

July 31, 1973

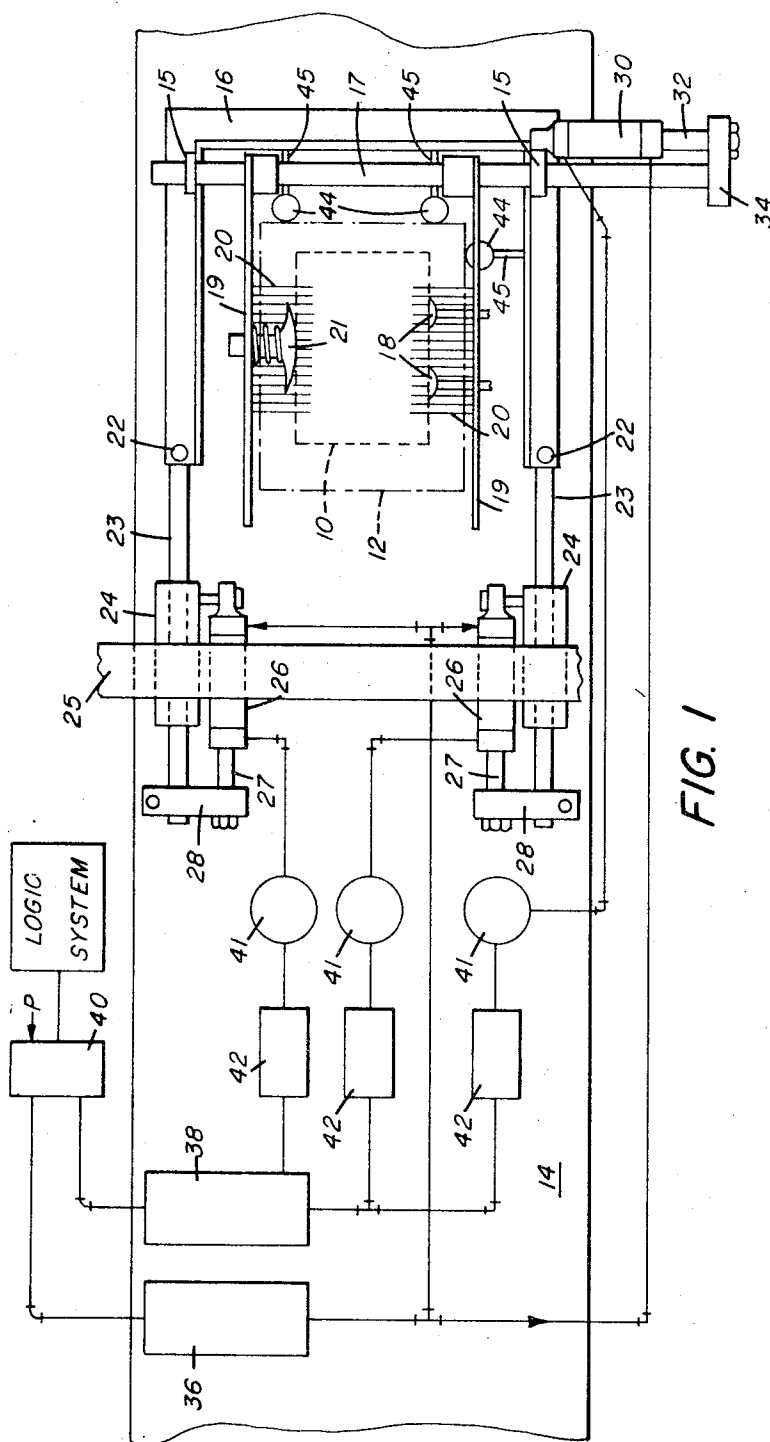
C. B. GIBBONS

3,749,632

MATERIAL EDGE DETECTING APPARATUS

Filed Aug. 16, 1971

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

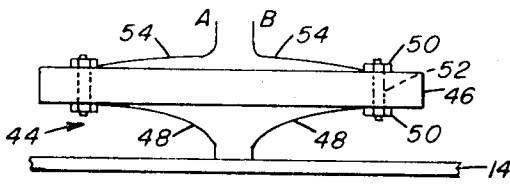


FIG. 2

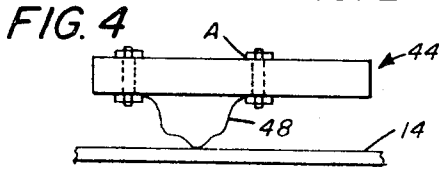


FIG. 4

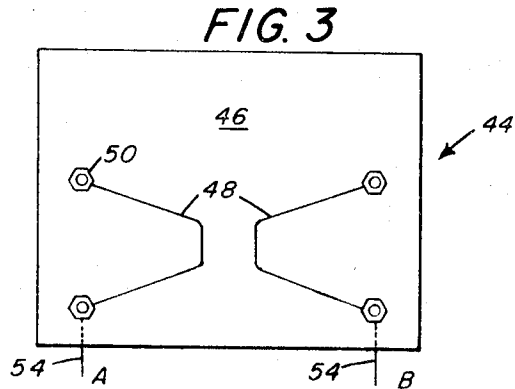


FIG. 3

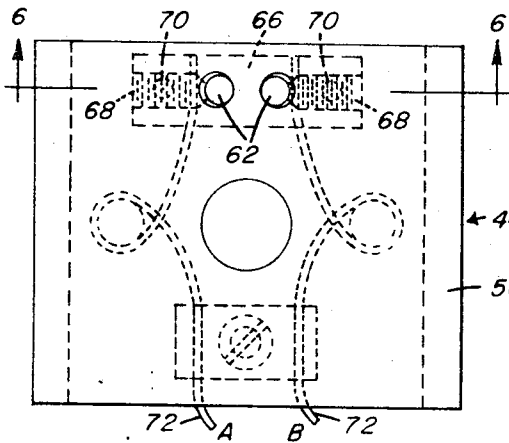


FIG. 5

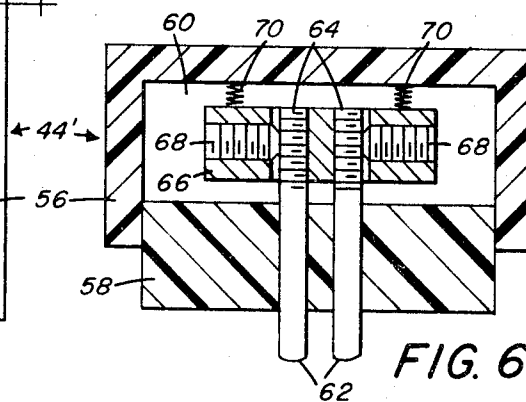


FIG. 6

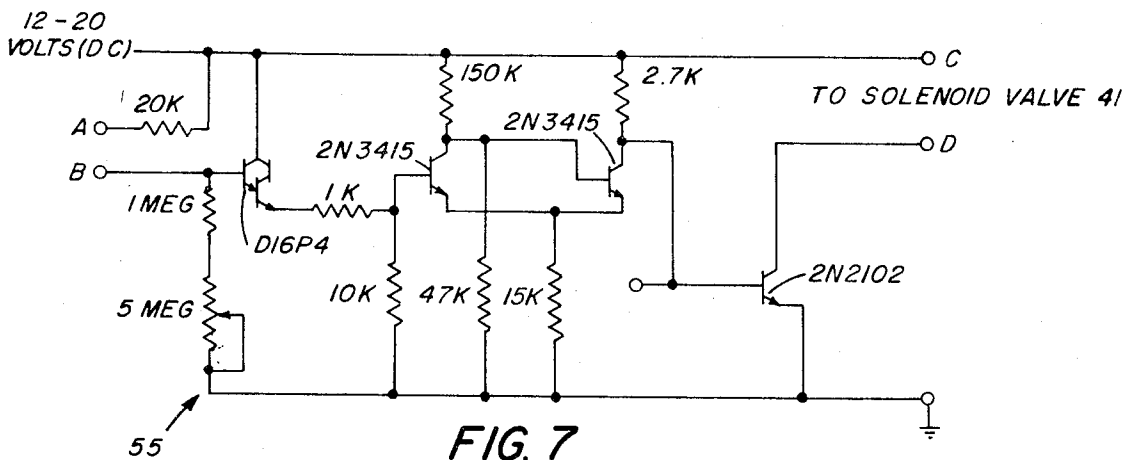


FIG. 7

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3,749,632

MATERIAL EDGE DETECTING APPARATUS

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Int. Cl. B32b 31/12; B31b 1/02

U.S. Cl. 156—364

15 Claims

ABSTRACT OF THE DISCLOSURE

A material edge detecting apparatus for electrically detecting the edge of a material such as a sheet by sensing the change in electrical resistivity between a sheet support and the sheet edge and in response thereto generating a signal. In one application, the detecting apparatus is embodied in an aligning or registration mechanism in which a sheet is supported on a sheet support such as a conveyor or the like constructed of a material having an electrical resistance which is detectably different than the resistance of the sheet. A moving mechanism is provided for moving a frame supporting the detecting apparatus and an object such as a cardboard box spaced from the sheet toward the sheet for aligning the sheet and box. The detecting apparatus electrically senses a change in resistivity when a portion thereof engages the edge of the sheet, and in response thereto substantially simultaneously disables the moving mechanism with the box precisely in register with the sheet.

BACKGROUND OF THE INVENTION**Field of the invention**

This invention relates generally to aligning or registration mechanisms, and more specifically to a material edge detecting apparatus for detecting the edge of a material such as a sheet by sensing a change in electrical resistivity between the sheet and its support, and in response thereto generating a signal.

Description of the prior art

Detecting apparatus for sensing or detecting the edge of a web and in response thereto correctly aligning the web for movement in a longitudinal direction are generally well known in the art. Such apparatus normally utilizes a light source such as a lamp on one side and adjacent each edge of the web for directing a beam of light toward the web, a light-sensitive photocell on the opposite side and adjacent each edge of the web, and correcting means responsive to the photocells for correcting the misaligned web. As long as the photocells receive light from the lamps, the correcting means is disabled. However, if the web should creep laterally in one direction or the other and become misaligned, the edge of the sheet will block some or all of the light to the corresponding photocell, which in response thereto enables the correcting means for correcting the misaligned web. Photocell sensing means are also used in registration apparatus for vertically aligning and laminating sheet material, such as printed sheets on record jackets. Such a registration apparatus for vertically aligning an upper sheet with a lower sheet on a support surface is disclosed in U.S. Pats. 3,400,031 and 3,522,129, and relies on the difference in light reflectivity between the lower sheet and the support surface. Although such a photocell sensing mechanism operates satisfactorily for most conditions, a problem is presented in those situations in which the web support surface is dark and the material such as a sheet supported thereby is a dark color such as black, or the support surface is shiny and the sheet supported thereby is a light color such as white. In such situations, the light reflectivity of the material and support

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surface are substantially the same, and it is virtually impossible to reliably detect the edge of the sheet by the known light reflectivity sensing mechanisms.

SUMMARY OF THE INVENTION

This invention includes within its scope a material edge detecting apparatus for detecting the edge of a material such as a sheet in a sheet aligning apparatus or the like, and in response thereto generating a suitable signal. The detecting apparatus comprises an electrical circuit including spaced fixed contacts across which a potential is placed, spaced movable contacts connected in parallel with the fixed contacts, and mechanism for providing relative movement between the movable contacts and with one of a sheet or sheet support such as a web with which the contacts are in engagement. As long as the contacts are in engagement with one of the sheet or web, which may have a high value of resistivity such as 60 megohms or more, no signal is generated by the electrical circuit. However, in the event the contacts engage the other of the sheet or web that has a substantially different resistivity such as only a few megohms, a signal is generated and amplified to provide a control signal. The signal may be used for some purpose such as actuating an annunciator or disabling the mechanism that provides the relative movement between the movable contacts and one of the sheet or web.

The material edge detecting apparatus of this invention is adaptable for use in any application in which the need exists for locating the position of an edge of a material. Such apparatus is particularly adaptable for use in a registration apparatus of the type described in U.S. Pats. 3,400,031 and 3,522,129 in which it is desired to align or register one sheet of material in relation to an article vertically spaced apart therefrom such as another sheet for securing the sheets together or for wrapping the article.

It is therefore an object of the present invention to provide an improved material edge detecting apparatus for detecting the edge of a material such as a coated or uncoated sheet on a support by sensing the change in resistivity between the sheet and support.

Another object of the invention is to provide an improved material edge sensing apparatus for accurately and reliably detecting the edge of a material on a support surface under conditions where the light reflectivity of the material and the support surface are substantially the same.

Another object of the invention is to provide an improved aligning or registration mechanism for aligning one material such as a sheet with an article such as a box spaced therefrom.

Another object of the invention is to provide a material edge detecting apparatus that is of simple design and construction, thoroughly reliable in operation, and economical to manufacture.

The invention and its objects and advantages will become more apparent from the detailed description of the preferred embodiment presented below.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description of the preferred embodiments of the invention presented below, reference is made to the accompanying drawings, in which:

FIG. 1 is a top plan schematic view of an aligning or registration mechanism in which the detecting apparatus of this invention may be embodied;

FIG. 2 is a front elevational view illustrating one embodiment of the contact means of the detecting apparatus in engagement with a support surface;

FIG. 3 is a bottom view of the contact means of FIG. 2 with the support surface omitted for purposes of clarity;

FIG. 4 is a side elevational view of FIG. 2;

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FIG. 5 is a top plan view of another embodiment of the contact means for the detecting apparatus;

FIG. 6 is a section view taken along line 6—6 of FIG. 5; and

FIG. 7 is an electrical circuit diagram of an amplifier and flip-flop unit that is responsive to resistance between the spaced contacts of the detecting apparatus of a value within a predetermined range.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIG. 1 of the drawings, this invention is illustrated in connection with an aligning or registration mechanism of the general type described in U.S. Pats. 3,400,031 and 3,522,129, and incorporated by reference herein. The aligning mechanism vertically aligns or registers an upper article such as a box 10 of cardboard or the like, depicted by dotted lines, relative to a lower sheet 12 of paper or the like, depicted by broken lines, on a web support such as a web conveyor 14. The sheet is coated with a glue of any suitable commercially available type used in the box wrapping art, and following alignment of the sheet and box, the box is moved by any suitable means, not shown, into engagement with the sheet which is subsequently wrapped or pressed onto the box. Since the aligning mechanism is fully described in the aforementioned patents, only those portions of the mechanism that form part of or cooperate more directly with the present invention will be described.

Sheets 12 are individually conveyed in spaced relation by web conveyor 14 to a position underneath a U-shaped alignment frame 16 in an intermittently timed stop-and-go motion. This is accomplished by stopping web conveyor 14 by any suitable mechanism, not shown, each time a sheet 12 carried thereby is positioned under frame 16. Frame 16 has flanges 15 secured thereto for slidably supporting a shaft 17 to which a pair of spaced apart guide flanges 19 are secured. One flange 19 slidably supports a plurality of suction cups 18 movable by any suitable means, not shown, for engaging and holding one side of a box 10 fed onto flexible comb-like wires 20 on flanges 19 by any conventional sheet feeder, not shown. The suction cups 18 force box 10 against a spring biased guide shoe 21 slidably supported by the other flange 19 for properly positioning box 10 on wires 20. The ends of U-shaped frame 16 are pivotally secured or hinged at 22 to a pair of rods 23 journaled in bearings 24, the upper side of which is secured to a fixed support beam 25. The hinged connection 22 is of any conventional type that allows pivotal movement in only one plane. Accordingly, frame 16 is supported by hinges 22 for pivotal movement in a horizontal plane which is substantially parallel to and spaced from web 14. The rods 23 are slidably movable in a direction parallel to web 14 by any suitable fluid cylinders 26 secured to beam 25 and having piston rods 27 secured to rods 23 through rigid links 28. By virtue of pivots 22 and cylinders 26, frame 16 and box 10 may be moved not only in a direction parallel to an edge of web 14 when both cylinders 26 are equally operated, but may also be pivoted relative to the web on pivots 22 when only one of the cylinders 26 is operated, while the remaining cylinder 26 is inactive. Another fluid cylinder 30 is provided secured to one of the flanges 15 on frame 16, and has piston rod 32 secured through a rigid link 34 to shaft 17. Axial movement of shaft 17 upon operation of cylinder 30 causes guide flanges 19, suction cups 18, guide shoe 21 and box 10 to be moved as a unit in a direction transverse to the direction of movement of web 14. The fluid cylinders 26, 30 are operated by any suitable fluid such as oil in tanks 36, 38 connected to a source of air pressure P through a solenoid operated control valve 40. In one position of valve 40, oil under pressure is forced from tank 36 to one of the ports in cylinders 26, 30. The opposite port in each of the cylinders is connected to oil tank 38 through any

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suitable solenoid valves 41 which are normally in their open position, and through flow rate control valves 42. As mentioned heretofore, a sheet aligning apparatus of this general type is described in greater detail in the aforementioned U.S. Pats. 3,400,031 and 3,522,129.

The material edge detecting apparatus of this invention embodied in the sheet aligning mechanism of FIG. 1 will now be described. The detecting apparatus detects two adjacent sides of the sheet 12, and in response thereto aligns the frame 16 and box 10 in register or alignment with the sheet. When reference is made to placing a sheet and box in register or alignment, this preferably means positioning one of the two in a predetermined position relative to the other so that their center points are substantially in vertical alignment. However, any other predetermined relationship between box 10 and sheet 12 may be achieved such as aligning two adjacent edges of a sheet with the corresponding adjacent edges of a different sized sheet. The frame 16 is provided with two spaced electrical contact means 44 shown schematically in FIG. 1 and secured by any suitable bracket 45 or the like to one side of the frame, and a single contact means 44 secured by a similar bracket to an adjacent side.

In the embodiment of the contact means 44 illustrated in FIGS. 2 through 4, the contact means comprises an insulating base 46 having two spaced apart, substantially U-shaped resilient wire contacts 48 having their ends secured to base 46 by any suitable means such as electrically conducting nuts and bolts 50, 52 respectively. One of the ends of each wire 48 is also connected through bolts 52 and any suitable leads 54 to the fixed input contacts A, B of a conventional high gain, low current input amplifier and flip-flop circuit 55 of the type illustrated in FIG. 7. The midportion of the wire contacts 48 are bent downwardly towards the web support as best seen in FIGS. 2 and 4, and are spaced about 1/4-inch apart.

In FIGS. 5 and 6, a sturdier contact means 44' is illustrated in which an insulating U-shaped frame 56 of plastic or the like has an insulating base plate 58 secured thereto by any suitable means to form an insulator block having a cavity 60. The base 58 is provided with openings for slidably receiving a pair of pins 62, each having a threaded end 64 engaging matching threads in complementary bores in a rectangularly shaped pin holder 66. Each of the pins 62 is individually threaded in holder 66 to the correct axial position and then locked in that position by any suitable set screws 68. Any suitable springs 70 may be interposed between holder 66 and frame 56 for biasing the holder and pins 62 towards the web support 14. A pair of wire leads 72 (see FIG. 5) are provided having one of their ends interposed between set screws 68 and pins 62, and the opposite ends connected to the fixed inputs A and B of circuit 55 illustrated in FIG. 7.

It was noted that when a D.C. voltage substantially in the range of 12 to 20 volts was applied to one line of electrical circuit 55 with the circuit components and values designated in FIG. 7, a relay is actuated when there is a resistance of less than substantially 60 megohms between contacts A and B. According, if the upper sheet is made of a material having a resistance less than substantially 60 megohms, or is provided with a coating such as glue having a surface resistance of only several megohms, as soon as the spaced wire contacts 48 or pins 62 engage the edge of the sheet or glue upon relative movement of the contacts and web, a signal is generated energizing one of the solenoid valves 41 for closing the valve and stopping the flow of fluid out of one of the cylinders 26 and thereby stopping further movement of its corresponding rods 23, 27. Although the above circuit components and values of resistance operate satisfactorily, other circuit components sensitive to different values of resistance may be used provided a sufficient difference in resistance exists between the sheet material 12 and web support material 14 for actuating or enabling

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the circuit when the contacts are in engagement with one of sheet and web support materials 12, 14 respectively, and for not actuating or disabling the circuit when the contacts are in engagement with the other of the sheet and web support materials. The same action occurs for each of the contact means 44, resulting in movement being imparted to frame 16 by cylinders 26, 30 aligning the frame and box 10 held thereby into register with sheet 12 on web support 14. By using two spaced contact means 44 on one edge of frame 16, and a single contact means 44 on an adjacent edge (see FIG. 1), it is possible to accurately locate two adjacent sides of sheet 12, and such action automatically positions frame 16 and the center of box 10 in alignment or register with the center of sheet 12. Since sheet 12 is larger than box 10, the opposite edges thereof will extend past the edges of the box equal distances. By properly positioning the contact means 44, any other suitable relationship between the edges of box 10 and sheet 12 may be achieved.

In the operation of this invention, let us assume that the web conveyor 14 initially conveys a sheet 12 to a stopped position under frame 16 in a partly skewed position, and it is desired to align or register a box 10 with sheet 12 for subsequent wrapping of the box with the sheet. As soon as conveyor 14 stops, any suitable switch mechanism, not shown, is actuated by any suitable means such as the conveyor itself, or by any suitable conventional logic or timing system to operate solenoid valve 40 (FIG. 1) for directing fluid under pressure from tank 36 to one of the ports of one or both of the cylinders 26 for moving piston rods 27 at a rate controlled by fluid flow from the opposite cylinder ports through open valves 41 and flow valves 42 to tank 38. Movement of piston rods 27 causes frame 16 and one or both of the pair of contact means 44 to move towards the edge of sheet 12. As soon as the contacts 48 of one of the pair of contact means 44 engage the edge of sheet 12, its corresponding solenoid valve 41 is operated for movement to a closed position discontinuing further flow from the corresponding cylinder and hence stopping any further action of the corresponding cylinder rods 23, 27. When this occurs, the other cylinder 26 is either operated or continues to operate, pivoting frame 16 and the other contact means 44 around pivots 22 toward the same edge of sheet 12. Once again, as soon as the contacts 48 of the contact means 44 engage the edge of sheet 12, the change in electrical resistivity is such as to cause the circuit to operate energizing corresponding valve 41 for movement to a closed position closing off further flow of fluid from the remaining operating cylinder 26 and stopping any further action or movement of its cylinder rods 23, 27. At this time, one of the edges of box 10 and sheet 12 are in parallel registration. Also, at this time, the last cylinder 30 is actuated by the logic or timing system, not shown, and operated in the same manner as described for the previous two cylinders 26, moving frame 16 until contacts 48 of the single contact means 44 engage the adjacent edge of sheet 12 and then stopping further movement of frame 16. At such time, all edges of box 10 are in complete parallel alignment or register with the edges of sheet 12, and preferably the centers of the box and sheet are substantially coincidental. Suitable mechanism may be provided, not shown, for moving box 10 into engagement with the glue coated sheet 12 if such is desired. Naturally, any suitable commercially available electrical switching, timing, and pneumatic mechanisms may be used for controlling the operation and/or movement of web 14, frame 16, cylinders 27, 30, etc. in any desired timed relation or sequence, the above described sequence being illustrative of only one possible sequence.

In the event one of the contact means 48 fails to sense the edge of sheet 12, the corresponding piston in cylinder 26, 30 is moved to the end of its travel. Such action would result in improper alignment of the box and sheet. Ac-

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cordingly, such overtravel of the piston actuates a switch or the like for disabling the box moving mechanism, not shown, which normally moves box 10 into engagement with sheet 12, and further actuates the conveyor web 14 for advancing another sheet underneath frame 16.

The invention has been described in detail with particular reference to preferred embodiments thereof, but it will be understood that variations and modification can be effected within the spirit and scope of the invention as described hereinabove.

I claim:

1. In a detecting apparatus for detecting the edge of a sheet material on a support material in which the resistivity of the sheet material is different from that of the support material, the combination comprising:

electrically conductive contact means in contact with one of said sheet and support materials;
moving means adapted when enabled to impart sliding movement between said contact means and said one of said sheet and support materials;

an electrical circuit electrically coupled to said contact means is in contact with said one of said sheet and support materials, and to have a different output when said contact means is in contact with the other of said sheet and support materials; and

means responsive to the output of said electrical circuit for detecting the edge of said sheet material when the output changes upon relative movement of said contact means across the edge of said sheet material.

2. The invention according to claim 1 wherein said responsive means comprises means for disabling said moving means when the output changes.

3. In a detecting apparatus for detecting the edge of a sheet material on a support material in which the resistivity of the sheet material is different from that of the support material, the combination comprising:

electrically conductive contact means in contact with one of said sheet and support materials;

means for slidably moving said contact means across said one of said sheet and support materials toward the other of said sheet and support materials;

an electrical circuit electrically coupled to said contact means and adapted to be in an enabled condition for generating an output when said contact means is in contact with said one of said sheet and support materials, and to be in a disabled condition in which no output is generated when said contact means is in contact with said other of said sheet and support materials;

said moving means being responsive to the output of said electrical circuit for stopping said contact means precisely when the circuit changes from said enabled condition to said disabled condition upon movement of said contact means across the edge of said sheet material.

4. The invention according to claim 3 wherein said sheet material is provided with a coating which further reduces the resistivity of said sheet material relative to the resistivity of said support material.

5. The invention according to claim 4 wherein said coating is a glue.

6. The invention according to claim 3 wherein said contact means comprises a pair of spaced, resilient, electrically conductive strips having portions thereof engageable with the support surface.

7. The invention according to claim 6 wherein said strips are wires.

8. The invention according to claim 3 wherein said contact means comprises a pair of spaced, electrically conductive pins, and resilient means for biasing the ends of said pins into engagement with the surface of said support material.

9. The invention according to claim 3 wherein said contact means comprises an insulator block having a

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cavity, a support plate in said cavity, a pair of spaced, electrically conductive pins having one of their ends secured to said support plate, and the other of their ends extending through openings in said block, and resilient means interposed between said block and said plate for biasing said other ends of said pins into engagement with the surface of said support material.

10. In a registration mechanism for detecting the edge of a sheet on a support in which the resistivity of the sheet is different than that of the support, and for vertically aligning in spaced relation an object such as a box; with said sheet, the combination comprising;

a frame for receiving said box;

means for moving said frame relative to said sheet for aligning said box with said sheet;

electrically conductive contact means carried by said frame in slidable contact with the support;

an electrical circuit electrically coupled to said contact means and adapted to be in a disabled condition in which no output is generated when said contact means are in contact with said support and to be in an enabled condition for generating an output when the contact means are in contact with the sheet;

and

means responsive to said output generated by said electrical circuit in said enable condition for disabling said frame moving means precisely when a portion of said box is in alignment with a corresponding portion of said sheet.

11. The invention according to claim 10 wherein a plurality of contact means are provided with a pair of said contact means carried by one side of said frame in spaced

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relation, and one of said contact means carried by an adjacent side of said frame.

12. The invention according to claim 10 wherein said contact means comprises a pair of spaced resilient, electrically conductive strips having portions thereof engageable with the support.

13. The invention according to claim 12 wherein said strips are wires.

14. The invention according to claim 10 wherein said contact means comprises a pair of spaced, electrically conductive pins, and resilient means for biasing the ends of said pins into engagement with the support.

15. The invention according to claim 10 wherein said contact means comprises an insulator block having a cavity, a support plate in said cavity, a pair of spaced, electrically conductive pins having one of their ends secured to said support plate, and the other of their ends extending through openings in said block, and resilient means interposed between said block and said plate for biasing said other ends of said pins into engagement with the support.

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PHILIP DIER, Primary Examiner

U.S. Cl. X.R.

93—61; 156—366

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,749,632 Dated July 31, 1973

Inventor(s) Carl B. Gibbons

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 19, delete "stheet" and insert---sheet---.

Column 6, line 22, after the word "means" insert---and adapted to have one output when said contact means---.

Signed and sealed this 2nd day of April 1974.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents