April 11, 1967 E. ZAKROFF ET AL 3,313,191

SEPARATING APPARATUS

Filed Dec. 29, 1964

2 Sheets-Sheet 1

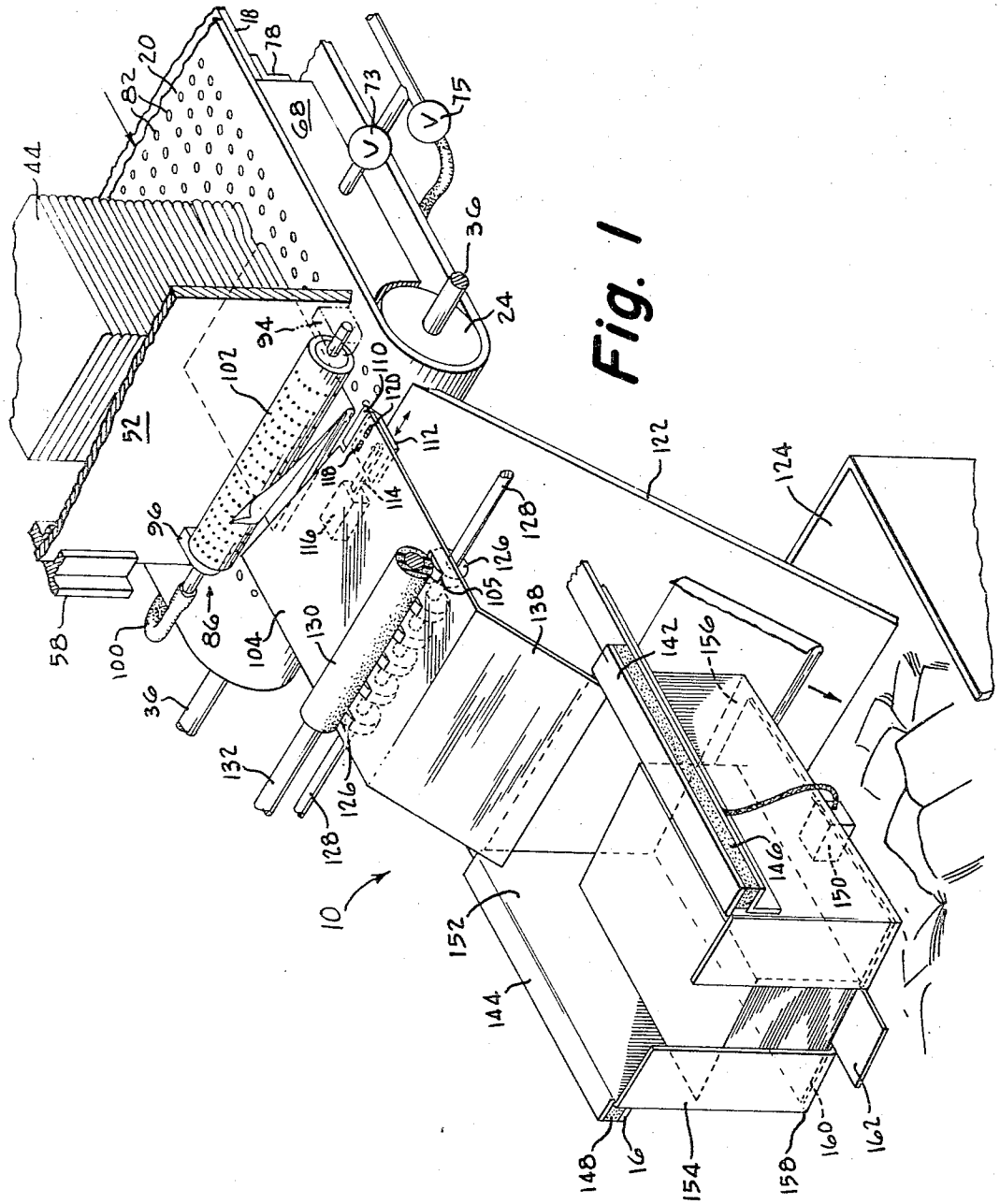

Fig. 1

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Fig. 2

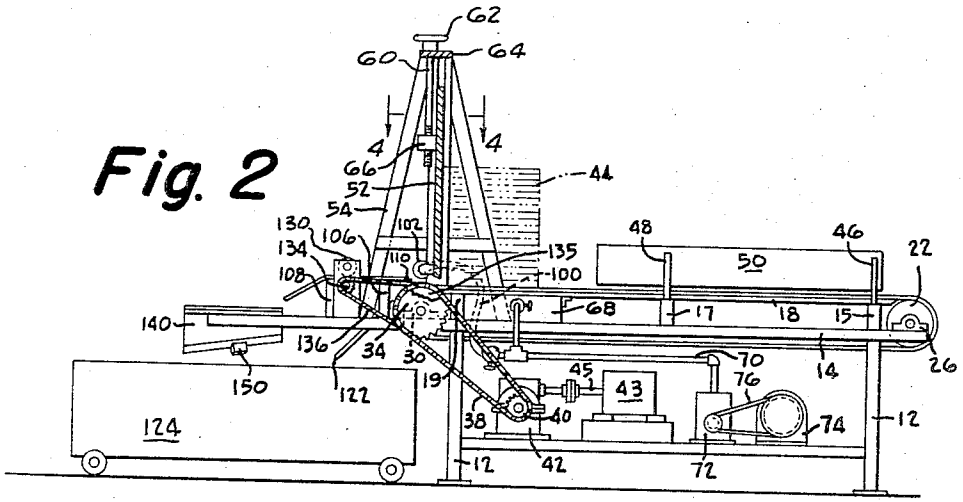


Fig. 3

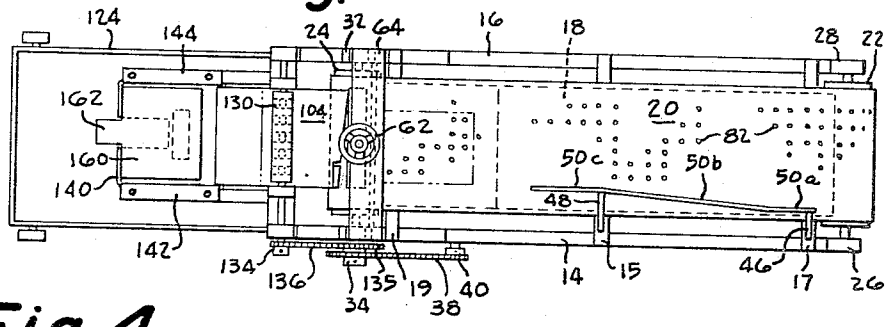


Fig. 4

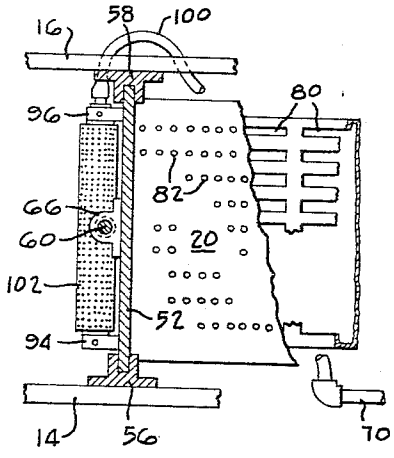
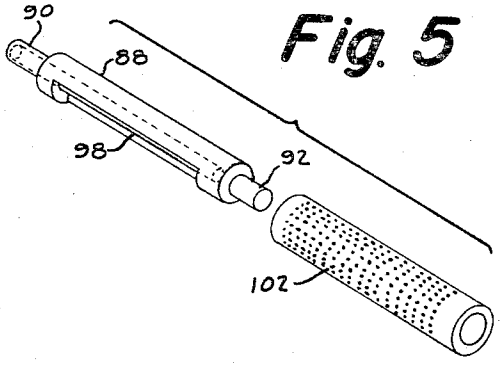


Fig. 5



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United States Patent Office 3,313,191 Patented Apr. 11, 1967

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SEPARATING APPARATUS

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Filed Dec. 29, 1964, Ser. No. 421,853
9 Claims. (Cl. 83—89)

This invention relates to a segregating apparatus. More particularly, this invention relates to an apparatus for severing sheets from a bound pile of sheets and assorting the same.

Magazines, books, and other forms of literature that come in bound volumes often comprise several types of paper. The most obvious examples of this are magazines which have covers made from a different material than the body of the magazine and books which have flyleaves that are made from a different type of paper than the body of the book. Other types of dissimilarities occur in printed literature. For example, the body of the magazine may be printed on a uniform type of paper stock, but several of the pages may be printed with colored ink while the remaining pages are printed with black ink. After magazines and other forms of bound literature have become discarded, it is often desirable to collect and re-use the literature for any one of several purposes.

The present invention is directed to the novel apparatus for transferring a stack of piles of bound sheets to a severing and segregating apparatus, feeding individual piles of sheets from said stack into said severing and segregating apparatus, apparatus for severing and segregating individual bound sheets from said pile (for example severing and segregating magazine covers from the body of a magazine), and means for collecting the severed sheets in aligned homogeneous piles.

It is a general object of this invention to provide a novel apparatus for severing and segregating sheets from bound piles of sheets.

It is another object of this invention to provide a novel apparatus for feeding piles of bound sheets and severing and segregating individual sheets from the piles.

It is yet another object of the present invention to provide a novel apparatus for feeding piles of bound sheets from a stack of such piles, severing and segregating individual sheets from said piles, and assorting the severed sheets in homogeneous stacks.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a partial perspective view of the apparatus illustrating the feed mechanism, the severing and segregating mechanism, and the collecting apparatus.

FIGURE 2 is a side elevational view of the apparatus in accordance with the present invention.

FIGURE 3 is a top plan view of the apparatus in accordance with the present invention.

FIGURE 4 is a partial sectional view of the apparatus illustrated in FIGURE 2 taken along the line 4—4.

FIGURE 5 is an exploded perspective view of the vacuum apparatus for partially separating a sheet from the bound pile of sheets.

Referring now to the drawings, wherein like numerals indicate like elements, there is shown in FIGURE 1 a partial perspective view of the severing and segregating apparatus designated generally as 10.

As shown in FIGURES 1, 2 and 3, the apparatus 10 is supported on legs 12. Horizontal supporting arms 14 and 16 which may consist of angle irons are connected to the tops of legs 12, transverse supporting blocks 15, 17 and 19 are connected to and extend between arms 14 and 16. A planar table is mounted on the supporting blocks 15, 17 and 19 with its longitudinal axis parallel to arms 14 and 16. A conveyor belts passes over rollers 22 and 24 which are mounted in journal blocks 26, 28, 30 and 32 on arms 14 and 16. The inner surface of belt 20 passes over table 18 and is supported by it. The idler roller 22 rotates freely in journals 26 and 28. The driver roller 24 is connected to a sprocket 34 which is fixed on the pulley shaft 36. A drive chain 38 connects sprocket 34 to sprocket 40 which is mounted on a shaft extending from a power transfer means 42, which may be a transmission. Motor 43 drives transmission 42 through shaft 45.

When the conveyor belt 20 is caused to move by driving roller 24, it may be used to transfer stacks of bound sheets 44, such as magazines, from a loading station adjacent roller 22 to a severing and segregating station adjacent roller 24. Brackets 46 and 48 are mounted on blocks 15 and 17 and serve to support a stack guide 50. As best shown in FIGURE 3, the bracket 48 extends a farther distance outwardly over the belt 20 than does the bracket 46. The stack guide 50 is mounted on brackets 46 and 48 with its guide surface normal to the surface of belt 20. The stack guide 50 is divided into three portions consisting of a receiving portion 50A, angle portion 50B and a directing portion 50C. Stacks of sheets are set upon belt 20 against the receiving portion 50A. The belt 20 transfers the stack 44 towards the severing and separating station with the result that the guide portion 50B forces the stack towards the center of belt 20 in proper alignment with a cutter 110. That is, the bound edge of stack 44 is aligned with cutter 110. The directing portion 50C is parallel to the longitudinal axis of the belt 20 and therefore assures that the edge of the stack is aligned perpendicular to the cutter 110.

After the stack 44 has been placed upon the belt 20 and guided into position by the stack guide 50 it is moved against a stack restraining means. The stack restraining means consists of a gate 52 adjustably supported in an A-frame 54 mounted on arms 14 and 16. Slots in rails 56 and 58 guide the gate 52 for vertical adjustment. A threaded shank 60 having a hand wheel 62 fixed to one end thereof rotatably extends through a beam 64 and matingly engages a threaded collar 66 fixed to the gate 52. To adjust the height of gate 52 above belt 20, the hand wheel 62 is turned causing shank 60 to rotate.

During the operation of apparatus 10, the gate 52 will be adjusted so that it is spaced away from belt 20 by a distance equal to or greater than the thickness of one bound pile of sheets in the stack 44, but less than the thickness of two such piles. In this manner the stack restrainer holds stack 44 on conveyor 20 so that individual piles of bound sheets are fed beneath gate 52.

Since the belt 20 must frictionally engage the bottom pile of stack 44 to force it beneath gate 52, and yet must be smooth enough to permit stack guide 50 to guide the pile 44 into position, means for holding the bottom pile in stack 44 against the belt 20 are provided adjacent the gate 52. As best shown in FIGURES 2 and 4, the holding means consists of a manifold 68 connected through appropriate tubing 70 to a vacuum pump 72 which is driven by a motor 74 through belt 76. The manifold 68 is supported on the end of table 18 by a bracket 78. The manifold 68 extends the full width of belt 20 and its top surface is even with the top surface of table 18 so that belt 20 rests thereon. As shown in FIGURE 4, the top of manifold 68 is provided with a lattice-like grill 80 so that there is open communication between its interior and belt 20. A plurality of holes 82 extend through belt 20 over its entire area.

When the vacuum pump 72 draws air from manifold 68

is creates a suction through grill 80 and holes 82 which holds the bottom pile in stack 44 against belt 20 with a greater force than that created by the weight of stack 44. The suction or force may be adjusted by valve 73. The result is an effective increase in the normal force upon belt 20 resulting in greater frictional engagement between it and the bottom pile in stack 44. In this manner, the belt 20 will force each successive bottom pile in stack 44 beneath the gate 52.

As best shown in FIGURES 1, 4 and 5 apparatus 86 for partially separating a sheet from the pile 84 fed from stack 44 is mounted on gate 52. The partial separating apparatus 86 consists of a hollow cylinder 88 having reduced diameter projections 90 and 92 extending from either end thereof. Projections 90 and 92 are adapted to be fixedly supported by brackets 94 and 96 mounted on gate 52. Part of the side of cylinder 88 is cut away to provide an opening 98. The projection 90 is drilled through so that there is open communication between the interior of hollow cylinder 88 and a flexible tube 100 which is connected to vacuum pump 72 through tubing 70 and valve 75. A cylindrical sleeve 102 having perforations at spaced intervals therethrough over its entire surface is rotatably mounted over the cylinder 88. Sleeve 102 is in intimate contact with the surface of cylinder 88.

In the operation of apparatus 10, the pump 72 will create a vacuum in cylinder 88. Valve 75 may be used to adjust the vacuum. This will also create a partial vacuum about sleeve 102 which will draw a top sheet from bound pile 84 towards it. The drawing force will act only on the top sheet of pile 84 and hence will not affect the sheets beneath it.

Since cylinder 88 is open only at opening 98, the suction force attracts the topmost sheet of pile 84 against only the portion of sleeve 102 that covers openings 98. The forward movement of pile 84, caused by belt 20, will also cause sleeve 102 to rotate as the topmost sheet is in frictional contact therewith. This causes the leading portion of the topmost sheet to rotate sleeve 102 and hence move past opening 98. This effectively breaks the suction force on the leading portion of the topmost sheet, allowing it and each following portion to drop away from the partial separating apparatus. It should be noted that the important function of the partial separating apparatus is to lift the topmost sheet long enough to permit the reception of blade 104 between it and the remainder of pile 84.

A blade 104 is supported in cantilever fashion by blocks 106 and 108 on arms 14 and 16. As shown in FIGURE 1, the foremost edge of blade 104 is positioned so as to be received between the topmost sheet, which has been partially pulled away, and the remainder of pile 84. The foremost edge of blade 104 is at an acute angle to the longitudinal axis of roller 24. This permits a leading non-cutting edge of blade 104 to be received between the topmost sheet and the remainder of pile 84 before the cutting edge engages the topmost sheet. Thus, the unbound end of pile 84 receives blade 104 before the bound edge is engaged by cutter 110 which may be a knife, razor or the like. The cutter 110 is mounted adjacent one side of blade 104 and is of substantial width to insure engagement of its sharpened edge with the bound edge of the topmost sheet in pile 84.

The cutter 110 is fixed to a block 112. Block 112 is fixed to arm 114. The arm 114 extends from a vibrator 116. As indicated by the double headed arrow, the vibrator 116 acting through arm 114 moves the block 112, and hence the cutter 110, laterally back and forth. A pair of headed studs extend from block 112 through elongated slots 118 and 120, and thus serve to support and guide block 112 and cutter 110.

As the pile 84 is moved forward by belt 20, it receives blade 104 and engages cutter 110 with the result that the topmost sheet is severed therefrom. Since the topmost sheet has been partially separated from pile 84 and the blade 104 caused to be received between said topmost sheet and the remainder of pile 84, the result is that the topmost sheet is guided over blade 104 while the remainder of pile 84 falls away. The remainder of pile 84 slides down slide 122 to be received within a bin 124.

The topmost sheet will slide along the upper surface of blade 104 until it is engaged between driven rollers 126 rotatably mounted on shaft 128 and idling pressure roller 130 rotatably mounted on shaft 132. The rollers 126 are mounted below blade 104 with a portion extending through slots 105 in blade 104. The surface of rollers 126 is above the top surface of blade 104. The rollers 126 and 130 are spaced away from the blade 104 by a distance which is less than the length of pile 84. Thus, the rollers 126 and 130 may engage the topmost sheet prior to the completion of the severing process by knife 110. A sprocket 134 is mounted on the end of shaft 128. A chain 136 extends around sprocket 134 and a sprocket 135 on shaft 36. The number of teeth on sprocket 134 is chosen in the correct ratio with respect to the number of teeth on sprocket 34 so that the surface velocity of rollers 126 is equal to the surface velocity of belt 20. This insures that the topmost sheet of pile 84 will not be torn or creased as it is received between rollers 126 and 130.

The rollers 126 and 130 direct the topmost sheet down a slide 138 into a bin 140. The bin 140 is provided with flanges 142 and 144 extending from its open top edge in overlapping relation with the arms 14 and 16. In this manner the arms 14 and 16 provide support for cantilever bin 140. Strips of resilient material 146 and 148 are mounted between the flanges 142 and 144 and arms 14 and 16. An electrically powered vibrator 150 is mounted on the bottom of bin 140 and vibrates the same to insure proper stacking of severed top sheets. The resilient strips 146 and 148 allow the bin 140 to vibrate and yet provide a secure mount to arms 14 and 16.

The bin 140 has vertical side walls. However, the walls 152 and 154 are shaped so that even though flanges 142 and 144 lie in a horizontal plane the planar bottom wall 156 will have a corner 158 which is lower than the remaining corners of bin 140. Thus, bottom wall 156 slopes downwardly and forwardly towards corner 158. The combined effect of the sloping planar bottom wall 156 together with vibrator 150 assures that the topmost sheets of piles 84 will be neatly stacked in bin 140.

To provide for removal of stacked sheets from bin 140 a pallet 160 is placed therein adjacent bottom wall 156. A handle 162 extends from pallet 156 through a slot-like opening 164 in wall 154. Thus, a stack of topmost sheets may be removed from bin 140 by merely engaging handle 162 and lifting the pallet 160 from bin 140.

Referring to FIGURE 2, it will be noted that the bin 124 for receiving the remaining portions of piles 84 is mounted upon wheels and therefore may be easily removed from beneath slide 122. It should also be noted that rails 14 and 16 support bin 140 and slide 122 in cantilever fashion thereby facilitating the ease with which bin 124 may be adjusted to receive remaining portions of piles 84.

From the foregoing it is clear that the apparatus 10 provides a means whereby sheets may be severed from bound piles of such sheets and separated therefrom. It will also be recognized by those skilled in the art that although the knife 110 and bin 140 are provided with means to vibrate the same, under certain conditions such vibrating means may be dispensed with. Thus, the materials being severed and separated may be of such nature that the knife 110 will sever the same without the aid of vibrating action and the topmost sheets will be stacked in bin 140 without the aid of vibrator 150. Circumstances may also arise wherein the knife 110 is vibrated and the bin 140 is not, or vice-versa. The precise conditions upon which the vibrators 150 and 160 are used or not used depend upon the materials being handled, and can best be determined by trial and error. The same is

true of the adjustment in the amount of vacuum created by cylinder 88.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specifications as indicating the scope of the invention.

We claim:

1. Apparatus for segregating individual sheets from a bound pile of sheets comprising means for transporting a stack of bound piles to severing and separating means, a stack restrainer including a gate spaced away from a moving surface a distance substantially equal to the thickness of said piles, said moving surface being adapted to apply a translational force upon piles juxtaposed thereto for removing individual piles from a restrained stack, means for partially separating a sheet from a removed pile, a blade positioned to be received between said pile and sheet, cutting means adjacent said blade, said cutting means being positioned to sever said sheet from said pile, means for directing a severed sheet away from said pile, said means for directing said sheet away from said pile including a fixed surface for supporting a severed sheet, and cooperating sheet drive rollers, at least one of which is adapted to be driven, positioned to engage said severed sheet and move it over said fixed surface, and a container positioned to receive said sheet.

2. Apparatus in accordance with claim 1 wherein said means for partially separating a sheet from a removed pile includes a cylinder mounted adjacent the spaced edge of said gate, an opening in said cylinder, a rotatable sleeve over said cylinder, said sleeve having a plurality of holes therethrough, and means to evacuate said cylinder.

3. Apparatus in accordance with claim 1 wherein said gate is adjustable to vary the space between it and said moving surface.

4. Apparatus in accordance with claim 1 including guide means for guiding a stack of bound piles into proper position against said restraining means, said guide means including a vertical wall adjacent said transporting means, said vertical wall including a portion against which said piles may be stacked.

5. Apparatus for segregating individual sheets from a bound pile of sheets comprising means for transporting a stack of bound piles to severing and separating means, a stack restrainer including a gate spaced away from a moving surface a distance substantially equal to the thickness of said piles, said moving surface being adapted to apply a translational force upon piles juxtaposed thereto for removing individual piles from a restrained stack, means for partially separating a sheet from a removed pile, a blade positioned to be received between said pile and sheet, cutting means adjacent said piles, said cutting means being positioned to sever said sheet from said pile, means for directing a severed sheet away from said pile, a container for receiving said severed sheet, said container having a planar bottom wall and vertical side walls, said bottom wall and vertical side walls cooperating to define bottom corners of said container, one of said corners being lower than the other corners.

6. Apparatus in accordance with claim 5 wherein said container is provided with means to vibrate said container for aligning severed sheets with said lower bottom corner.

7. Apparatus in accordance with claim 5 wherein a pallet is juxtaposed said bottom wall, and said pallet is provided with a handle extending through a slot in a side wall of said container.

8. Apparatus for segregating individual sheets from a bound pile of sheets comprising means for transporting a stack of bound piles to severing and separating means, a stack restrainer including a gate spaced away from a moving surface a distance substantially equal to the thickness of said piles, said moving surface being adapted to apply a translational force upon piles juxtaposed thereto for removing individual piles from a restrained stack, means for holding piles juxtaposed to said moving surface against said moving surface, means for partially separating a sheet from a removed pile, a blade positioned to be received between said pile and sheet, cutting means adjacent said blade, said cutting means being positioned to sever said sheet from said pile, and means for directing a severed sheet away from said pile.

9. Apparatus in accordance with claim 8 wherein said holding means includes a chamber juxtaposed the side of said moving surface opposite to the force applying side, openings in said chamber cooperating with holes in said moving surface, and means to evacuate said chamber.

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