United States Patent [19]

Hatzmann

[11] **3,815,899**

[45] **June 11, 1974**

[54] **SHEET DELIVERY DEVICE**

[75] Inventor: **John F. Hatzmann,** Rochester, N.Y.

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

[22] Filed: **Mar. 19, 1973**

[21] Appl. No.: **342,654**

[52] **U.S. Cl.** **271/80,** 271/178

[51] **Int. Cl.** **B65h 29/22**

[58] **Field of Search** ..... 271/80, 71, 68, 174, 177, 271/51, 86–88, 69, 46, 184, 185, 178; 214/6 D, 6 H

[56] **References Cited**

UNITED STATES PATENTS

2,389,848	11/1945	Gibson et al.	271/69 X
3,052,467	9/1962	Fertig	271/87 X
3,166,313	1/1965	Rehm	271/86
3,351,215	11/1967	Kitch	214/6 D

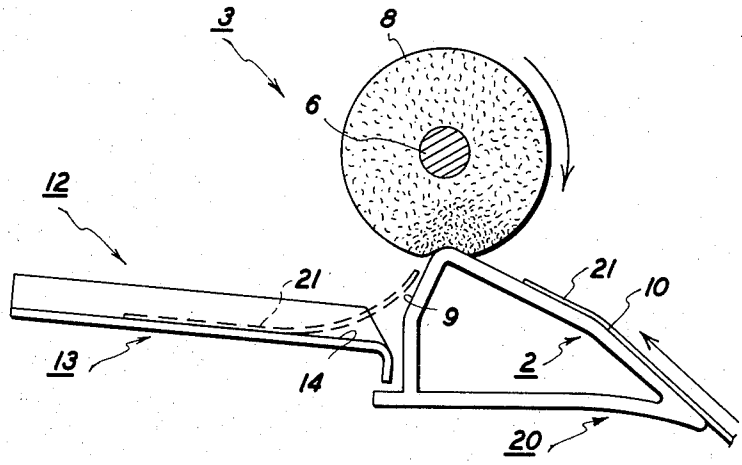
Primary Examiner—Evon C. Blunk

Assistant Examiner—Bruce H. Stoner, Jr.

[57] **ABSTRACT**

A sheet delivering and propelling device for use in a reproducing machine for moving copy sheets from the end of a delivery or processing surface to a collecting tray. The device comprises resilient foam rolls mounted on a delivery shaft which extends substantially across the width of the machine and generally vertically above a downwardly inclined portion of the processing surface. The outer radius of each roll is greater than the distance between the axis of the delivery shaft and the top surface of the processing surface to thereby continuously compress and release radial sectors of the foam rolls which, after passage of the sheets thereunder, momentarily thrust the sheets toward the collecting tray.

15 Claims, 3 Drawing Figures



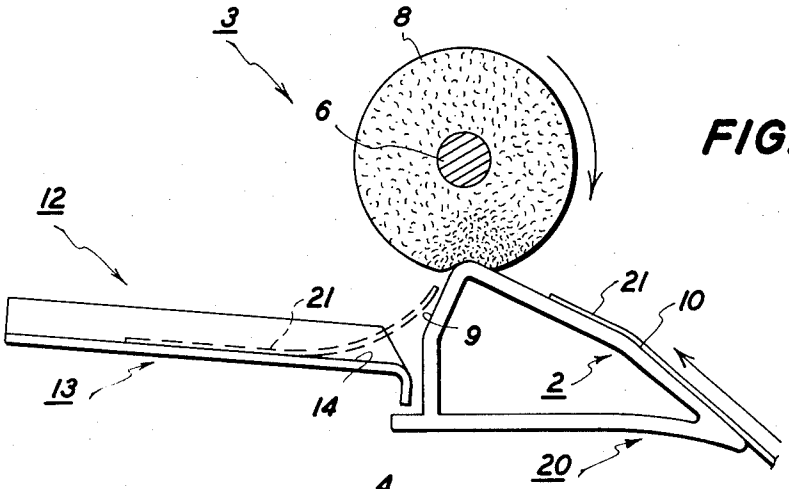


FIG. 1

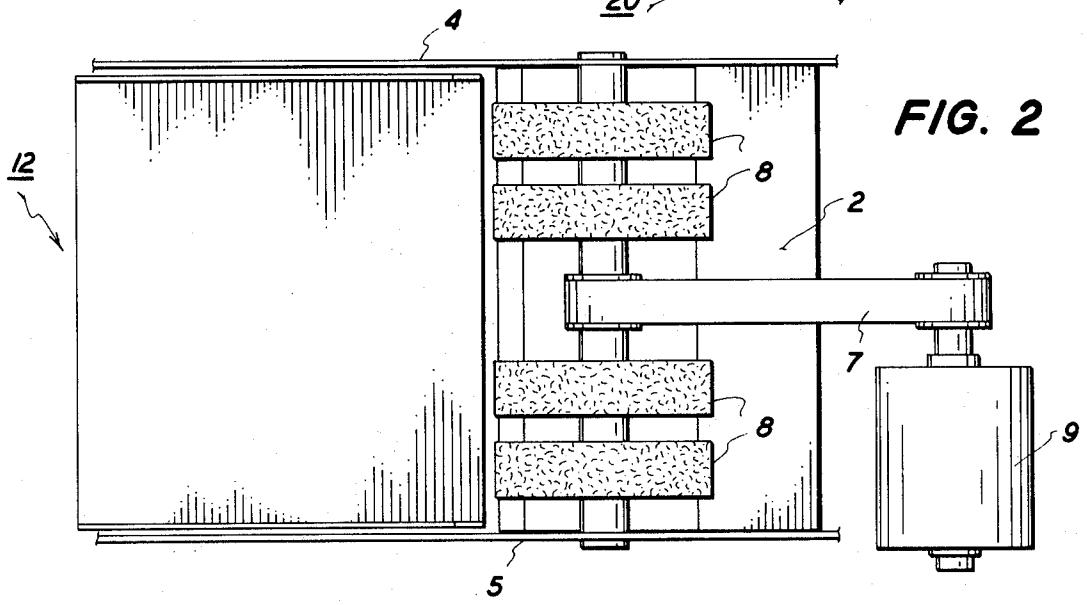


FIG. 2

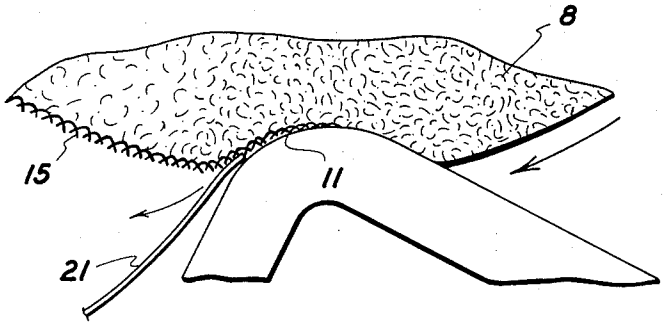


FIG. 3

SHEET DELIVERY DEVICE

BACKGROUND OF THE INVENTION

This invention relates to a sheet delivery and propelling device for positively moving processed copy sheets from a processing plane to a collecting tray.

More specifically, this invention relates to a sheet handling device suitable for use in an automatic copying or facsimile machine for delivering processed copy sheets to a collecting tray. With the advent of quick copying processes and facsimile apparatus capable of producing copies at remote locations via signals transmitted over telephone lines, there has come an increased demand for more compact and higher speed machines.

The compactness of the machines necessitates a document drive arrangement which is capable of dependably moving a copy sheet from an entrance or delivery area, through the processing machine, to an exit or collecting tray. As the speed of the machine increases, higher requirements of positive movement are placed on the arrangements for delivering the copy sheets into the collecting tray which may occupy a relatively confined space. In addition, the collecting tray may extend at such an angle so as to make it difficult to easily move processed copy sheets thereinto rapidly and accurately. This tends to cause the sheets to curl or become misaligned, ultimately resulting in the sheets either "walking" out of the collecting tray area or backing up into the copy sheet processing mechanism. Even where the sheets remain within the collecting area, they tend to become misaligned, thus requiring the operator to restack the sheets upon removal from the machine. This results in increased work load on the operator with consequent loss of efficiency in the copying or reproducing process.

In prior art devices, where sufficient space exists, the collection tray may be placed well below the last processing station so that gravity may be effectively used to draw the paper into the collection tray. However, where space is at a premium, the collection tray may have to be placed only a relatively short distance below the delivery or processing plane such that the lead edge of the sheet contacts the collection tray while the trailing edge of the same sheet has not yet cleared the delivery roll. Under these circumstances, the effects of gravity may not be sufficient to adequately propel the sheet into the tray.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide improved apparatus for delivering copy sheets from the processing section of a recording or facsimile machine to a collecting tray.

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

A still further object is the provision of a paper propelling and delivery device for use in very compact reproducing machine arrangements.

A further object is to provide a delivery device which reduces the backing up of copy sheets into the processing section of the machine.

These and other objects and advantages of the present invention are attained by a sheet delivery and propelling device comprising a roll made of resilient material such as open cell polyurethane foam which is arranged to advance copy sheets. The resilient roll is mounted on a shaft substantially directly above a portion of the copy support surface at which said support surface drops-off or inclines downwardly. The roll has a radius which is greater than the distance from the center of the roll to the support surface vertically thereunder and includes tiny finger-like projections on the periphery thereof which tend to grasp and propel the trailing edge of the copy sheets. Thus, as the roll turns to advance a copy sheet it is compressed against the sheet by the support surface to energy-load the roll. As the trail edge of the copy sheet passes under the roll, this energy is transferred by the tiny finger-like projections on the roll to the trailing edge of the copy sheet to impart energy thereto and propel it into the collection tray.

BRIEF DESCRIPTION OF THE VIEWS

For a better understanding of the invention as well as the objects and advantages thereof, reference may be had to the drawings illustrating the invention wherein:

FIG. 1 is a side-elevation view of the exit end of a recording or copy machine with the side walls of the apparatus removed for clarity and showing the resilient roll of the invention;

FIG. 2 is a top view of the machine shown in FIG. 1; and

FIG. 3 is an enlarged view of the roll at the area of intersection with the copy sheet.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown the delivery end of a copy or facsimile machine comprising a processing or delivery surface **2** on which the copy sheet moves in the direction indicated by the arrow toward a delivery roll assembly **3**. The surface **2** is generally flat and extends across the width of the machine. The surface **2** includes an ascending section **10** which inclines upwardly in the direction of the delivery roll assembly **3**. Alternatively, a horizontally disposed section may be used. A copy sheet is moved toward the delivery roll assembly **3** by means of another driven roll or processing drum (not shown) located adjacent the bottom of the inclined surface **2**. The surface **2** may be an integral part of a bracket **20** supported by conventional means from the side walls **4** and **5** of the housing.

The processing surface **2**, as shown in FIG. **1**, also forms a crest or corner **11**, and thereafter forms a descending section **9** which drops-off or inclines downwardly toward a collection tray **12**. The corner **11** is rounded intermediate the ascending and descending sections of surface **2**.

The collection tray **12** is disposed in front of the advancing copy sheet and includes a base plate **13** which is inclined slightly upwardly in the direction of paper advance. The lowermost end **14** of the base plate **13** terminates adjacent the descending section **9** of the processing surface **2** to prevent passage of copy sheets therebetween.

The roll assembly **3** comprises a shaft **6** mounted for rotation in bearings in the side walls **4** and **5**. The shaft **6** is rotated by means of a belt **7** attached to a motor **9**. The axis of the shaft **6** is disposed substantially vertically above the corner **11**, however, the exact location of the shaft may be varied somewhat without effecting

the satisfactory operation of the arrangement. Mounted on the shaft **6** are a plurality of rolls **8** made of a resilient open cell polyurethane foam. The outer radius of each of the rolls **8** is selected to be greater than the vertical distance between the axis of the shaft **6** and the nearest portion of the surface **2.** The resiliency of the rolls **8** is such that adequate frictional contact is created between the periphery of the rolls **8** and the paper sheet to move the sheet along the processing surface **2.**

A characteristic of the foam used in the construction of the rolls **8** is that when it is cut, a plurality of tiny elongated fingers or projections **15,** FIG. **3,** are created at the periphery of the rolls which extend generally radially. As will be described hereinafter, these fingers **15,** along with sections of the rolls **8** in contact with the surface **2,** become energy-loaded through compression and bending during rotation of the rolls. Subsequently, as the rolls **8** continue rotation these energy-loaded sections of the rolls are released in an area just beyond the corner **11.** If, as this energy release is taking place, the trailing edge of the copy sheet **21** has just cleared the corner **11,** the trailing edge is acted upon by the fingers **15** and accelerated momentarily in the direction of the collection tray **12.** This added thrust is sufficient to assist in propelling the copy sheet into the collection tray **12.**

Referring to FIG. **3,** another characteristic of the roll arrangement of the invention is that the surface area of the rolls **8** in driving contact with the paper **21** is greater than in prior art devices for this purpose. More specifically, prior art drive arrangements generally utilize hard rubber rolls in place of foam rolls of the invention. Such rolls tend to contact the processing surface in only a relatively small area. Contrary to this, the area of driving contact or pinch area associated with the foam rolls of the invention extends from an area well in front of the corner **11** to an area beyond the midpoint of the corner **11.** As will be understood, this is a result of the large radius of the rolls **8** relative to the distance from the center of the rolls to the processing surface and the easy compressibility of the rolls. The combination of the above parameters combines to direct the force of the above-noted energy release advantageously against the trailing edge of the copy sheet.

Referring to FIG. **1,** the general path of a copy sheet **21** through the illustrated arrangement is upwardly along the ascending inclined section **10** of surface **2,** over the corner or crest **11,** and down the downwardly inclined section **9** into the collection tray **12.** The lead edge of the copy sheet **21,** after going over the crest **11,** generally rotates downwardly to initially contact the lower portion **14** of the base plate **13** and is subsequently pushed upwardly by the continuous driving action of the delivery roll arrangement **3,** as will be explained in greater detail hereinafter.

In machines not incorporating the roll arrangement of the invention, as the trailing edge of the copy sheet **21** passes under the drive rolls, the sheets have a tendency to lodge with their trailing edge just beyond the corner **11** of the surface **2,** just beyond the area of tangency with the drive rolls, as illustrated in dotted lines in FIG. **1.** The copy sheets **21** tend to be supported in this position by the bending of the paper during the course of its upward travel into the collection tray **12.**

Contrary to this, in the arrangement of the invention, as the rolls **8** rotate to advance the sheets **21,** sections of the rolls are continually compressed against the sheet by the surface **2** to energy-load these sections of the rolls. As rotation of the compressed sections of the rolls continues, the compressed sections snap back or are released beyond the corner **11.** As the trailing edge of the sheet **21** passes over the corner **11,** this released energy is directed against the trailing edge of the sheet **21** to accelerate and thrust it forwardly into the collection tray.

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

What is claimed is:

1. An arrangement for propelling a sheet of paper into a collection tray comprising,

a plane surface on which said sheet rides,

a shaft spaced above said surface, the axis of said shaft being substantially parallel to said surface, said surface defining a corner substantially directly below said axis,

a plurality of resilient, open cell plastic rolls mounted on said shaft, the radius defined by the periphery of each of said rolls being greater than the distance between said axis and the nearest portion of said surface whereby the sector of said roll in contact with said surface is compressed to energy-load said roll, and is released by subsequent rotation thereof beyond said corner, and

means for rotating said shaft so as to friction drive said paper along said surface toward said tray,

whereby upon passage of the trailing edge of said sheet into said corner the release of said roll propels said sheet momentarily in the direction of said tray.

2. The combination defined in claim **1** wherein said surface is inclined upwardly in the direction of said shaft on the side of said shaft opposite said tray.

3. The combination recited in claim **2** wherein the base surface of said collection tray is inclined upwardly away from said shaft.

4. Apparatus for delivering copy sheets from a processing surface to a collecting tray located forwardly and below said surface comprising a resilient roll, means mounting said roll for rotation above said surface, said roll having a radius sufficiently large such that peripheral areas thereof are continuously compressed by said surface during rotation to energy-load said roll, said surface adjacent said area of compression being shaped to allow release of said roll against the trailng edge of said sheet to accelerate said sheet in the direction of its advance after passage thereunder.

5. The combination recited in claim **4** wherein said roll is made of a polyurethane foam.

6. The combination recited in claim **5** wherein said roll is characterized by a plurality of hairlike resilient projections covering substantially the entire periphery thereof.

7. The combination recited in claim **4** wherein said roll is made of a porous foam material.

8. The combination recited in claim **4** wherein said surface defines a corner approximately vertically below the axis of said roll.

9. An arrangement for moving a sheet of paper into a collection tray comprising a surface on which said sheet is conveyed, said surface defining a corner, roll means mounted for rotation above said corner, a peripheral sector of said roll means being continuously compressed by said surface adjacent said corner to thereby energy-load said roll means, the compressed sector being released by rotation beyond said corner, whereby upon passage of the trailing edge of said sheet over said corner the release of said sector propels said sheet momentarily in the direction of said tray.

10. The combination defined in claim 9 wherein said roll means comprises an open-cell urethane roll.

11. The combination defined in claim 9 wherein said roll means comprises a plurality of open-cell rolls spaced apart across the width of said sheet.

12. The combination defined in claim 11 wherein said rolls are mounted on a shaft, the axis of said shaft being substantially directly above said corner.

13. The combination recited in claim 9 wherein said collection tray is located below said corner in the direction of movement of said sheets and is inclined upwardly in the direction away from said corner.

14. Apparatus for delivering a sheet from a processing surface to a collecting tray located forwardly of and below said surface comprising a roll having resilient hairlike projections integral therewith over substantially the entire periphery thereof, means for mounting said roll for rotation above said surface, said roll having a radius sufficiently large to continuously bend some of said projections by contact with said surface during rotation of said roll to thereby energy load said projections, whereby when the trailing edge of said sheet passes under said roll it is accelerated by the release of said projections beyond the area of contact with said surface.

15. The combination recited in claim 14 wherein said roll comprises an open-cell plastic.

* * * * *