United States Patent

[11] 3,596,901

[72] Inventors **Karl Rehm;**
Hermann Schwarz, both of Constance, Germany

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[73] Assignee **Licentia Patent-Verwaltungs-G.m.b.H.**
Frankfurt/am Main, Germany

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[33] **Germany**
[31] **P 19 14 839.1**

[54] **SHEET SEPARATOR**
2 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **271/35**
[51] **Int. Cl.** **B65h 3/04**
[50] **Field of Search** 271/35, 37, 38, 36

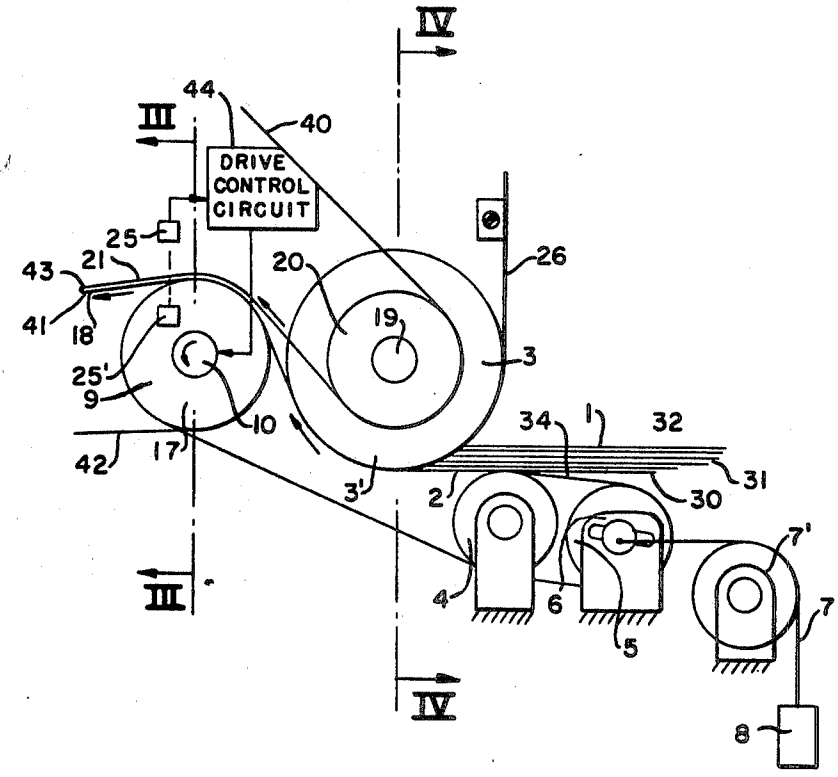
[56] **References Cited**

UNITED STATES PATENTS

1,011,820	12/1911	Labombarde	271/35
2,273,288	2/1942	Rouan	271/35
3,239,213	3/1966	Griswold	271/35
3,288,461	11/1966	Smith	271/35

Primary Examiner—Joseph Wegbreit
Attorney—Spencer and Kaye

ABSTRACT: Apparatus for removing sheets one by one from a stack includes a transfer belt which engages one surface of a sheet on one end of a stack to remove it from the stack, and a convex surface stripper means disposed on the opposite side of the end sheet, the transfer belt looping about the convex surface for an angle which is greater than approximately 25° and pressing a sheet against it while it is being removed, so that the convex surface retards removal of adjacent sheets and separates the end sheet from the stack.



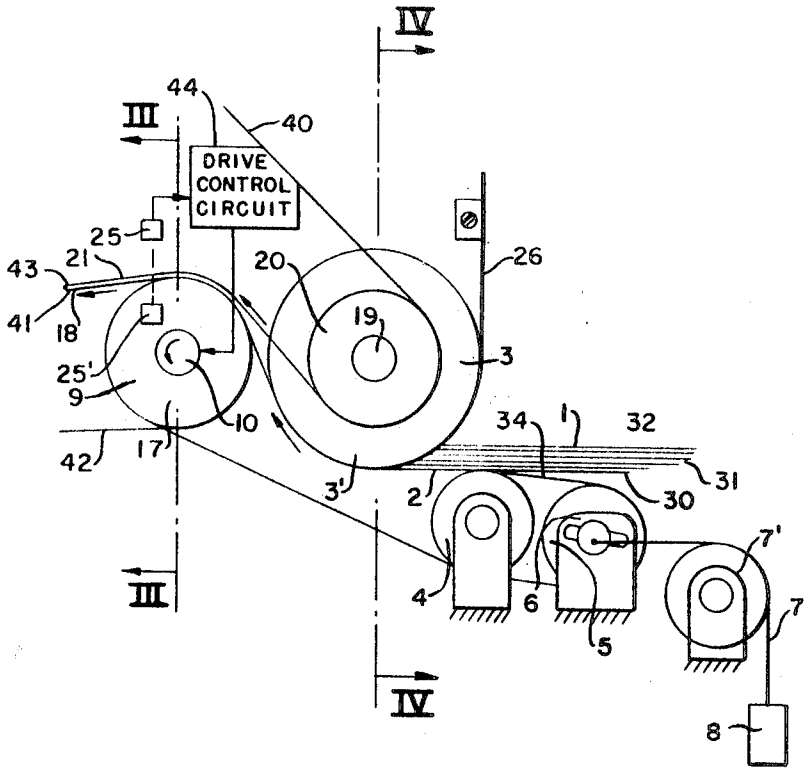


FIG. 1.

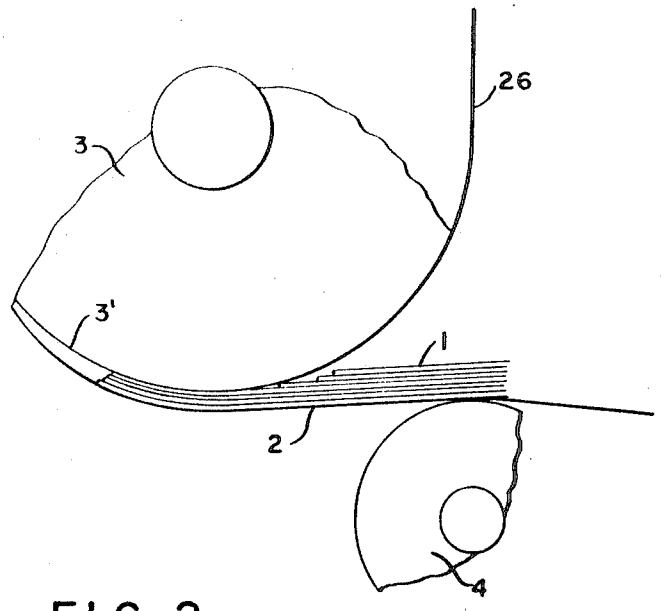


FIG. 2.

INVENTORS
Karl Rehm &
Hermann Schwarz

BY Spencer & Kaye
ATTORNEYS

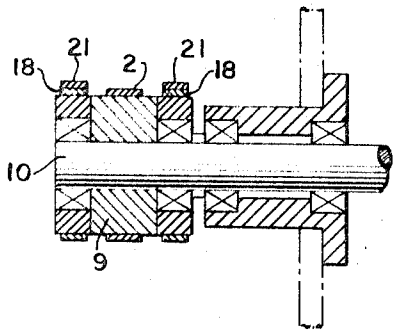


FIG. 3.

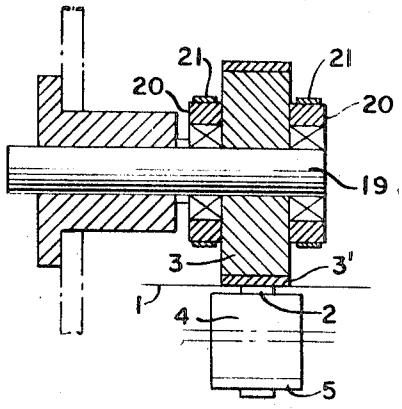


FIG. 4.

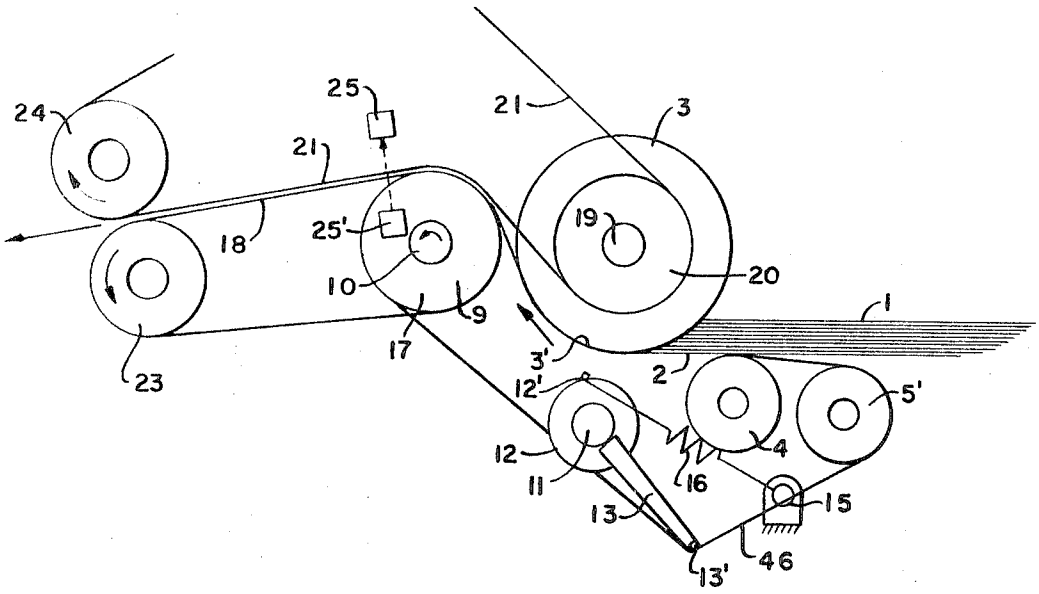


FIG. 5.

INVENTORS
Karl Rehm &
Hermann Schwarz

BY Spencer & Kaye
ATTORNEYS

SHEET SEPARATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a device for individually removing sheets, one by one, from a stack, and more particularly to such a device in which a moving transfer belt engages one surface of a sheet on the end of a stack to remove it therefrom, while the convexly curved stripper engages the opposite surface of sheets in the stack to retard removal of adjacent sheets and thus separate the end sheet from the adjacent sheets.

2. Description of the Prior Art

Such a device is described in U.S. Pat. No. 1,214,474. The stripper of this device is a roller provided with a friction coating. A portion of the roller projects through a slot in a guide plate, and the roller is driven slowly in a direction opposite to the direction in which the transfer belt moves. The frontal drive roller for the transfer belt is positioned opposite the stripping roller. The operating range within which the transfer belt and the stripping roller can cooperate with each other to separate the end sheet from the adjacent sheets in the stack is relatively short. In this device separation of the end sheet from the stack may fail to occur particularly if the sheets are of uneven configuration or are deformed, as for example by being crumpled, limp, or torn. It is also possible that a number of sheets may become wedged together at a discharge point so that manual removal of the wedged sheets is necessary before operation of the apparatus can be resumed.

Such malfunctions are particularly undesirable if the apparatus is used to separate individual pieces of paper currency in an automatic money-dispensing machine. Individual bills which have been in use for differing periods of time have very different paper properties, particularly with respect to coefficient of friction. Further variations between bills occur because some bills may have become damaged.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a device of the above-described type, in which individual sheets are reliably separated from the stack, which can be operated without attention for long periods of time, and in which malfunctions, if they occur at all, are automatically remedied.

Briefly stated, these and other objects of the invention are achieved in that a stripping surface having a convex curvature is provided at the discharge point of the stack and that the drive roller pulling the transfer belt is so disposed adjacent said discharge point that the transfer belt is looping about said stripping surface.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side view of one embodiment of the present invention.

FIG. 2 is an enlarged view of a portion of FIG. 1 illustrating a particular operating situation.

FIG. 3 is a section along the line III–III of FIGURE 1.

FIG. 4 is a section along the line IV–IV of FIGURE 1.

FIG. 5 is a schematic side view of another embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGURE 1, a stack 31 of bills 1 is vertically arranged with the underside 30 of the lowermost bill 32 resting upon a portion of the outer surface 34 of the forward reach of a transfer belt 2. At the lowermost corner of the stack there is disposed a rigid and nonrotatable cylindrical disc 3 whose outer surface 3' is formed so as to have a higher coefficient of friction than that between adjacent sheets of a stack.

Below the stack there is a support roller 4 which rotates about a fixed axis to support the rear portion of the forward reach of transfer belt 2 and the stack and a tension roller 5 which is mounted for longitudinal movement in a support 6. The end of transfer belt 2 is looped about the tension roller 5. A weight 8 acts on tension roller 5 via a cable 7 which is entrained about a guide roller 7' and pulls the belt 2 so as to maintain it under constant tension. The other end, i.e. the front end of the forward reach of transfer belt 2 is looped about a drive roller 9. The coefficient of friction between the surface of transfer belt 2 and the sheets is higher than that between said surface 3' and the sheets.

Drive roller 9 is so positioned relative to the stripper disc 3 and the guide roller 4 of the transfer belt 2 that the transfer belt is in contact with the stripper surface through an angle of approximately 60°.

Referring to FIG. 3, it will be seen that drive roller 9 is fixed on a drive shaft 10 which is pivoted on support structure 45. Two freely rotatable guide rollers 17 are rotatably mounted on the shaft 10 on each side of the drive roller 9. A conveying belt 18 is entrained about each of the guide rollers 17, and the belts together serve as a delivery belt for sheets received from the transfer belt 2.

Referring now to FIG. 4, the same shows further details of the stripper disc 3 and associated structure. Disc 3 is rigidly mounted on a shaft 19 which is rigidly secured to support structure 40. A friction surface 3' is formed on the circumference of disc 3. Freely rotatable guide rollers 20 are rotatably mounted on shaft 19 on each side of the disc 3. Guide rollers 20 have a lesser diameter than the disc 3. A delivery belt 21 is entrained about each of the guide rollers 20 and thereafter entrained so that its outer surface 40 is in contact with the outer surface 42 of delivery belt 18 as the belts pass along about guide rollers 17. The lower run 43 of the delivery belt 21 moves in contact with the upper run 41 of belt 18 so that a sheet, once delivered between belts 18 and 21 by the transfer belt 2, is thereafter carried along to a further destination. Delivery belts 18 and 21 are driven via appropriately arranged drive rollers 23 and 24, which are illustrated in connection with the FIG. 5 embodiment and are independent of the drive of the drive roller 9 of the transfer belt 2.

A photoelectric barrier 25/25' is arranged adjacent the beginning of the cooperating runs of the delivery belts 18 and 21 so that it responds to the passage of the front edge of a bill 1 pulled out of the stack by a transfer belt 2 through the barrier. An appropriate control signal is then supplied through a drive control circuit 44 which then stops the drive roller 9 of the transfer belt until the next call for a bill. The delivery conveyor belts 18 and 21, however, continue their movement to carry the bill to its further destination, after which they may be stopped, although this is not relevant to the invention disclosed in this application.

A plate 26 having a lesser coefficient of friction than the friction surface 3' is vertically arranged and is tangential to disc 3 on the side facing the stack. It provides a guide for the front edge of the stack of bills 1.

Referring now to FIG. 5, a different embodiment of the apparatus for maintaining tension on the transfer belt 2 is shown. The apparatus is generally similar to that of FIG. 1 and corresponding parts have corresponding reference numerals. As in that embodiment, the drive roller 9 and the support roller 4 of the transfer belt 2 are mounted for rotation about fixed axes. However, roller 5', unlike the tension roller 5 of the FIG. 1 embodiment is not movably mounted, but also rotates about a fixed axis and serves as an additional support roller for the transfer belt 2. The loose reach 46 of the transfer belt 2 which extends along its lower run is biased downwardly by a tensioning arm 13 having a sliding guide 13' fastened thereto. Arm 13 is fixed to a disc 12 which is rotatable around an axis 11, and is biased into the tensioning position by a spring 16 which is secured to the disc 12 at 12' and to fixed support structure 15. The arrangement of these elements is such that, as is also true in the embodiment illustrated in FIG. 1, the belt tension is substantially independent of the position of the transfer belt.

In an experimental type of a device substantially similar to that illustrated in FIG. 5 the stripper disc 3 was 95 mm. in diameter, the roller 9 56 mm. in diameter, the rollers 4 and 5 were 40 mm. in diameter. The rollers were each made of nylon plastic, roller 9 having a coating of natural rubber. Transfer belt 2 was 15 mm. in width and 580 mm. long.

About disc 3 a coating of a synthetic known under the trade name "Vulcollan" was formed which had a Shore hardness of 80. "Vulcollan" is an elastomeric polyurethane. The surface which were finished by grinding had a coefficient of friction of 0,5...0,6 to paper of the kind involved.

Transfer belt 2 were made of fabric coated with synthetic rubber and sold by the VIS-Kunststoffwerk Offenburg under the designation model number "C 10" in one version and "B 08" in another version. A coefficient of friction of 0,7... 0,9 to paper were measured. The loose reach 46 of transfer belt 2 was held under a tension of about 180 p (Pond). All other belts were made from pure rubber.

Under the conditions indicated above an angle of enclosure at disc 3 of about 60° was found advantageous.

By varying the particular parameters concerned it has been found that with angles of enclosure smaller than about 25°, all other parameters optimally choosen, the specific functional properties of a device according to the invention were not obtainable any more.

OPERATION OF THE PREFERRED EMBODIMENTS

When it is desired to deliver a bill 1 from the stack 31, the drive control means 44 is selectively operated. Drive roller 9 is rotated and transfer belt 2 then pulls the lowermost bill 32 out of the stack and carries it into the region between the delivery conveying belts 18 and 21. These belts then engage the bill therebetween and pull it for delivery to a further point. As soon as the front edge of the bill reaches the light barrier 25/25', a signal is supplied to the drive control means 44 and drive roller 9 of the transfer belt 2 is stopped. The delivery belts 18 and 21 continue to move to completely pull the bill out of the separator device and to bring it to its further destination. Thereafter, they are also automatically stopped.

Due to the fact that the transfer belt 2 encloses a stripping surface 3', an automatic adaptation to the varying frictional forces is realized which result from the different paper consistencies of different bills.

With papers which are difficult to separate, for example, the enclosure results in an increased belt tension in the pulling reach. As a result of this, the bills are pressed closer to the transfer belt and into the stripping surface. Both the forward pushing force exerted by the transfer belt 2 on the lowermost bill 32 and the retarding force exerted by the stripper surface 3' on the upper surface of the uppermost bill is increased. The absolute value of the differential force on these bills increases until finally the frictional force between the bills is markedly exceeded and separation is accomplished.

FIG. 2 shows a situation in which a number of bills 1 have advanced between a portion of the stripping surface 3' and the belt 2. Since the belt tension in the loose reach is maintained constant, the play of forces is not interfered with during the removing process and is independent of the fact whether or not the transfer belt is deflected to a greater or lesser degree.

If in a situation like that of FIG. 2 two or more bills are delivered to the output of the device, this can be tolerated since the device may be followed by a doubles detector not shown and a reject switch controlled by the same. It is essential however that under no circumstances wedging of bills at the discharge point occurs and that malfunctions are automatically remedied.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations.

We claim:

1. In apparatus for separating sheets from a stack, which apparatus includes rotatably mounted transfer belt means having a forward reach for removing individual sheets from the stack, delivery means for receiving each sheet removed from the stack by said belt means and for delivering the sheets to a receiving point, means defining a convex stripping surface adjacent the outlet end of said apparatus, support roller means supporting the rear portion of said forward reach, and drive roller means supporting the front end of the forward reach of said transfer belt means for moving said belt means in a direction to convey sheets from the stack to said delivery means, said belt means having a loose return reach arranged to move in the opposite direction, said drive roller means being positioned for causing said forward reach to be urged against and conform to the shape of, said stripping surface along a portion of its length which subtends an angle of more than about 25°, the improvement wherein said portion of the length of said forward reach which conforms to the shape of said stripping surface is spaced from the parts of said forward reach which bear against said support roller means and said drive roller means, said forward reach of said transfer belt means constitutes the sole sheet contacting surface opposite said stripping surface in the vicinity of said stripping surface during all separation operations, and the region at the opposite side of said forward reach portion from said stripping surface is free of all obstructions, whereby the entirety of said forward reach portion may be deflected away from said stripping surface by a distance equal to at least several thicknesses of the sheets to be separated, and said apparatus further comprises tension means connected to said belt means for maintaining its said return reach under a constant tension force which is independent of changes in the belt configuration.

2. The combination defined in claim 1 wherein:

said delivery means includes delivery belt means and drive means for driving said delivery belt means, and said apparatus further comprises:

means for sensing the delivery of a sheet from the transfer belt to the delivery belt means,

means responsive to said sensing means for stopping said drive roller of the transfer belt means while said drive means of the delivery belt means continues to operate, and

means for starting the drive roller of said transfer belt means when the delivery of a new sheet is desired.