United States Patent [19]

Fagan et al.

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[45] **Nov. 27, 1973**

[54] **SORTING AND COLLATING APPARATUS**

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[73] Assignee: **EMF Corporation,** Seattle, Wash.

[22] Filed: **July 28, 1971**

[21] Appl. No.: **166,905**

[52] **U.S. Cl.** **271/64,** 270/58, 271/74

[51] **Int. Cl.** **B65h 29/60**

[58] **Field of Search** ..... 271/64, 74, DIG. 2, 271/56, 76, 71; 270/58

[56] **References Cited**

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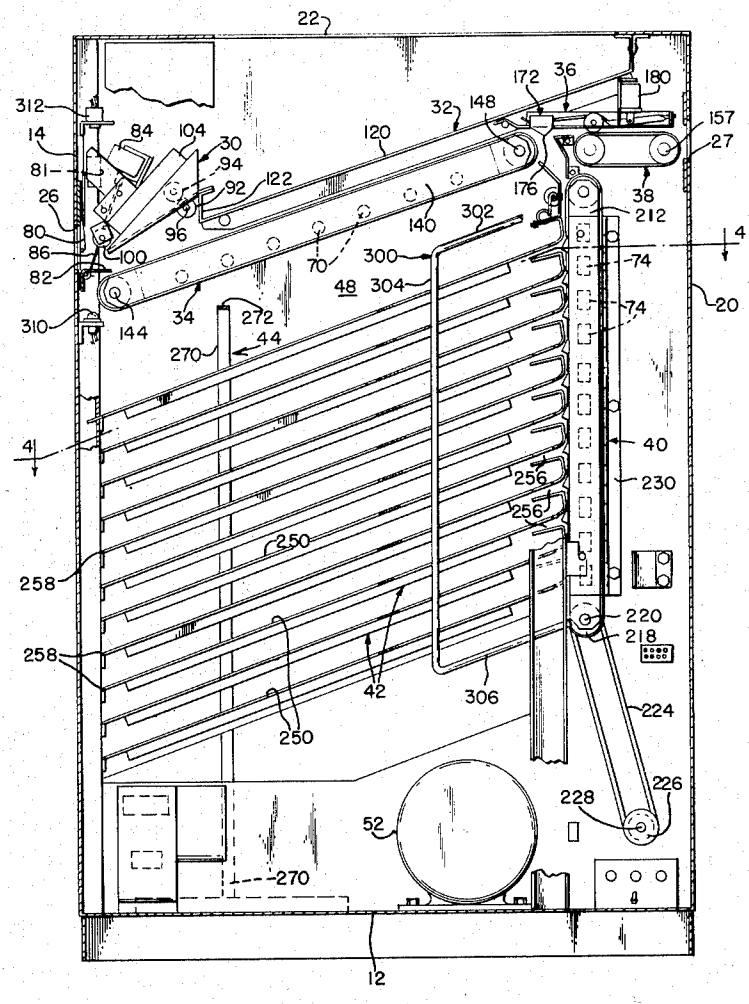
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[57] **ABSTRACT**

Sorting and collating apparatus for use with copying and duplicating machines for distribution of flexible sheet material. Paper is accepted into the apparatus and immediately diverted either into a receiving tray, separated into individual sorting trays in the machine or sent on through the machine into another sorter unit. The apparatus employs vacuum and belt conveying of the sheet material and deflectors for the sorting trays move in and out of one of the conveyor vacuum chambers. Means are provided for making the paper more accessible to the operator after it has been deposited in the sorting trays.

46 Claims, 12 Drawing Figures

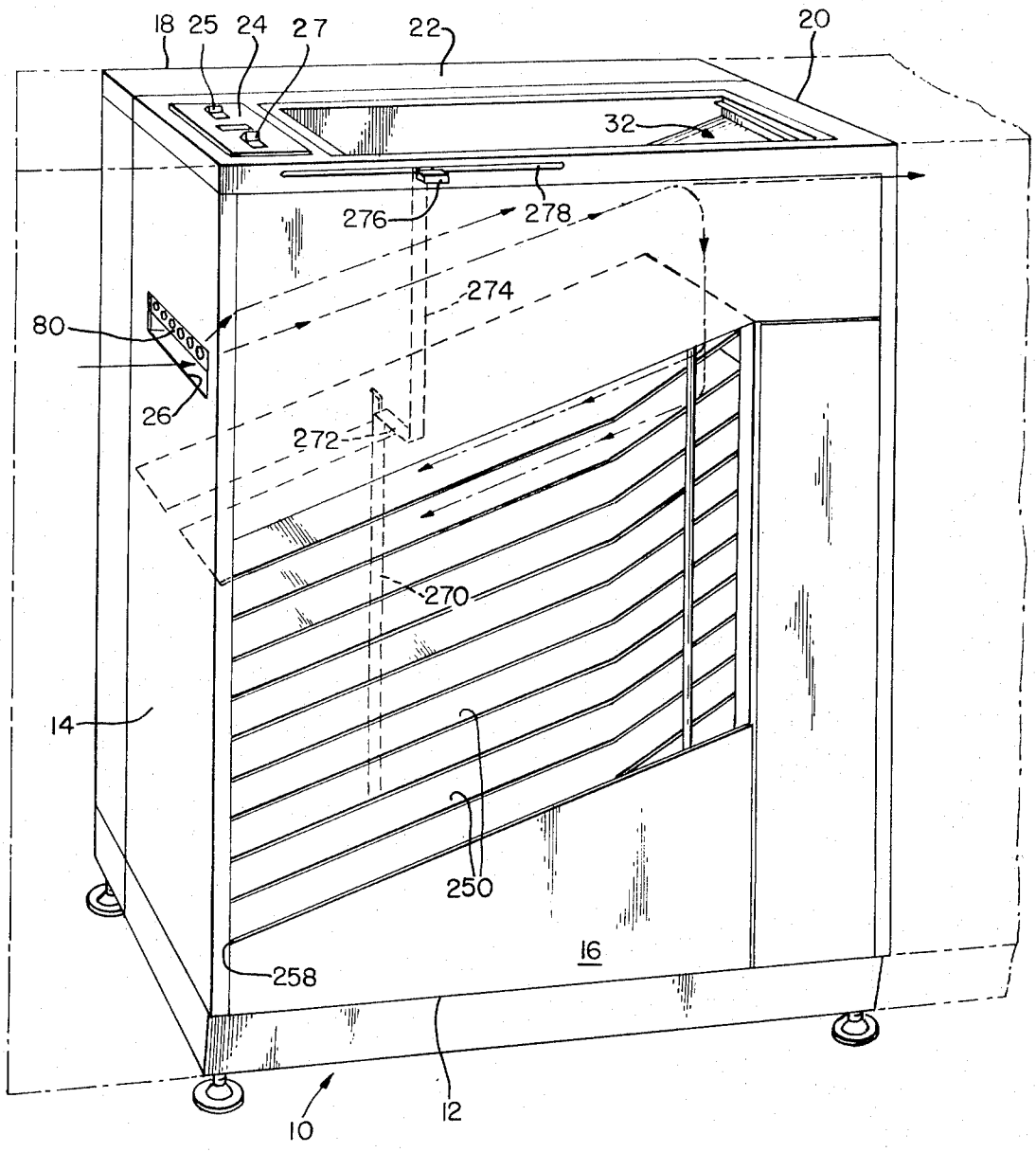


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SHEET 1 OF 7

FIG. 1



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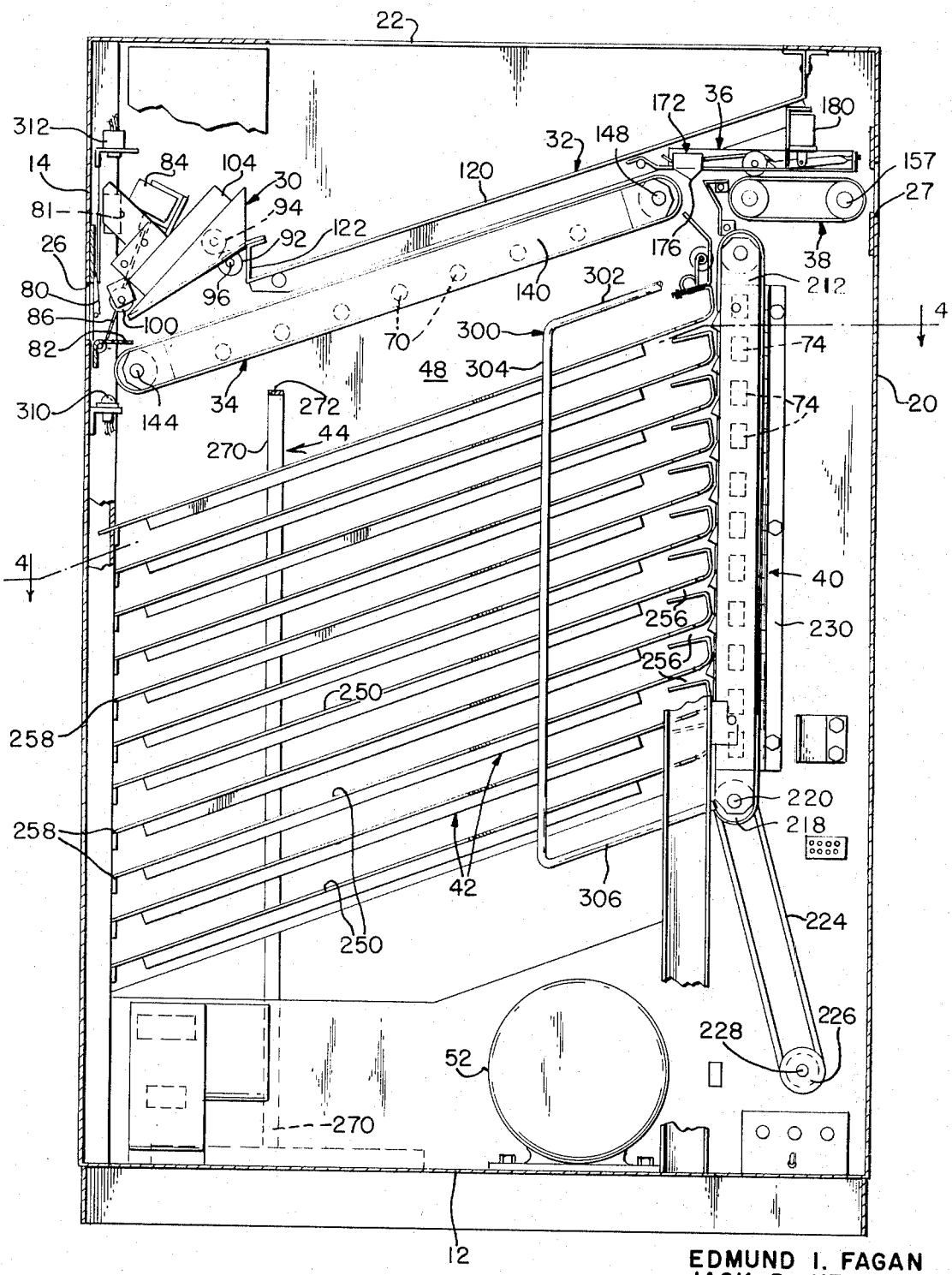


FIG. 2

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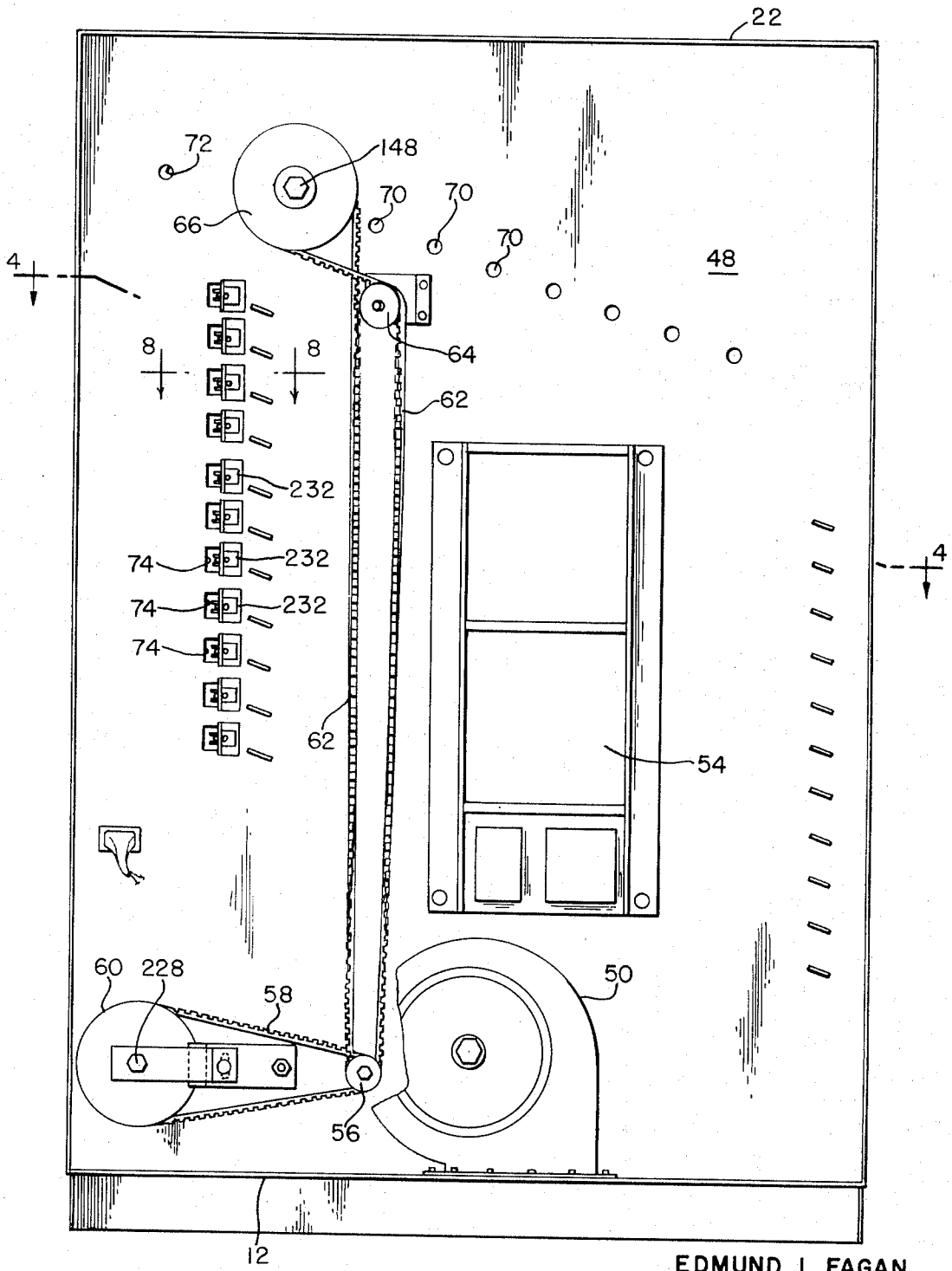


FIG. 3

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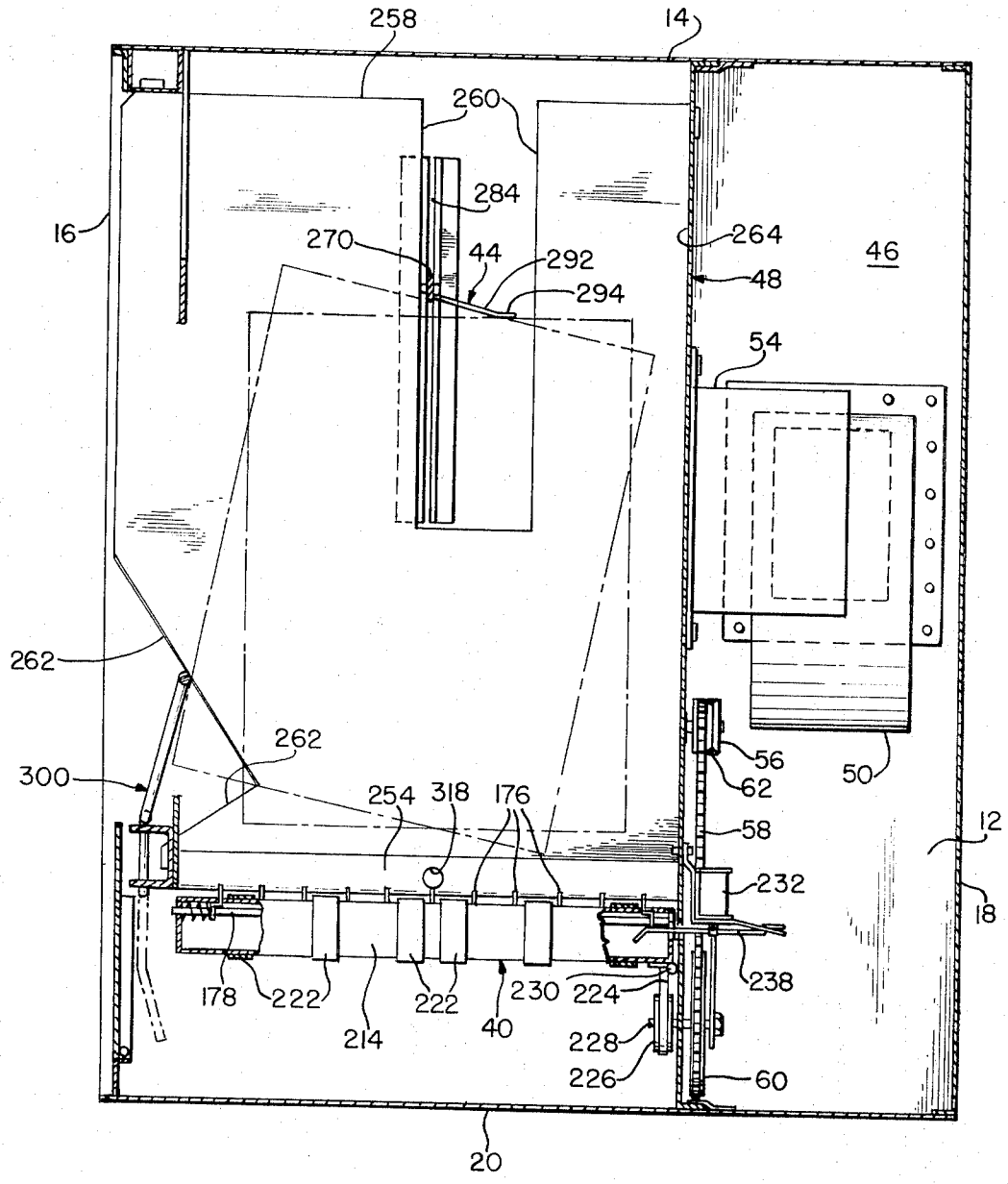


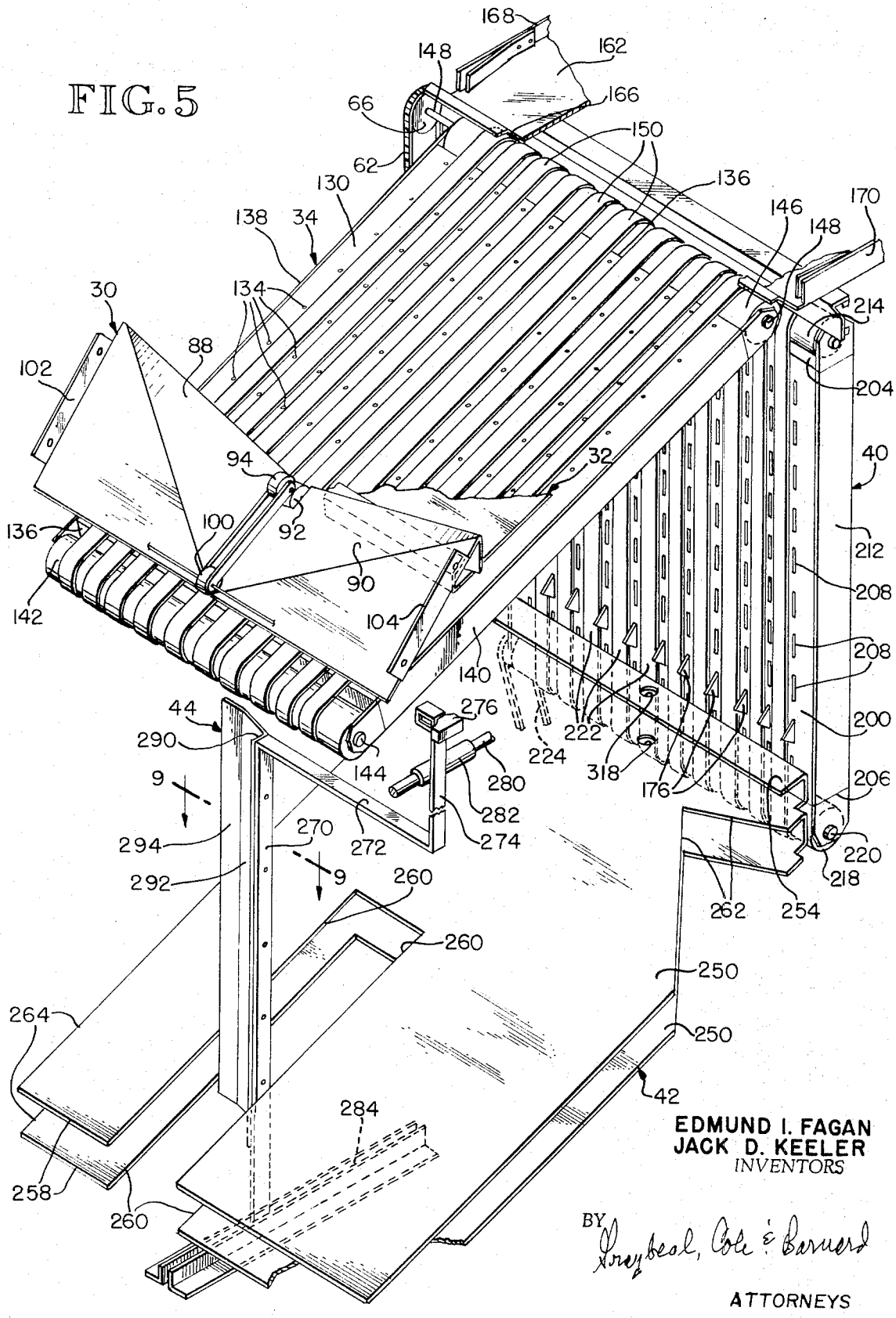
FIG. 4

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FIG. 5



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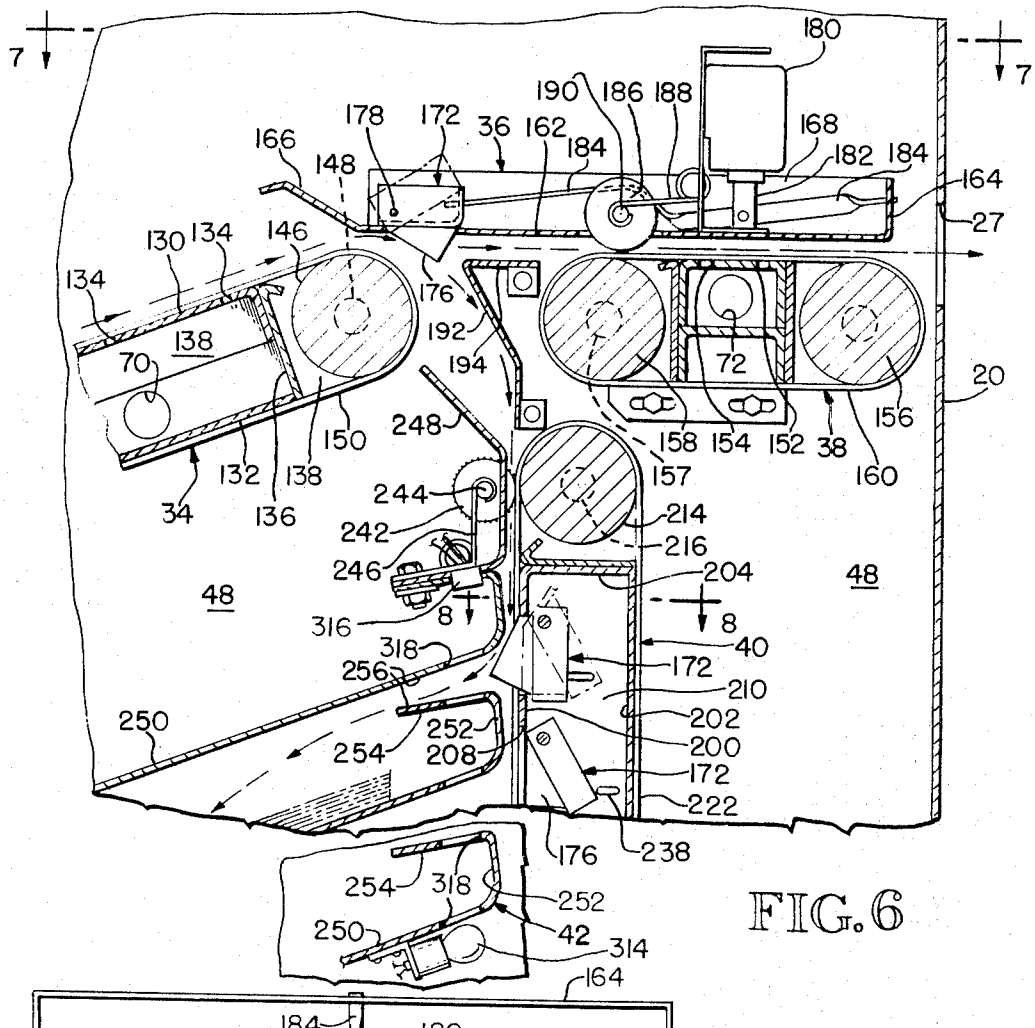


FIG. 6

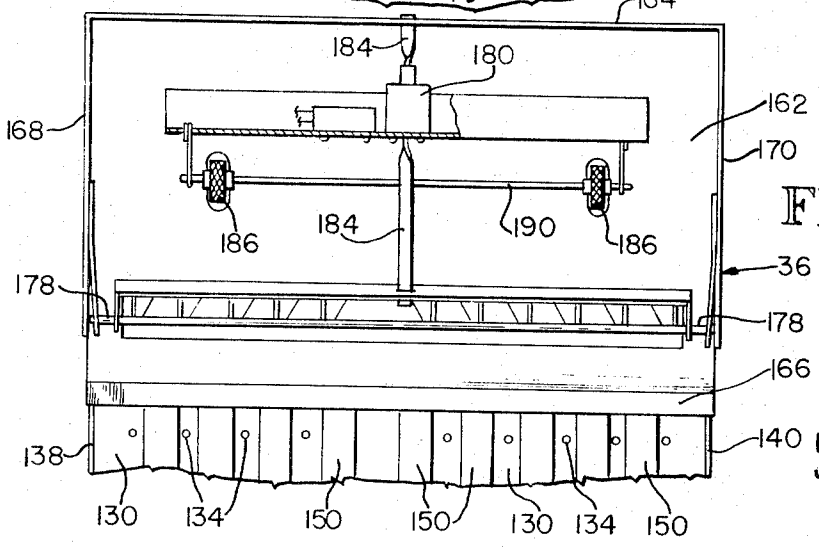


FIG. 7

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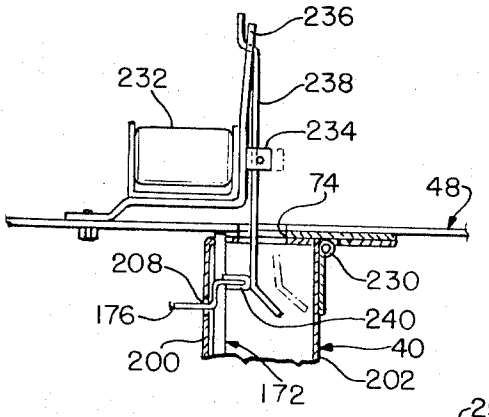


FIG. 8

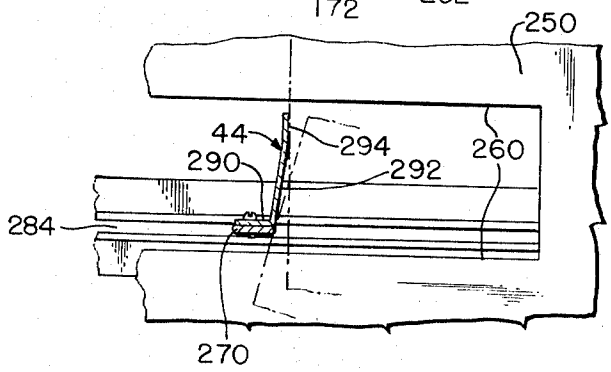


FIG. 9

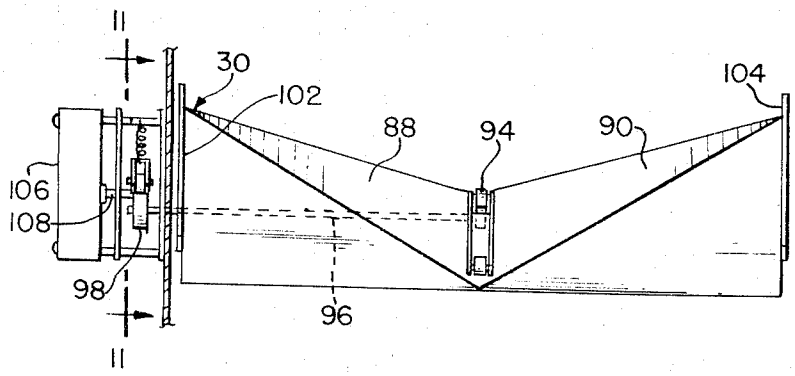
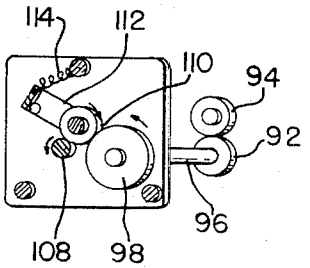


FIG. 10



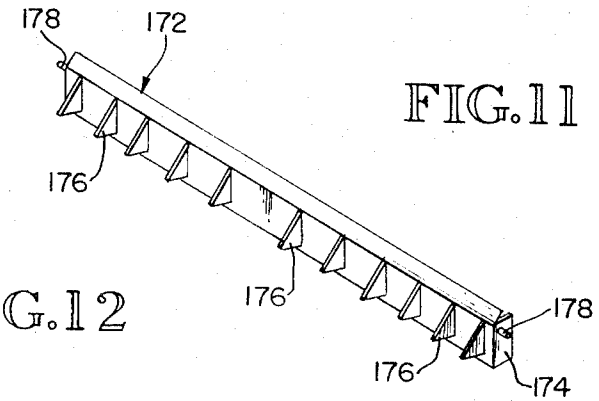


FIG. 11

FIG. 12

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SORTING AND COLLATING APPARATUS

BACKGROUND OF INVENTION

This invention relates to sheet distributing and in particular, to apparatus adapted to separate and sort sheet material as it is fed into the apparatus from different types of reproducing or printing devices.

Prior art sorters and collators have encountered a number of problems. One is that the rapid advances in copy producing machines themselves have made increased demands on sorters and collators. For instance, the speed of a copy producing machine to reproduce a number of sets of copied materials requires that the sorter have the capacity to accommodate changing work loads. The sorter or collator should be able to increase or decrease its capacity by adding on modular slave units rather than requiring a variety of sizes in individual machines. Additionally, the types and weights of papers used in copy machines may differ substantially and the sorter or collator apparatus must be prepared to handle these differences. The variety of copying jobs sorter-collators must handle suggests they should be modular to the extent that if one unit cannot handle a copy task, the materials can be passed on to a second modular unit without any loss of time or extra handling of the copied materials.

Among the prior art references which may be considered with respect to the features of this invention are the following: U.S. Pat. Nos. 3,572,685; 3,497,207; 3,484,101; 3,467,371; 3,460,824; and 3,273,882. The devices covered by the above list of patents are of interest only and are not considered pertinent to the teachings of this invention.

SUMMARY OF INVENTION

The sorter-collator of this invention utilizes a partial vacuum and belt-type conveyor system. As a paper copy enters the machine it may be diverted upwardly into a receiving tray or to a conveyor which in turn directs the paper to the sorting area of the machine or passes it on through to the next modular unit. At one side of the machine housing is a large vacuum chamber or major plenum which is separated from the other working parts by a wall or partition. Openings in the partition allow the vacuum in this plenum to draw on the subplenums or vacuum chambers for the conveyors in the copy distribution section of the machine. At the entrance a sheet stiffener is provided to assist paper being directed into the receiving tray. Backstop means act to pick or jog one corner of the paper towards the exposed side of the sorting trays so that the operator can readily see and grasp the paper. Conveyor deflectors for diverting sheets into a particular sorting tray actually are retracted into and extend out of the vertical conveyor vacuum chamber. Side stop means for the paper, an air actuated turn-on switch, and unique actuators for the deflectors are also provided.

Accordingly, it is among the many features, objects and advantages of this invention to provide a sorting and collating apparatus which substantially improves copy distributing and sorting mechanisms. The device more conveniently handles a variety of types and weights of paper than prior art devices. It particularly handles lighter weight papers more reliably. The machine is capable of receiving sheets and distributing the same at the high speeds demanded by present advanced copy machines. The device by design lends itself to automatic programming for random or sequential sheet distribution. Paper jam-ups within the machine are made readily accessible so that down time is negligible. The receiving tray is integral with the machine rather than an external attachment. The apparatus as designed can be modular depending on distribution capacity needed.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view of the machine showing the input end and the path of movement of the sheets;

FIG. **2** is a cross-section view in elevation of the entire machine showing location of the major components of the apparatus in the sheet handling section;

FIG. **3** is a rear elevational view with the cover panel removed to show the auxiliary compartment and vacuum section of the machine;

FIG. **4** is a cross-sectional view in plan taken along the line **4—4** of FIGS. **2** and **3** and showing in plan the major plenum section, the sheet distribution section, and separating partition together with other details of paper handling components;

FIG. **5** is a perspective view of the upper and vertical conveyors and also showing other details of the machine;

FIG. **6** is a partial cross-sectional view of the exit end of the upper conveyor and the upper end of the vertical conveyor and other details showing additional structure for distributing sheets;

FIG. **7** is a partial plan view taken along the line **7—7** of FIG. **6** and further illustrating details of the diverting mechanism at the exit end of the upper conveyor;

FIG. **8** is a partial plan view in cross section taken along the line **8—8** of FIG. **6** to show actuator details for the deflectors;

FIG. **9** is a partial cross-section view taken along the line **9—9** of FIG. **5** and illustrating further details of the paper stopping and jogging mechanism in the sorting trays;

FIG. **10** is a partial elevational view showing details of the paper stiffener and forwarding rollers associated therewith;

FIG. **11** is a side elevation view taken along the line **11—11** of FIG. **10** and illustrating further details of the drive mechanism for the forwarding rollers attached to the paper stiffener; and

FIG. **12** is a perspective view of the deflector mechanism as employed in various parts of the machine.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings, and particularly FIG. **1**, it will be seen that the apparatus, generally designated by the number **10**, has an upstanding rectangular housing. It is provided with a supporting frame having base **12**, entrance sidewall **14**, front wall **16**, back wall **18**, and exit sidewall **20**. In addition, the machine has top surface **22**, which as can be seen has an opening therein to expose the receiving tray. Also, controls for the apparatus will be located on the top surface as indicated by the panel board **24**. An entrance opening **26** is provided in entrance sidewall **14** which is an elongated rectangular slot through which paper enters the sorter. Major areas for discussion will now be pointed out to be followed by a detailed description of each. Within the machine, see FIG. **2**, is a paper stiffening structure generally designated by the number **30** which directs paper to a collection tray generally designated

by the number **32.** If paper is not sent to collection tray **32,** it will be directed to the upper or generally horizontal conveyor assembly generally designated by the number **34.** At the exit end of conveyor assembly **34** is a sheet diverting structure generally designated as **36.** A short paper conveyor assembly **38** is provided for paper that is to go directly on through and out of the apparatus. If the paper is retained in the machine for distribution to sorting trays, it will be transported by the vertical sheet conveyor generally designated by the number **40.** The trays themselves are identified by the number **42.** A backstop mechanism is also provided and is identified by the number **44.** The major vacuum chamber or plenum is identified by the number **46** (FIG. **4**) as opposed to the main paper handling or distribution compartment of the machine which is separated from vacuum chamber **46** by partition **48.**

Auxiliary Compartment and Vacuum Chamber

As seen in FIGS. **3** and **4,** on the rear side of the apparatus **10** is vacuum chamber **46** defined by base wall **12,** entrance and exit sidewalls **14** and **20,** back wall **18,** top surface **22,** and partition **48.** Within the vacuum chamber is a vacuum fan or blower **50** driven by a motor **52** on the distribution side of partition **48** and which is located beneath the stack of sorting trays. The blower or fan can also be driven by its own motor if desired. Within auxiliary chamber **46** is a panel and support structure **54** for housing electronics, controls and other circuitry for the machine. Motor **52** drives a pulley **56** which in turn by virtue of a belt **58** drives another larger pulley **60.** Note in FIG. **4** that pulley **56** is doubled for accommodating not only belt **58** but also for receiving belt **62** which runs upwardly and is reeved around a larger pulley **66.** An idler pulley **64** is interposed to provide tensioning of belt **62** which is twisted to turn pulley **66** in the proper direction. Thus, a series of pulleys and belts driven by main drive motor **52** provides drive shafts at needed locations within the housing. Such powered shafts will be discussed below more precisely and in greater detail. Partition **48** is provided with a series of openings **70** extending through the partition into the interior of the horizontal conveyor **34** vacuum chamber assembly as will be seen in FIGS. **2** and **3.** An opening **72** near pulley **66** opens into the conveyor vacuum chamber in assembly **38** as shown also in FIG. **6.** In like manner a series of vertically arranged openings **74** open into the vacuum chamber of the vertical conveyor assembly as seen in FIGS. **2, 3** and **8.**

Entrance Area, Stiffener and Receiving Tray

As seen in FIGS. **1** and **2** entrance slot **26** is an elongated rectangular opening. The apparatus can be made to turn on automatically in response, for instance, to an air stream from the copying machine with which the invention is used. Thus, an air vane **80** which presents a flat surface to the air stream from the copier is moved inwardly to actuate a switch **81** to turn on the sorter. Upon entering the machine a sheet of paper may proceed directly onto the conveyor assembly **34** or into receiving tray **32.** To this end a simple diverter mechanism is provided which comprises a hinged angle member **82** connected to an entrance solenoid **84** by link member **86.** In its normal position shown in FIG. **2,** deflector **82** is down so that sheets will proceed to the conveyor assembly. By actuation of solenoid **84** the horizontal leg of member **82** will swing up around its hinge to direct the paper into stiffener structure **30.**

Details of stiffener structure **30** will be found in FIGS. **2, 5** and **10.** The essential purpose of stiffener **30** is to form the incoming sheets by turning the edges up to form the paper in a U-shape along its direction of track. Thus, the paper is mechanically stiffened and is enabled to enter the receiving tray. The stiffener structure is essentially a V-shape metal sheet having upwardly angling surfaces **88** and **90.** Between surfaces **88** and **90** is located a pair of forwarding rollers comprising driven roller **92** and a coacting friction roller **94.** A shaft **96** connects driven roller **92** to a driven roller **98** located to one side of the structure as shown in FIGS. **10** and **11.** Note that forwarding rollers **92** and **94** are located towards the upper end of stiffener assembly **30.** At the rear thereof and just above deflector **82** there may be an idler roller **100.** Side brackets **102** and **104** are provided to connect or mount the stiffener structure within the apparatus housing. Paper entering the stiffener structure from the copy machine is engaged between forwarding rollers **92** and **94** and propelled into receiving tray **32.** A small motor **106** is mounted to one side and has drive shaft **108** which frictionally rotates a wheel or roller **110** mounted on a bracket **112.** A spring **114** urges one end of bracket **112** so that roller **110** is biased against both drive shaft **108** and driven roller **98.**

The receiving tray **32** is a removable member having a bottom wall **120** and a lower upstanding retaining wall **122.** Receiving tray **32** is made easily removable since it is spaced above the paper transport and thus allows quick access in the event a paper jam occurs in the upper part of the machine. The tray is open and forms a separate receiver for non-sorted copy materials so that paper coming in is readily visible and easily removed.

Upper Conveyor, Transfer Conveyor, and Transfer Guide Assembly

The upper conveyor assembly **34** extends from just inside entrance opening **26** substantially across the width of the machine as best shown in FIGS. **2, 5** and **6.** Conveyor **34** includes a shallow rectangular housing having upper and lower walls **130** and **132,** respectively. Upper wall **130** has a plurality of small openings **134** through which the partial vacuum inside is exposed to the paper sheets so that the pressure differential holds the sheets against the moving belt to be described. Conveyor housing **34** also has end walls **136** and sidewalls **138** and **140** to define an enclosed chamber in which a partial vacuum or reduced pressure is induced. The sidewalls **138** and **140** can be seen to extend outwardly beyond end walls **136** to act as structural supports for belt rollers. Thus, entrance belt roller **142** is supported on shaft **144** extending between sidewalls **138** and **140.** In like manner, belt exit roller **146** is supported on shaft **148** at the exit end of the conveyor assembly. Note that shaft **148** extends through the bulkhead or partition **48** and has mounted thereon the pulley **66** forming part of the drive train from motor **52.** A plurality of relatively flat and spaced apart belts **150** extend around the rollers and the housing. Spacing the belts exposes the openings **134.** Since conveyor housing **34** opens into the major vacuum chamber area **46** through openings **70,** a partial vacuum can be drawn in the vacuum chamber of conveyor assembly **34** which

in turn will have the effect of acting through holes **134** to urge the paper sheets onto the moving belts **150.** The result is positive reliable movement or transport of the paper sheets on the conveyor belts.

A short transfer conveyor assembly **38** is provided so that sheets can be directed out of the apparatus through exit opening **27** in wall **20.** Again, a closed housing is provided having a top wall **152** with vacuum openings **154** therein. Transfer conveyor **38** has rollers **156** and **158** around which a plurality of belts **160** are received. The rollers can be driven by pulleys attached to shaft **148** of conveyor **34** and shaft **157** of conveyor **38** and a connecting belt received around both in order to provide power for conveyor assembly **38.** Vacuum is drawn through opening **72** into the housing which in turns draws vacuum through openings **154** to urge paper sheets against belts **160.**

The transfer guide assembly **36** is supported on a generally flat supporting plate **162** which is in spaced relation to transfer conveyor **38** and the exit end of upper conveyor **34.** Plate **162** has a back wall **164** and a projecting guide lip **166** which, as can be seen, extends upwardly at an angle above roller **146** and the exit end of conveyor assembly **34.** Support plate **162** also has sidewalls **168** and **170.** A paper deflector generally designated by the number **172,** the details of which can be seen in FIG. **12,** is located at the entry end of plate **162** generally at the base of the upwardly angling lip **166.** Deflector **172** has a supporting body **174** and a series of triangular deflector teeth **176.** Deflector assembly **172** is pivotally mounted between sidewalls **168** and **170** on shaft **178** projecting from each end thereof. Deflector assembly **172** is normally biased downwardly so that teeth **176** in their usual position extend through the opening or openings in plate **162** into the path of oncoming paper. Thus, paper will be deflected downwardly in the normal course unless it is desired that the paper proceed on through the apparatus and out exit slot **27** to another module. A solenoid **180** has armature **182** to which is attached an actuator lever **184.** One end of lever **184** is movably anchored to back wall **164** and is pivotally attached to armature **182.** The forward end of lever **184** engages deflector assembly **172.** When the solenoid is actuated, armature **182** is retracted to raise the deflector assembly and accordingly teeth **176** are retracted to permit paper to pass on through in a horizontal direction over transfer conveyor **38.** A pair of knurled friction wheels **186** are biased by spring **188** into engagement with belts **160** on the transfer conveyor. The knurled friction wheels **186** are mounted on shaft **190.** The spring mechanism for biasing the deflector assembly **172** into its downward position is not shown since the details thereof are not essential to an understanding of the inventive features.

A stationary intermediate guide piece or member **192** assists in deflecting paper sheets downwardly and a horizontal section **194** disposed between upper conveyor **34** and transfer conveyor **38** aids in horizontal guiding.

Vertical Conveyor, Vacuum Plenum and Deflector System

Vertical conveyor **40** in its basic structure is similar to that of upper conveyor **34,** reference being had to FIGS. **2, 5** and **6.** Conveyor assembly **40** has face wall **200,** outside wall **202,** top end wall **204,** lower end wall **206,** and a plurality of deflector slots **208** arranged in horizontal and vertical rows. Vertical conveyor assembly **40** is also provided with sidewalls **210** (see FIG. **6**) and **212** which extend outwardly beyond the vacuum housing to support the belt rollers. Thus, upper roller **214** is supported on shaft **216** extending between sidewalls **210** and **212.** In like manner lower roller **218** is supported on shaft **220** extending between sidewalls **210** and **212.** A plurality of belts **222** extend around rollers **214** and **218** between the spaced apart deflector slots **208.** At one end of shaft **220,** supporting lower roller **218,** is a pulley which in turn is rotated by belt **224.** The lower end of belt **224** extends around pulley **226,** see FIG. **2,** mounted on shaft **228** which extends through partition **48.** Shaft **228** also mounts pulley **60** on the other side of the partition **48** as described above. As seen particularly in FIGS. **2, 4** and **8,** vertical conveyor housing **40** is mounted on a hinge structure **230** supported on partition **48.** Hinge **230** permits the vertical conveyor to be pivoted away from the entrance to the sorting trays. A simple latching mechanism enables the vertical conveyor to be held in place but to be unlatched easily and swung away to expose the working face of the conveyor and the entrance to the sorting trays. Thus, paper jams can be quickly and conveniently cleared.

Within the housing of vertical conveyor **40** are located a series of deflectors **172** of the type shown in FIG. **12.** A deflector assembly **172** is provided within the vacuum chamber for each of the sorting trays in the apparatus. The deflector assemblies **172** are resiliently biased as by a spring to a retracted position as shown in phantom lines in FIG. **6.** Actuating mechanisms as shown in FIGS. **4** and **8** extend through the openings **74** through which a vacuum is drawn from the major plenum chamber **46** to the housing of vertical conveyor **40.** Slots **208** in face wall **200** of the conveyor **40** permit the partial vacuum to be exerted against the sheets to urge them against the belts. The actuating mechanism consists of a series of bracket mounted solenoids **232** having armatures **234.** The mounting bracket for each solenoid **232** has an extension arm **236** in which is mounted a linkage **238.** When solenoid **232** is energized, the linkage member **238** which extends through opening **74** and into the interior of the housing of vertical conveyor **40** makes contact engagement with a follower member **240** connected to the back of each deflector assembly **172.** Energization of solenoid **232** retracts armature **234** forcing linkage **238** against follower **240** to push or rotate teeth **176** out of the housing against spring pressure. Upon de-energization of solenoid **232** the natural spring bias of the deflector assembly **172** retracts the teeth **176** back into the interior of the housing through openings or slots **208.**

A knurled wheel or wheels **242** mounted on a shaft **244** are resiliently biased against vertically running belts **222** by spring **246** as shown in FIG. **6.** Finally a guide means **248** is provided above knurled wheels **242** and in spaced relation to guide piece **192** to ensure that the leading edges of the sheets are directed to the vertical conveyor.

Sorting Trays, Jogger, and Side Stop

As shown in FIGS. **1, 2, 5** and **6,** the sorting trays, generally designated by the number **42,** are generally flat, elongated, spaced apart sheet metal structures disposed at an angle within the apparatus. Thus trays **42** have flat receiving surface **250,** the entry end of which

has an upstanding portion **252** and a double back portion **254.** It is the spaced relationship of the double backed edge **254** and the main floor sections **250** of the next tray above which establishes the entrance openings **256.** The openings **256** and the trays are positioned so that as seen in FIG. **6,** paper being conveyed downwardly can be deflected into an entrance opening **256** for a given tray. The trays have a lower end **258** and each has an elongated rectangular slot **260** extending from the lower end or edge **258** for perhaps half the length of the main tray floor **250.** Each tray **42** has one of the rectangular slots for a purpose which will be explained more fully hereinafter. The trays will be exposed on one side of the machine and in order to facilitate grasping the sheets or stacks of paper from the trays a niche **262** is cut into each floor portion **250** near the entrance end of the tray. The inside edge **264** of the trays abuts partition **48.** While the trays are shown to be angled or inclined about 20° from the horizontal, the incline may vary or for that matter could be adjustable.

A paper jogger **44,** as can best be seen in FIGS. **4, 5** and **9,** comprises a vertical bar member **270** which is disposed within the aligned slots **260** of the sorting tray, said bar member **270** extending generally from the bottom of the machine to above the topmost sorting tray. A horizontal bar section **272** extends outwardly, as seen in FIGS. **1** and **5,** to the outside of the trays but inside the covering panel. At the outer end of horizontal section **272** the bar has an upwardly extending or short vertical section **274** at the upper end of which is an operator's handle **276** which extends outwardly through a slot **278** in the housing. A support rod **280** holds the backstop assembly by virtue of a sleeve **282** secured to section **274** which slides on the rod. At the lower end of main vertical bar **270** is a guide and support channel **284** in which the lower end of bar **270** slides. In this way the backstop can be set to the length of the particular paper being distributed to the trays.

Attached to vertical bar **270** is a resilient jogger material. In the preferred form a light gage metal is used. It extends from below the bottom tray to above the top tray as is best seen in FIG. **5.** It includes a mounting leg **290** for securing the same to bar **270.** The jogger member has a second section **292** extending toward the tray entrance at an angle and inwardly from the exposed side of the machine across generally the central part of tray slots **260.** At the outer end of the jogger is a third section **294** of somewhat shorter dimension and angling back from section **292** generally transversely to the trays. Be reference made to FIGS. **4** and **9** it will be seen that paper entering a tray as shown in FIG. **4** will slide into a tray and the leading edge of the sheet will strike the jogger on the far side of the paper's centerline. The resilient nature of the jogger is such that it will give way and then by spring return action deflect the paper into the skewed position also shown in FIG. **4** to place the upper outer corner of the sheet in the niche area **262.** Also the leading edge of the paper will come to rest against bar **270,** thus leaving the jogger free to repeat the action on the next incoming sheets.

In order to restrain the upper outer corner of the paper from moving too far out or perhaps even from sliding out of the tray, a side stop bar generally designated by the number **300** is provided. By reference to FIGS. **2** and **4,** it will be seen that the side stop bar **300** has an upper leg **302,** a vertical leg **304** and a bottom leg **306.** The upper and bottom legs **302** and **306** are supported in a frame member of the machine not described. While the machine is in operation side stop bar **300** will be in the position shown in full lines in FIG. **4.** When it is desired to remove sheets from the machine, side stop bar **300** is slid into the position shown in dash-dot lines also in FIG. **4.** Thus, it is understood that the bar is easily slipped rearwardly in the supporting frame member so that it does not hinder removal of the sorted or distributed material.

Operation

The machine as seen in FIG. **1** has a "sort-no sort" switch **25** and a "power on" switch **27.** If the copy machine is started without turning on the power switch, air vane **80,** which is actuated by air from the copy machine will energize through switch **81** the entrance solenoid **84** and the deflector drive motor **106** for turning forwarding roller **94.** In this way copies will be directed into the receiving tray to prevent jamming of the copy machine.

With power on, energy is supplied to the controls permitting the sorter to be operated in either the sort or no-sort mode. Power actuates light **310** just below the entrance slot **26,** as for instance shown in FIG. **2,** which in turn activates photocell **312.** Power also actuates sorting tray lamp **314** which in turn energizes photocell **316** as can be seen in FIG. **6.** Note that lamp **314** is below the bottommost sorter tray and that photocell **316** is above the topmost tray. A series of apertures **318** in the trays are aligned so that light from lamp **314** reaches photocell **316.** When the copy machine is started and sorter switch **25** is in the sort mode, a second switch activated by air vane **80** will actuate a relay, which in turn starts the main drive motor **52.** The conveyor belts start as does blower **50** to create the "vacuum" necessary for reliable transport of the copies on the belts.

When a copy enters the sorter, references now being had to FIGS. **1** and **2,** the light beam between lamp **310** and photocell **312** is broken. A corresponding pulse from the photocell is sent to the controls where a retriggerable multivibrator is energized and which functions as an automatic reset. As long as copies enter the sorter at a predetermined minimum frequency, the automatic reset is retriggered and maintains its activated state. In the normal sorting operation the first copy is directed into the top sorting tray, the second copy into the second sorting tray, etc. so that each consecutive copy is directed to a separate sorting tray. Actual steering or guiding of a copy into a particular sorting tray is accomplished by energizing a solenoid **232,** which in turn causes its associated deflector **172** with teeth **176** to extend out of the vacuum chamber into the paper path. It will be seen, incidentally, that no pinch or friction rolls are necessary at the entrance to each sorting tray to assist the deflectors and conveyor in directing the sheets into their trays.

As stated above, aligned openings **318** are located at the entrance to the sorting trays. As a copy enters a sorting tray, the light beam from lamp **314** is temporarily interrupted resulting in a pulse change from the photocell **316.** The pulse corresponds to the time the paper blocks the light beam. The leading edge of the "paper" pulse triggers a monostable multivibrator with a predetermined and precise pulse duration referred to as the jam detect time. The trailing edge of the "paper" pulse, indicating that the paper has cleared the sorting tray

entrance, triggers a one-shot which in turn generates a clock pulse. To prevent accidental triggering of photocell **316**, as for instance when the sorting trays are being emptied, pulses will only be recognized by the controls when the automatic reset is active.

The bank of solenoids **232** is controlled by a binary up-counter circuit and a binary-to-decimal decoder, and thus only one solenoid **232** at a time is energized. For each clock pulse the counter steps to the next solenoid, thereby directing the next copy into the next lower sorting tray. The time or the moment at which a given solenoid is activated is decided only by the trailing edge of the paper successfully entering the sorting tray immediately above. As a result the sorter is insensitive to the number of copies per minute supplied by the copying machine and thus the sorting rate is limited only by conveyor speed and copy length. When an interruption longer than the predetermined reset time occurs in the flow of copies from the copy machine, the automatic reset will clear the counter and the sorter is ready for a new sorting sequence beginning with the topmost sorting tray. The reset time, that is, the period of time permitted before the machine automatically resets, is predetermined by circuitry to be longer than the feed rate of the copy machine with which the sorter is used. In any event, the reset interval will be somewhat longer than the interval between copies at continuous operation, but less than the interval normally required to change originals in the copier. It should be mentioned that since the trailing edge of a paper copy is responsible for generating a clock pulse by clearing the beam from light **314**, the machine does not operate on a set time pulse generator.

In normal operation paper will clear the sorting tray entrance before jam detect time has expired. If the back stop and jogger **44** is incorrectly adjusted, a sheet of paper will not enter the sorting tray completely. Thus, the light beam will be blocked, creating a potential jam condition for oncoming copies. If this condition prevails when the jam detect time expires, a jam detect pulse is sent to the control unit. This pulse forces the sorter into a no-sort mode and succeeding copies are therefore directed into the receiving tray **32** as described above. At the same time the conveyor belts in the machine are stopped. If the jam detect pulse reaches the control unit while the next incoming paper has only partially entered the sorter, a secondary jam could be created if the deflector **82** were actuated. If the entrance photocell indicates that a copy is in transit, the no-sort command initiated by the jam detect pulse is therefore inhibited until the deflector is clear.

The machine lends itself readily to programming. For instance, by using a program card copies may be randomly directed to the sorting trays selected by means of holes punched in the program card. The hole permits a contact to be made and a circuit completed to identify a particular tray to which a copy is to be directed. When a copy enters the sorter, the pulse from the photocell **312**, besides triggering the automatic reset interrogates the programmer circuits. If no hole is punched for sorting tray No. **1**, the counter automatically steps down to sort tray No. **2**. The interrogation time is approximately 5 microseconds, so that if no hole is punched in the card indicating that a copy is to go into sorting tray No. **2**, sorting tray No. **2** is skipped. A new clock pulse is thus generated every **5** microseconds until the first hole in the program card is found. Because of the high interrogation frequency, any sorting tray can be selected in fractions of a millisecond and random or sequential sorting patterns can be easily handled at high copy sorting rates.

What is claimed is:

1. Sheet sorting apparatus, comprising:

a. a housing having a sheet distribution compartment including a plurality of spaced and generally vertically aligned sheet sorting trays, said housing also having an auxiliary compartment including vacuum inducing means,

b. first generally horizontally disposed and second generally vertically disposed belt conveyor sections in said distribution compartment including vacuum chamber means in and extending over substantially the entire width of each of said first and second conveyor sections, said second section being adjacent said plurality of sheet sorting trays, and

c. a series of selectively movable deflector means in the vacuum chamber of said second conveyor section for being extended out of said vacuum chamber into the path of sheets and deflecting sheets into said sorting trays, there being deflector means for each sorting tray.

2. The apparatus according to claim **1** and wherein said auxiliary and distribution compartments are separated by partition means.

3. The apparatus according to claim **2** and wherein said vacuum inducing means generally creates vacuum in substantially all of said auxiliary compartment and wherein openings in said partition connect said auxiliary compartment with the vacuum chambers of said first and second conveyor sections.

4. The apparatus according to claim **3** and wherein separate actuator mechanisms for each deflector means are provided in the vacuum chamber means of said second conveyor section to move said deflectors.

5. The apparatus according to claim **4** and wherein said deflectors include a plurality of teeth which extend outwardly through openings in said vacuum chamber and retract to the interior of said chamber.

6. The apparatus according to claim **5** and wherein sensing means are provided to detect the paper copy which is responsible for actuation of deflector means for directing the next oncoming paper copy into the next designated sorting tray.

7. The apparatus according to claim **6** and wherein a generally vertically extending adjustable paper backstop means is provided for jogging an outer corner of paper coming into said sorting trays to the exposed side of said sorting trays.

8. The apparatus according to claim **7** and wherein said sorting trays are provided with aligned slots within which said backstop is movable for adjustment to various paper lengths.

9. The apparatus according to claim **8** and wherein a side stop means is provided to limit the side movement of paper deflected outwardly by said backstop.

10. The apparatus according to claim **9** and wherein said second conveyor section, including its vacuum chamber and belt assembly, are hinged so as to permit pivotal movement for quick access to and removal of paper jams.

11. The apparatus according to claim **1** and wherein a receiving tray is located above and in spaced relation to said first conveyor section for receiving copies not needing to be sorted.

12. The apparatus according to claim 11 and wherein a selectively actuable entrance deflector means is located at the copy entrance of said apparatus so as to direct paper either onto said first conveyor section or to said receiving tray.

13. The apparatus according to claim 12 and wherein a paper stiffener means is provided for said receiving tray whereby the side edges of the paper copies are turned up to stiffen the longitudinal dimension of said paper as it moves into said receiving tray.

14. The apparatus according to claim 13 and wherein said paper stiffener means includes a pair of upwardly angling surfaces for turning said side edges up.

15. The apparatus according to claim 14 and wherein said paper stiffener means includes forwarding means for propelling paper through said stiffener and into said receiving tray.

16. The apparatus according to claim 15 and wherein an air vane switch is actuated by the movement of air from a copy machine to actuate at least said entrance deflector and said means for propelling paper into said receiving tray.

17. Sheet sorting apparatus, comprising:

a. a housing having a sheet distribution compartment including a plurality of spaced and generally vertically aligned sheet sorting trays, said trays being disposed at an angle with the entrance thereto being at the high end, said housing also having an auxiliary compartment separated from said distribution compartment by a partition and including vacuum inducing means therein,

b. first generally horizontally disposed and second generally vertically disposed belt conveyor sections in said distribution compartment including vacuum chamber means in and extending over substantially the entire width of each of said first and second conveyor sections, said second section being adjacent said plurality of sheet sorting trays, said first and second conveyor sections being in proximity to each other for the transfer and guiding of sheets from said first to said second section,

c. a series of selectively movable deflector means in the vacuum chamber of said second conveyor section for being extended out of said vacuum chamber into the path of sheets and deflecting sheets into said sorting trays, there being deflector means for each sorting tray.

18. The apparatus according to claim 17 and wherein said vacuum inducing means generally creates vacuum in substantially all of said auxiliary compartment and wherein openings in said partition connect said auxiliary compartment with the vacuum chamber of said first and second conveyor sections.

19. The apparatus according to claim 18 and wherein separate actuator mechanisms for each deflector means are provided in the vacuum chamber means of said second conveyor section to move said deflectors.

20. The apparatus according to claim 18 and wherein said deflectors including a plurality of teeth which extend outwardly through openings in said vacuum chamber and retract to the interior of said chamber.

21. The apparatus according to claim 20 wherein sensing means are provided to detect the paper copy which is responsible for actuation of deflector means for directing the next oncoming paper copy into the next designated sorting tray.

22. The apparatus according to claim 21 and wherein a generally vertically extending adjustable paper backstop means is provided for jogging an outer corner of paper coming into said sorting trays to the exposed side of said sorting trays.

23. The apparatus according to claim 22 and wherein said sorting trays are provided with aligned slots within which said backstop is movable for adjustment to various paper lengths.

24. The apparatus according to claim 23 and wherein a side stop means is provided to limit the side movement of paper deflected outwardly by said backstop.

25. The apparatus according to claim 24 and wherein said second conveyor section, including its vacuum chamber and belt assembly, are hinged so as to permit pivotal movement for quick access to and removal of paper jams.

26. The apparatus according to claim 17 and wherein a receiving tray is located above and in spaced relation to said first conveyor section for receiving copies not needing to be sorted.

27. The apparatus according to claim 26 and wherein a selectively actuable entrance deflector means is located at the copy entrance of said apparatus so as to direct paper either onto said first conveyor section or to said receiving tray.

28. The apparatus according to claim 27 and wherein a paper stiffener means is provided for said receiving tray whereby the side edges of the paper copies are turned up to stiffen the longitudinal dimension of said paper as it moves into said receiving tray.

29. The apparatus according to claim 28 and wherein said paper stiffener means includes a pair of upwardly angling surfaces for turning said side edges up.

30. The apparatus according to claim 29 and wherein said paper stiffener means includes forwarding means for propelling paper through said stiffener and into said receiving tray.

31. The apparatus according to claim 30 and wherein an air vane switch is actuated by the movement of air from a copy machine to actuate at least said entrance deflector and said means for propelling paper into said receiving tray.

32. Sheet sorting apparatus, comprising:

a. a housing having a sheet distribution compartment including a plurality of spaced and generally vertically aligned sheet sorting trays, said housing also having an auxiliary compartment separated from said distribution compartment and including vacuum inducing means therein,

b. first generally horizontally disposed and second generally vertically disposed multiple belt conveyor sections in said distribution compartment including vacuum chamber means underlying substantially the entire length and width of each of said first and second conveyor sections, said second section being adjacent the entrances of said plurality of sheet sorting trays, said first and second conveyor sections being in proximity to each other for the transfer and guiding of sheets from said first to said second section, the vacuum chambers of said conveyor sections being provided with a plurality of openings so that sheets are held by vacuum against the belts,

c. a series of selectively movable deflector means in the vacuum chamber of said second conveyor section for being extended outwardly through said

vacuum openings into the path of sheets and deflecting sheets into said sorting trays, there being deflector means for each sorting tray.

33. The apparatus according to claim **32** and wherein said vacuum inducing means generally creates vacuum in substantially all of said auxiliary compartment and wherein openings connect said auxiliary compartment with the vacuum chambers of said first and second conveyor sections.

34. The apparatus according to claim **33** and wherein separate selectively controllable actuator mechanisms for each deflector means are provided in the vacuum chamber means of said second conveyor section to move said deflectors.

35. The apparatus according to claim **34** and wherein said deflectors include a plurality of teeth which extend outwardly through said openings in said vacuum chamber and retract to the interior of said chamber.

36. The apparatus according to claim **35** and wherein sensing means are provided to detect the paper copy which is responsible for actuation of an actuator mechanism and deflector means for directing the next oncoming paper copy into the next designated sorting tray.

37. The apparatus according to claim **36** and wherein a generally vertically extending adjustable paper backstop means is provided for jogging an outer corner of paper coming into said sorting trays to the exposed side of said sorting trays.

38. The apparatus according to claim **37** and wherein said sorting trays are provided with aligned slots within which said backstop is movable for adjustment to various paper lengths.

39. The apparatus according to claim **38** and wherein a side stop means is provided to limit the side movement of paper deflected outwardly by said backstop.

40. The apparatus according to claim **39** and wherein said second conveyor section, including its vacuum chamber and blet assembly, are hinged so as to permit pivotal movement for quick access to and removal of paper jams.

41. The apparatus according to claim **32** and wherein a receiving tray is located above and in spaced relation to said first conveyor section for receiving copies not needing to be sorted.

42. The apparatus according to claim **41** and wherein a selectively actuable entrance deflector means is located at the copy entrance of said apparatus so as to direct paper either onto said first conveyor section or to said receiving tray.

43. The apparatus according to claim **42** and wherein a paper stiffener means is provided for said receiving tray whereby the side edges of the paper copies are turned up to stiffen the longitudinal dimension of said paper as it moves into said receiving tray.

44. The apparatus according to claim **43** and wherein said paper stiffener means includes a pair of upwardly angling surfaces for turning said side edges up.

45. The apparatus according to claim **44** and wherein said paper stiffener means includes forwarding means for propelling paper through said stiffener and into said receiving tray.

46. The apparatus according to claim **45** and wherein an air vane switch is actuated by the movement of air from a copy machine to actuate at least said entrance deflector and said means for propelling paper into said receiving tray.

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