United States Patent [19]

Brant et al.

[11] **3,847,391**

[45] **Nov. 12, 1974**

[54] **STACKING CONTROL APPARATUS**

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[73] Assignee: **Xerox Corporation**, Stamford, Conn.

[22] Filed: **Feb. 20, 1973**

[21] Appl. No.: **333,817**

Related U.S. Application Data

[63] Continuation of Ser. No. 146,331, May 24, 1971, abandoned.

[52] **U.S. Cl.** **271/220**

[51] **Int. Cl.** **B65h 31/00**

[58] **Field of Search** 271/64, 86, 87, 220

[56] **References Cited**

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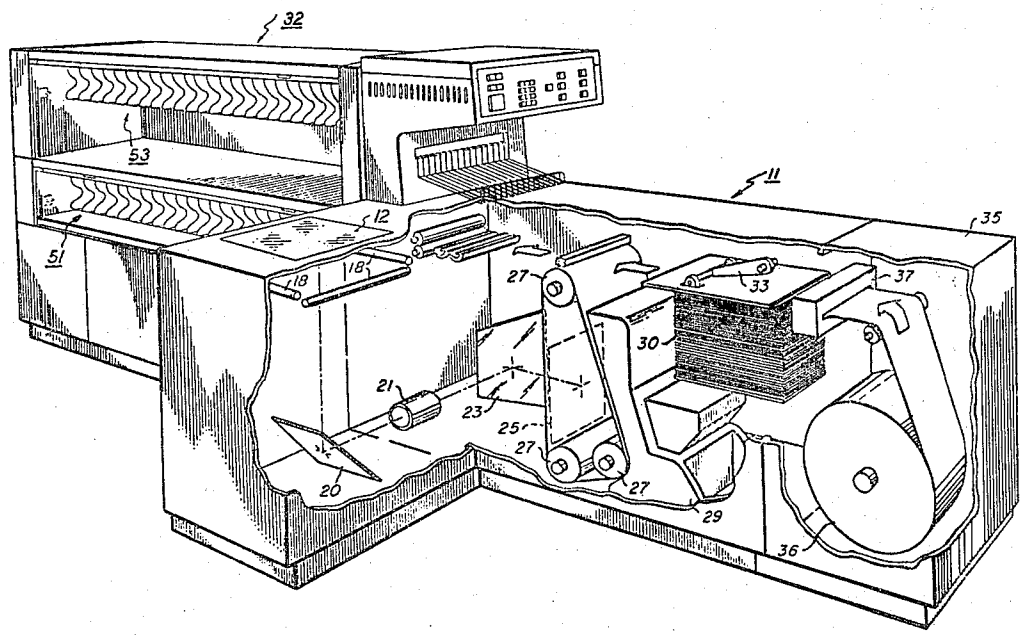
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Primary Examiner—Richard E. Aegerter

[57] **ABSTRACT**

A roller assembly is suspended from the top of a tray to deflect sheets transported along a predetermined path into a path tangential to a roller member at the bottom of the assembly. Hanging wire devices are positioned along the same plane at the upper portion of the roller assembly and pivot to compact the part of sheets being received to clean a path for the next incoming sheet and effect a neatly aligned stack.

13 Claims, 12 Drawing Figures



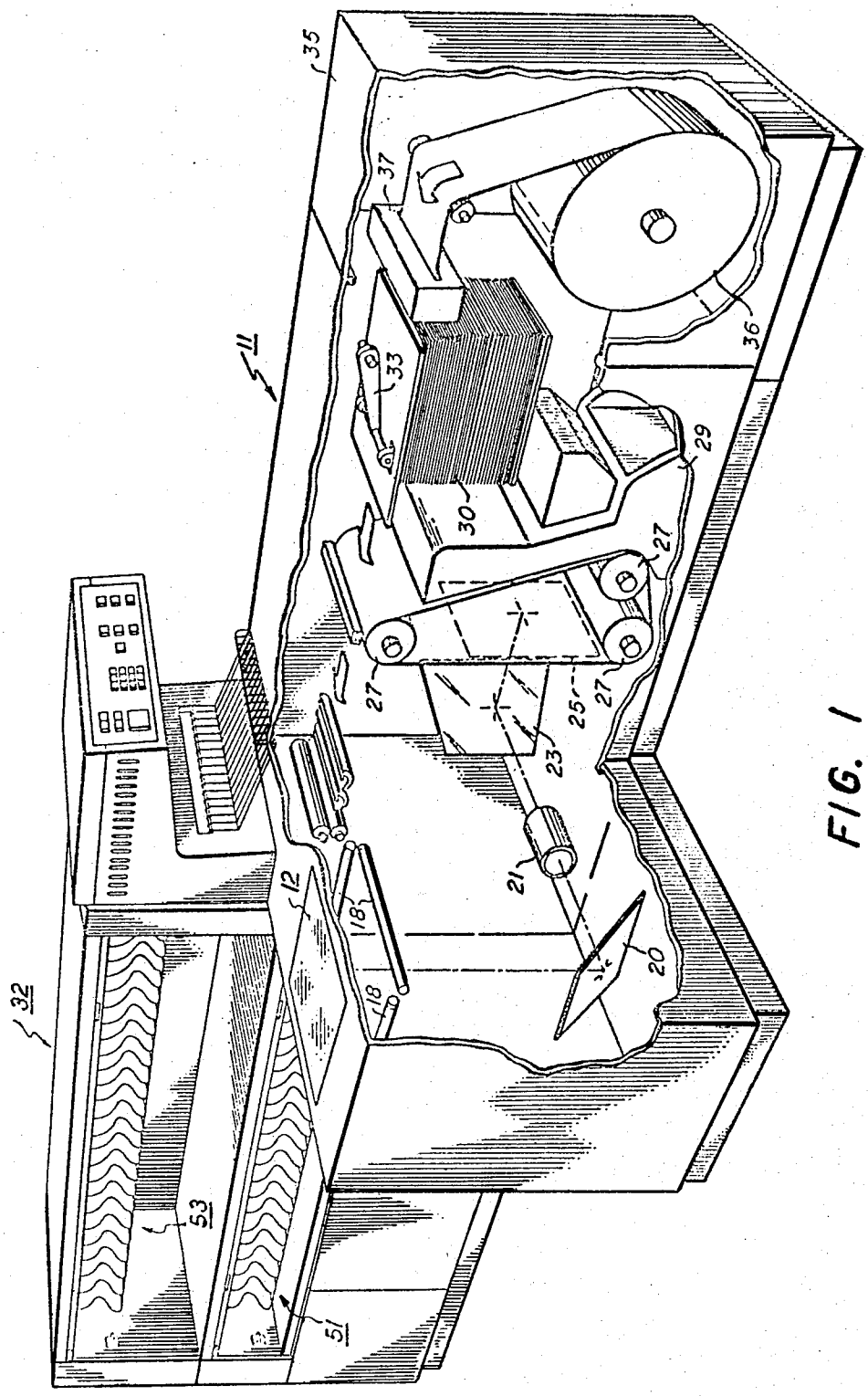


FIG. 1

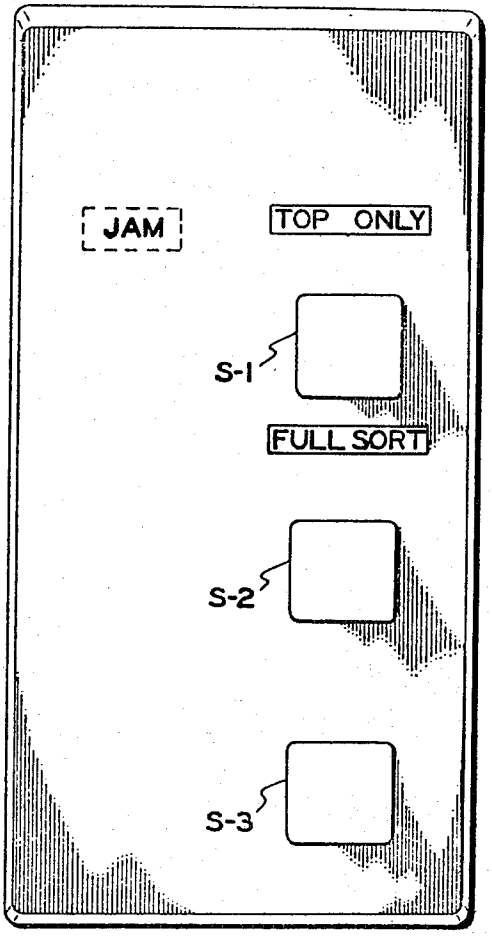


FIG. 1(a)

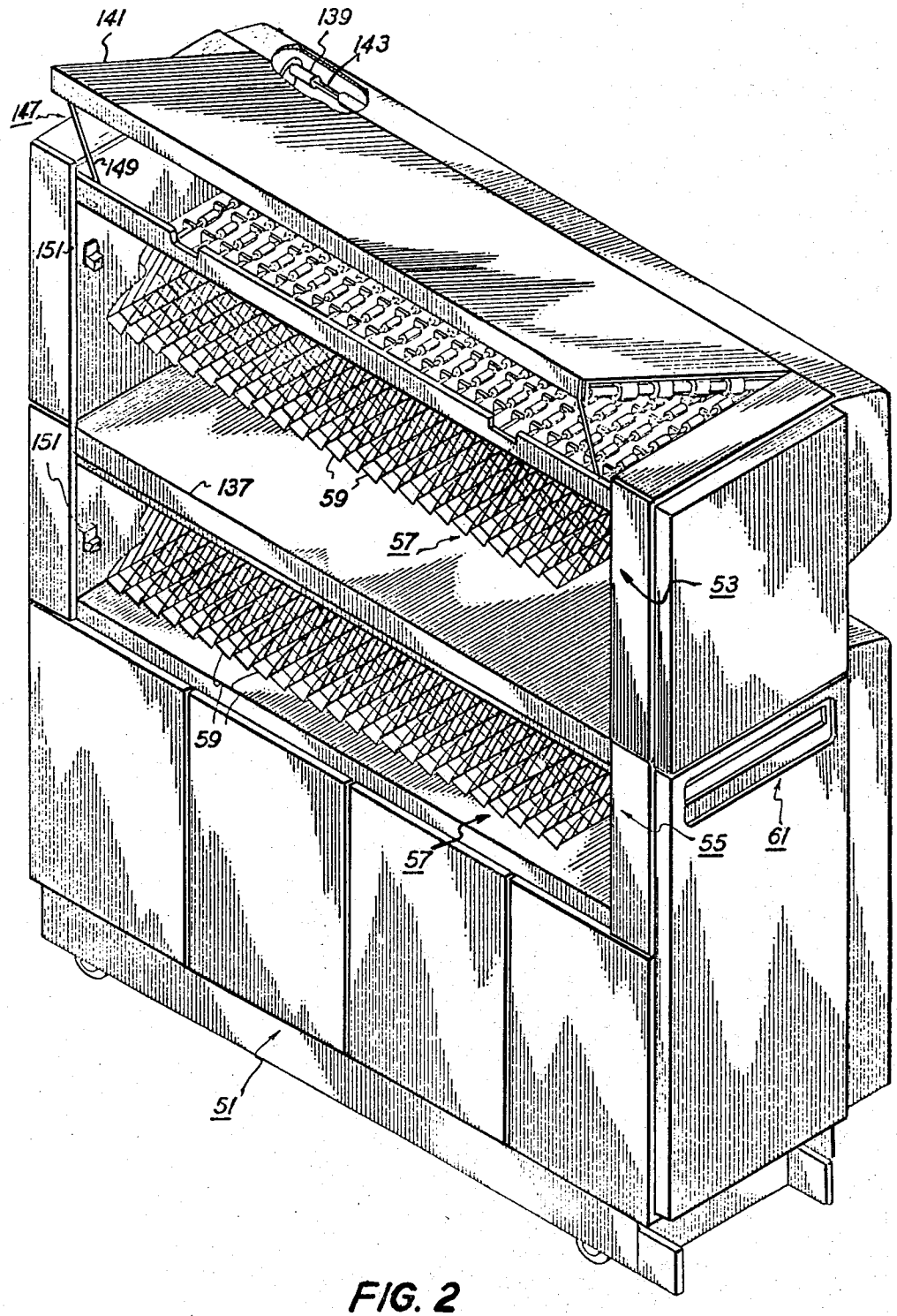


FIG. 2

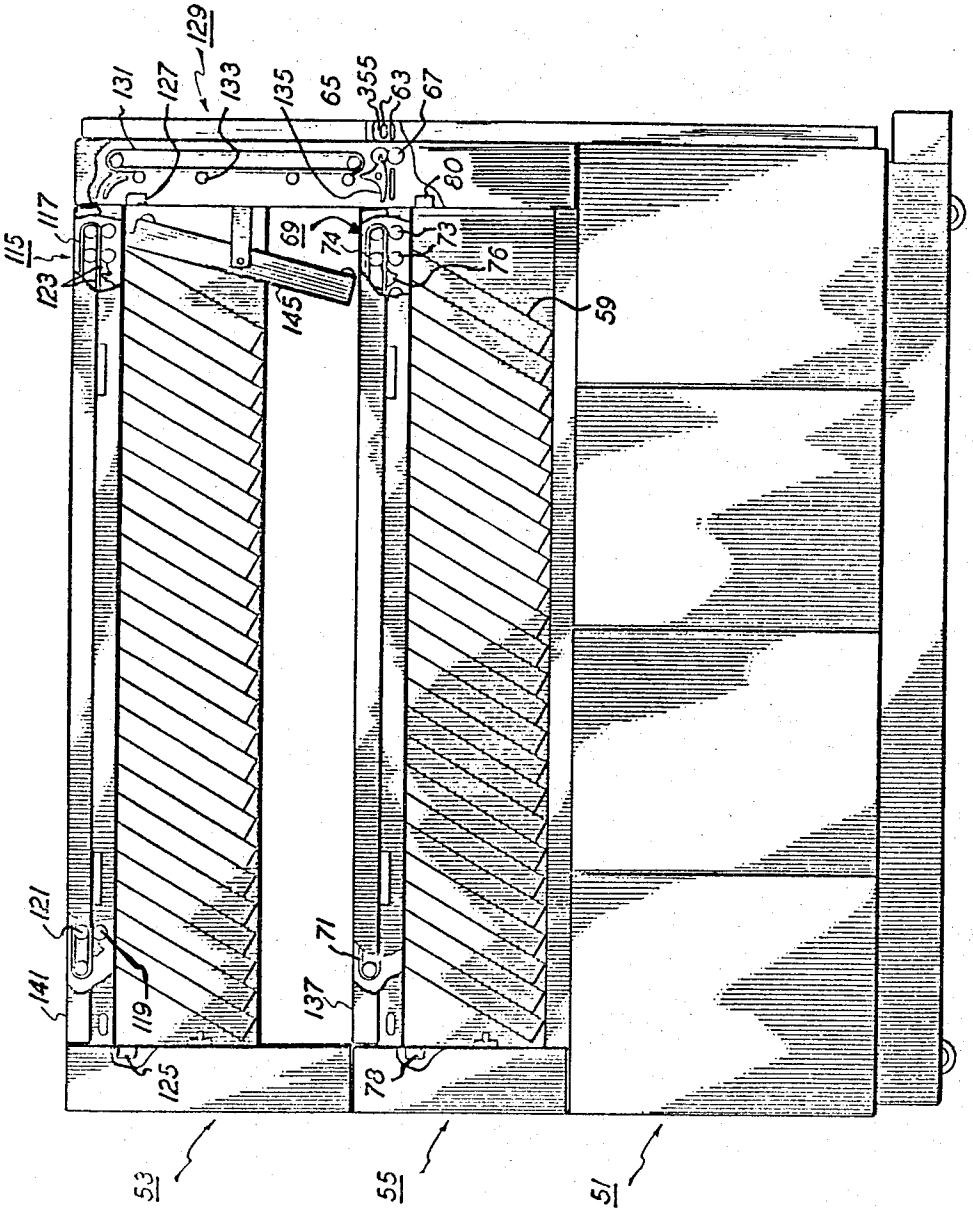

129
131
127
133
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63
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80
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73
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71
137
125
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53
55
51

FIG. 3

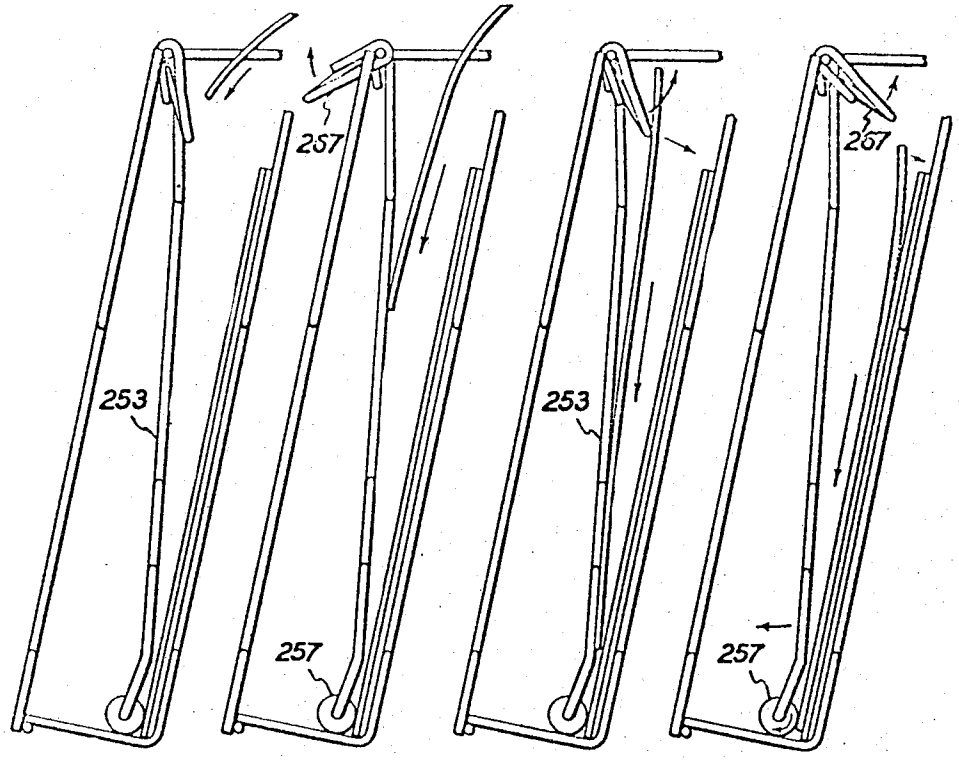


FIG. 7(a) FIG. 7(b) FIG. 7(c) FIG. 7(d)

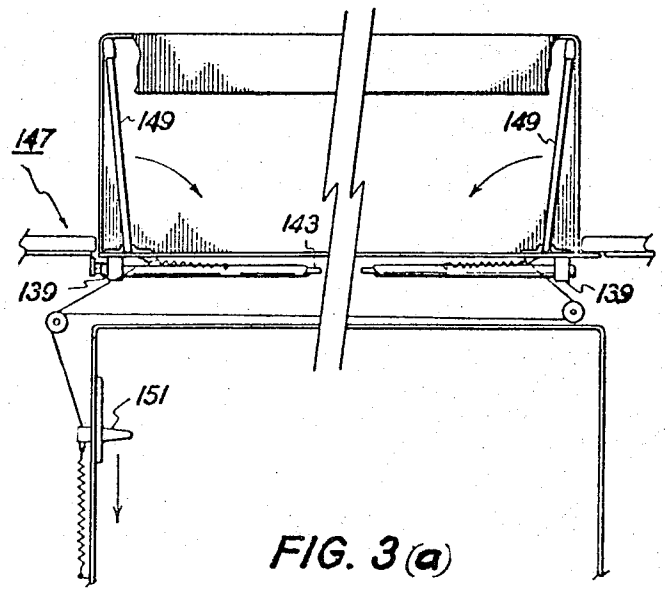


FIG. 3(a)

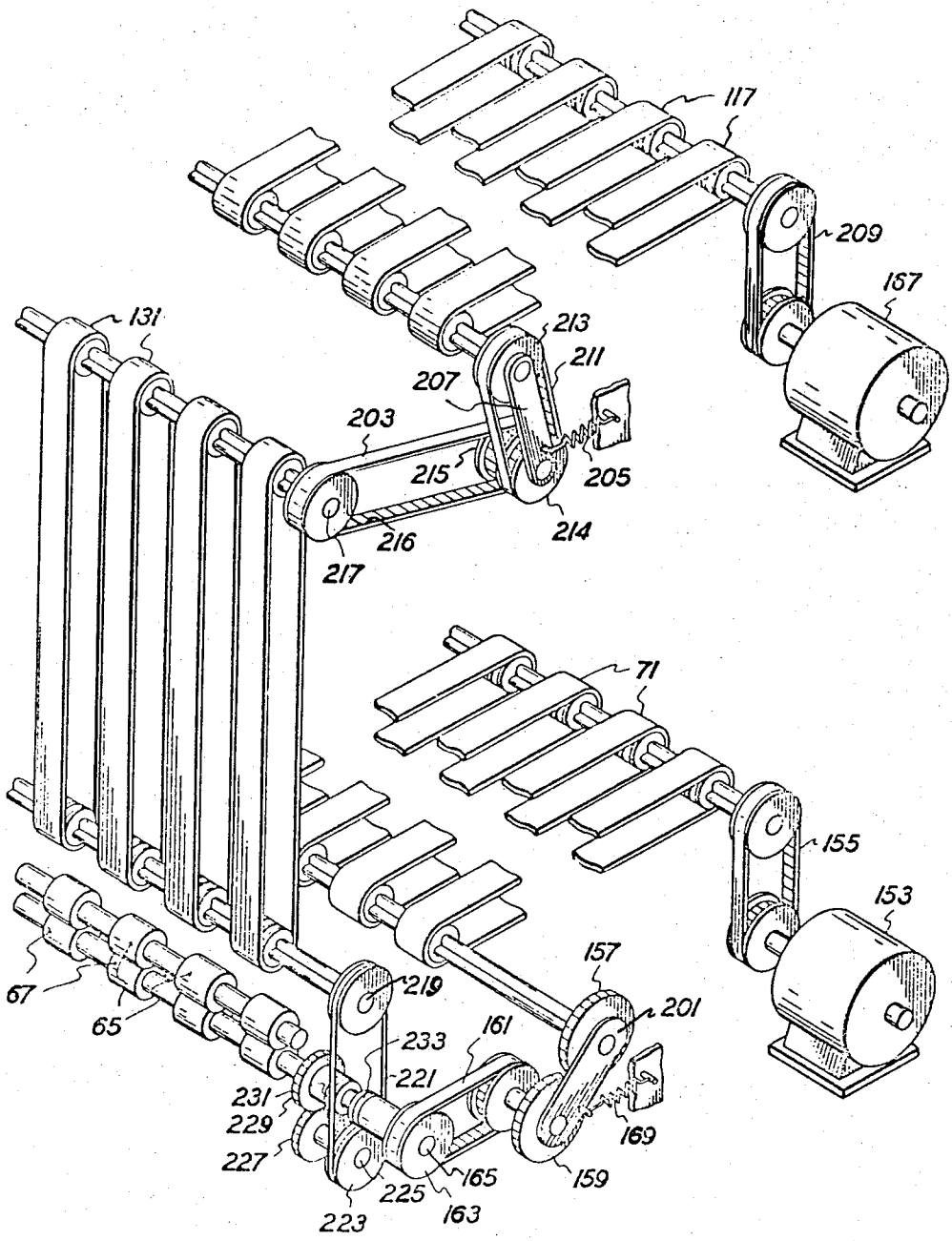

117
209
157
131
213
211
207
203
205
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214
216
217
71
155
153
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67
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221
231
229
227
225
223
165
163
159
169

FIG. 4

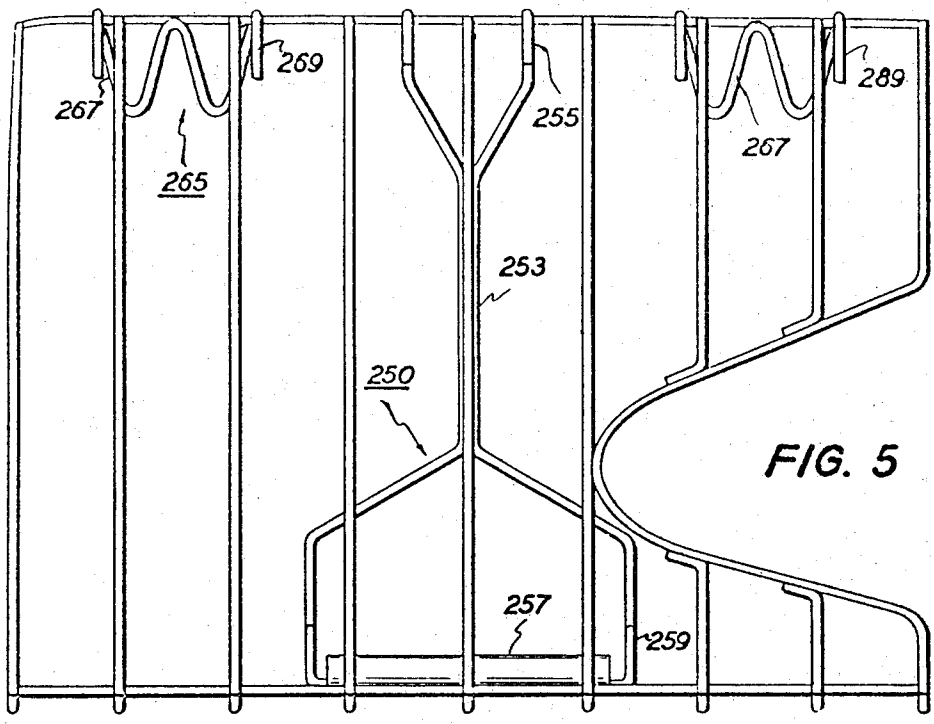


FIG. 5

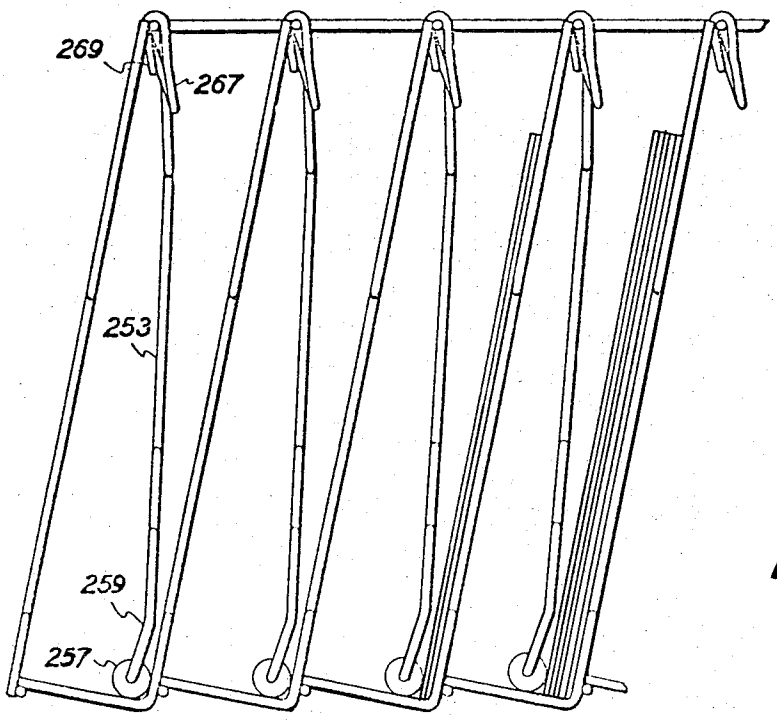


FIG. 6

STACKING CONTROL APPARATUS

This is a continuation of application Ser No. 146,331, filed May 24, 1971, now abandoned.

This invention relates to apparatus for stacking sheets in trays such that the sheets do not bounce but form neatly aligned stacks.

Sorters for copying machines are of several types. One type shifts copy receiving trays arranged in columns relative to a fixed sheet feed path as described, for example, in U.S. Pat. No. 3,372,922. Another type feeds copy sheets to a plurality of modular assemblies in a serial fashion as described, for example, in U.S. Pat. No. 3,484,101. With the advent of high speed copier machines where sheet sorting speeds are necessarily increased, it is desirable to route the copy sheet material into the receiving trays in neat stacks and without bouncing which may trigger jam detection circuits erroneously.

It is therefore an object of the present invention to improve the sorting of sheet material.

It is another object of the present invention to ensure that sheet materials received in trays does not bounce.

It is a further object of the present invention to enable neat stacking of sheets received in trays.

It is a further object of the present invention to minimize static charge imparted to sheets being sorted into receiving trays.

It is a further object of the present invention to enhance the flexibility in which sheet material is handled by high speed sorting apparatus.

These objects as well as others will become more apparent upon considering the following description which is to be read in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective view of a copying machine incorporating a sorting apparatus having stacking control apparatus according to the present invention;

FIG. 2 is an isometric view of the exterior of the sorting apparatus;

FIG. 3 is a front sectional view of the sorting apparatus;

FIG. 3*a* is a front view of the sorting apparatus with cover open illustrating certain details of the latch assembly;

FIG. 4 is an isometric view of the drive mechanism of the sorting apparatus

FIGS. 5 and 6 are end and front sectional views of the trays and stacking control apparatus; and

FIGS. 7*a* through 7*d* are front views illustrating sequential operation of the stacking control apparatus according to the principles of the invention.

GENERAL

For a general understanding of reproduction apparatus with which the present invention may be incorporated, reference is made to FIG. 1 wherein various components of a typical electrostatic printer system are illustrated. It should be understood, however, that any type of printer system could be used with the present invention and not necessarily the printer system described herein. The printer system is of the xerographic type and is generally designated with the reference numeral **10.** As in all xerographic systems, a light image of an original to be reproduced is projected onto the sensitized surface of a xerographic plate to form an electrostatic latent image. Thereafter, the latent image is developed with toner material to form a xerographic powder image corresponding to the latent image on the plate surface. The powder image is then electrostatically transferred to a record material such as a sheet or web of paper or the like which it may be fused by a fusing device whereby the powder image is caused permanently to adhere to the surface of the record material.

The xerographic processor indicated by the reference numeral **11** is arranged as a self-contained unit having all of its processing stations located in a unitary enclosure or cabinet. The printer system includes an exposure station at which a light radiation pattern of a document to be reproduced is positioned on a glass platen **12** for projection onto a photoconductive surface in the form of a xerographic belt **13.**

Imaging light rays from the document as flash illuminated by lamps **18** are projected by a first mirror **20** and a projection lens **21** and another mirror **23** onto the belt **13** at the focal plane for the lens **21** at a position indicated by the dotted line **25.**

As an interface structure and for unobstructive optical projections, the side of the cabinet is formed with an enlarged rectangular opening to permit the projection of image light rays from the lens **21** to the mirror **23.** Similarly, the cabinet supporting the document plane is formed with a corresponding rectangular opening that mates with the opening in the printer cabinet when the two cabinets are operatively joined together for copy/duplicating purposes. Suitable light-type gaskets may be utilized adjacent the exterior of each opening in the cabinets in order to minimize the leakage of unwanted extraneous light. The xerographic belt **13** is mounted for movement around three parallel arranged rollers **27** suitably mounted in the frame of processor **11.** The belt may be continuously driven by a suitable motor (not shown) and at an appropriate speed corresponding to the discharge responsive the photoconductive material that comprises the belt and the intensity of the imaging light rays from the document. The exposure of the belt to the imaging light rays from the document discharges the photoconductive layer in the area struck by light whereby there remains on the belt an electrostatic latent imaging of figuration corresponding to the light image projected from the document. As the belt continues its movement, the electrostatic latent image passes a developing station at which there is positioned a developer apparatus **29** for developing the electrostatic latent image. After development, the powdered image is moved to an image transfer station whereat record material or sheet of paper just previously separated from a stack of sheets **30** is held against the surface of the belt to receive the developed powder image therefrom. The sheet is moved in synchronism with the movement of the belt during transfer of the developed image. After transfer, the sheet of paper is conveyed to a fusing station where a fuser device **31** is positioned to receive the sheet of paper for fusing the powder thereon. After fusing of the powder image, the sheet is conveyed through an opening in the cabinet to a sorting apparatus **32** for distributing into trays or bins in a manner as will be described more fully hereinafter. The sheets are separated from the stack and fed from the top of the stack by means of a separator roll device **33** and timed sequence of the movement of the developed images on the belt **13.**

Further details of the processing devices and stations in the printer system are not necessary to understand the principlas of the present invention. However, a detailed description of these processing stations and components along with the other structures of the machine printer are disclosed and copending application Ser. Nos. 731,934, filed May 24, 1968, and 756,598, filed Aug. 30, 1968, which are commonly assigned with the present invention.

It will be appreciated that the printer system may be operated in conjunction with a roll converter unit indicated by the reference numeral **35.** The roll converter unit **35** is adapted to convert a relatively large roll of paper **36** into various sizes of sheets of paper by means of a cutter device **37** and a suitable control system (not shown) arranged to control cutting and feeding of the individual sheets into operative cooperation is assured between the various units operating with the printer system by the physical association of the cabinets for the units and the matching openings which enable full cooperation of the imaging light rays and sheet transport path between the units. In this regard, locking clamps may be provided on all the units for preventing the inadvertent movement of such units during use and interlocks which is an alignment device may be utilized on each unit for ensuring upper alignment and to terminate or suspend operation in the event misalignment or separation of the units occur. For facility and needs of operation, each of the units provided with caster wheels and locking brakes thereby aiding in the movement of the units into and out of cooperative engagement.

SORTING APPARATUS

Referring now to FIGS. **2–6,** sorting apparatus **32** comprises a base frame **51** which supports upper and lower sorting assemblies **53, 55,** respectively. Lower sorting assembly **55** includes a unitary framework **57** defining a series of bins or trays **59** which receive copy sheets in a downward direction. Similarly, upper sorting assembly **53** has a unitary framework **57** which defines a series of trays or bins **59** for receiving copy sheets.

Sheets enter the sorting apparatus through an opening **61** formed in the frame of the lower sorting assembly **55.** The sheets pass through guides **63** to a pair of pinch rolls **65** and **67** which direct their travel to a horizontal transport **69** which is made up of a plurality of horizontal driving belts **71** which are above the sheet path and free wheeling rollers **73** positioned below the sheet path. Above rollers **73** are rollers **74** which are positioned within belts **71** and are spring loaded downward to ensure proper traction between the belts and the sheets being transported. The sheets traveling on the horizontal belts are deflected downward into an appropriate tray by fingers or gates **76** actuated into the sheet path by an associated solenoid in accordance with the control logic. The control logic is triggered by the passage of the sheet from the horizontal transport into a tray which causes the breaking of the light beam between a light source **78** and a photo-transistor **80.** The breaking and then re-establishment of the light beam results in the open gate closing and the next gate opening which continues until the last copy is received in the appropriate sorting assembly.

The upper sorting assembly **53** includes a transport **115** made up of horizontal belts **117** which moves above the sheet path and free wheeling rollers **119** positioned below the sheet path. Above rollers **119** are rollers **121** which are positioned in belts **117** to ensure proper traction as in the case of rollers **74.** Fingers or gate members **123** serve to deflect the copy sheets into the bins or trays when actuated by the control logic which includes a light source **125** and phototransistor **127.**

To transport the copy sheets into the upper sorting assembly, there is provided a vertical transport **129** made up of vertical belts **131** which moves against rollers **133.** The vertical transport **129** receives the sheets when solenoid actuated sheet deflector **135** is positioned so as to direct the sheet upwardly in accordance with control logic as will be described hereinafter.

Horizontal belts **71** are received and supported in a pivotable cover **137** connected to the frame by one or more hinges **139.** Similarly, horizontal belts **117** are received in and supported by a pivotable cover **141** connected to the frame by one or more hinges **139.** By this arrangement, if a jam occurs within the transport path, the belts **71** and **117** may be raised clear from the transport path by pivotable movement of the covers **137** and **141,** respectively. Torsion springs **143** extend along the length of covers **137** and **141** and serve to facilitate raising of the covers. In the event that a jam occurs in the vertical transport **129,** a hinged cover **145** is provided for easy access to the transport path. It will mow be appreciated that if a jam occurs anywhere along the sheet path, the sheet may be cleared expeditiously by opening of the covers **137, 141** or **145** to a displaced position away from the sheet path sufficiently so that an operator's hand may be inserted and the jammed sheet removed from the sheet path. A latch assembly **147** including spring biased pins **149** serves to maintain each of the covers **137** and **141** in a raised position to prevent inadvertent closing on the hand of an operator. Handle **151** operates to retract the spring biased pins for closing of the covers.

Sheets may be sorted by either the lower sorting assembly **55** or the upper sorting assembly **53** or both together for long runs. The lower sorting assembly includes a drive motor **153** which drives transport belts **71** through a timing belt **155** (FIG. **4**). Transport belts **71** drive gears **157, 159** which, in turn, drive pinch rolls **67** through a timing belt **161** which is mounted on a pulley **163** driving shaft **165** carrying the pinch rolls **67.** It will be appreciated that by virtue of the flexibility of belt **161,** that transport belts **71** which are housed in cover **137** may be pivoted away from and into the sheet path. A spring **169** connected to the frame and a link member **201** maintains proper belt tensioning during operating conditions. The pinch rolls **67** are desirably driven at a speed or rate slightly lower than the speed at which the belts **71** are moving so that the paper is pulled smoothly along its transport path rather than being pushed or jerked.

Upper sorting assembly **53** includes a drive motor **167** which drives the transport belts **117** through a timing belt **209.** The transport belts **117,** in turn, drive transport belts **131** through a timing belt **211** mounted on pulleys **213** and **214** and a belt **203** which is mounted on pulleys **215** and **216** which serve to drive shaft **217** drivingly connected to the belts **131.** It will be appreciated that belt **203** is able to flex when belts **117** and cover **141** are raised above the sheet path. A spring **205** connected to link **207** maintains proper belt

tension for accomplishing the desired drive operation. It will be noted that a shaft 219 which is at the lower extent of the transport belts 131 is drivingly connected to a pinch roll 67 through an O-ring 221 which is received on a pulley 223 mounted on a shaft 225 which carries gear 227 which meshes with a gear 229 mounted on a shaft 165.

The driving mechanism described above enables the vertical transport to be driven by motor 167, and pinch rolls 67 to be driven through the upper or lower sorting assemblies by motors 153 and 167, respectively. To accomplish this operation, a pair of overrunning clutches 231 and 233 are mounted on shaft 165. The shaft 165 may then be driven through either the upper sorting assembly drive motor or the lower sorting assembly drive motor. It will now be appreciated that when clutch 231 is in driving relation that clutch 233 overruns and vice versa. By virtue of this driving arrangement, the pinch rolls 65 and 67 may be operated to provide alternate sorting paths into the two sorting assemblies. Thus in the event that drive motor 153 becomes inoperative, the pinch rolls are driven by drive motor 167 through clutch 233. Furthermore, by virtue of the flexibility of belts 161 and 203, the transport belts may be moved out of the sheet path to remove sheet jams expeditiously.

STACKING CONTROL APPARATUS

In accordance with the present invention associated with each of the trays 59 is a stacking control apparatus 250 which serves to ensure that the sheets when received in a tray do not bounce to interrupt the light beam and assures proper stacking alignment of the sheets. The stacking control apparatus comprises a roller assembly 251 which includes an X-shaped frame 253 with loop portions 255 engaging wire framework 57. Suspended from X-shaped frame 253 is a roller member 257. It will be noted that the configuration of frame 253 is such that a crimped or offset portion 259 is located in the vicinity of roller member 257 to enable sheets to enter tangentially to the roller. By this structure the sheet acceleration is controlled to prevent bouncing of the sheets off the tray bottom back into the light beam.

The sheets are aligned in the trays to form desirable stacks. Associated with roller assembly 251 is a plurality of hanging wire devices 265 which serve to retard the velocity of an incoming sheet and further compress the top of the stack being formed in its tray. It will be noted that pairs of hanging wire devices are suspended from framework 57 symmetrically on each side of the sheet centerline. It will be further noted that each of the hanging wire devices has generally W-shaped portions 267 and loop portions 269 for free pivoting on the framework as they are impacted by incoming sheets. By this structure, the top of a stack formed is compacted to assure clearance in the sheet path for the next incoming sheet. The hanging wire device are easily mounted on the framework by virtue of loop portions 269 yet retained on the framework due to the cooperation between W-shaped portions 267 and loop portions 269 with the framework. It has been found that the hanging wire devices which are made of a conductive metal contribute to the dissipation of static electricity normally imparted to the sheets being transported along their path.

While the invention has been described and illustrated herein as preferred form of the invention, it will be apparent to those skilled in the art that changes and modifications may be made thereto without departing from the spirit and intent of the invention which is to be limited only to the scope of the appended claims.

What is claimed is:

1. In sorting apparatus in which sheets are moved along a horizontal path and deflected downwardly into substantially vertical trays, an improved stacking control apparatus comprising:
   - a roller assembly suspended from the inlet of an associated tray and extending substantially in a vertical direction along the length of the tray, including a frame member and roller means positioned at the lowermost portion of said frame member to receive the downwardly directed sheets, and
   - a plurality of wire members pivotally supported on the same axis as said roller assembly extending from the top of said tray for guiding the sheets along a predetermined path in the direction of said roller means and impacting the top portion of the sheets to clear the path for the next incoming sheet.

2. Apparatus according to claim 1 wherein said roller means is positioned for rotation on an axis offset from the plane of said frame member.

3. Apparatus according to claim 2 wherein said roller means comprises at least one cylindrical member and said frame member is in a plane extending substantially tangentially thereto.

4. Apparatus according to claim 1 wherein said wire members define A w-shaped portion and end loop portions.

5. Apparatus according to claim 1 wherein said frame member extends substantially in the same plane as said wire members.

6. Apparatus according to claim 1 wherein said wire members are made from a conductive material.

7. Stacking apparatus comprising:
   - a receiving tray having a first wall inclined to the vertical for receiving sheets and a bottom wall extending from the lower end of and substantially perpendicular to said first wall,
   - a frame having a roller journaled on one end and the other end having a loop portion for engagement with and for supporting said frame from the upper end of said first wall, and
   - a plurality of wire devices each having a loop portion for engagement with and suspending the devices from said the upper end of first wall.

8. Apparatus as claimed in claim 7 wherein said wire devices are formed in a W-shape.

9. Apparatus as claimed in claim 7 wherein said wire devices are formed of conductive material.

10. Apparatus as claimed in claim 7 wherein said frame comprises a main portion in a plane which is tangential to said roller.

11. Apparatus as claimed in claim 7 including at least two wire devices each positioned on each side of said frame across the width of said tray.

12. Apparatus according to claim 7 including plurality of trays arranged in parallel fashion.

13. Apparatus according to claim 12 wherein said trays are formed from a unitary framework.

* * * * *