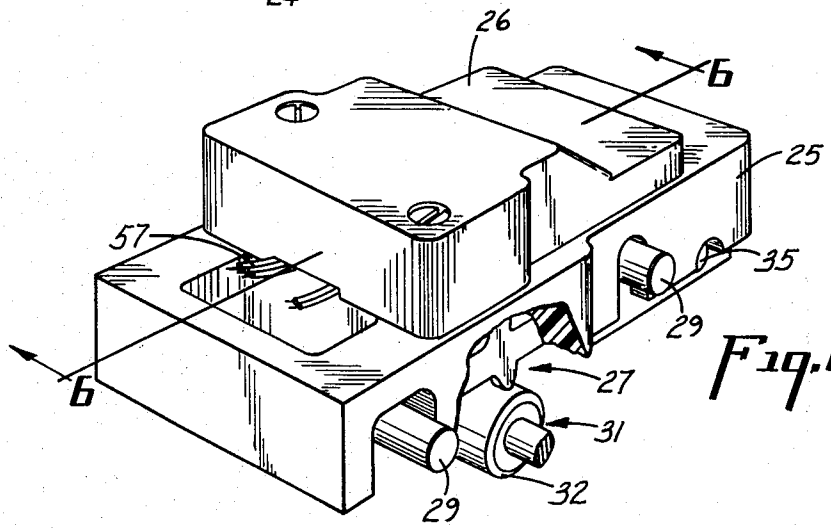


Fig. 2

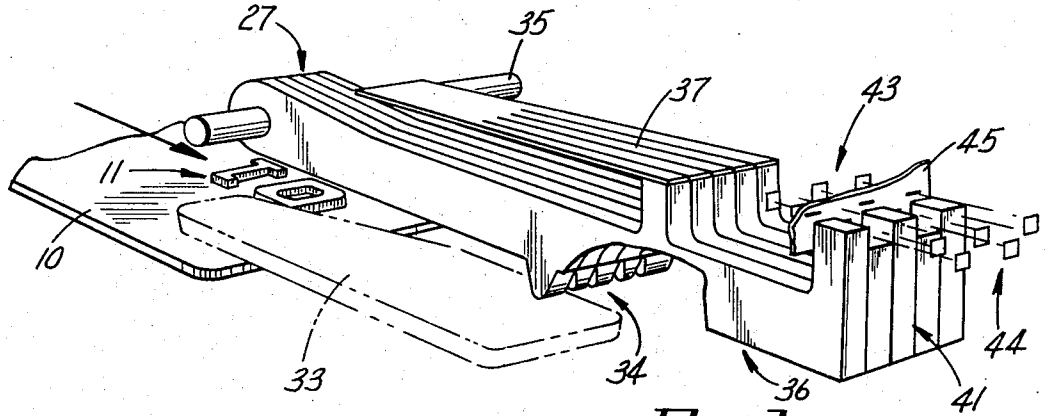


Fig. 3

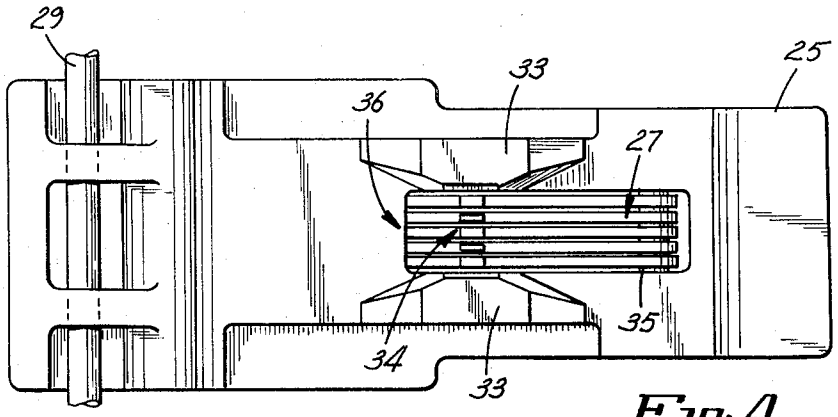


Fig. 4

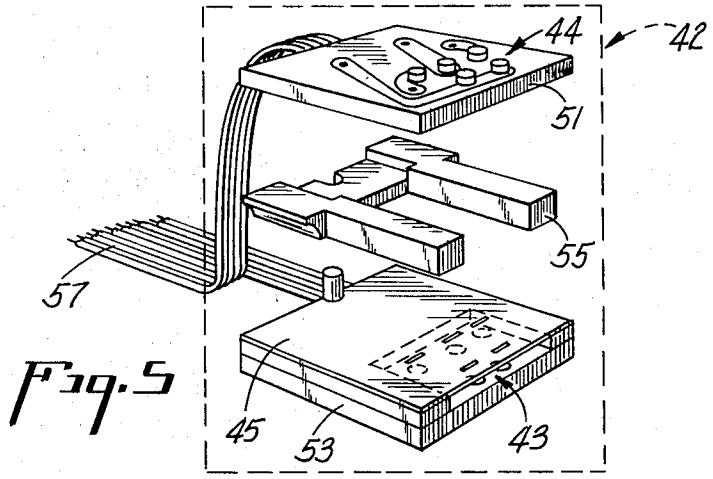


Fig. 5

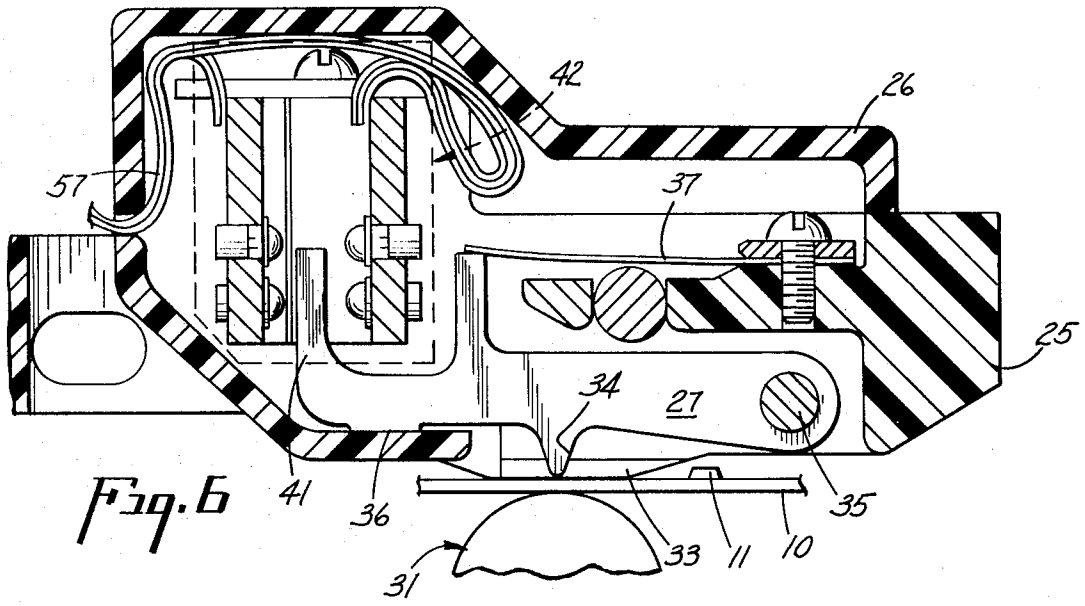


Fig. 6

EMBOSSED CHARACTER SENSING DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to the machine reading of embossed indicia on documents and, more particularly, to an electromechanical method of sensing embossed characters on the surface of data cards.

In one prior art concept, embossed indicia are read by mechanical sensors physically making a contact closure, directly or indirectly, upon detection of a protrusion on a document surface. Such an approach is shown by U.S. Pat. No. 3,470,358 where one of the electrical contact members is used as the mechanical sensor.

A refinement on the above approach is suggested by U.S. Pat. No. 3,627,944 where almost vertical movement of the mechanical sensor was required in order that the signal resulting to be an accurate reproduction of the embossed indicia.

Another approach involves using a pivoting mechanical sensor which is designed to amplify movement corresponding to embossed indicia and thus activate an electrical contact. Such a device is indicated by U.S. Pat. No. 2,273,740.

Due to the nature of the signals produced by these methods, the electronic circuitry required to obtain readily usable output signals becomes quite involved. Since the closing of contacts often results in bouncing contacts, the effect of this bouncing on the signal must be eliminated. Also, the contact signals must be digitalized to be used throughout the remaining circuitry.

A more recent concept to reading embossed characters involves the use of optical principles. One such method includes fiber optic bundles directing light onto the surface of the document where the amount of light reflected into return fiber optic bundles indicates the presence or absence of an embossure. The light reflected into return fiber optic bundles represents either the unembossed surface of the card interrupted by embossures or only the surfaces of embossed characters.

The embossed indicia of the prior art generally has been bar code as opposed to human readable characters. Such simple bar code marks may be sensed by one mechanical probe, and positioning of the probe with respect to the mark is not critical. When an embossed character is to be sensed, a number of mechanical probes are required for each character to effect identification. The identification is dependent upon the correct position of the character with respect to any particular mechanical probe. For this reason, positioning of the embossed character with respect to the sensing elements is extremely critical.

SUMMARY OF THE INVENTION

This invention presents a solution to sensing embossed indicia which eliminates most of the electronic circuitry problems encountered in the mechanical contact approach.

One object of this invention is to ensure accurate sensing of embossed characters by positioning the sensing device precisely with respect to the embossed characters.

A further object is to adjust for horizontal and vertical misalignment of a data card containing embossed characters on the surface.

A further object of this invention is to identify an embossed character by dividing each such character into a number of unique portions and sensing these portions through the use of mechanical sensors.

A still further object of this invention is to directly convert the mechanical signals identifying a character into digital electrical signals through the use of photosensitive devices.

IN THE DRAWINGS

FIG. 1*a* is a perspective view of a floating mount read head assembly;

FIG. 1*b* is a schematic plan view of an embossed data card and the floating mount read head;

FIG. 2 is a perspective view of a fixed mount read head assembly;

FIG. 3 is a diagrammatic illustration of the mechanical probes and alignment shoe as the data card approaches the read head;

FIG. 4 is a plan view of the bottom of the fixed mount read head;

FIG. 5 is an exploded perspective view of the mounting assembly for the phototransistors and light emitting diodes;

FIG. 6 is a cross sectional view of the fixed mount read head taken substantially along the line 6—6 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1*a* illustrates an embodiment utilizing a method of supporting the sensing head referred to herein as floating. As shown in the figure, a data card **10** is used which has embossed characters **11** positioned in a horizontal row on the card. The embossed characters are produced by known methods of embossing. A sensing head frame **13** is supported by a frame yoke **15.** The frame yoke in turn is held by a support **17.** Finally, an assembly support **19** holds the support **17.**

The several parts providing support for the sensing head frame **13** are arranged to allow movement in any respect necessary to obtain alignment of the sensing head with a data card. A pivot **20** mounts yoke support **17** for vertical movement of the sensing head frame **13.** However, any vertical movement is returned to an initial position through the pressure provided by a frame spring **21.** The connection between the frame yoke **15** and the support **17** consists of a single sliding pin (not shown) to allow the frame to pivot and follow a data card which is not parallel to the surface upon which it is moving.

The sensing head frame **13** is mounted to the yoke **15** by two frame pins **22.** The sensing head frame is allowed to slide laterally with respect to the plane of the frame yoke **15** on these pins in order to be positioned directly over the embossed characters. The frame **13** is urged in a direction through the data card and across the row of embossed characters and returned to an initial position adjacent to one side of the yoke **15** through pressure exerted by a spring **23.**

Thus the spring **23** urges the frame **13** in a direction relative to the frame yoke **15** along the frame pins **22.** The frame pins **22** are mounted in the frame yoke **15** so as to allow the frame **13** to pivot and follow a data card which is not parallel to the alignment shoes **24.**

Guide means carried by the sensing head tracks the sensing head along a row of embossed characters on a

data card. This causes the alignment of the sensing head with the row of embossed characters. The guide means which position the sensing head are alignment shoes **24.** The arrangement of these alignment shoes in the case of the floating mount will be better understood by viewing FIG. 1b. The larger alignment shoe has a beveled lead edge to guide the upper edge into a line substantially equivalent to the tops of the characters in a row. The smaller shoe is presently primarily to ensure a parallel relationship of the sensing head frame to the data card surface. Notice should be taken of problems which arise if additional embossing is positioned too close to the characters to be read. In an instance such as this, if the smaller alignment shoe aligns itself with the additional embossing or rides up onto the additional embossing, misalignment of the sensing head will result causing incorrect reading of the information.

FIG. 2 illustrates an alternative method of supporting the sensing head. Because the sensing head is supported in a stationary position, with respect to vertical movement, the method is referred to herein as a fixed mount sensing head.

In FIG. 2 the sensing head frame **25** is shown with a frame cover **26** in place. This cover encloses the mechanical and electrical parts of the sensing head. Mechanical probes **27,** used to sense the embossed characters, are partially shown through the cut-away. Mechanical probes are likewise present in the method of supporting the sensing head illustrated in FIG. **1** although none are shown in the figure. In the interest of both simplicity and efficiency, five (5) mechanical probes are used to read the characters in these embodiments. Each of the mechanical probes is arranged for sensing a unique, vertical portion of any character embossed on the surface of a data card.

Pins **29** support the frame **25** in a stationary position with respect to vertical movement in this fixed mount embodiment. The pins **29** allow only longitudinal movement of the frame **25** with respect to the machine onto which the sensing head is mounted. A roller **31** with a flexible coating **32** over the entire surface area is also shown beneath the sensing head frame. This roller is not an integral part of the sensing head but is mounted on the machine with which the sensing head is being used. The roller is spring supported and serves to hold a card against the bottom of the sensing head. The purpose of the flexible coating is to compensate for any skewing or warping of a data card.

Since the operation of the two differently supported sensing heads are the same, a detailed discussion of the operation of only one is necessary. The case of the fixed mount sensing head will be used as the example.

A means for supporting data cards is provided with mechanical and electrical apparatus for causing relative movement between the sensing head carriage and the card supporting means. Since the sensing head is stationary the relative movement is a result of the data card being moved beneath and past the sensing head.

As the card approaches the mechanical probes **27,** the flexible coated roller **31** lifts the embossed surface into contact with the alignment shoes **33.** In this case, the alignment shoes are separated only by the height of a single character. The lead edges of the shoes are beveled to allow the sensing head to align itself with the top and bottom rises of an embossed character. The alignment shoes extend for a distance of two character widths in the immediate area of the mechanical probes. This additional length aligns the sensing head with the row of embossed characters, thus eliminating the possibility of errors due to differences in character placement. The alignment shoes may be better viewed in FIG. **4.** Since the sensing head frame **25** is able to slide longitudinally on the pins **29,** the mechanical probes **27** are caused to be positioned directly over the embossed characters.

The alignment shoes **33** additionally operate to maintain a spacing between the sensing head frame and the surface of a data card thus positioning the mechanical probes intermediate the unembossed surface of the data card and the height of the embossed characters. This is a result of the aligning shoes riding on the surface of the data card.

The sensing head contains a plurality of mechanical probes extending in the direction of a data card being moved past them. The purpose of the mechanical probes is to contact the embossed characters without contacting the unembossed surface of the card adjacent to the characters. A different portion of any character embossed on the surface of a card is sensed by each mechanical probe. The size and number of mechanical probes is directly dependent upon the size and type of embossed character to be sensed.

Farrington 7B is an industry standard embossed character font which is practically universal for credit card embossing. Five mechanical probes were determined to be acceptable for 7B font, and hence five are referred to in this embodiment.

As can be seen in FIG. **3,** the widths of the five mechanical probes **27** are not identical. The two outside probes and the middle probe are wider than the remaining two probes. That is, the body of each probe is the same size, but the sensing tips **34** of two of the probes have been reduced in width. The wider probes correspond to the horizontal strokes characteristic of the characters to be read, i.e., two, three, five, etc., which have a somewhat arcuate shaped horizontal stroke. The probes corresponding to these positions are wider to ensure detection. Correspondingly, the remaining two probes must be smaller in width to ensure that the horizontal strokes will not be detected by them. The design of these mechanical probe sensing tips **34** is directly dependent upon the style and size of the characters to be read.

Again referring to FIG. **3,** the mechanical probes **27** are held in the sensing head carriage at one end by a pivot pin **35.** Vertical movement is limited, downwardly, at the opposite end of the mechanical probes by allowing the mechanical probes to contact the sensing head frame at a stop position **36.** The return springs **37** ensure that the mechanical probes return to the stop position **36,** in contact with the sensing head frame, after any vertical movement.

At the extreme end of each mechanical probe **27** is a physical extension **41.** The mechanical probes are designed so that when pivoted from the stop position **36** in respect to the sensing head frame **25,** any movement of the mechanical probes in contacting embossed characters is mechanically amplified at the physical extension. The mechanical amplification is a result of the physical extension **41** being a greater distance from the pivot pin **35** of the mechanical probe than is the sensing tip **34.** This mechanical amplification is not a unique

feature and therefore is not described in detail. However, the very brief description given may be helpful in understanding this invention.

As in the prior art, an electrical signal means **42** (See FIGS. **5** and **6**) is operated in response to movement of any of the mechanical probes. The physical extension **41** of the mechanical probes are arranged to directly activate the electrical signal means upon movement of a corresponding mechanical probe. The electrical signal means **42** in these embodiments comprises photosensitive devices and corresponding light sources whereby any movement of the physical extensions of the mechanical probes causes a light beam to be effected and an electrical signal to be produced.

Arranged on opposite sides of each physical extension **41** is a phototransistor **43** and a light emitting diode (LED) **44.** Adjacent to the phototransistors is an aperture plate **45** which has a slot for each phototransistor. The aperture slots restrict the light directed towards the phototransistors to a thin beam of light. In this particular embodiment, all of the phototransistors are ordinarily subject to the light from the corresponding LED. However, when vertical movement of any of the mechanical probes occur, causing movement of the physical extensions, the light beams are interrupted. Thus a signal is produced which can be used to determine the character detected. The function of the physical extensions could easily be reversed thus producing a light beam on the photosensitive device only when the physical extensions encounter an embossed character.

For the purpose of ease of assembly and adjustment, the light emitting diodes **44** for each mechanical probe are mounted on a LED mounting board **51.** Likewise, the phototransistors **43** for each mechanical probe are mounted together on a phototransistor mounting board **53.** Both of these mounting board and the aperture plate **45** are assembled as a complete electrical signal means **42.** A spacer **55** is included to maintain the opening necessary for proper movement of the physical extensions **41** of the mechanical probes **27.** An electrical connector **57** conducts the signals to and from the appropriate phototransistors and light emitting diodes.

As shown in FIGS. **3** and **5,** the phototransistors and LED's are staggered, three up and two down, on the corresponding mounting boards. The only reason for this is to allow the utilization of standard dimension phototransistors and LED's, which are too wide to be placed side by side. The electrical signal means **42** is shown assembled with all of the read head elements in FIG. **6.**

An understanding of the operation of the sensing head will be obtained from a discussion involving FIG. **3.** As a data card **10** bearing embossed characters **11** approaches the sensing head, the alignment shoes **33** contact the first character in a row. The beveled lead edges of the alignment shoes guide the sensing head around the top and bottom of the embossed character. The sensing head frame **25** slides on the pins **29** when the alignment shoes are forced around the character. The sliding action of the sensing head frame, the distance between alignment shoes, and the alternating width design of the mechanical probe sensing tips **34** allow for tolerance in the vertical character orientation in the sensing of the embossed characters.

After the alignment shoes have positioned the sensing head with respect to the row of characters on a card, the mechanical sensing takes place. All five sensing tips **34** of the mechanical probes will initially sense the character "**0**" as shown in FIG. **3.** As the card progresses in the direction of the arrow in FIG. **3,** the middle three mechanical probes will return to the stop position **36** while the two outside sensing tips remain on the top and bottom horizontal strokes of the character. When the card **10** has progressed further, the middle three probes will again rise to sense the final vertical stroke of the character.

A better understanding of the probe tip design may be afforded through a hypothetical sensing of the character "**3**". The three wide sensing tips **34** of the mechanical probes will first sense the character. These will ride up onto the top, middle, and bottom horizontal strokes of the character. The remaining two sensing tips are designed to be thin enough to fit between the horizontal strokes without being affected by them. These remaining two sensing tips will not ride up until the vertical stroke at the end of the character is encountered. The return spring **37** will return any one or more mechanical probes to the stop position **36** when the data card moves to a position where no embossure is beneath a respective sensing tip **34.**

When one of the sensing tips **34** encounters a segment of an embossed character **11** and rides up onto the character, the amplified movement of the corresponding physical extension **41** causes the electrical signal of the corresponding phototransistor to be interrupted. The physical extensions could just as easily be designed to turn the phototransistor signal on by allowing light to pass when the sensing tips encounter an embossed character.

The sensing head is designed so that the output signals from the phototransistors represent an accurate reproduction of the embossed character. This is due to the vertical motion of the mechanical probes at the sensing tips and at the physical extensions.

In addition, the outputs of the phototransistors are immediately digital signals due to the on and off operation of the devices. This eliminates the need of preamplifiers to digitalize the signals.

Although the electronic circuitry required to use the signals developed by this invention are not included in this disclosure, any of a number of logic circuits or methods are acceptable. One such method of electronics is shown by a presently pending application of the assignee corporation. This application is Bentivegna, et al., Ser. No. 226,462.

What is claimed is:

1. A device for sensing embossed indicia on the surface of data cards, comprising in combination:

a sensing head frame;

means for supporting said data cards;

means mounting said head frame for a universal movement relative to said means for supporting said data cards;

means for causing relative scanning movement between said sensing head frame and said data cards;

guide means carried by said sensing head frame for riding a card on said means for supporting said data cards and for tracking the sensing head frame along a row of embossed indicia on a card for causing

alignment of said sensing head frame with said row of indicia, and

means urging said sensing head frame in a direction toward a data card and across the said row of embossed indicia.

2. A device for sensing embossed indicia on the surface of data cards, comprising in combination:

a sensing head frame;

means for supporting said data cards;

means mounting said head frame for a universal movement relative to said means for supporting said data cards;

means for causing relative scanning movement between said sensing head frame and said data cards;

guide means carried by said sensing head frame for tracking the sensing head frame along a row of embossed indicia on a card and causing alignment of said sensing head frame with said row of indicia;

said guide means serving to maintain said sensing head frame at a predetermined distance from said means supporting data cards throughout said relative movement; and

means urging said sensing head frame in a direction through a data card and across the said row of embossed indicia.

3. In a device for sensing embossed indicia on the surface of data cards, an improvement in electromechanically sensing the embossed indicia, comprising:

a sensing head frame;

means for supporting said data cards;

means mounting said head frame for a universal movement relative to said means for supporting said data cards;

means for causing said data cards to move in a scanning movement relative to said sensing head frame;

guide means carried by said sensing head frame for riding a card on said means for supporting said data cards and for tracking the sensing head frame along either edge of a row of embossed indicia on a data for causing alignment of said sensing head frame with said row of embossed indicia;

said guide means serving to maintain said sensing head frame at a predetermined distance from a data card throughout the movement of the data card by riding the unembossed surface of said data card; and

means urging said sensing head frame in a direction toward a data card and across the said row of embossed indicia.

4. A device for sensing embossed indicia as claimed in claim 3 further characterized in that a plurality of mechanical probes extends from said sensing head frame in the direction of a data card being moved for contacting said embossed indicia without contacting the unembossed surface adjacent to said embossed indicia.

5. A device for sensing embossed indicia as claimed in claim 4 wherein each of said mechanical probes are arranged for sensing a unique, vertical portion of any embossed indicia on the surface of a data card.

6. A device for sensing embossed indicia as claimed in claim 5 wherein said mechanical probes are designed with alternating wide and narrow widths to ensure independence of signals resulting from sensing of said unique, vertical portions of embossed indicia.

7. A device for sensing embossed indicia as claimed in claim 4 further characterized in that said plurality of mechanical probes is a plurality of five.

8. In a device for sensing embossed indicia on the surface of data cards, an improvement in electromechanically sensing the embossed indicia, comprising:

a sensing head frame;

means for supporting said data cards;

means mounting said head frame for a universal movement relative to said means for supporting said data cards;

means for causing said data cards to move in a scanning movement relative to said sensing head frame;

guide means carried by said sensing head frame for riding a card on said means for supporting said data cards and for tracking the sensing head frame along either edge of a row of embossed indicia;

a plurality of mechanical probes extending from said sensing head frame in the direction of said means for supporting data cards for a limited distance;

said guide means serving to maintain said sensing head frame at a predetermined distance from a data card throughout the movement of the data card by riding the unembossed surface of said data card and holding the mechanical probes a distance from the unembossed surface of the data card related to said limited distance to cause said mechanical probes to be positioned intermediate the unembossed surface of said data cards and the height of said embossed indicia; and

means urging said sensing head frame in a direction toward a data card and across the said row of embossed indicia.

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