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Lynch

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[54] **SHEET STACKING METHOD AND APPARATUS**

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[52] **U.S. Cl.** **271/174,** 271/80, 271/220

[51] **Int. Cl.** **B65h 29/22,** B65h 31/34

[58] **Field of Search** 271/220, 221, 222, 86, 271/87, 89, 68, 71, 80, 174, 177–179

[56] **References Cited**

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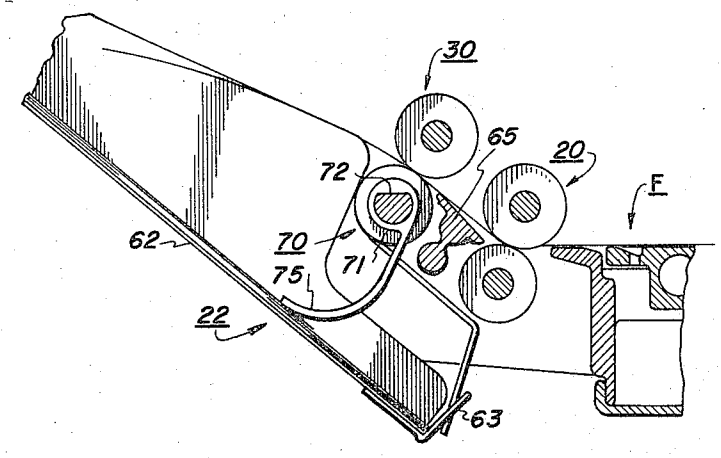
[57] **ABSTRACT**

A sheet delivering and propelling device for stacking sheets of cut material in alignment within a collecting tray. An extended flapper element of elastomeric resilient material is coaxially aligned with one of a pair of cooperating pinch rollers arranged to deliver sheets into a collecting tray. The flapper is mounted within the pinch roll assembly so that it is deformed into a loaded condition as it is drawn into the nip formed between the cooperating rolls and, upon passing through the nip, is released against the uppermost sheet delivered into the tray imparting the energy stored therein to the sheet effecting the alignment of the sheet within the tray.

9 Claims, 5 Drawing Figures



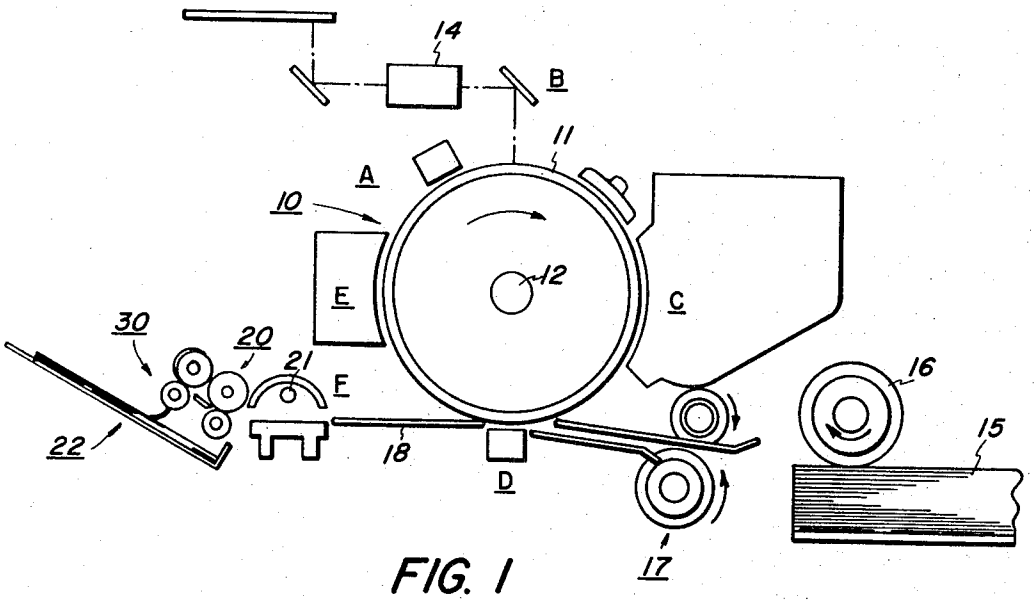


FIG. 1

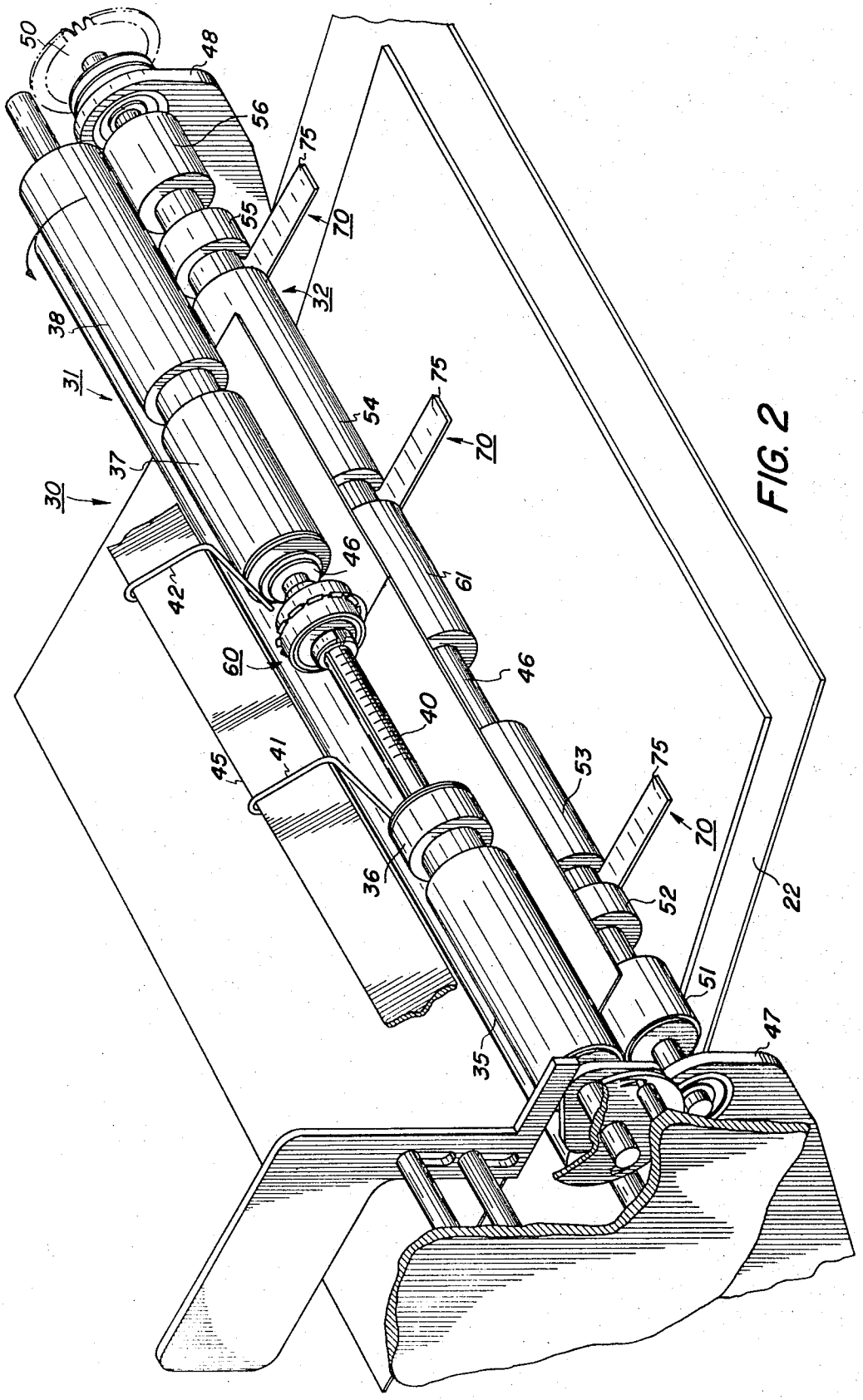

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FIG. 2

FIG. 3

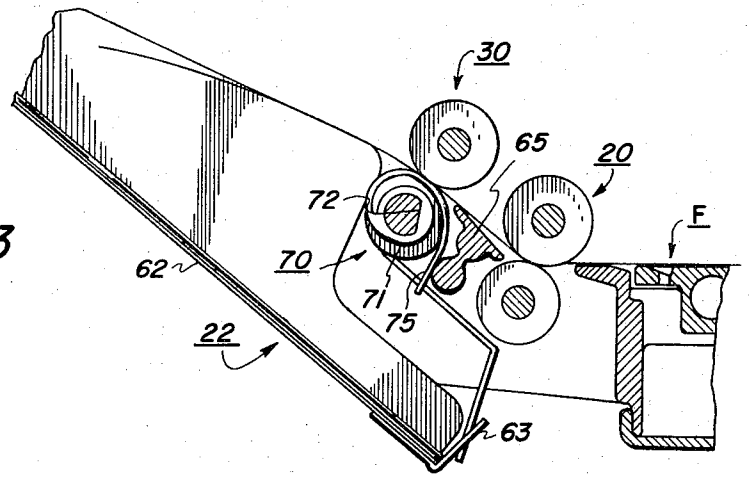


FIG. 4

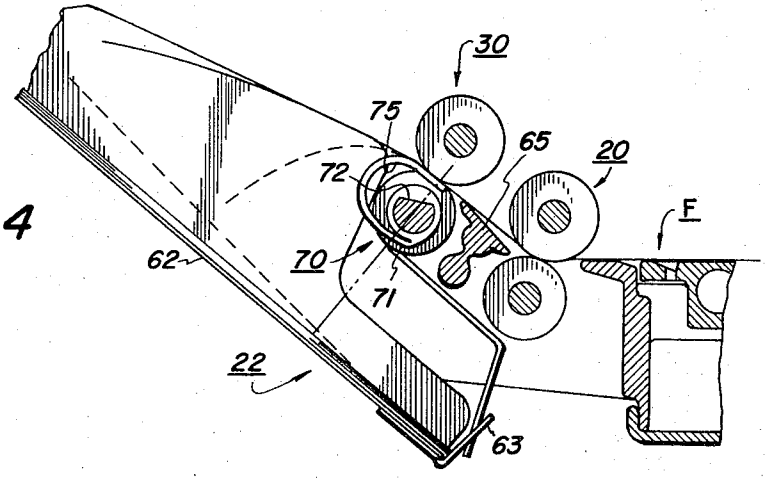
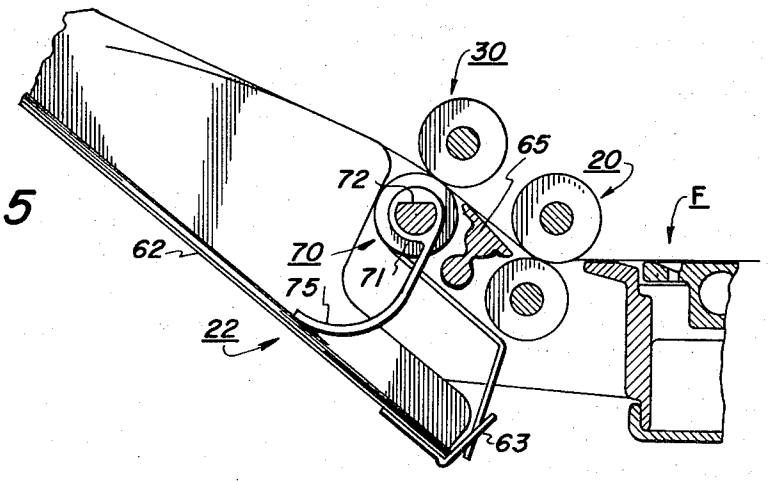


FIG. 5



SHEET STACKING METHOD AND APPARATUS

This invention relates to a sheet delivery and propelling device for stacking sheets of cut material in alignment within a collecting tray.

More specifically, this invention relates to a sheet handling device suitable for use in an automatic copying machine for delivering and stacking process and sheets of material within a collecting tray. With the advent of the xerographic process has come an increased demand for more compact and higher speed office copying machines which are capable of processing cut sheets of material. As these machines attain higher speeds, the sheet handling requirements imposed on the apparatus have similarly increased. This is particularly true in machine environments where the finished copies must be rapidly fed into a final collecting tray, bin or the like. It has been found that delivering individual cut sheets of material rapidly into a relatively confined space such as a collecting tray causes the sheets to curl or become misaligned which may ultimately result in the sheets either "walking" out of the tray area or backing up into the sheet delivery mechanism. Even where the sheets remain within the collecting area, the sheets tend to become so misaligned that the operator is forced to restack the sheets upon their removal from the machine thus increasing, rather than decreasing, the work load imposed upon the machine user.

Some paper handling devices have been devised for stacking sheets of cut material as they are delivered into a collecting tray as exemplified by U.S. Pats. Nos. 3,630,515 and 3,669,447. In general, most of these prior art devices involve sheet handling mechanisms which are relatively bulky, complex, and incapable of uniformly acting upon the sheets as the size of the stack changes.

It is therefore an object of the present invention to improve apparatus for delivering and stacking cut sheets of material in a collecting tray.

Another object of this invention is to improve the efficiency and reliability of sheet stacking in automatic copying machines.

A still further object of this invention is to provide a sheet collecting device for use in high speed copiers.

Yet another object of this invention is to compact sheet delivery and stacking apparatus employed in high speed copiers.

A further object of this invention is to prevent copy sheets delivered at high speed into a copy tray from escaping the collecting area.

These and other objects of the present invention are attained by a sheet delivery and stacking system wherein a pair of cooperating pinch rolls are arranged to advance cut sheets of final support material, introduced into the nip formed by the rolls, the apparatus further including at least one sheet stacking element operatively associated with one of the feed rolls so as to turn therewith, the stacking element having a resilient arm extending from the outwardly roll in a generally radially direction being arranged so that the arm is deformed as it is drawn through the nip and is released, upon passage through the nip, into contact with the uppermost sheet delivered into the tray to impart the energy stored in the arm to the sheet thus effecting alignment of the sheet within the tray.

For a better understanding of the invention as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic representation of an automatic xerographic copying device incorporating the apparatus of the present invention;

FIG. 2 is a partial perspective view showing the sheet handling apparatus of the present invention as utilized in the automatic copying device illustrated in FIG. 1;

FIGS. 3 through 5 are partial plane views showing the various steps of loading the flapper element and bringing the element into contact with sheets stored within a collecting tray.

Referring now to FIG. 1, there is shown an automatic xerographic reproducing machine incorporating the sheet delivery and stacking mechanism of the present invention. The copying machine illustrated employs an image recording drum member **10** having an outer surface thereon coated with a suitable photoconductive material **11**. Any suitable material, such as selenium or the like, capable of supporting a latent magnetic image thereon can be used to coat the drum surface. The drum, which is journaled for rotation within the machine frame by means of a shaft **12**, is rotated in the direction indicated so as to transport the photoconductive recording surface through a plurality of xerographic processing stations. Although not shown, it should be understood that suitable means are also provided to both drive and coordinate the movement of the various machine components whereby a faithful rendition of the original to be copied is created upon the drum surface and recorded on a cut sheet of final support material.

Since the practice of xerography is well known in the art, the various processing stations for producing a copy are herein represented in FIG. 1 as a series of block diagrams delineated A through E. At station A, an electrostatic charge is uniformly placed upon the photoconductive surface preparatory to the surface receiving a light image of the original to be recorded. The charged drum is then moved through an exposure station B containing a scanning apparatus **13** wherein a flowing light image of a stationary original **14** is recorded upon the photoreceptor in the form of a latent electrostatic image.

Next, in the direction of drum rotation, the image bearing plate surface is transported through a developing station C wherein toner material is applied to the charged surface thereby rendering the latent electrostatic image visible. The now developed image is brought into contact with a sheet of final support material, such as paper or the like, within a transfer station D wherein the toner image is electrically removed from the drum surface and loosely bonded to the contacting side of the final support sheet.

Finally, any residual toner remaining on the drum after the transfer operation is completed is removed therefrom within a cleaning station E thus placing the photoconductive plate in a condition to be once again recycled through the automatic machine.

It is herein contemplated that the sheets of final support material processed in this automatic machine will be stored in the machine frame within a removable paper cassette **15**. It is further contemplated that the automatic reproducing machine will have the capability of accepting and processing copy sheets of various lengths, the length of the sheet selected being dictated by the size of the original to be reproduced.

The individual sheets of support material are supported in a stacked configuration within the cassette and forwarded through the transfer station D in synchronous moving relationship with the visible toner image deposited on the drum. Sheet feeding is accomplished by means of a feed roll **16** and a sheet registering device **17.** In operation, the sheet roller serves to separate the uppermost sheet from the stack and advance the sheet into the registration mechanism **17.** Here, the motion of the leading edge of the sheet is momentarily interrupted while the sheet is properly aligned and registered with the image on the drum surface. The registering mechanism then advances the sheet into the transfer station D where the image is placed upon the copy sheet in the manner described above.

Upon completion of the transfer operation, the imaged sheet of final support material is forwarded to a xerographic fusing station F via a conventional belt transport **18** or any other switchable means. Within the fusing station, the xerographic toner image supported on the cut sheet is heated to a temperature sufficient to fix the toner image to the support material thus creating a permanent record of the information. Although any number of well known fixing techniques can be employed to produce the desired results, a conventional radiant heat fuser **21** is herein employed.

Referring now specifically to FIGS. **2** through **5,** there is illustrated the sheet delivering and stacking apparatus of the present invention for aligning cut sheets of material in a stack configuration within a collecting tray. As more clearly seen in FIG. **2,** a pinch roll advancing assembly, generally referenced **30,** is mounted above the sheet receiving and collecting tray **22** so that the sheets passing through the advancing nip formed between the cooperating pinch rolls is allowed to fall freely into the bottom of the tray.

The feed roll assembly basically consists of an upper roll sub-assembly includes a series of idler rolls **35** through **38** which are mounted for free rotation about a support shaft **40.** Although not shown, both ends of the support shaft **40** are pivotably mounted within the machine frame so that the entire upper roll sub-assembly can be pivoted downwardly towards the lower sub-assembly. A pair of biasing springs **41, 42** are supported upon a stationary bracket **45** with the free ends of the springs riding in contact with bearing surfaces **46** carried in the upper roll sub-assembly. The spring elements urge the entire sub-assembly downwardly into contact with the lower pinch roll sub-assembly and provide sufficient nip pressure to hold a sheet of material introduced into the feed roll assembly in friction driving contact between the coacting rolls.

The lower roll sub-assembly **32** is supported upon a shaft **46** and a shaft rotatably mounted at each end in roller bearings contained within support brackets **47, 48.** The right hand end of shaft **46,** as viewed in FIG. **2,** extends beyond the support bracket **48** and has a drive sprocket **50** affixed thereto. The sprocket is operatively attached to the main machine drive system via a chain (not shown) to turn the lower roll sub-assembly in the direction indicated.

A series of pinch rolls **51** through **56** are coaxially aligned upon the shaft **46** and are adapted to turn therewith. In operation a sheet of support material introduced into the nip between the feed rolls is held in friction driving contact against the lower drive rolls by means of the biasing pressure imparted thereto via the upper roll sub-assembly thus causing the sheet to be driven in the direction indicated into the collecting tray.

Although not involved with the present invention, a sheet cutting system made up of a multiple cutting blade support element **60** and a blade backing roller **61** is also contained within the assembly for slitting or perforating the sheets as they are advanced through the sheet advancing between the rolls.

As more clearly illustrated in FIGS. **3** through **5,** the collecting tray includes an inclined main base plate **62** and an upwardly turned margin stop **63** mounted substantially parallel to the base frame. Copy sheets, upon leaving the fuser assembly F, are initially engaged by a first set of advancing rolls **20** (FIG. **1**) and are then forwarded along a guide plate **64** into the nip of the second advancing roll assembly **30** and subsequently deposited within a copy tray in the manner described above. As can be seen, the cut sheets of material leaving the advancing roll assembly **30** would normally drop onto the base plate of the tray and then slide downwardly into stack alignment against the margin stop **63.** However, this gravity induced process has proven to be unreliable. In the case of high speed machines, the sheets tend to pile one upon the other in such rapid succession that the sheet becomes misaligned or invariably walk out of the tray or back up into the feed roll assembly. The apparatus of the present invention provides a means by which each individual sheet delivered into the paper tray is actively engaged by a compact propelling mechanism which moves the sheet rapidly and efficiently into alignment against the stop **63.** Furthermore, the present apparatus, because of its flexibility is relatively insensitive to any changes in stack height.

The propelling means shown in this embodiment of the invention is made up of three stacking elements **70** which are secured to the lower drive shaft **46** of the feed roll assembly. Although a specific number of flapper elements are herein utilized, it should be clear to one skilled in the art that the number of stacking elements can be employed in the practice of the present invention without departing from the teachings of the invention.

The stacking elements are interposed between the lower feed rolls and are affixed to the shaft **46** in the manner best illustrated in FIGS. **3** through **5.** In practice, the stackers are formed of a relatively tough elastomeric material having resilient properties, such as polyurethane or the like. The elements basically are provided with a hub portion **71** having a central aperture therein which permits the elastomeric element to be slipped over the drive shaft. The aperture formed in the hub is provided with a flat **72** which is capable of seating itself against a complementary flat machined on the shaft causing the stackers to be driven in a positive manner by the rotating shaft.

Extending downwardly from the hub **71** is an elongated arm or flapper **75** which normally extends outwardly from the hub in a substantially radial direction as seen in FIG. **2.** Initially, as the lower shaft rotates in the direction indicated, the normally extended arm **75** of the flapper is drawn into the feed roll nip in the manner illustrated in FIG. **3.** As shown, drawing the arm into the nip forces the resilient arm back into a deforming posture thus placing considerable stress upon the

element. Further rotation of the shaft brings the free end or tip of the stressed flapper into the nip while at the same time placing the base or root of the arm well beyond a line extended from the feed roll shaft perpendicular to the base plate of the tray. At this time, the flapper is placed in what herein is referred to as a fully loaded condition preparatory to acting upon the uppermost sheet delivered into the collecting tray.

Further rotation of the shaft frees the tip of the flapper arm from between the pinch rolls thus allowing the arm to unload against the top sheet in the tray. The combined energy stored in the flapper, due to the driving action of the shaft and the force or deformation, is imparted to the sheet upon contact thus driving the sheet downwardly into a stack for alignment against the stop 63. As can be seen, the circumference of the pinch rolls acting upon the copy sheets is considerably less than the length of the sheets individually. As a consequence, the flapper arm makes a multitude of contacts upon each sheet delivered into the tray thereby insuring that the sheet will be properly aligned against the stop.

While this invention has been described with reference to the structure disclosed therein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the scope of the following claims.

What is claimed is:

1. A sheet propelling and aligning device comprising:

a sheet collecting tray, said tray including a base means for supporting said sheets and a stop means extending upwardly of said base means;

a rotating means positioned over said tray and said base means for advancing said sheet in a first direction over and past said stop means and into said tray, said rotating means further including propelling means for contacting a downwardly facing side of said sheet during advancement of said sheet in said first direction and for then contacting an upwardly facing side of said sheet delivered into said tray for propelling the entire sheet in a second direction different from said first direction to align said sheet in said tray against said stop means, said propelling means comprising at least one resilient blade member arranged to provide said contact with said upwardly and downwardly facing sides of said sheet and to turn with said rotating means, and extending outwardly of said rotating means in a generally radial direction, said blade member being of sufficient length to contact said base means when no sheets are supported thereon.

2. A device as in claim 1 wherein said second direction generally opposes said first direction.

3. A device as in claim 2 wherein said rotating means comprises a pair of cooperating pinch rolls.

4. A device as in claim 3 further including means to deform said blade member into a loaded condition prior to said member contacting said sheet, and means to release said deformed blade against the sheet whereby the energy stored within said blade is imparted to the sheet.

5. A device as in claim 4 wherein said first direction is an upwardly direction and said second direction is a downwardly direction.

6. A device as in claim 5 wherein said resilient member is coaxially aligned on a common shaft with the lower of said pinch rolls.

7. A device as in claim 6 including a plurality of said elongated resilient members.

8. A device as in claim 7 wherein said resilient members are constructed of an elastomeric material.

9. A device as in claim 8 wherein each of said resilient members are arranged to make a plurality of contacts against each sheet delivered to said collecting tray and supported by said base means.

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