United States Patent

[11] 3,601,389

[72] Inventor **William E. Kramer**
Ontario, N.Y.

[21] Appl. No. **838,906**
[22] Filed **July 3, 1969**
[45] Patented **Aug. 24, 1971**
[73] Assignee **Xerox Corporation**
Rochester, N.Y.

[54] **SHEET FEEDING APPARATUS**
4 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **271/18,** 271/61
[51] **Int. Cl.** **B65h 3/56**
[50] **Field of Search** 271/61, 18, 36, 39, 27, 28, 22, 21

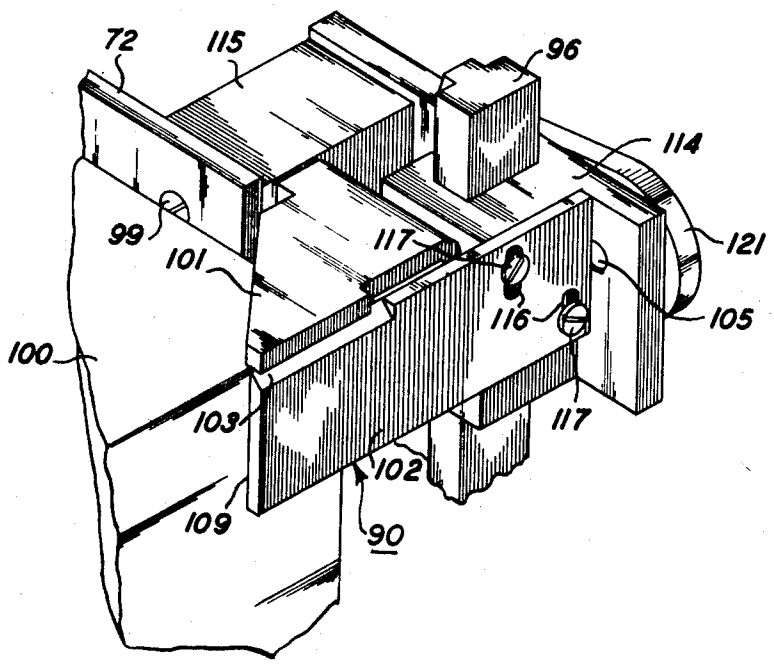
[56] **References Cited**

UNITED STATES PATENTS

2,260,045	10/1941	Morrison et al.	271/36
2,343,187	2/1944	Jagger	271/36
2,912,241	11/1959	Tonkin	271/22
3,447,798	6/1969	Bishop et al.	271/21
3,481,597	12/1969	Wanek	271/36

Primary Examiner—Joseph Wegbreit
Attorneys—Norman E. Schrader, James J. Ralabate and Michael J. Colitz, Jr.

ABSTRACT: Apparatus to separate and feed individual sheets from the top of a stack in which a snubber plate, acting in conjunction with a knife edge retaining bar, is biased into contact with each forward corner of the topmost sheet in said stack to cause a sheet of predetermined beam strength to be buckled by said snubber and to cause a sheet of greater beam strength to pass between the snubber and the retaining bar.



PATENTED AUG 24 1971

3,601,389

SHEET 1 OF 5

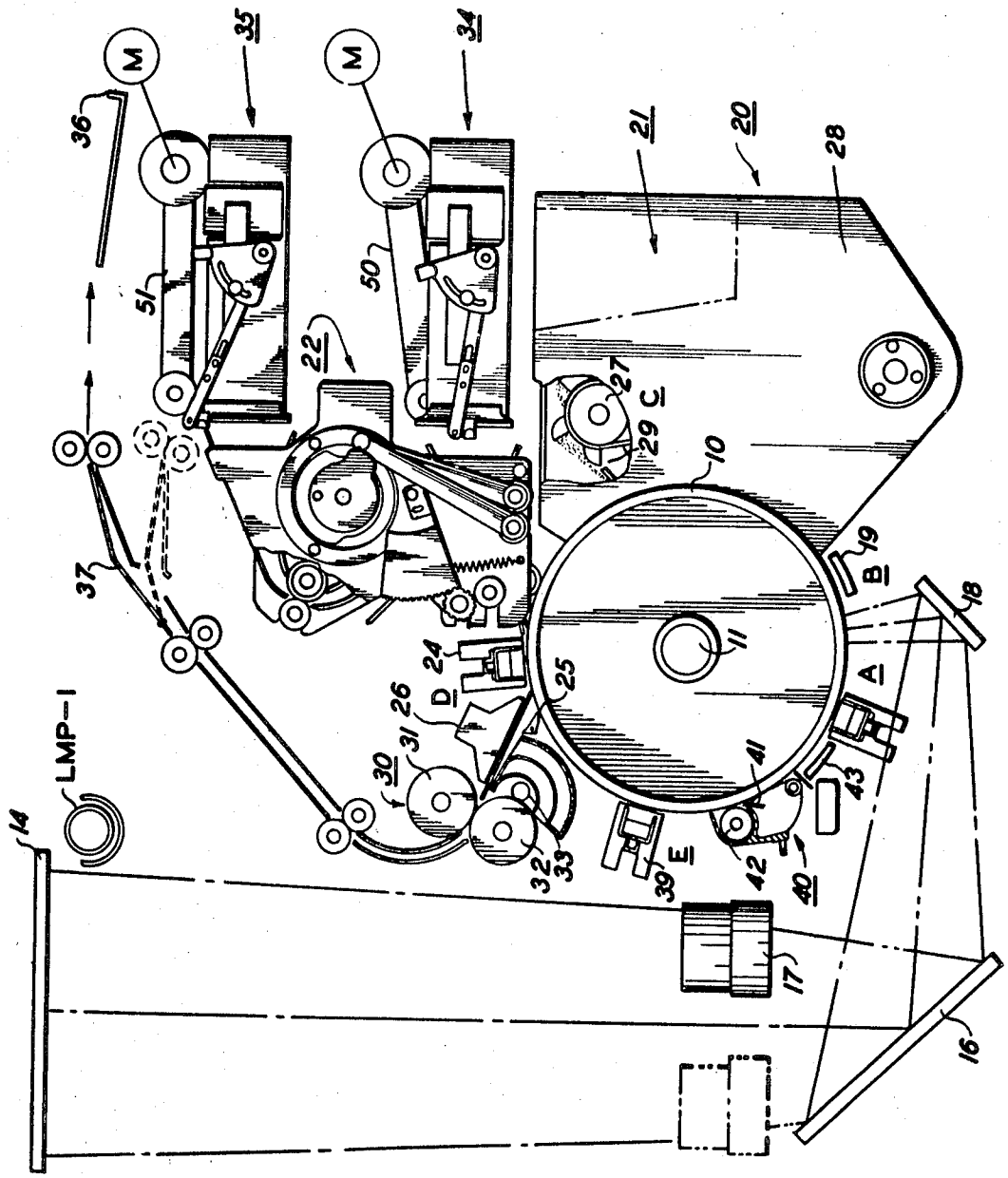


FIG. 1

INVENTOR.
WILLIAM E. KRAMER

BY

ATTORNEY

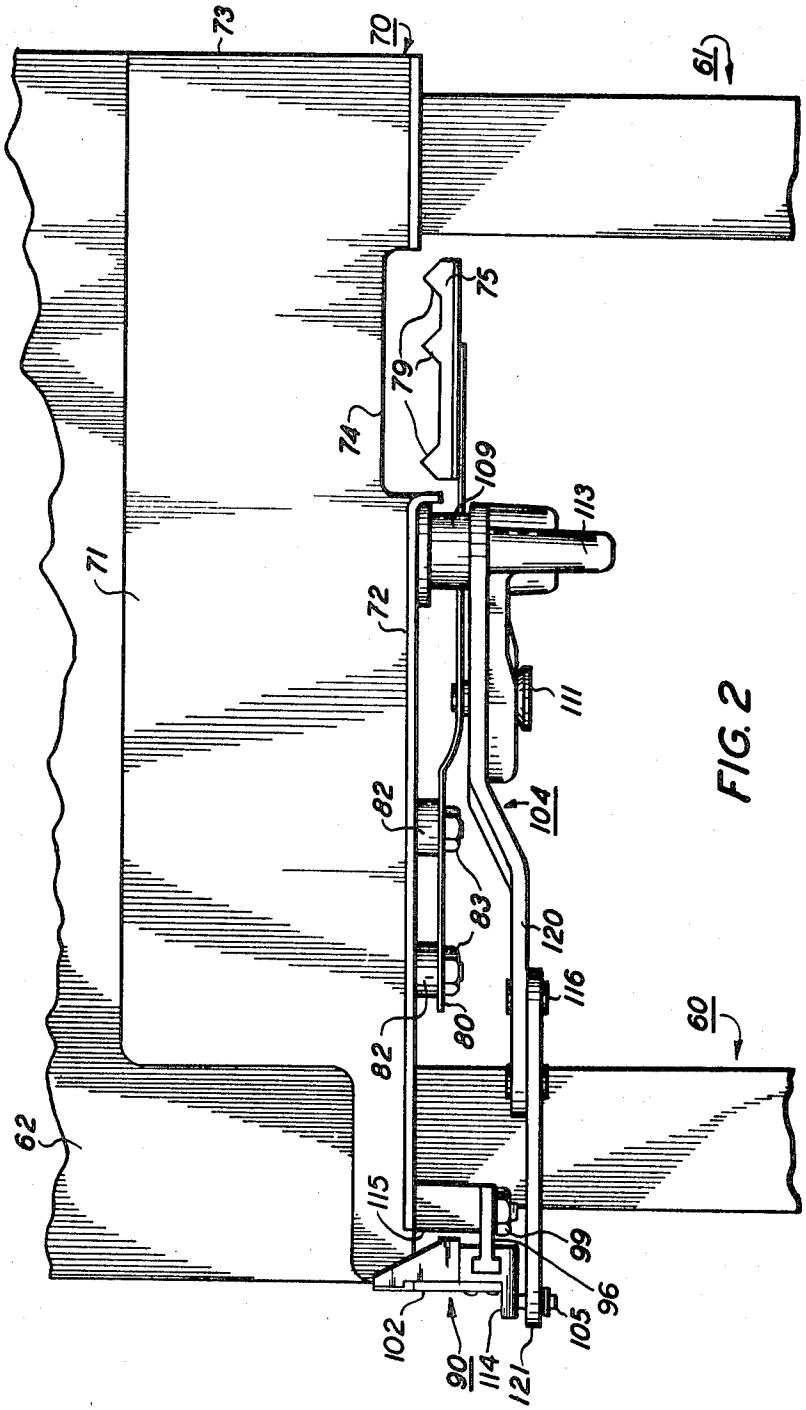

73
70
61
75
79
74
109
113
71
72
111
82
104
83
120
116
80
60
82
62
115
99
96
102
105
90
114
121

FIG. 2

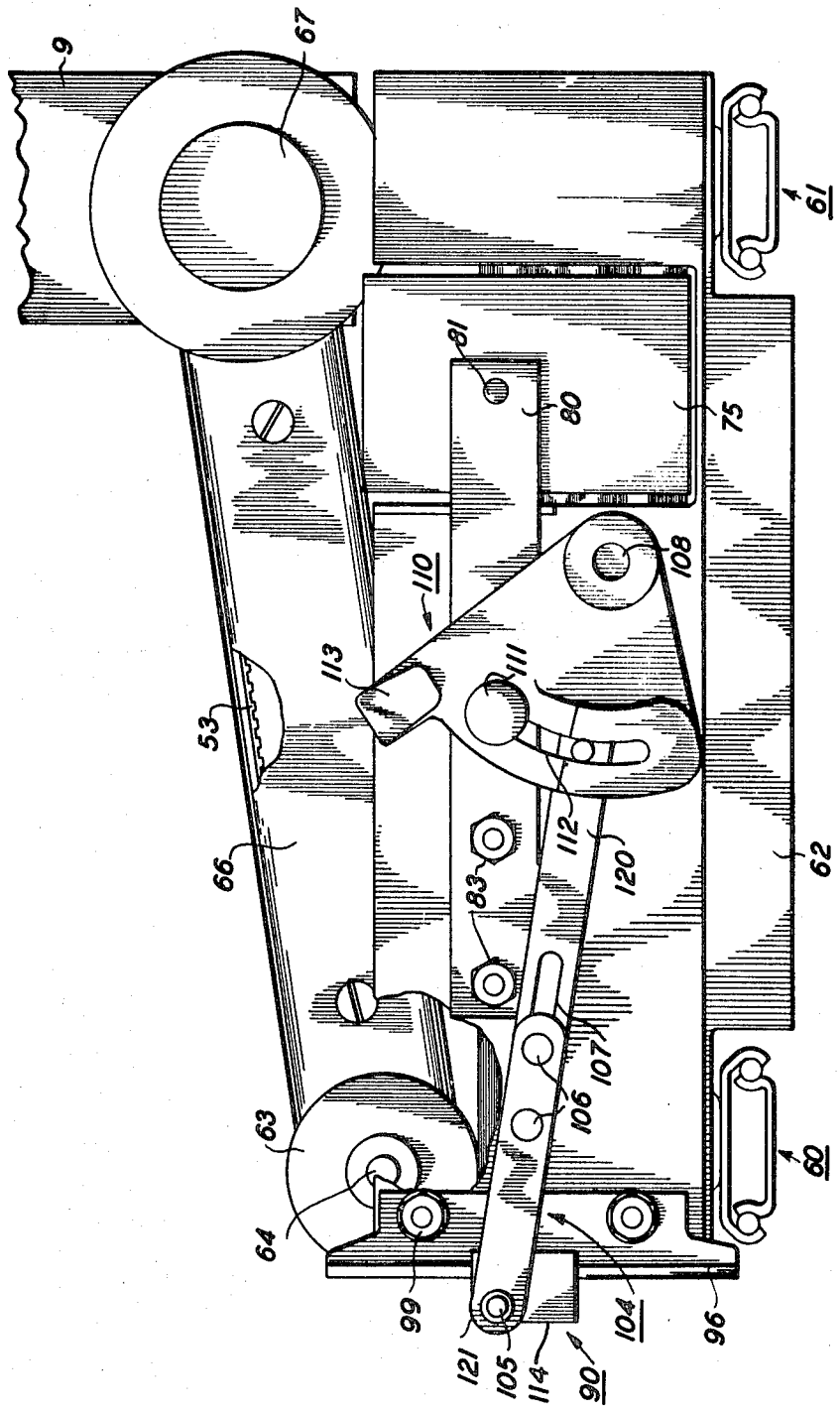

9
67
61
91
80
75
110
108
113
111
53
66
112
120
62
83
107
106
63
60
64
99
104
96
121
105
114
90

FIG. 3

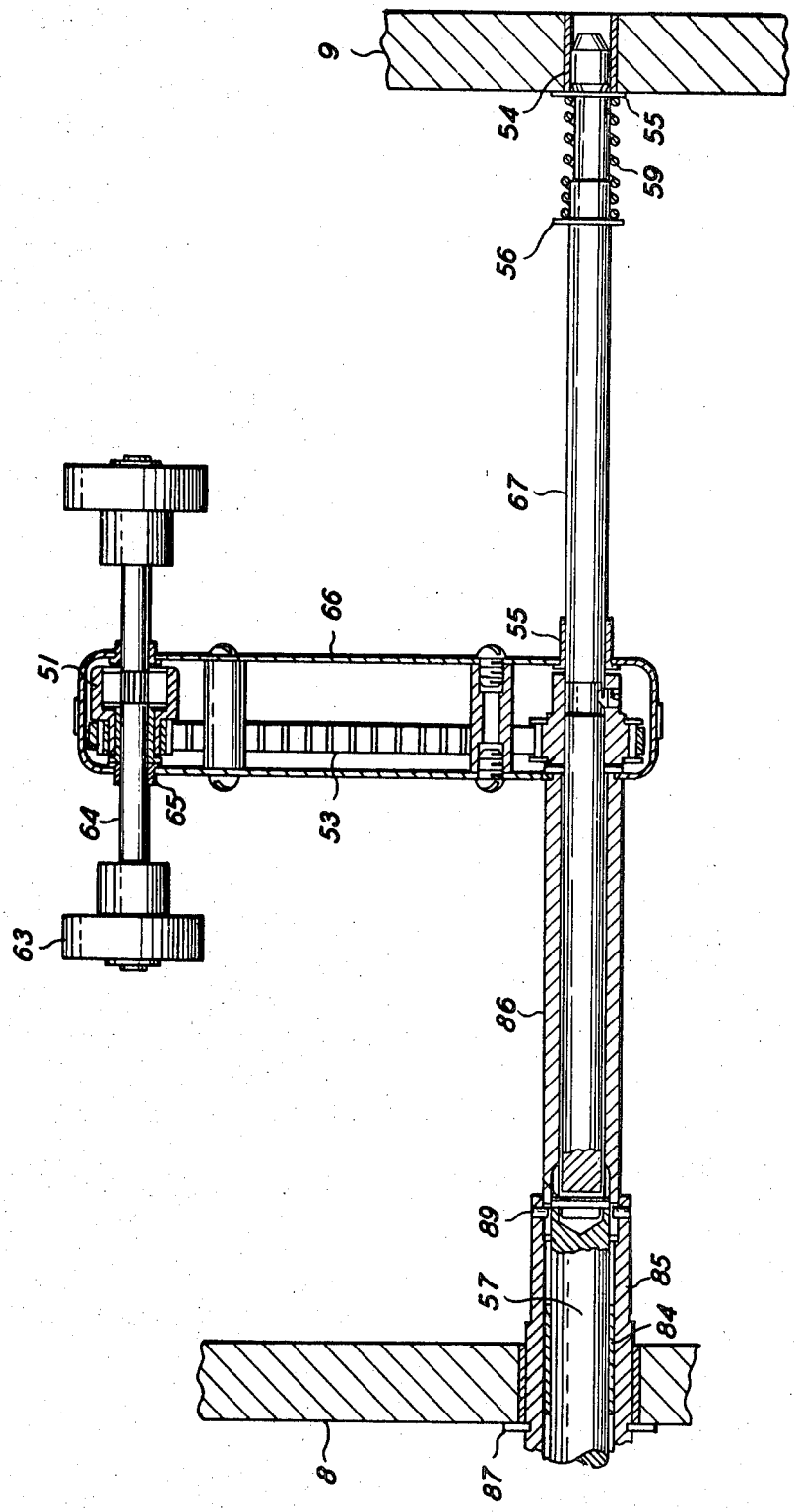


FIG. 4

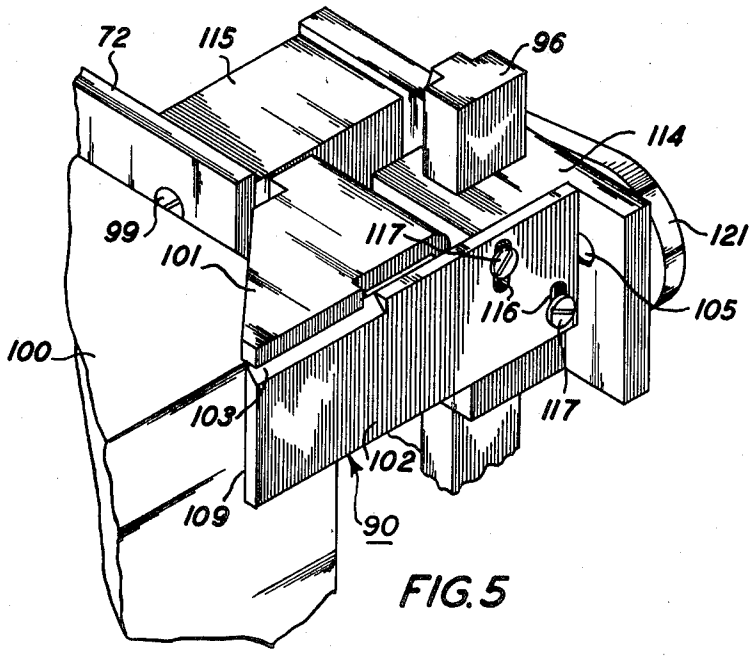

72
115
96
114
99
101
117
121
116
105
100
103
117
102
109
90

FIG. 5

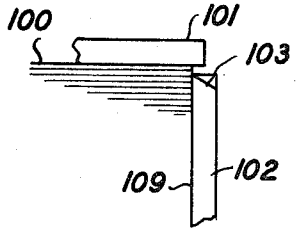

100
101
103
109
102

FIG. 6

SHEET FEEDING APPARATUS

This invention relates in general to a sheet feeding mechanism, and, in particular, to a device for causing a single sheet to be separated and advanced from a stack.

More specifically, this invention relates to a sheet separator or stripper for separating and forwarding individual sheets of various thickness and stiffness for use in a sheet feeding device of the type in which sheets of a stack or pile of sheets are fed from the top seriatim. It is well known that the separation and feeding of sheets seriatim from a stack or pile of sheets presents many problems due to difference in weight, stiffness and/or surface characteristics of the paper to be conveyed by the sheet feeding mechanism. Furthermore, for a given type of sheet the characteristics of the sheet are effected by variations in humidity and electrostatic conditions in the areas in which the sheets are to be stored and used.

It is therefore, the primary object of this invention to improve sheet separators for use in sheet feeding mechanisms whereby the topmost sheet in a stack is separated from the remaining sheets of a stack.

A further object of this invention is to improve sheet separators capable of separating individual sheets from a stack independently of the surface characteristics of said sheets.

A further object of this invention is to separate individual sheets from the top of a stack regardless of the stiffness of said sheets.

A still further object of this invention is to improve sheet separators adapted to separate individual sheets from a stack whereby sheets of varying thickness will be satisfactorily separated and forwarded under a wide variety of conditions.

It is yet another object of this invention to improve apparatus for forwarding individual sheets from a stack in which sheets of various thickness and stiffness are forwarded without adjustment of said sheet separator.

These and other objects of the present invention are attained by means of a snubber plate slidably mounted in a support member, said snubber plate being adapted to overlay in contact the front corner of the topmost sheet in a stack, a knife edge retaining bar affixed to said support member and positioned in relation to said snubber plate to permit passage of a sheet of material from said stack between said snubber plate and said bar, and means to bias said snubber plate in contact with the topmost sheet with sufficient force to cause a sheet of a predetermined beam strength to be buckled or snapped from beneath the snubber as the sheet is forwarded from the top of said stack and to cause a sheet of greater beam strength to be separated between said snubber and said knife edge retaining bar.

For a better understanding of the invention as well as other objects and 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 illustrates schematically an automatic xerographic reproducing apparatus having a sheet feeding mechanism using a preferred embodiment of the sheet separator or stripper of the instant invention;

FIG. 2 is a partial top view of the paper tray including the sheet separator constructed in accordance with the instant invention;

FIG. 3 is a side elevation of the paper tray, sheet stripper and associated elements of the paper feed system;

FIG. 4 is a sectional view of the sheet separator rolls and the associated elements;

FIG. 5 is an enlarged perspective view of the right-hand sheet separator shown in the preferred embodiment of the instant invention;

FIG. 6 is a sectional view of the sheet separator taken along lines 6—6 in FIG. 2.

As shown, the xerographic apparatus comprises a xerographic plate including a photoconductive layer of light receiving surface on a conductive backing and formed in a shape of a drum, generally designated by the numeral **10**, which is journaled in the frame of the machine. The xerographic plate is rotated in the direction indicated by the arrow (FIG. 1) to cause the drum surface to pass sequentially a plurality of xerographic processing stations.

For the purpose of the present disclosure the several xerographic processing stations in the path of movement of the drum surface may be described functionally as follows:

a charging station A in which a uniform electrostatic charge is deposited on the photoconductive layer of the xerographic drum;

an exposure station B at which a light or radiation pattern of an original document to be reproduced is projected onto the drum surface to dissipate the charge on the drum in the exposed areas thereof to form what is herein referred to as a latent electrostatic image of the original document to be reproduced;

a developing station C in which a xerographic developing material having toner particles possessing an electrostatic charge opposite to the charge found on the latent image are cascaded over the upwardly moving drum surface whereby the toner particles adhere to the electrostatic latent image to form a xerographic powder image in the configuration of the original document to be reproduced;

a transfer station D wherein the xerographic powder image is electrostatically transferred from the drum surface to a transfer material or final support surface; and,

a drum cleaning station E wherein the drum surface is first charged and then wiped with a doctor blade to remove the residual toner particles remaining thereon after image transfer, and at which the drum surface is exposed to an illuminescent panel to effect substantially complete discharge of any residual electrostatic charge remaining thereon.

It is believed that the foregoing description is sufficient for the purposes of this application to show the general operation of a xerographic reproducing apparatus using a sheet registration device constructed in accordance with this invention.

The sheet feeding mechanism is positioned adjacent to the transfer station of the xerographic apparatus and is adapted for seriatim feeding of cut sheets of final support material, such as paper or the like, into contact with the drum surface so that the developed image thereon can be transferred to the final support material. The sheet feeding mechanism consists of two paper feed trays **34** and **35** for holding a supply of cut sheets of final support material, separation rollers **63** for separating a single sheet of support material from the individual trays and forwarding said sheet to a sheet registering device **22**, and drive means **50** for driving the separation rolls. Sheets of material fed into sheet registering device **22** are directed into a movable gate adapted to register and align the sheets and to forward them to xerographic transfer station D in timed relation with the xerographic image on the drum. The sheet of support material is advanced into the transfer station adjacent to the corona transfer device whereat the powder image previously formed on the drum surface is transferred from the drum to the support material. The sheet is then forwarded to a pressure heat fuser for image fixing. The fused copy, leaving the fuser is advanced by means of a set of delivery rolls which are arranged to either forward the individual sheets to collection trays **36** or into upper paper feed tray **35**.

In many business situations it is desirous to reproduce extra copies of an original business instrument for bookkeeping purposes or the like. The weight of the material used generally varies between orders. For example, first order might be reproduced on 20 lb. bond paper while a higher order produced on more substantial stock. To achieve such multiple order reproductions in the present apparatus, copy sheets of a first order are placed on one of the two feed trays while copy sheets of the second order are placed in the remaining feed tray. The operator selects the number of sheets of the first to be reproduced and the required amount of sheets are fed from the appropriate tray. Upon completion of the first order run, the number of copies of the second or higher order are

selected and these sheets fed from the second feed tray. As can be seen, it is highly desirous, if not necessary for this type apparatus to be able to automatically feed sheets having varying characteristics and different beam strengths from the individual feed trays without having to adjust or replace the sheet separating apparatus associated therewith.

Basically, the individual sheet feed trays **34** and **35** (FIG. **1**) are of identical construction and include a platform or support member **62** upon which is slidably mounted right-hand and left-hand guide members. Because the guide members are formed complementary to each other, it is believed necessary to describe only one of the guides in detail for the purpose of this disclosure.

As shown in FIGS. **2** and **3**, left-hand guide, generally designated **70**, comprises a horizontal flange portion **71** and upright margin guides **72** and **73** and the vertical sheet guide arranged perpendicular to horizontal flange **71**. Aperture **74** is machined in the guide member **70** and provides an opening through which friction drag pad **75** can communicate with a stack being supported in the paper feed tray. Friction drag pads **75**, having a plurality of bearing points **79** thereon, are affixed to leaf spring **80** by means of rivets **81** (FIG. **3**). The leaf spring is mounted on two embossed pads **82** on vertical sheet guide **72** and affixed thereto by means of studs **83** provided. As shown in FIG. **3**, the drag pads are biased by the spring inwardly towards the center of the feed trays so that the bearing surfaces on the drag pad extend beyond the vertical side flanges when the spring is in the nonworking or unflexed condition.

The right and left hand guide members are adjustably mounted on the platform by conventional means in order to accommodate stacks of various size materials therebetween. In operation, a stack of sheets to be fed to the xerographic apparatus are positioned with the trailing edge of said sheet in contact with the vertical trailing edge guides **73**. The left- and right-hand guide members **70** are moved and adjusted inwardly until the vertical sheet guides **72** contact the side margins of the stack thus positioning drag pads **75** in friction contact with said stack.

In order to feed sheets of final support material one at a time from either of the paper trays, into the sheet registering device **22**, each feed tray is provided with a paper feeding means comprising intermittently driven rollers **63** fixedly mounted upon shaft **64** journaled in bearings **65** mounted in arm **66**. The arm is adapted to swing about the axis of shaft **67** to place the rollers in contact with the top of the stack. The means for driving rollers **63** comprise a pulley secured to a conventional slip clutch **51**, and a pulley. The pulleys are mounted on shafts **64** and **67**, respectively, and operatively connected together by means of timing belt **53**. The slip clutch **51** permits the rollers to be rotated either by the timing belt **53** or by frictional contact with the sheet of transfer material as it is pulled forward by feed rollers positioned in the sheet registering device **22**.

Shaft **67** is journaled by means of a bearing **54** in back plate **9** of the machine frame and by a bearing **55** in arm **66**. The shaft is normally biased to the left, as seen in FIG. **4**, by means of spring **59** interposed between snap ring **56** fixed to the shaft and shaft encircling washer butting against plate **9**. As shaft **67** is forced to the left, the notched end of said shaft is forced into the aperture in the end of shaft **57** to engage the drive pin secured therein. Shaft **57** is journaled for rotation in bearing **84** mounted in sleeve **85** and the sleeve, in turn mounted in machine frame **8**. A washer **87** rides in sleeve **85** against the machine frame to prevent outward axial movement of the shaft. Driving power to the rollers is provided by drive means M (FIG. **1**) acting through shaft **57**.

To adjust the pressure of rollers **63** on the stack material being supported in the feed trays, arm **66** is fixed to one end of a hollow arm shaft **86** and the opposite end of the arm shaft being notched to engage locating pin **89** secured to the counter bore end of sleeve **85** journaled in machine frame **8**. The roller pressure on the stack of paper in the paper tray due to the forces of gravity is sufficient to maintain the sheet of paper and rollers in friction driving contact when the two are in operative relation with each other.

In feeding sheets from the individual stacks, the topmost sheet in the stack is advanced forward, that is away from the vertical trailing edge guide **73** (FIG. **2**), by rotating feed rollers. The feed rollers act upon the topmost sheet to slide said sheet forward over the second most sheet in the stack. The movement of the topmost sheet therefore tends to advance the second sheet, the amount of movement depending on the surface characteristics of the sheets. In order to insure separation of only the topmost sheet from the stack, there is provided at opposite corners of the stack sheet separators, generally designated **90**, which are adapted to apply a restraining force to the topmost sheet as well as the leading edge of the uppermost sheets in the stack. The separators **90**, like the edge guides, are formed complementary to each other and it is believed necessary to describe in detail only one of these units for purposes of this disclosure.

Sheet separator **90** is pivotally mounted about adjustable linkage **104** and arranged to move vertically along vertical guide member **96**. As shown in FIG. **2**, slidable support member **114** has a female T-slot machined therein which is adapted to mate with T-shaped guide member **96**. Guide member **96** is supported in mounting post **115** by means of studs **99** passing through the vertical edge guide **72** to secure and properly positioned guide **96** so that slidable member **92** moves substantially parallel to the side margin of stack **100**.

Referring now to FIG. **5**, a snubber plate **101** is shown securely affixed to slidable support member **114** so that the plate overlies the uppermost sheet in the stack and the snubber is arranged so that the bottom surface of the plate is substantially coplanar with the top surface of the topmost sheet in the stack.

A retaining bar **102** is also adjustably mounted on slidable member **114**. The retainer is fastened to the member by means of screws **117** passing through slotted holes **116**. The retainer is supported so that its working face **109** contacts at least a portion of the leading edge of the upper part of stack **100**. The upper edge **103** of the retainer forms an acute angle with the working surface of the retaining bar and extends laterally across the front of the stack from the outboard end of the retainer beyond the side margin of the stack. This knife edge surface is substantially parallel with the bottom surface of the snubber plate and cooperates with the extended portion of the snubber to provide a guideway through which the topmost sheet on the stack may pass. The knife edge surface acts upon the bottom surface of a sheet fed through the guideway. Because only a point contact is had between the sheet and the knife edge surface, little or no binding is produced when a sheet is passed therethrough.

Referring now to FIG. **3**, sheet separator **90** is pivotally mounted in adjustable linkage **104** by means of pivot pin **105**. Linkage **104** is formed with two coacting arms **120** and **121**. Arm **121** has two rivets **106** affixed thereto which ride in slotted hole **107** provided in the second arm, arm **121**. The opposite end of the adjustable linkage is pivotally mounted about pin **106** and the pin stacked to vertical guide **72**. Spacial relationship between the linkage and the vertical guide is maintained by spacer **109**. A counterweight **110** is also pivotally mounted on pin **108**. The counterweight is operatively connected to linkage **104** by means of a thumb screw **111** riding in arcuate slotted hole **112**. An embossed or weighted section **113** on the counterweight is offset some distance from pivot point **108**. The weighted section, acting through its moment arm, creates a moment about pin **108** which tends to rotate the counterweight in a counterclockwise direction (FIG. **3**). When thumb screw **111** is tightened, the counterweight and movable linkage assembly **104** are locked together and cooperated to urge or bias the snubber plate into contact with the topmost sheet on stack **100**. The amount of pressure exerted by the snubber upon the topmost sheet can be adjusted by repositioning the offset counterweight **110**. That is, by

loosening thumb screw **111** and moving the weighted portion **113** about pin **108**, the moment arm can be increased or decreased to change the amount of pressure exerted by the snubber plate.

In operation, the feed rolls forward the topmost sheet on the stack towards the sheet registering device **22** (FIG. **1**). However, when the topmost sheet is of light bond paper, such as letter paper, the forward motion of the sheet is restrained by the biased snubbers acting on the forward corners of the sheet. The sheet, having low beam strength, is caused to be buckled or snapped from under the snubber plate as it is forced forward by forwarding rolls **63**. The rear edge of the snubber is machined at an acute angle with the front edge of the snubber to form a wedge tapering rearwardly towards the side margin of the stack causing the snubbed sheets to buckle inwardly. As the sheet clears the snubber, the entire separator assembly **90** is moved by the counterweight arrangement down into operative engagement with the next subsequent sheet on the stack.

It has been found, however, that when the corners of a heavier sheet, such as card stock or the like, are forced to be buckled under a conventional snubber the corners of heavy sheets are damaged or torn away. However, because of strong beam strength, a heavy sheet of material can be individually separated and forwarded from the top of a stack by means of a feed roll acting in cooperation with friction drag pads. The stiff sheets are separated much in the same manner as cards are dealt from a deck. That is, the drag pads act much like the fingers of the supporting hand on the side of the stack; the feed roll acting in the same manner as the thumb of the dealing hand separates the top card by sliding it forward over the stack.

In the present invention the biasing pressure that the snubber places on the topmost sheet is set so that the beam strength of the individual sheets forwarded therethrough automatically control whether or not the sheet will be buckled or passed directly through the separator. It has been found that sheets possessing marginal beam strength fed from the stack will sometimes be snapped from under the snubber while at other times may pass thereunder. However, because of the properties of the sheet itself determines whether or not it will be buckled or passed directly under the snubber, no damaging effect can result. In fact, in some cases, one corner of the sheet will be buckled by the snubber while the other corner of the same sheet will pass directly through the separator mechanism.

While this invention has been described herein the reference to the xerographic machine and a specific sheet feeding mechanism, it is not confined to the details set forth, since it is apparent that the sheet separator of the invention could be used in any other type of reproducing machine and in connection with other forms of sheet feeding mechanisms. Therefore, this application is intended to cover such modifications or changes as may come with the purposes of the improvements of the scope of the following claims.

What I claim is:

1. In the sheet feeding device of the type wherein the topmost sheet in the stack is forwarded along a predetermined path of travel, sheet separating apparatus including

vertical guide members positioned adjacent the forward side margins of the stack,

movable support members slidably mounted in each said guide member and being adapted to move in a vertical direction,

a snubber plate securely affixed to each said support member and being arranged to overlay the front corners of the topmost sheet in the stack so that a portion of each said plate extends beyond the leading edge of the stack,

a retaining bar affixed to each said movable support member and being adapted to contact at least a portion of the leading edge of the stack, each said retaining bar being positioned in relation with the extended portion of said snubber plate to permit sheets in the stack to pass therebetween,

biasing means associated with said snubber plates to hold said plates in contact with the corners of the topmost sheet in the stack with sufficient force to buckle sheets of a predetermined beam strength forwarded thereunder and to permit sheets of greater beam strength to pass between said retaining bar and said snubber plate.

2. The apparatus of claim **1** wherein the top edge of said retaining bar forms an acute angle with the surface of said bar in contact with the leading edge of said stack.

3. The apparatus of claim **2** wherein the edge of each said snubber plate positioned furthest from the associated side margin of the stack is tapered rearwardly at an acute angle relative to the leading edge of said stack to cause sheets separated thereby to be buckled inwardly towards the center of the stack.

4. The apparatus of claim **3** wherein each said retaining bar is adjustable in a vertical direction.