United States Patent [19]

McInerny

[11] **3,771,783**

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[54] **MECHANISM FOR FEEDING, SEPARATING AND STACKING SHEETS**

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[73] Assignee: **Pennsylvania Research Associates, Inc.**, Philadelphia, Pa.

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[52] **U.S. Cl.** **271/125**

[51] **Int. Cl.** **B65h 1/06**

[58] **Field of Search** 271/10, 37, 41

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Attorney—Ostrolenk, Faber, Gerb & Soffen

[57] **ABSTRACT**

A sheet hopper had multi-angled bottom portions and an angled front side. A segmented wheel protrudes into the bottom portion to separate the lowermost sheet and feeds the sheet to gripper rollers outside the hopper. The hopper angles are such so as to relieve the bottom portion of the full weight or pressure from the stock.

43 Claims, 19 Drawing Figures

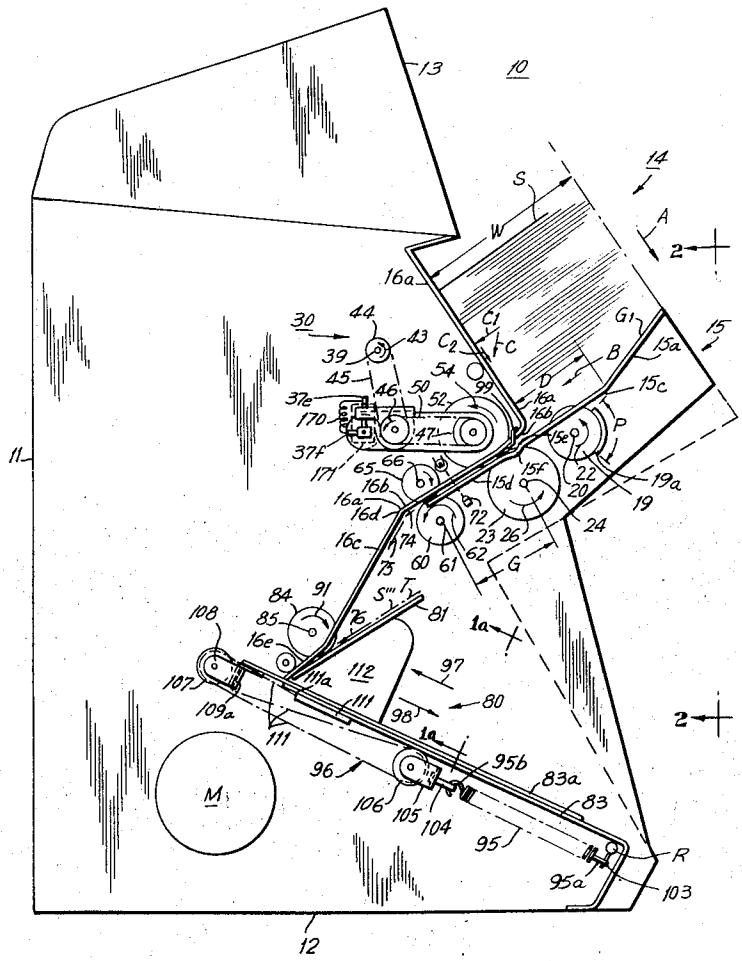
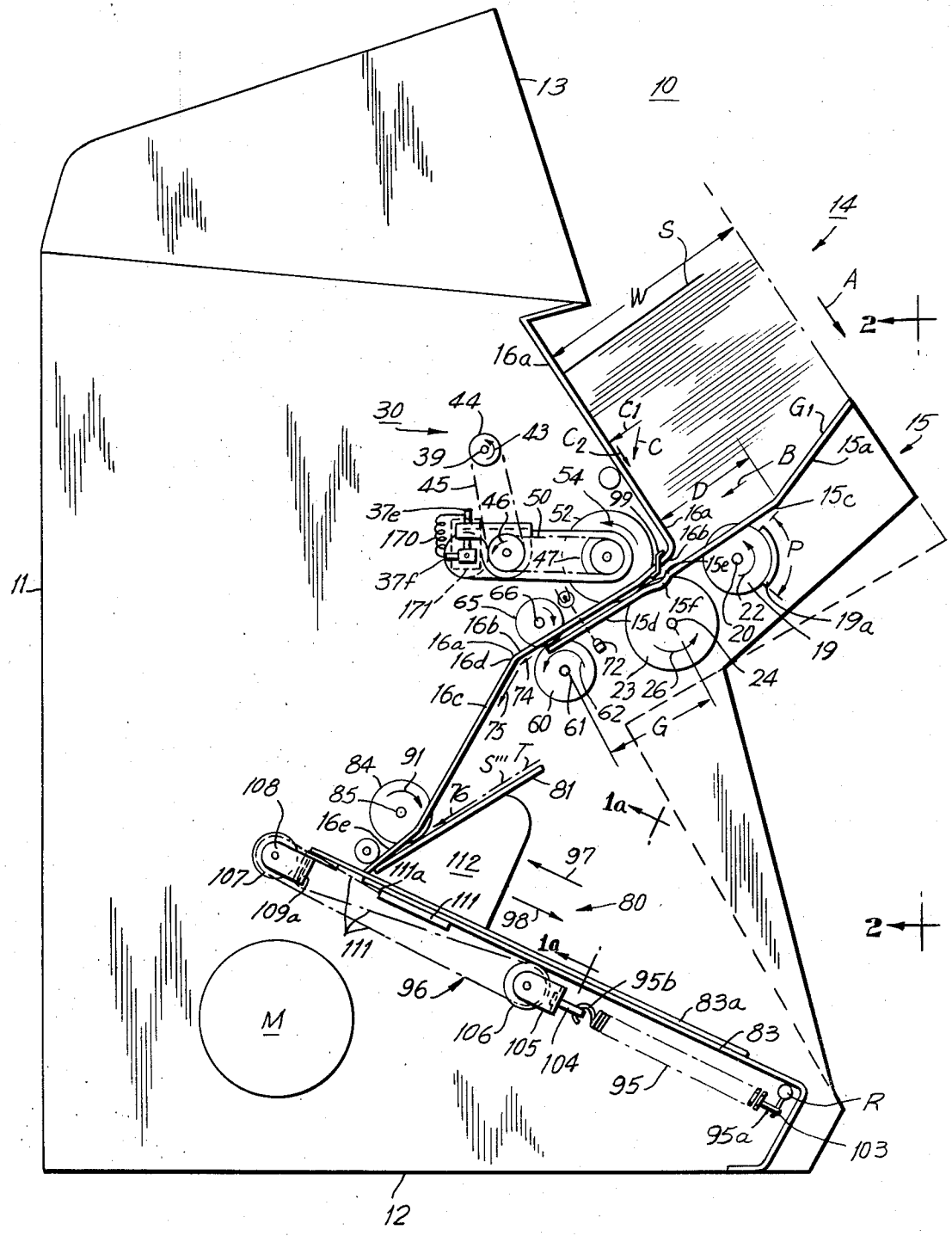


FIG. 1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109a
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83
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R
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103
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FIG. 1a

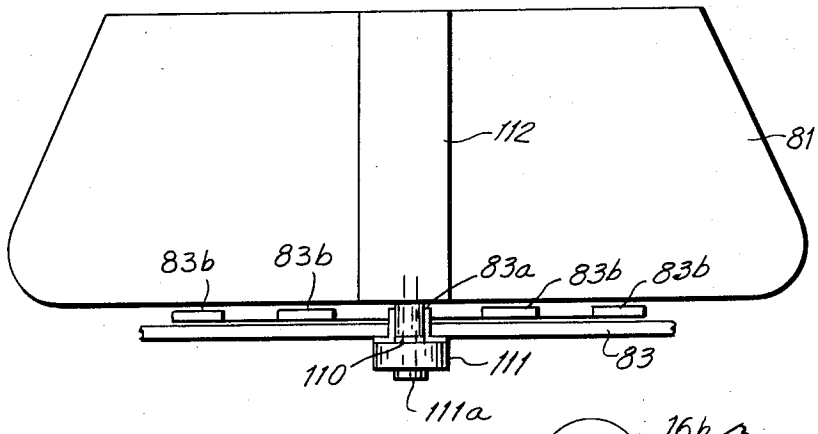


FIG. 1b

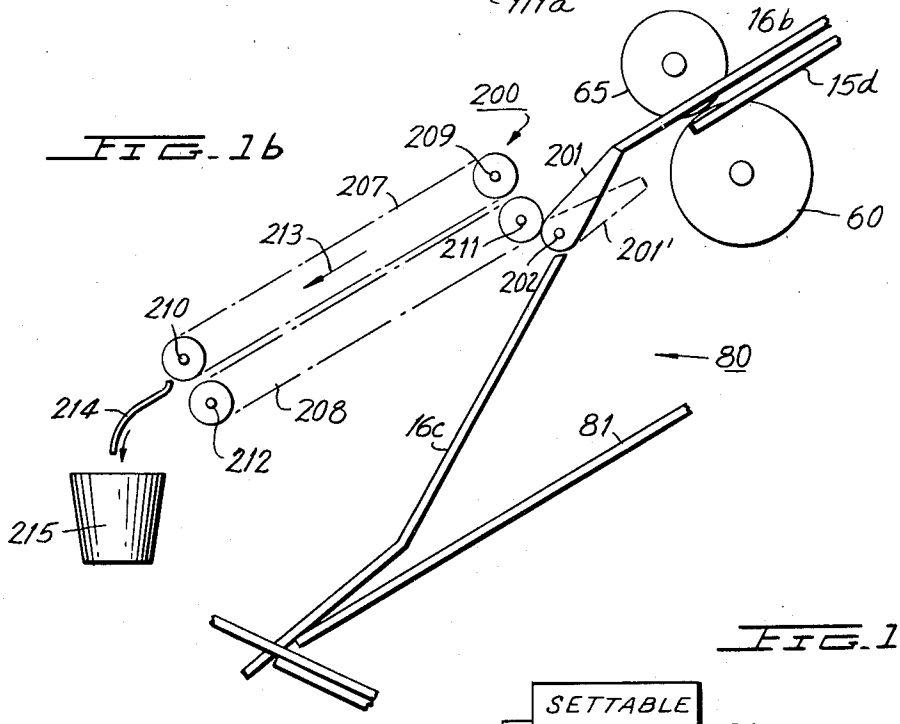


FIG. 1c

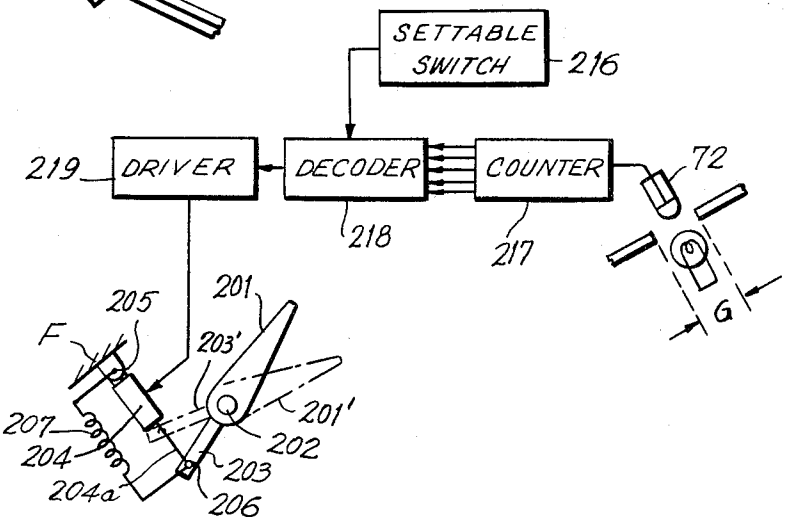


FIG. 2

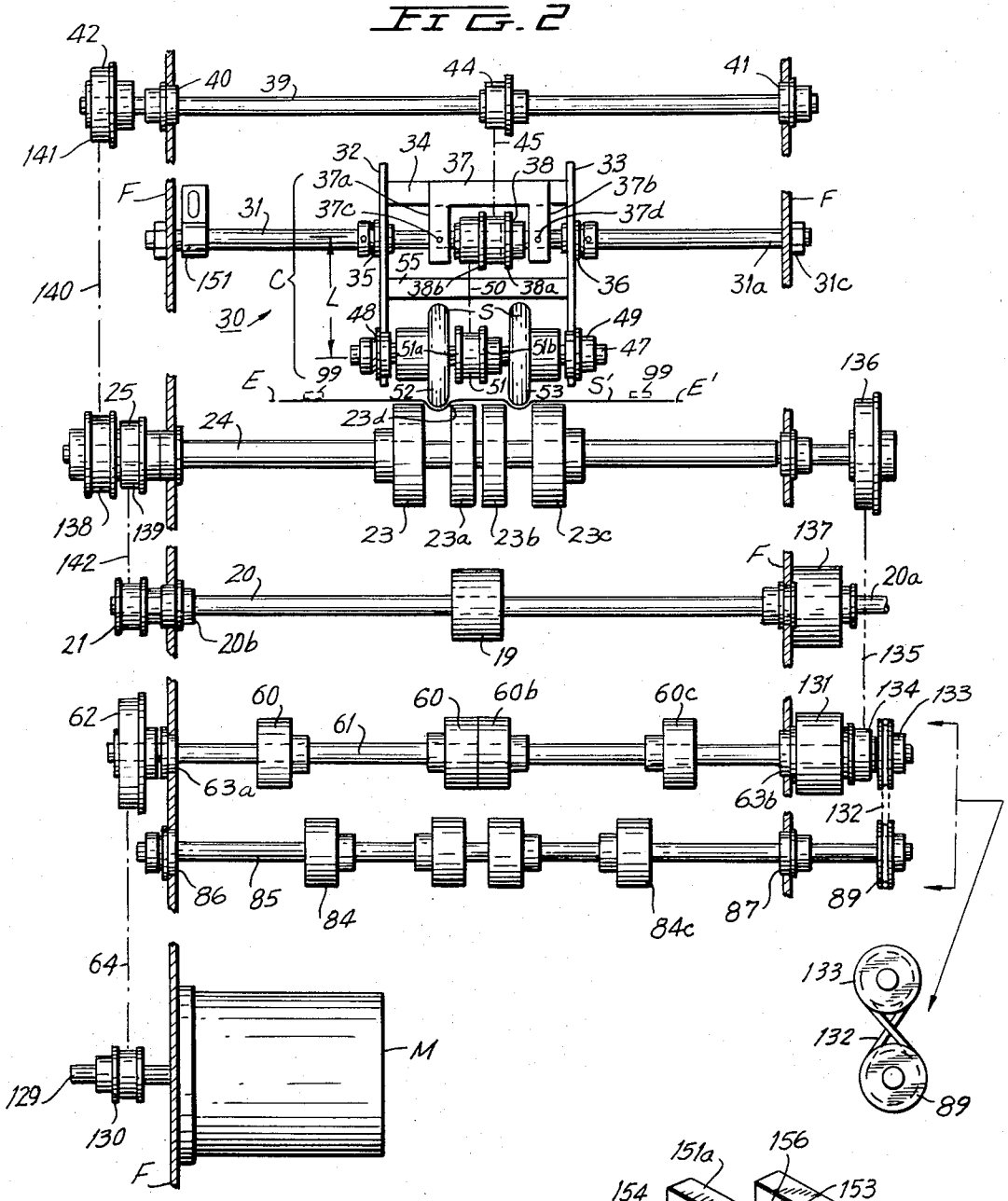


FIG. 2a

FIG. 2b

FIG. 3

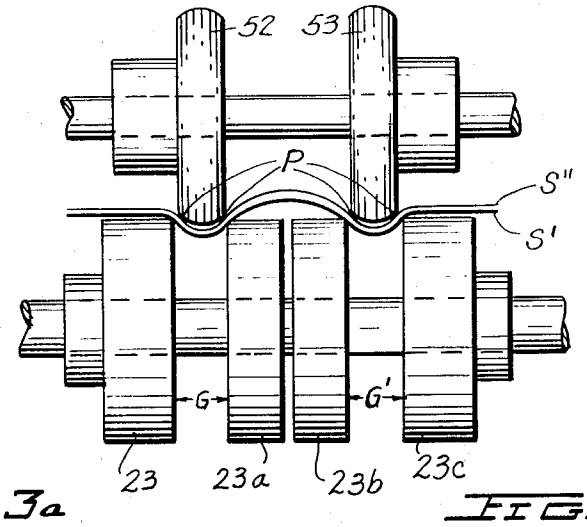


FIG 3a

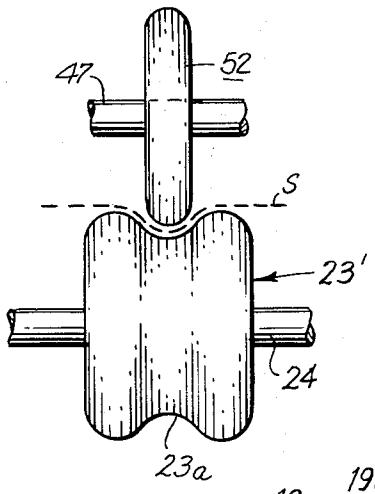
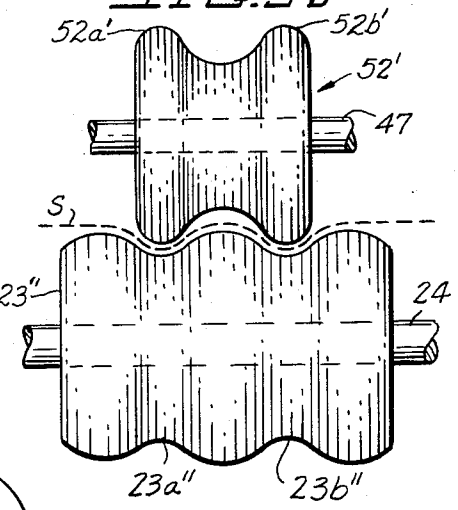


FIG. 3b



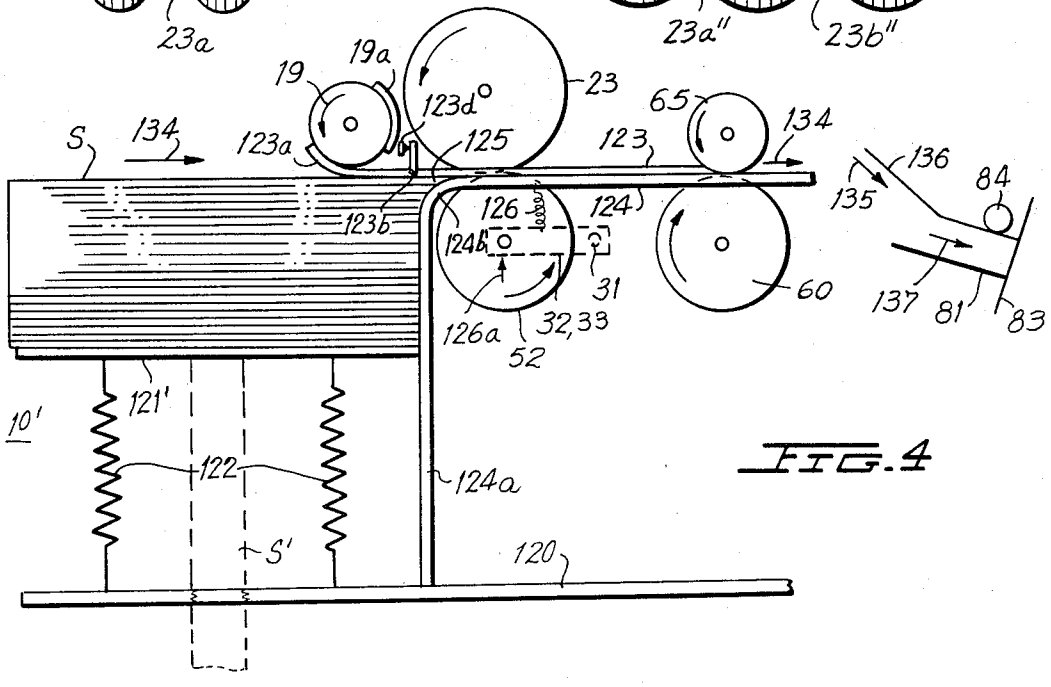


FIG. 4

FIG. 5a

FIG. 5b

FIG. 5c

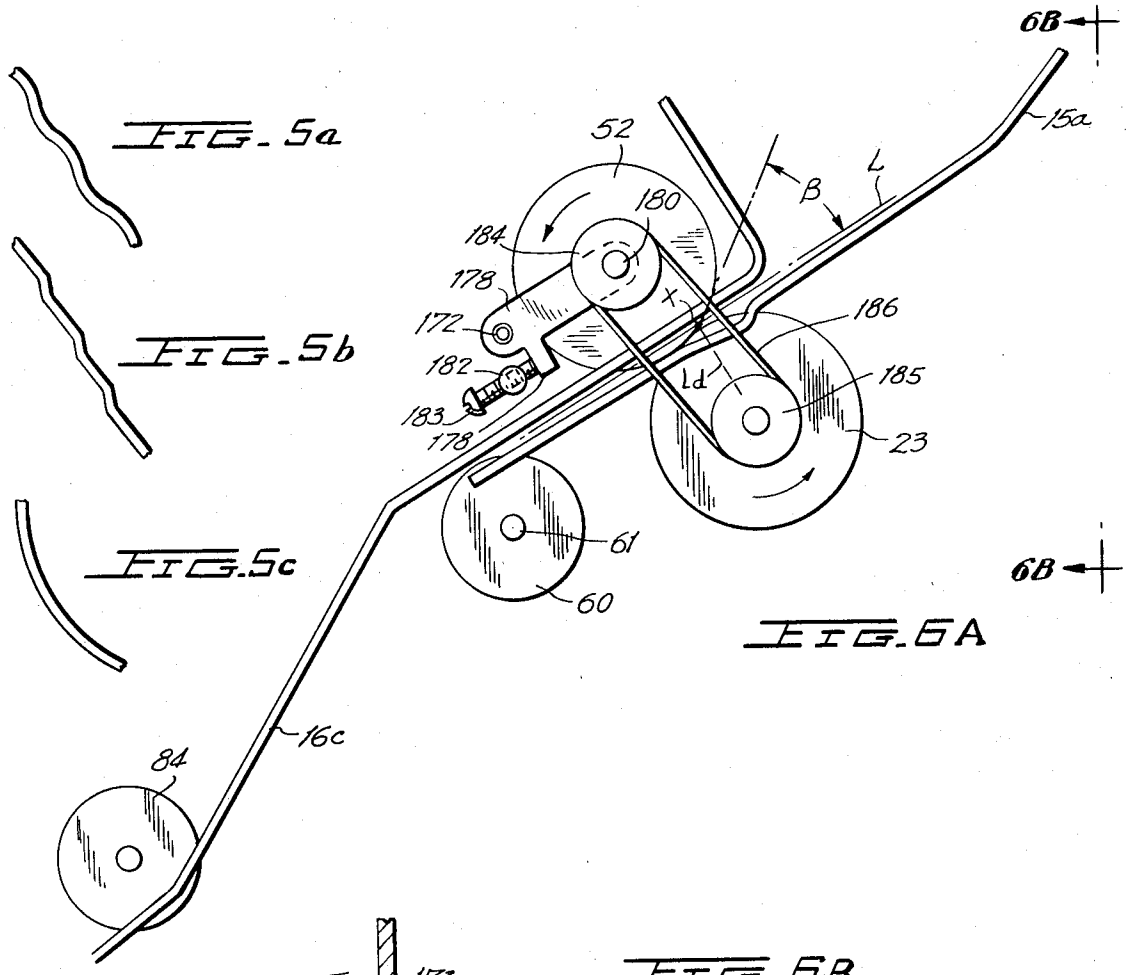


FIG. 6A

FIG. 6B

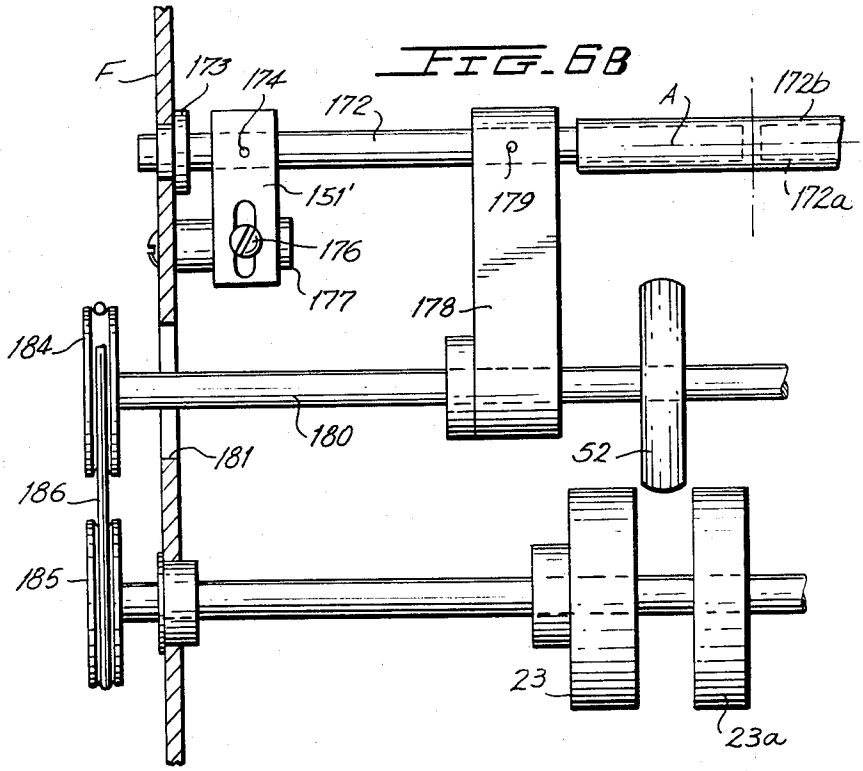


FIG. 7a

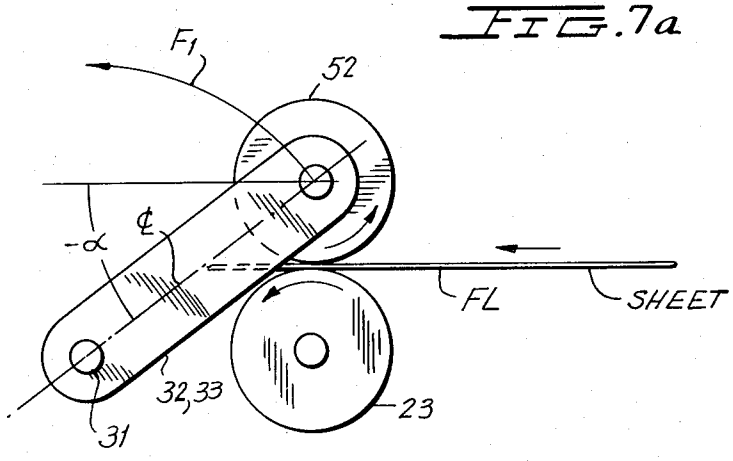


FIG. 7b

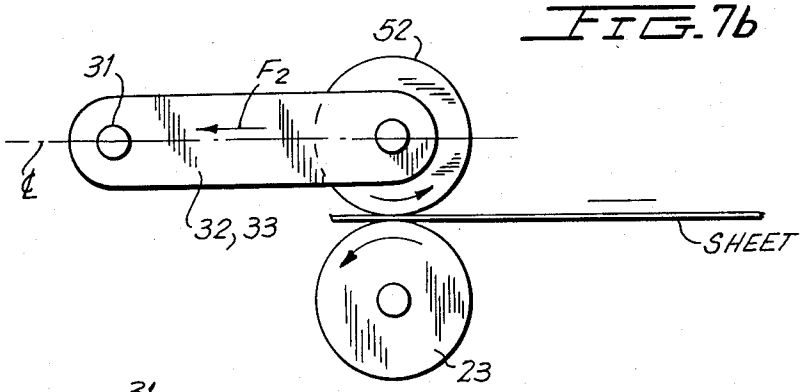
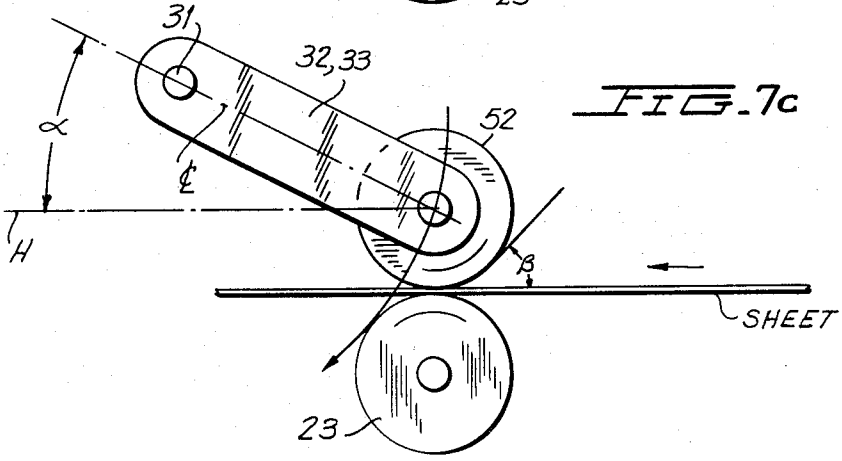


FIG. 7c



MECHANISM FOR FEEDING, SEPARATING AND STACKING SHEETS

BACKGROUND OF THE INVENTION

There are a wide variety of applications in which document feeders and/or separators are either required or are advantageous for use. For example, in banks or other like institutions, it is very advantageous to provide apparatus for accurately counting large stacks of bills (i.e., paper currency). One of the problems encountered in counting stacks of bills at relatively high rates of speed resides in the fact that some or many of the bills being counted may be either slightly or severely mutilated or creased from folding, hence they require special care and handling or, alternatively, such damaged or mutilated bills must first be removed from the stack of like bills due to the fact that present day feeding and separating devices are incapable of counting such bills. In addition thereto, bills which may be perfectly intact but may be either severely folded or creased require special handling procedures wherein the bills must be carefully and firmly pressed or smoothed down before being capable of being handled by present day feeding and counting devices.

Banks and other similar institutions also handle tremendous volumes of checks which are of varying sizes, thicknesses, finishes and the like. As a result, stacks of checks of the same dimensions and thicknesses must be formed before such checks can be counted, thereby greatly increasing the amount of handling operations necessary in the processing of such documents.

Another typical application in which such feeding, separating, counting and stacking devices are employed is in the field of coupons. Coupons may take a variety of forms such as those which are printed in newspapers and/or periodicals and which are normally cut out from such newspapers and periodicals prior to use. Coupons may also be provided as part of the package in which a product is wrapped and hence be of still another form of paper insofar as size, weight and/or thickness of paper and finish are concerned. Companies processing such coupons would find it highly advantageous to be able to process coupons of varying sizes, thicknesses and finishes while at the same time being capable of counting stacks of such dissimilar coupons accurately and at a high rate of speed. It should be understood that the applications set forth hereinabove are merely exemplary and that a large variety of other applications in which devices capable of separating and counting documents of dissimilar sizes, weights, thicknesses and finishes can be used to great advantage.

BRIEF DESCRIPTION OF THE INVENTION

The present invention is characterized by providing a sheet feeding, separating and stacking device which is simple in design and yet which is capable of feeding and separating sheets of different thicknesses, weight, dimensions and finishes while at the same time being capable of providing a highly accurate count of a stack of such sheets with the feeding, separation and counting occurring at speeds not heretofore obtainable through conventional apparatus. The present invention comprises an infeed hopper for depositing a large stack of sheets which may be of dissimilar size, thickness, weight and finish. The operator need not exercise any special care in forming a stack of such sheets not need

the operator exert any special care as to the manner in which the stack of sheets is deposited in the hopper, thereby greatly facilitating the sheet feeding and separating operation.

The infeed hopper is provided with an inclined support having an opening through which a portion of the periphery of a picker wheel protrudes. The picker wheel is preferably caused to rotate at a constant speed and is provided with an eccentric surface along the portion of its periphery with said eccentric surface having a higher coefficient of friction than the remaining peripheral portion of the picker wheel. The picker wheel performs the dual functions of advancing at least the bottom-most sheet in the stack of sheets toward the stripping and separating apparatus while at the same time, due to its eccentric periphery, causing the entire stack to be jostled or jogged upwardly so as to facilitate separation of sheets within the stack. The infeed hopper is provided with a configuration which causes the bottom-most group of sheets in the stack to be relieved from the weight of or on the remaining sheets within the stack thereby facilitating separation of the bottom-most sheets from one another.

The picker wheel advances the bottom-most group of sheets toward the drive wheel assembly thereby releasing the aforesaid group of sheets from the weight of the stack at the rearward end of the stack due to the shape of the rearward portion of the inclined support. The infeed hopper also includes a second inclined surface which supports the weight of the forward end of the stack to further relieve the weight of the stack from the bottom few sheets. The sheets thus released are then free to slide downwardly along the support surface to come under the influence of the drive and stripper assemblies.

The drive wheels are arranged in spaced parallel fashion along a common shaft and rotated at a substantially constant velocity at least equal to the rotational speed of the picker wheel.

A stripper wheel is mounted at the free end of a floating stripper wheel assembly comprised of a pair of arms whose rearward ends are pivotally mounted within the machine frame and whose free ends support a shaft upon which the stripper wheel is mounted. The stripper wheel slidingly engages the document (or documents) fed to the drive wheel and the stripper wheel mounting automatically adjusts the position of the stripper wheel relative to the sheet being fed to the drive wheel so as to automatically compensate for differences in weight, stiffness, and/or thickness of the sheets being processed.

The stripper wheel is rotated at a constant rate of speed with the rotational velocity being in a range which extends from a value which is less than the rotational velocity of the drive wheel to a value which is greater than the velocity of the drive wheel. The stripper wheel is rotated so that the peripheral portion thereof which engages the sheet (or sheets) being fed to the drive wheels moves in a direction reverse from that of the forward feed direction. The stripper wheel is also mounted so as to be positioned to lie in a gap formed between a pair of spaced drive wheels whereby the periphery of the stripper wheel is positioned at a height below the peripheries of the drive wheels between which the stripper wheel is located. This arrangement causes the sheet (or sheets) fed to the drive wheel assembly to assume a curved undulating configu-

ration which stiffens the sheet or sheets to cause the sheets to undergo lateral movement to thereby greatly facilitate separation of the sheets in cases where two or more sheets are fed into the region between the stripper wheel and the drive wheels. The stiffness imparted to the sheets also enhances the frictional engagement with the drive and stripper wheels.

The coefficient of friction of the peripheries of the drive wheels is substantially greater than that of the coefficient of friction of the periphery of the stripper wheel and preferably the material from which the stripper wheel is formed is less resilient than the material from which the drive wheels are formed (i.e., it has a higher durometer).

The infeed hopper is provided with a surface portion lying immediately adjacent the region of the drive wheels and stripper wheels which forms an abrupt incline so as to enable the leading edge of the bottom sheet to "droop" down and thereby enhance the frictional engagement between the bottom-most sheet fed toward the drive wheels by the picker wheel.

The surface of the infeed hopper supporting the leading edge of the stacked sheets preferably has at least a portion thereof being formed or otherwise machined to exert an increased frictional force upon the leading edges of the stacked sheets to remove the weight of the major portion of the stack from the bottom-most sheets to permit the group of bottom-most sheets to substantially freely slide downwardly toward the drive wheels when advanced by the picker wheel. In the case where a single sheet is fed between a stripper roller and the drive wheel, the relative differences of the coefficients of friction between these wheels will cause the stripper roller to slippingly engage the confronting surface of the bottom-most sheet with the major influence upon the bottom-most sheet being the frictional engagement of the drive wheels. The single sheet will thus be fed toward a plurality of acceleration wheels which cooperate with free wheeling idler wheels to accelerate the sheet being fed toward the acceleration wheels which enters between the acceleration wheels and the idler wheels and is moved at a faster rate of speed as the sheet comes under the influence of the acceleration wheels which are rotated at a substantially constant tangential velocity greater than the tangential velocity of the drive wheels. The spacing between the centers of rotation of the drive wheels and the acceleration wheels is such that the document fed between the acceleration wheels and the cooperating idler rollers will undergo acceleration before the next sheet in the stack makes frictional engagement with the drive wheel. This operation creates a finite gap between the trailing edge of the sheet being fed between the acceleration wheels and the idler rollers and the leading edge of the next sheet passing over the drive wheels.

The acceleration wheels and cooperating idler rollers act to rapidly advance the single sheet fed therebetween toward a stacker which is designed to abruptly move the trailing edge of the last sheet fed thereto out of the path of the leading edge of the next sheet to be fed thereto and before the next sheet enters into the stacker region, thereby forming a substantially neat and compact stack of sheets within the stacker in original sequence.

In the case where more than one sheet enters into the region between the drive and the stripper wheels, the larger coefficient of friction of the drive wheels operates to urge the bottom-most sheet in the forward feed direction toward the acceleration wheels since the frictional grab between sheets is less than the frictional grab between the drive wheels and the bottom-most sheet. The drive wheels and stripper wheel arrangement cause the plural sheets fed therebetween to assume a curved undulating configuration which greatly facilitates "stripping" the upper sheet from the bottom-most sheet due to the separation of the sheets in the region or regions of the undulations which greatly reduces the frictional forces between engaging surfaces of the plural sheets. The upper sheet is then "kicked" back into the infeed hopper.

The jogging action of the picker wheel serves to jar the sheets in the infeed hopper to enhance the stripping operation and to urge the leading edges of the sheets upward against the associated engaging surface of the infeed hopper. The differing coefficients of friction of the stripper and the drive wheels positively assures the fact that the bottom-most sheet (of a bottom feed apparatus), or the top-most sheet (of a top feed apparatus), will be the first sheet fed from the region of influence of the drive wheels and stripper wheel toward the acceleration wheels regardless of the fact that the leading edge of the "next" sheet may be fed to the drive and stripper wheels before the leading edge of the bottom (or top)-most sheet. The "floating" stripper wheel mounting enables the device to accurately feed and strip sheets at a high rate of speed while at the same time accommodating documents of dissimilar thicknesses, weights, dimensions and finishes to provide a feeding and separating mechanism which is highly advantageous for use in the applications set forth hereinabove, as well as a wide variety of other applications.

In an alternative embodiment, the "floating" stripper assembly may be replaced by a fixed stripper wheel assembly in which the distance the stripper wheel may move in a direction away from sheets being fed between the stripper and drive wheels is restrained by resilient spring or drive means for those applications in which the feed and separation apparatus is adapted to handle sheets within a narrow range of sheet thickness (such as just paper currency, for example). Alternatively, the "floating" stripper wheel assembly may be provided with strap means for achieving the same objective.

The apparatus is adapted to perform batching operations, collating operations, and operations in which only selected sheets are fed to the stacker while, all sheets are counted (i.e., "statistical sampling"). Clutch and brake means are provided to separate batches of sheets, each containing a precise preselected number of sheets wherein the clutch means is provided to selectively disengage the stripper, drive and picker wheels from the apparatus drive source while the brake means abruptly halts rotation of the stripper, drive and picker wheels. The primary drive source for the apparatus continues to operate until the last sheet of the batch of preselected count reaches the stacker.

For collating operations, i.e., operations in which it is desired to count all sheets deposited in the infeed hopper and to separate every "Nth" (i.e., every second, third, fourth, etc.) sheet from the remainder of the stack, a gate means is provided to allow selected sheets to bypass the stacker when leaving the acceleration wheel when the gate is in a first position while deflecting the remaining sheets toward the stacker when the

gate is in a second position. The gate is employed for statistical sampling as well as collating operations.

The clutch and brake assemblies may also be employed in conjunction with the gate means to enhance the operation of the gate means by increasing the gap between the "sampled" sheet and the sheets passing through the feed mechanism immediately before and immediately after the "sampled" sheet. The clutch and brake mechanisms act to "slow down" the feed of the "sampled" sheet by the drive wheels after the sheet preceding the "sampled" sheet is sensed and to "slow down" the feed of the sheet immediately following the "sampled" sheet by the drive wheels after the "sampled" sheet has been sensed to provide sufficient time for the gate to undergo mechanical movement.

OBJECTS OF THE INVENTION

nturmyxed is therefore one primary object of the present invention to provide an apparatus for feeding and accurately separating intermixed documents of dissimilar characteristics at speeds not heretofore attainable through conventional apparatus.

Still another object of the present invention is to provide apparatus for feeding and accurately separating sheets of widely differing thicknesses and characteristics at high speed even though such sheets may be partially or even severely mutilated.

Still another object of the present invention is to provide a novel apparatus for feeding and accurately separating sheets of dissimilar characteristics arranged within a single stack of sheets wherein the sheets fed thereby are separated one from the other and wherein feeding of more than one sheet at a time is prevented through the use of a stripper wheel assembly arranged to cooperate with a drive wheel assembly to automatically accommodate sheets of varying thicknesses within the stack and to thereby permit only one sheet at a time to be advanced from the cooperating drive and stripper assemblies toward a stacking facility.

Yet another object of the present invention is to provide a novel apparatus for feeding and accurately separating sheets of dissimilar characteristics arranged within a single stack of sheets wherein the sheets fed thereby are separated one from the other and wherein feeding of more than one sheet at a time is prevented through the use of a stripper wheel assembly arranged to cooperate with a drive wheel assembly to automatically accommodate sheets of varying thicknesses within the stack and to thereby permit only one sheet at a time to be advanced from the cooperating drive and stripper assemblies toward a stacking facility and whereby acceleration means are provided to increase the velocity of the last sheet fed thereto by the stripper and drive wheel assemblies to provide a finite gap between sequentially advanced sheets to thereby enable said sheets to be accurately counted before they are stacked in an outfeed stacker.

Another object of the present invention is to provide a hopper for stacking and feeding sheets which is designed to release several of the bottom-most sheets in the stack from the weight of or on the remainder of the stack thereby enabling the aforesaid several sheets to freely slide downwardly along an inclined supporting surface of the infeed hopper to undergo further processing, such as a separating and advancing operation.

Still another object of the present invention is to provide a sheet feeding and separating apparatus including anti-skewing means for causing sheets being processed by said apparatus to be advanced through various portions of the apparatus with their leading edges moving in a nonskewed alignment.

Still another object of the present invention is to provide a stacker for receiving and stacking sheets in an orderly manner and in original sequence even though said sheets are advanced toward the stacker in a high speed and skewed manner.

Still another object of the present invention is to provide feeding and separating means wherein sheets may be accurately counted and divided into distinct "batches."

Another object of the invention is to provide feeding and separating means in which sheets may be accurately counted and either collated after being counted or in which "statistical samples" may be extracted from the counted sheets.

BRIEF DESCRIPTION OF THE FIGURES

The above as well as other objects of the present invention will become apparent when reading the accompanying description and drawings in which:

FIG. 1 is an elevational view of a feeding, separating and stacking apparatus designed in accordance with the principles of the present invention.

FIG. 1*a* is a sectional view showing a portion of the stacker of FIG. 1 looking in the direction of arrows 1*a*—1*a*.

FIG. 1*b* is an elevational view showing a portion of the apparatus of FIG. 1 and incorporating a gate mechanism.

FIG. 1*c* shows the gate mechanism of FIG. 1*a* in greater detail and includes a block diagram of the electronics used to operate the gate mechanism and associated mechanisms.

FIG. 2 is an elevational view of a portion of arrows 2—2 wherein only those portions which are felt to be important to clarify an understanding of the operation of the mechanism have been illustrated.

FIG. 2*a* is a perspective view of a portion of the stripper assembly of FIGS. 1 and 2.

FIG. 2*b* shows one idler assembly of FIG. 1 in greater detail.

FIG. 3 is an elevational view of a portion of FIG. 2 provided to explain the manner in which a plurality of sheets entering the drive and stripper assemblies are separated.

FIGS. 3*a* and 3*b* are elevational views showing alternative arrangements for the drive and stripper wheels of FIGS. 2 and 3.

FIG. 4 is another preferred embodiment of the present invention showing a top feed input hopper for feeding sheets to the separating apparatus.

FIGS. 5*a*—5*c* show various embodiments of the portion of the infeed hopper employed to support the leading edges of the stacked sheets.

FIGS. 6A and 6B show an end view and front view, respectively, of an alternative embodiment of the stripper wheel assembly.

FIGS. 7*a*–7*c* are elevational views showing the stripper and feed wheel drives for explaining the optimal arrangement for the stripper assembly.

DETAILED DESCRIPTION OF THE FIGURES

FIGS. 1 and 2 show a device 10 designed in accordance with the principles of the present invention,

which device **10** is comprised of a housing **11** having a base portion **12** for supporting device **10** upon any suitable surface such as, for example, a table or counter. The relatively small size and light weight of the device greatly enhances its portability and facilitates handling of the device to enable its use in practically any desired location.

The housing **11** is provided with a front face **13** at its upper end which may be fitted or otherwise provided with control panels incorporating controls (not shown for purposes of simplicity) for turning the machine on and off, providing a visually observable count of the number of documents handled by the device and so forth, with the number and type of display mechanism and controls being dependent merely upon the needs of the particular application. 3ys The face **13** forms a portion of the front of housing **11** which is further provided with an infeed hopper **14** which consists of a stack supporting member **15** and a forward edge supporting member **16.** A stack of sheets to be fed and separated is positioned within infeed hopper **14** in the manner shown best in FIG. **1** with a portion of the weight of the stack substantially resting upon the upper exposed surface of plate **16.** The inclination of the hopper **14** and specifically base plate **15** and supporting plate **16,** as shown best in FIG. **1,** is such that the weight of the sheets within the stack serve to cause the stack to remain within the hopper without providing any top weight upon the stack. The right-hand-most portion **15**a of the hopper supporting plate **15** is inclined at an angle greater than that of the adjacent surface portion **15**b to which it is integrally joined. Also the plate portions **15***a* and **15***b* can be seen to define an angle of greater than 90°. The inclined orientation of the entire infeed hopper is such as to cause the forward or leading edges of at least some of the sheets in stack S to rest against plate **16.** It should, however, be carefully noted that the nature of the sheet feeding and separating mechanism is such that no special care need be given to the preparation of a stack before being placed in the infeed hopper. For example, there is no need whatsoever to cause all of the forward edges of the sheets within the stack to be aligned so as to rest against the exposed surface of plate **16** and, in fact, some sheets within stack S are shown with their forward edges lying a spaced distance from the surface **16.**

The infeed hopper supporting surfaces **15***a* and **15***b* are integrally joined at a "knee" portion **15***c* which is located a predetermined distance D from portion **16***a* of infeed hopper plate **16.** This distance is preferably selected so as to be substantially less than the width W of the narrowest document which the infeed hopper is designed to process. As the sheets of the stack are fed in the direction of arrow A, a small group of the bottom-most sheets are displaced or otherwise moved in the direction shown by arrow A so that their trailing edges are moved downwardly along inclined portion **15**a of the infeed hopper supporting plate **15.** The remainder of the stack S, however, has its rearward portion resting upon the right-hand end of inclined portion **15**a (relative to FIG. **1**). This arrangement removes the weight of or on the rearward end of stack S from the group of sheets (usually **1–5** in number) removed from beneath the right-hand end of the stack, thereby greatly facilitating the feeding and separating operations as will be more fully described.

A picker wheel **19** is mounted upon a shaft **20** (see FIG. **2**). Shaft **20** is journalled at a first end thereof **20**a and is also journalled at a second end thereof **20**b. The left-hand end of shaft **20** (relative to FIG. **2**) extends beyond the machine frame F and is fitted with a pulley **21** rigidly secured to shaft **20** for driving the picker wheel in a manner to be described.

The portion **15***b* of supporting plate **15** is provided with an opening (not shown) to enable the upper portion of the picker wheel **19** to protrude therethrough. The angle of inclination of surface **16***a* of the infeed hopper which engages the leading edges of most of the sheets is such as to support some of the weight of the sheets and thereby release this weight from the bottom-most group of sheets to greatly facilitate the feeding of the sheets from the infeed hopper to the next processing location. The weight of the sheets may be represented as a force vector C whose direction is vertically downward. This force may be represented as the force components C_1 and C_2 which are, respectively, perpendicular and parallel to surface **16***a*. Surface **16***a* to counteracts to the force component C_1 and thereby relieves this force component from the weight of the bottom-most sheets. Additionally, there is some frictional force between the leading edges of the sheets and the engaging surface **16***a* to reduce the effect of the force component C_2 upon the bottom-most sheets. This frictional force may be enhanced or increased by treating or otherwise forming the sheet engaging surface of portion **16**a to provide a roughened finish. Alternatively, the portion **16**a may have a corrugated configuration **16***a'* as shown in FIG. **5***a*, a step-like configuration **16***a'* as shown in FIG. **5***b;* or a gently curved surface portion **16***a'''* as shown in FIG. **5***c*.

Picker wheel **19** is provided with an insert **19***a* along a portion of its periphery which is formed of a material having a substantially high coefficient of friction and which is raised a finite distance above the remaining periphery of wheel **19.** A suitable driving belt (shown schematically as dotted line **142** for purposes of simplicity) is entrained about drive wheel pulley **139** and pulley **21** so as to rotate picker wheel **19** at a substantially constant angular velocity whereby wheel **19** rotates in the direction shown by arrow **22.** The raised portion **19***a*, having a higher coefficient of friction than the remainder of the periphery of wheel **19,** serves the dual functions of jogging or jarring at least the small group of (five or six) sheets positioned at the bottom-most portion of stack S so as to jar the sheets loose from one another to reduce their frictional engagement while at the same time causing the bottom-most sheet to be easily "picked up" and accelerated in the direction shown by arrow B where it is then caused to be fed toward the stripping and separating mechanisms.

The jogging effect of the picker wheel also serves to urge the stack upwardly and in a forward direction. This action serves to move the leading edges upwardly against the surface portion **16***a* to "lift" the weight of the forward end of stack S off the bottom-most sheets and enable the bottom-most sheets to freely slide downwardly along base member **15** toward the drive wheels.

The picker wheel tangential velocity should preferably be chosen to cause the insert **19***a* to engage the largest document processed by the apparatus only once per revolution with the "critical" sheet dimension being the length of the document measured in the feed direc-

tion. In cases where the document length (in the "critical" dimension) is uniform for all sheets being handled, the circumference of the picker wheel should preferably be slightly greater than the "critical" length. For example, if the document "critical" length is 2 inches, the picker wheel circumference should be about 2 ⅛ inches. The picker wheel should also preferably be designed to have its raised portion **19a** in engagement with the document being fed at least until the leading edge of that document engages the periphery of the drive wheel. This feature may be achieved by adjusting the picker wheel circumference and/or adjusting the length P of the raised portion **19*a***.

The tangential velocity of the picker wheel is preferably less than that of the drive wheel so as not to feed documents faster than they can be handled by the drive wheel.

The bottom-most sheet in the stack is thus urged toward a plurality of drive wheels **23** which are all mounted upon a common shaft **24** journalled within the machine frame F near its right and left-hand ends. At least one end of shaft **24** is provided with a pulley **25** for receiving a belt (not shown for purposes of simplicity) which is entrained about a suitable drive wheel and pulley **25** to rotate shaft **24** and hence rollers **23** in the direction shown by arrow **26**. Portion **15*e*** of infeed hopper support plate **15** is integrally joined to portion **15*b*** of plate **15** in the region of a double bend or "kink" provided within support plate **15**. As can best be seen in FIG. **1**, the forward-most end of support plate portion **15*b*** bends downwardly at **15*e*** and upwardly at **15*f*** so that plate portion **15*d*** lies a slight distance below plate portion **15*b***. Plate portion **15*d*** is further provided with a plurality of apertures (not shown for purposes of simplicity) to enable a portion of the periphery of rollers **23** to protrude therethrough in the manner shown best in FIG. **1**. The centrally located rollers **23*a*** and **23*b*** are positioned in closely spaced fashion while the spacing between rollers **23** and **23*a*** and **23*b*** and **23*c*** is substantially greater than the spacing between rollers **23*a*** and **23*b***. This arrangement is to accommodate the stripper wheel assembly to be described in more detail hereinbelow.

The "kink" or double bend provided in the immediate region wherein the peripheries of rollers **23–23*c*** protrude through plate portion **15*d*** serves to facilitate the frictional engagement between the bottom-most sheet fed toward drive wheels **23** by picker wheel **19** due to the fact that the leading edge of the bottom-most sheet is enabled to "droop" downwardly over the kink in the support member to assure better frictional engagement of the sheet with the peripheries of rollers **23–23*c***.

A stripper assembly **30** is positioned substantially above the drive wheel assembly comprised of drive wheels **23–23*c***. Assembly **30** consists of a shaft **31** having one end **31*a*** mounted within an elongated opening in machine Frame F. A nut **31*c*** engages the threaded end of shaft **31**. The elongated opening in the machine frame receiving shaft end **31*a*** allows for adjustment of the stripper wheel assembly to assure parallelism with the drive wheel assembly. The opposite end **31*b*** of shaft **31** fits within an opening in the machine frame and is secured thereto by a nut **31*d***.

A stripper wheel depth adjusting member **151** (see FIG. **2*a***) has an opening **152** which receives shaft **31** which is press fitted or alternatively provided with a set screw (not shown) to lock shaft **31** to member **151**. An adjusting screw passes through elongated clearance opening **154** in member **151** and threadedly engages a tapped opening provided in an inwardly projecting portion F_1 of the machine frame. A helical spring **156** encircles adjusting screw **153** and has its ends bearing against projection F_1 and the arm **151*a*** of member **151**. This assembly (by adjustment of screw **153**) controls the angular orientation of shaft **31** and hence controls the depth of entry of the stripper wheels between the drive wheels. Spring **156** acts to prevent screw **153** from moving from the adjusted position.

A pair of stripper wheel supporting plates **32** and **33** are secured to one another by means of a cross-arm **34** (shown best in FIG. **2**) and are each provided with openings for receiving bearings **35** and **36** which free wheelingly mount arms **32** and **33** to shaft **31**. Assembly **30** further includes a substantially U-shaped member **37** whose arms **37*a*** and **37*b*** are provided with openings for receiving shaft **31**. Set screws **37*c*** and **37*d*** provided in arms **37*a*** and **37*b*** lock member **37** to shaft **31** causing member **37** to assume the same angular orientation as shaft **31**. A pulley member **38** is embraced by arms **37*a*** and **37*b*** and is arranged to rotate in a free wheeling manner upon shaft **31**. Pulley **38** is provided with a pair of continuous annular-shaped rims **38*a*** and **38*b***. A cylindrical bushing (not shown) is preferably mounted between pulley **38** and shaft **31** to enhance the free wheeling movement of the pulley.

Positioned above pulley member **38** and shaft **31** is a shaft **39** having bearings **40** and **41** near its free ends to mount shaft **39** to machine frame F in a free wheeling manner. Shaft **39** is provided with a pulley **42** adapted to receive a belt **140** (shown schematically as a dotted line for purposes of simplicity) which is entrained about a drive pulley **138** and pulley **42** so as to rotate shaft **39** in a direction shown by arrow **43** (see FIG. **1**). Shaft **39** is provided with a pulley **44** rigidly secured to shaft **39** and located at a point substantially intermediate the ends thereof. A belt **45** is entrained about pulley **44** and pulley **38** (in the region between rings **38*a*** and **38*b***) so as to impart rotation of shaft **39** and hence pulley **44** to pulley **38**. For purposes of simplicity, belt **45** has been represented as a dotted line extending between pulleys **38** and **44** in FIG. **2**. This arrangement causes pulley **38** to rotate in the direction shown by arrow **46** (see FIG. **1**).

Stripper assembly **30** is further comprised of a shaft **47** mounted to the forward free ends of arms **32** and **33** by means of bearings **48** and **49** which mount shaft **47** in a free-wheeling manner relative to arms **32** and **33**. A belt **50** (see FIG. **1**) is entrained about the left-hand portion of pulley **38** and a pulley **51** secured to free-wheeling shaft **47**. Belt **50** is shown in dotted line fashion in FIG. **2** for purposes of simplicity. Belt **50** is fitted between rims **51a** and **51b** provided on pulley **51**. Free-wheeling shaft **47** is further provided with a pair of stripper rollers **52** and **53** rigidly secured to shaft **47** and arranged so that the peripheries of wheels **52** and **53** extend slightly below the peripheries of drive wheels **23–23*c***, as shown in both FIGS. **1** and **2**. Thus rotation of shaft **39** and pulley **44** is ultimately imparted to stripper wheels **52** and **53** which rotate in the direction shown by arrow **54** (see FIG. **1**). The wheels **52** and **53** are laterally adjustable along shaft **47** as are the drive wheels **23–23*c*** along their shaft **24**, to adjust the assemblies for accommodating sheets of different thicknesses

and stiffness as well as providing for periodic adjustment due to the normal wearing of the wheels.

The stripper wheels supporting arms **32** and **33**, being mounted to common shaft **31** in a free-wheeling manner, enable the stripper wheels to exert a downward force upon a sheet entering into the region between drive rollers **23–23***c* and stripper wheels **52** and **53** whose magnitude is a function of the weights of arms **32** and **33**, shaft **47**, bearings **48** and **49**, pulley **51** and at least a portion of belt **50**, as well as a cross-arm **55** and the counter balancing effect of the rearward portion of supporting arms **32** and **33**, cross-arms **34** and the rearward portion of U-shaped member **37**. The downward force exerted by the stripper wheel assembly is also a function of the length L of arms **32** and **33** between shafts **31** and **47**, as shown best in FIG. **2**. The force may therefore be altered by using arms **32** and **33** of differing lengths or from the use of arm portions between shafts **31** and **47** which may be made adjustable.

It should be noted that the downward force exerted by stripper wheels is totally independent of the rotational driving force applied to stripper wheels **52** and **53** due to the unique mounting assembly which enables wheels **52** and **53** to "ride" upon the sheets passing beneath the wheels and to pivot about shaft **31** totally independent of the driving force mechanism.

The maximum depth which stripper wheels **52** and **53** may enter between drive rollers **23–23***c* is controlled by adjusting member **151** by adjusting screw **153**, which provides a "fine" adjustment thereof.

The depth to which stripper rollers **52** and **53** may be lowered between drive wheels **23–23***c* is further controlled by a set screw **37***e* (see FIG. **1**) which threadedly engages a tapped opening in member **37** so that its lower end extends toward the upper surface of cross-arm **34**. The rotation of arms **32** and **33** about shaft **31** in the direction reverse that of arrow **46** is controlled by the adjustment of screw **37***e*. Member **37**, set screw **37***e* and bar **34** provide the "coarse" adjustment for the depth.

If desired, the arms **32** and **33** may be spring loaded to limit the amount of their movement in the clockwise direction about shaft **31** by means of spring **170** coupled between cross-arm **34** and U-shaped member **37** by fasteners **37***f* and **37***e*, respectively, to reduce the amount of "free floating" of the stripper wheels.

In applications wherein it is desired to process sheets whose thicknesses fall within a moderate range, as compared with the broad range of thicknesses which the stripper is presently designed to handle, a strap **171** (shown in dotted line fashion) may be entrained around U-shaped member **37** and cross-arm **34** (in place of spring **170**) to substantially lock the stripper wheels in a position (relative to said drive wheels) which is optimized for handling sheets having thickness lying within the aforesaid narrow range.

FIGS. **6A** and **6B** show a stripper wheel alternative embodiment **30'** which may be employed in units used to process documents whose thicknesses fall within a rather moderate range (i.e., from as thin as paper currency to as thick as punch cards). Only one-half of the assembly is shown in FIG. **6***b*, it being understood that the opposite half of the assembly is the mirror image of the half being described.

A shaft **172** is journalled within a bearing **173** provided in the machine frame F. A member **151'**, substantially identical to member **151** shown in FIG. **2***a*, is secured to shaft **172** by set screw **174**. An adjusting screw **176** threadedly engages an opening in member **151'** and bears against a fixed projection **177** extending inwardly from machine frame F. A stripper wheel support arm **178** is fixedly secured to shaft **172** by set screw **179**, and free-wheelingly mounts stripper wheel shaft **180** thereto. A clearance opening **181** is provided in frame F to allow for adjustment of shaft **180** to maintain parallelism between stripper wheels **52–53** and drive wheels **23–23***c*, by means of the pair of adjusting screws **176**.

A shaft **182** secured between the side walls of frame F and positioned beneath shaft **178** (see FIG. **6A**) is fitted with an adjusting screw **183** which bears against a downwardly extending stop **178***a* on member **178** to control the amount which the stripper wheels may be lowered. The ends of rod halves **172** and **172***a* remote from the machine frame F are telescoped within a hollow cylindrical tube **172***b* which acts to keep shafts **172** and **172***a* substantially in alignment with an imaginary longitudinal axis A, while at the same time permitting shafts **172** and **172***a* to be independently rotated about axis A by their "fine" adjusting members **151** and **151'**.

Shaft **180** is fitted with a pulley **184** and drive wheel shaft **24** (note also FIG. **2**) is fitted with a pulley **185**. A resilient O-ring type belt **186** is entrained about pulleys **184** and **185** to rotate the drive and stripper wheel shafts as well as controlling the amount of separation which may occur between the drive and stripper rollers.

The adjustment of the stripper assembly controls the angular relationship between stripper wheels **52–53** and drive wheels **23–23***c* as well as the angular orientation of the center lines CL of arms **32** and **33** relative to the feed direction. If the angle α (see FIG. **7***c*) is increased beyond a predetermined value, a wedging or jamming of the sheets occurs. If the angle α is decreased beyond a predetermined value (i.e., as shown respectively in FIGS. **7***b* and **7***a*), the stripper wheels undergo "bouncing." By selection of the appropriate positive angle α, (relative to the horizontal line H) the stripper assembly provides a self-clamping effect to eliminate "bouncing" and yet prevent the "wedging" or jamming effect and thereby facilitate handling of sheets over a wide range of thicknesses, stiffnesses and finishes.

The angle α is also a function of the coefficient of friction of the stripper wheel periphery such that α may be decreased by increasing the coefficient of friction and vice versa.

The angle β formed between the feed direction and stripper wheel **52** (see FIGS. **6A** and **7***c*) is also important. If β is too small, the "wedging" effect will occur. However, β can be significantly decreased (for example, by increasing the diameter of wheel **52**) due to the counter rotation of the stripper wheels.

Ideally (see FIG. **6A**) stripper wheel **52** should be aligned so that a line drawn through point X on its surface is tangential to line L_a, line L being coincident with the plane of movement of sheets in the feed direction. Line L_a should also be perpendicular to the plane of sheet movement and pass through the center of rotation of drive wheel **23**. The point X need not lie on the surface of wheel **23**.

FIGS. **7***a–7c* show the various orientations of the stripper assembly arms **32, 33**. In FIG. **7***a* the shaft **31** about which arms **32, 33** pivot is positioned below line

FL which represents the plane in which sheets are fed. The direction of rotation of the stripper wheel **52** and the coefficient of friction of the stripper wheel relative to pivot point **31** tends to lift the stripper wheel **52** off the sheet as shown by arrow F_1.

The orientation of arms **32, 33** in the "neutral" position (i.e., with center line CL parallel to the plane of the sheet [FIG. 7*b*]) the counter-rotation of wheel **52** exerts a force F_2 along the center line CL, which force is substantially neutralized, so that the stripper wheel is free to "bounce."

The orientation of arms **32, 33** with the pivot point **31** positioned above the plane of the sheet causes counter-rotating stripper wheel **52** to tend to hold the stripper wheel against the sheet and thereby prevent "bouncing" to provide the aforementioned self-clamping effect.

The means of imparting rotational movement between pulley **44** and stripper wheel pulley **51** can therefore be seen to impart the necessary rotation to stripper wheels **52** and **53** without having any effect whatsoever upon either the orientation or downward force exerted by the stripper wheels upon the sheet entering between stripper wheels **52** and **53** and drive wheels **23–23***c*.

Drive wheels **23–23***c* are formed of a resilient material whose periphery exhibits a high coefficient of friction, while wheels **52** and **53** are formed of a material which, while being somewhat resilient, are less resilient than wheels **23–23***c* and whose peripheries exhibit a coefficient of friction which is less than that of the peripheries of wheels **23–23***c*. As can clearly be seen from FIG. **2**, the fact that the lower portions of the peripheries of wheels **52** and **53** lie slightly below the peripheries of the wheels **23–23***c*, cause sheet S′ to assume an undulating or corrugated configuration. The peripheries of wheels **52** and **53** are preferably curved as shown best in FIG. **2**, whereby the contour of sheet S′ substantially follows the shape of the curved peripheries. The severity of the undulations formed in sheet S′ is substantially a function of the spacing between wheels **23** and **23***a*, and wheels **23***b* and **23***c*, the width of wheels **52** and **53** and the thickness and inherent strength of the sheet S′. Typically, thinner sheets will cause the stripper rollers to have their peripheries inserted more deeply in the gaps provided between the spaced drive rollers **23–23***c*.

The stripper and drive wheels of FIGS. **2** and **3** may be replaced by wheels of the type shown in FIGS. **3***a* or **3***b*. FIG. **3***a* shows a drive wheel **23′** having an arcuate shaped groove **23***a′* for receiving stripper wheel **52** to impart a corrugated shape to sheet S. The drive wheel **23″** of FIG. **3***b* has a pair of grooves **23***a″* and **23***b″*, the raised portions **52***a′* and **52***b′* of stripper wheel **52′** to impart a corrugated configuration to sheet S. If desired, a plurality of pairs of stripper and drive wheels of the type shown in FIGS. **3***a* and **3***b* may be mounted upon their associated rotating shafts. Also, the wheel **23″** may be provided with a greater number of grooves (i.e., three or more). If desired, wheel **23′** may be mounted upon the stripper wheel shaft **47** and wheel **52** may be mounted upon the drive wheel shaft **24**. A similar reversal may be made for the wheels **23″** and **52′** of FIG. **3***b*.

In cases where only a single sheet (i.e., the bottom-most sheet) enters into the region between stripper rollers **52** and **53** and drive rollers **23–23***c*, the relative coefficients of friction of these rollers are such that the drive rollers **23–23***c* exert the primary influence upon the sheet fed thereto whereby the sheet is caused to be fed in the forward feed direction and toward acceleration wheels **60**, to be more fully described. The coefficient of friction of the stripper wheel peripheries will cause these wheels to make slipping engagement with the single sheet fed thereto, which action is further aided to a degree due to the fact that the stripper wheels are biased downwardly upon the single sheet by virtue of the weight of the stripper wheel assembly, and hence the stripper wheels may be free to move upwardly under the influence of the single sheet as it is fed therethrough. The undulating configuration of the sheet acts to greatly stiffen the sheet as it passes between rollers **52–53** and **23–23***c* to greatly increase the effective frictional engagement between the sheet and rollers **52–53** and **23–23***c*.

The most effective frictional engagement is exerted by the "near edges" of adjacent drive and stripper wheels (i.e., near edges **52***a* and **23***d*, for example) which cooperate to "pinch" the sheet therebetween and thereby impart their opposing driving forces.

In the case where a pair of sheets are fed toward the drive wheels **23–23***c* and stripper wheels **52** and **53**, which is shown best in FIG. **3**, the drive wheels and stripper wheels similarly cause the pair of sheets to form the undulating pattern shown in FIG. **2** for a single sheet feed. However, in the regions outside of the gaps G and G′, the effect of the stripper wheels moving at least partially between the drive wheels causes the sheets S′ and S″ to be slightly separated, thereby reducing the amount of surface contact between the sheets with the primary driving effect of the stripper wheels and drive wheels occuring in the region where the "near" curved edges of the wheels are positioned closest to one another as designated by the locations P as shown in FIG. **3**. The separation between the sheets in the regions outside of the gaps G and G′ greatly facilitate the stripping of the sheet S″ from sheet S′. The coefficient of friction of the stripper wheels **52** and **53** is greater than the coefficient of friction between the engaging surfaces of the two contacting sheets S″ and S′ causing the stripper wheel to drive the top-most sheet S″ backwards toward the infeed hopper while sheet S′ is driven toward the acceleration wheels by the drive rollers. Similarly, the coefficient of friction of the peripheries of drive wheels **23–23***c* is greater than the restraining frictional forces between the contacting sheets to enable the drive wheels to move the bottom-most sheet S′ toward the acceleration wheels. Thus, even if the two sheets S′ and S″ are exactly in alignment when fed between the drive and stripper wheels, the stripper wheels are nevertheless effective in "stripping" the topmost sheet away from the bottom-most sheet and thereby enabling only the bottom-most sheet to be fed toward the acceleration wheels.

The stripper wheels **52–53** cause the sheet engaging their peripheries to be fed rearwardly thereby urging the sheet back toward the stack. Since the major portion of the weight of the stacked sheets is removed from the substantially "weight free pocket" formed within the bottom-most region of the infeed hopper **14**, the reverse movement of the sheet fed rearwardly toward the infeed hopper permits the trailing edge of the sheet to move rearwardly without experiencing any curling over or bending.

The operation in which two sheets are fed simultaneously occurs as described hereinabove even though the first sheet which engages the drive wheels is not the bottom-most sheet (for example, in the case of a bottom feed arrangement of FIGS. 1 and 2). The sheet will be advanced by the drive wheels (with the stripper wheels slippingly engaging the sheet) until the leading edge of the bottom-most sheet engages the drive wheels. When the bottom-most sheet is advanced so that portions of both the bottom-most sheet and the sheet above it are between the stripper and drive wheels, the stripper wheels exert a greater influence upon the sheet which they engage to drive the sheet toward the infeed hopper. Once the "bottom-most" sheet is removed from the influence of drive wheels **23–23***c*, the drive wheels exert the major influence upon the sheet still remaining between wheels **52–53** and **23–23***c* to cause it to be advanced to the acceleration wheels behind the "bottom-most" sheet. This operation assures feeding, separation and stacking of sheets in the same order as the sheets were arranged in the infeed hopper.

The acceleration wheels are shown best in FIG. 2 and are comprised of individual wheels **60–60***c*, all mounted upon a common shaft **61** and being locked thereto so as to rotate with the rotation of shaft **61.** The shaft is journalled to machine frame F by bearings **63***a* and **63***b* so as to be mounted in a free-wheeling manner relative to the machine frame. The left-hand end of shaft **61** is provided with a pulley **62** which cooperates with a belt **63** (shown in phantom line fashion in FIG. **2** for purposes of simplicity) for imparting the rotational drive required for the acceleration wheels.

The acceleration wheels cooperate with a plurality of idler rollers **65** (only one of which is shown in FIG. **1** for purposes of simplicity). The peripheries of the outer idler rollers have a lower coefficient of friction than the idler rollers associated with acceleration wheels **60***a* and **60***b*. It should be understood that there is one idler roller arranged in alignment with each of the acceleration wheels **60–60***c* which idler rollers are preferably independently mounted in the manner shown best in FIG. **2***b*.

The rollers **60***a* and **60***b* are tightly aligned near the center of shaft **61,** while rollers **60** and **60***c* are positioned a large distance away from rollers **60***a* and **60***b*. The peripheries of rollers **60***a* and **60***b* have a higher coefficient of friction than rollers **60** and **60***c*. Due to the tight alignment of rollers **60***a* and **60***b* at the center of shaft **61** these rollers do not promote skewing of a sheet engaging the rollers **60***a* and **60***b*. In order to prevent the outer rollers **60** and **60***c* from promoting skewing, the idler rollers cooperating with acceleration wheels **60** and **60***c* are positioned slightly downstream of the idler rollers cooperating with acceleration wheels **60***a* and **60***b*. FIG. **2***b* shows wheel **60** mounted on shaft **61.** All of the rollers **60–60***c* are in alignment. Idler **65***a* (shown in dotted line fashion) represents the idler roller which rollingly engages wheel **60***a*. Idler **65***a* is arranged to be tangent to a line which is coincident with the feed direction (see arrow in FIG. **2***b*). Idler **65** (shown in solid line fashion) has its axis of rotation X_1 on the downstream side of the axis of rotation X of roller **65***a*. All idler rollers are mounted by means of a resilient U-shaped member whose yoke is secured to plate **16** by fastener **302.** The arms of a U-shaped member **301** receive a pin **303** upon which the idler roller is mounted. U-shaped member **301** urges its idler roller against the surface of its associated acceleration wheel.

In cases where a sheet is skewed as it advances toward the acceleration wheels, the alignment of the idler roller's cooperation with acceleration wheels **60** and **60***c* is such as to cause the leading edge LE advanced thereto, to strike the surface of idler **60** (for example) a spaced distance away from the point (X_2) where it engages the periphery of wheel **60.** This causes either realignment or a significant reduction in the skewing of the document. The leading edge will then be directed toward point X_2 to be accelerated by wheel **60** and idler **65.**

In cases where some skewing exists even after the document has entered between wheels **60***a–***60***b* and the associated idlers, the outer wheels **60** and **60**c and their associated idlers assure the fact that the end portion of the trailing edge which is the last to leave the influence of the acceleration wheels will nevertheless be advanced to the stacker.

The infeed hopper plate **16** is provided with a plate portion **16***b* integrally joined to plate portion **16**a which plate portion **16***b* is aligned so as to be arranged in substantially spaced parallel fashion relative to plate portion **15***d* of the infeed hopper support plate **15.** Plate portion **16***b* is provided with suitable openings sufficient to permit a portion of the peripheries of idler roller **65** to protrude therethrough, in a manner shown best in FIG. **1,** so as to make surface engagement with the periphery of acceleration wheels **60.** The rearward end of portion **16***b* cooperates with member **15** to define a narrow outfeed "throat" to limit the number of sheets which may be advanced to drive wheels **23–23***c*. The centers of rotation of acceleration wheels **60** are spaced a distance G from the center of rotation of drive wheels **23,** which distance G is preferably less than the width of the smallest sheet which can be accommodated by the feed and separating mechanism to cause the acceleration and idler wheel to grip the sheet before its trailing edge leaves the drive wheels. However, the spacing may be greater, if desired, since the drive wheels impart sufficient movement to sheets passing the drive wheels to assure proper advancement to the acceleration wheels. The tangential velocity of the peripheries of acceleration wheels **60** is significantly greater than the tangential velocity of the peripheries of drive wheels **23–23***c* to cause the single sheet fed thereto to move at a greater linear speed as the leading edge of the single sheet enters between acceleration wheels **60** and their cooperating idler rollers **65.** This absolutely assures the fact that the trailing edge of the sheet passing between rollers **60** and **65** will clearly be separated by a finite gap from the leading edge of the next sheet in the stack which is delivered to rollers **60** and **65** by the drive wheels **23–23***c*. The gap formed between succeeding sheets fed between drive wheels **23–23***c* and acceleration wheels **60–60***c* may be used to great advantage by providing a detector assembly which may be employed for counting purposes. For example, a light source **71** may be positioned in the manner shown in FIG. **1** with the light rays emitted therefrom being directed through suitable openings (not shown for purposes of simplicity) provided in plate portions **16***b* and **15***d* so as to enable the light rays to pass through these aligned openings and thereby be detected by the light sensitive photo cell **72.** Detection of the light rays will occur during a time interval between

the passage of the trailing edge of a sheet fed to acceleration wheels **60** and the leading edge of the next single sheet leaving drive wheels **23–23***c*. These pulses may be accumulated by a suitable counter (not shown).

GATE ASSEMBLY

A gate assembly **200** as shown in FIGS. **1***b* and **1***c* is provided for performing the "statistical sampling" and collating operations and comprises a gate member **201** rigidly secured to shaft **202.** At least one end of shaft **202,** which extends through one sidewall of the machine frame (not shown for purposes of simplicity) is fitted with a lever arm **203** rigidly secured thereto. A relay **204** secured to the machine frame at **205,** has its armature **204***a* secured to arm **203** by pin **206.** With solenoid **204** deenergized, a spring means **207** coupled between **205** and **206** normally maintains the gate and arm in the dotted line positions **201'** and **203'**, respectively. Energization of relay **204** causes the gate and arm to move against the force of spring **207** to the solid line positions **201** and **203,** respectively.

Let it be assumed that it is desired to count a large number of sheets while retaining only "statistical samples" of the sheets being counted (i.e., every 100th sheet). The gate is maintained in dotted line position **201'**, causing sheets advanced by the acceleration sheets to be fed between belts **207** and **208** entrained about roller pairs **209–210** and **211–212** respectively. Belts **207** and **208** advance the sheets in the direction of arrow **213** where a curved plate **214** deflects the counter sheets into a waste container **215.** As the trailing edge of the "99th" sheet clears gate **201** and enters between belts **207** and **208,** gate relay **204** is energized to move the gate to position **201,** for deflecting the "100th" sheet toward stacker **80.** As the "100th" sheet passes gate **201,** relay **204** is deenergized to cause the next sheet to be fed toward belts **207–208.** Thus, every "hundredth" sheet is retained as a "sample" while the remaining sheets may be discarded.

Obviously, any desired statistical sample may be selected by means of a settable switch **216.** As the gap between sheets (i.e., sheets S_1 and S_2) is detected, the sensor **72** advances the count of counter **217.** The accumulated count in counter **217** is compared against the setting of settable switch **216** by decoder **218** to activate a driver circuit **219** which energizes gate relay **204** for each Nth document to be sampled, where "N" may be any real integer. The clutch and brake mechanisms described hereinabove may be activated by an "N-1" signal and an "N+1" signal to assure the presence of a gap G of sufficient length between the sheet preceding the "Nth" sheet and the sheet following the "Nth" sheet to provide sufficient time for the physical movement of gate **201.** The decoding circuitry in decoder **218** generates an N-1 signal when the trailing edge of the sheet preceding the "Nth" sheet passes sensor **72,** causing the drive, stripper and picker wheels to be disengaged from the motor drive and be abruptly halted, thereby "slowing down" the "Nth" document. Gate **201** is moved and the brake and clutch mechanisms are released to continue the feed operation. When the trailing edge of the "Nth" sheet is sensed, the above operation is repeated to allow the gate to be set to position **201'**. The feed operation is again restored until the next statistic sample is about to pass sensor **72.** This gate assembly may also be used for collating. for example, it may be desired to stack every "odd" sheet (an original) in one pile, and every "even" sheet (a carbon copy of its associated original) in a separate stack. This may be done by operating the gate as described above between every sheet fed through the apparatus.

ENDORSER

If desired, an endorser or stamping wheel may be positioned downstream of the acceleration wheels **60.** Plate portion **16b** is preferably lengthened to accommodate the endorser roller and a cooperating elongated idler roller for stamping or "endorsing" sheets as they pass between the endorser assembly. After leaving the endorser stage, documents are then stacked in the same manner as will be more fully described.

Plate **16** has a remaining plate portion **16***c* integrally joined to plate portion **16***b* which forms substantially an acute angle with plate portion **16***b* at a bend **16***d* which causes the path of movement of single sheets accelerated by wheels **60** (moving in the direction of arrow **74**) to be deflected somewhat so as to move in the direction shown by arrow **75,** whereupon the single sheets are fed to a stacker assembly **80.** The surface **16***c* acts to realign any sheets striking surface portion **16***c* in a skewed manner by causing the end of the leading edge striking portion **16***c* to be decelerated somewhat and thereby move the leading edge uniformly in the forward feed direction.

The preferred pulley arrangement for operation of the apparatus is shown best in FIG. **2.** The apparatus is provided with a motor M (also shown in FIG. **1**) having output shaft **129** extending through machine frame F to which motor M is fastened. A pulley **130** is rigidly secured to shaft **129** and drives the acceleration wheel shaft **61** by means of a belt **64** entrained about pulleys **130** and **62.** The opposite end of shaft **61** is provided with pulleys **133** and **134.** Pulley **133** is locked to shaft **61** and drives kicker wheel shaft **85** by belt **132,** which is entrained about pulley **133** and pulley **89** locked to shaft **85.** Belt **132** is a resilient O-ring type belt, and is looped in "figure 8" fashion to rotate shaft **85** in a direction reverse that of shaft **61.** Thus, whenever motor M is energized, shafts **61** and **85,** which are directly coupled thereto are rotated.

Shaft **61** is further provided with a clutch **131** which, when energized, causes the pulley **134** mounted upon clutch **131** to rotate. When deenergized, clutch **131** causes pulley **134** to be free-wheeling relative to shaft **61.** Belt **135** is entrained about pulley **134** and a pulley **136,** locked to one end of drive wheel shaft **24.** The opposite end of drive wheel shaft **24** has two pulleys **25** and **138** locked to the shaft. A belt **142** is entrained about pulley **25** and pulley **21,** which is locked to picker wheel shaft **20.** Belt **140** is entrained about pulley **138** and idler shaft pulley **42** which is locked to idler shaft **39.** The shaft **39** serves to impart rotation to the stripper wheels **52–53** as was previously described.

The pulleys **133** and **89** are provided with semicircular grooves around their periphery for receiving O-ring type belt **132.** All of the remaining pulleys are provided with gear-like peripheries for engaging teeth provided on the belts which they engage, which belts are commonly referred to as timing belts.

An electromagnetic brake **137** is fastened to the machine frame and receives one end **20***a* of picker wheel shaft **20.** When energized, brake **137** abruptly stops shaft **20** from rotating. When deenergized, brake **137** permits shaft **20** to rotate.

In operation, shafts **61** and **85** rotate as long as motor M is energized. Clutch **137** permits drive wheel shaft **24**, idler shaft **39**, and picker wheel shaft **20** to be selectively disengaged from motor M when energized. The clutch **131** and brake **137** are operated substantially simultaneously to both disengage and abruptly halt the rotation of shafts **24, 39** and **20**, even though motor M is running.

The advantageous features of this design can best be appreciated from the description of the gate assembly described hereinabove. This mechanism is also advantageous for use in "batching" operations, i.e., operations in which a precise number of sheets are to be arranged in a separate stack. For example, let it be assumed that paper currency is to be arranged in stacks of 50. The counter **217** (see FIG. 1*b*) after counting the 50th bill, energizes clutch **131** and brake **137** to abruptly stop the operation of the stripper, drive and picker wheels. The 50th bill is advanced to the stacker (since the kicker wheels and acceleration wheels are still running) while the 51st bill is prevented from advancing to the stacker. The stack of 50 bills may then be removed from the stacker **80** and a "continue" button (not shown for purposes of simplicity) is depressed to initiate reset counter **217** and deenergize clutch **131** and brake **137** to permit the next stack of 50 bills to be formed. The size of the batch to be formed is dependent only upon the setting of settable switch **216** (see FIG. 1*b*).

STACKER

Each single sheet is fed into the region between plate **16***e* and plate **81** of a movable member **112** forming part of the stacker assembly **80** (see FIGS. 1 and 1*a*). Each single sheet is kicked against the base plate **83** of the stacker by means of stacker wheels **84–84***c* which are mounted upon a common shaft **85** journalled within bearings **86** and **87** so as to be free-wheeling relative to machine frame F. Shaft **85** is driven by a pulley member **89** which is coupled to a suitable pulley belt (not shown for purposes of simplicity) so as to rotate the stacker wheel in a direction shown by arrow **91** (see FIG. 1) to cause the leading edges of the sheets being fed thereto by acceleration wheels **60–60***c* to be "kicked" against base plate **83**. A plurality of elongated strips **83***b* are arranged on the top surface of base plate **83** and are arranged in spaced parallel fashion as shown best in FIG. 1*a*. The top surfaces are polished to provide a smooth finish. The strips **83***b* reduce the amount of surface area of sliding engagement with the leading edges of the sheets stacked within the stacker. Wheels **84** preferably have peripheries exhibiting a coefficient of friction similar to that of wheels **23–23***c*, for example. Stacker member **112** is biased by a spring and pulley mechanism **95** and **96**, respectively, which normally biases the stacker movable member **112** in the direction shown by arrow **97**. As the sheets are deposited within the stacker, movable member **112** moves in the direction shown by arrow **98** against the force of spring **95** to form a neat and somewhat compressed stack of sheets within the stacker. Hooked end **95***a* of the spring is secured to a rod R, forming a part of the machine supporting frame, by fastening member **103**. Hooked end **95***b* of the spring is fitted through an eyelet **104** secured to bracket **105** which rotatably supports pulley **106**. A second pulley **107** is rotatably mounted upon bracket **108** which is fixedly secured to the left-hand end of base plate **83** by an L-shaped bracket **109**. A thin tape member **110** has a first end secured between the yoke of bracket **108** and arm **109**, as shown at **109***a*, is entrained about pulleys **106** and **107** and has its opposite end secured between the downward projection **112***a* of member **112** (which rides in slot **83***a*) and plate **111** which is secured to projection **112***a* by fasteners **111***a*. Bracket **111** is secured to the underside of member **112** enabling member **112** to move within an elongated guide slot **83***a* provided within base plate **83**, while preventing member **112** from being lifted out of slot **83***a*. The use of a block and pulley arrangement yields a mechanical advantage in that pulley **106** moves only half the distance moved by member **112** to permit the use of a shorter spring (**95**) of greater spring tension.

Plate **16** has a final plate portion **16***e* integrally joined with plate portion **16***c* so as to alter the part of movement of the sheets from the direction shown by arrow **75** to the direction shown by arrow **76**. Each sheet, in addition to being kicked against stacker base plate **83**, is further abruptly urged against the confronting surface of plate **81**, so that its trailing edge (see trailing edge T of sheet S''' in FIG. 1) is moved a substantial distance away from plate portion **16***e* of plate **16** so as to provide clearance for the next sheet to be fed to the stacker assembly. **6** The high-speed movement of sheets through apparatus **10** frequently causes the sheets to pick up some static electric charge, and thereby causing the sheets to be attracted to surface **16***c*. The action of kicker wheels **84** serves to overcome this attraction in driving the sheets against plate **81**. In addition, the kicker wheels urge the leading edges of the sheets against base plate **83** to stack the sheets in a neat fashion. The force of spring **95** normally urges member **112** in the direction of arrow **97** to compress the formed stack. If desired, the plate **81** may be removed, whereby only upwardly projecting member **112** is employed in the stacker to support sheets within the stacker. The ends of the sheets extending laterally of the member **112** experience no restraining force and thereby form a "butterfly" pattern. However, the stacking operation is performed as effectively as would be the case if plate **81** were provided. The removal of plate **81** facilitates removal of all sheets in the stack, whereas plate **81** obscures the stack and the possibility that one or more sheets may not have been removed from the stacker may go undetected.

As can best be seen from FIG. **2**, the stripper and drive wheels are centrally located whereby the influence exerted by these wheels is applied substantially to the central portions of sheets S'. Since the edges E and E' of sheet S' may extend a substantial distance beyond this central region C (note FIG. 2), plate portion **16***b* of plate **16** may be provided with a pair of free-hanging "flaps" **99** which are mounted within suitable apertures provided in plate portion **16***b* and whose lower edges **99***a* extend downwardly and into the infeed opening between plates **16***b* and **15***b*. These members extend downwardly by virtue of their weight and exert a guiding influence upon the sheets fed toward the drive wheels **23–23***c* by the picker wheel **19** to further assure that skewed sheets fed toward the drive wheels are realigned whereby their leading edges are simultaneously engaged by the contacting peripheral portions of drive wheels **23–23***c* and stripper wheels **52** and **53**. However, it has been found that the stripper and drive wheel

assemblies have been capable of feeding only single sheets toward the acceleration wheels, even in the case where the leading edge of the sheet (or even of the sheets) is unevenly fed toward the stripper and drive wheels. It has been found that these assemblies are nevertheless capable of feeding only single sheets toward the acceleration wheel and that a gap of finite length sufficient to permit a counting operation will occur. FIG. **2** shows the relative location of the "flaps" **99** with respect to the stripper and drive wheels.

FIG. **4** shows another preferred embodiment of the present invention in which top feeding of the documents may be provided, and wherein like elements as between the embodiments of FIGS. **1** and **5** are designated by like numerals.

In this embodiment, the apparatus **10'** is mounted upon a suitable base member **120** forming part of the apparatus frame. A movable tray member **121'** is positioned between a pair of vertical side plates (not shown for purposes of simplicity) and a biasing means is mounted between base plate **120** and document advancing support plate **121.** The biasing means may, for example, be a plurality of spring members **122** normally urging member **121'** vertically upward. The stack S of sheets is placed upon support **121'** by urging plate **121'** downwardly to a degree sufficient to permit the top of the stack S to clear support picker wheel **19.** The stack may then be released, causing biasing members **122** to urge the stack of sheets in the upward vertical direction. Picker wheel **19,** which is similar to that shown in FIGS. **1** and **2,** is similarly provided with a raised portion **19***a* having a high coefficient of sliding friction to cause the stack of sheets to be jogged and further to advance the topmost sheet toward the feed and stripper roll assemblies. A suitable opening is provided in plate **123** to permit the periphery of picker wheel **19** to protrude therethrough. The topmost sheet (or sheets) are advanced by picker wheel **19** in the direction shown by arrow **134** so as to move toward the drive roll assembly comprised of drive roll **23.** The stripper roll **52** is mounted therebeneath, and is arranged so as to have a portion of its periphery protrude through its suitable opening provided in lower guide plate **124.** The left-hand end of lower guide plate **124** is provided with a knee portion **124***b* joined to a vertically aligned portion **124***a*, with knee portion **124***b* cooperating with upper guide plate **123** to define a narrow throat region **125** which aids in limiting the number of sheets advanced to the feed and stripper rolls.

The operation of the feed and stripper rolls is substantially identical to that described hereinabove, with the stripper wheel mounting assembly being positioned beneath guide plate **124.** The stripper wheel mounting assembly may be modified so as to provide a biasing force in the form of a spring means **126** mounted between each of the arms **32, 33,** as shown in FIG. **2** (only one of such arms being shown in FIG. **5** for purposes of simplicity) and plate **124.** The force exerted by spring **126** urges the stripper rollers in the direction shown by arrow **126***a* about pivot shaft **31.** The feeding and stripping operation is substantially identical to that described hereinabove, wherein a suitable number of feed and stripper rollers are provided to impart an undulating or corrugated contour to the sheet or sheets being fed between the feed and stripper rollers. It should be noted that whereas FIG. **2** shows two stripper rollers **52** and **53,** and four feed rollers **23–23***c*, it should be understood that any other number of such rollers may be employed and, in fact, the number of stripper rollers employed may be greater than the number of driver rollers, if desired. The preferential arrangement is to provide at least a plurality of both stripper and drive rollers so as to impart a corrugated or undulated contour to the sheet or sheets fed therebetween to enhance the stiffening of the sheets fed therebetween and thereby facilitate their separation over as large a surface area as is possible. Providing a single stripper roller having its periphery extending into a gap between a pair of drive rollers greatly reduces the amount of stiffness imparted to sheets fed between the driver and stripper rollers and further makes it possible to cause a single sheet or sheets to be pushed so far downwardly into the gap between adjacent drive rollers (or stripper rollers, if such is the case) as to significantly reduce the effectiveness of the driving and stripping operations.

The drive act to advance only a single sheet toward the acceleration rollers **60** (only one being shown in FIG. **4** for purposes of simplicity) which cooperate with their associated idler rollers **65** to abruptly increase the velocity of single sheets fed therebetween so as to provide a predetermined gap between the trailing edge of the sheet passing between the acceleration and idler rollers and the leading edge of the next sheet to be fed thereto.

The apparatus of FIG. **4** may be provided with a stacker assembly of the type shown in FIG. **1** wherein the leading edges of sheets advanced by acceleration roller **60,** and moving in the direction shown by arrow **134,** are caused to be deflected downwardly in the direction of arrow **135** by plate **136.** Kicker wheels **84** cause the sheets to be altered in their direction of movement from that shown by arrow **135** to that shown by arrow **137** wherein the sheets are kicked against base plate **83** and thereby stacked within the stacker. Surface **136** functions as an anti-skewing surface in the same manner as that described in connection with the embodiment of FIG. **1,** as does surface **83** which serves to form a neat stack in cooperation with the operation of kicker wheel **84.**

The top feed embodiment of FIG. **4** simplifies the feeding of single sheets to the drive and stripper assemblies, since the weight of the stack S is beneath the topmost sheet. The means for moving the stack S upwardly need only exert a light, upward force upon the stack so as to place the topmost sheet under the influence of picker wheel **19.** If desired, the upper guide plate **123** may be provided with a portion **123***a* pivotally mounted at **123***b*. A microswitch **123***d* is employed to detect the lowering of plate portion **123***a* (by counterclockwise rotation about pivot **123***b* to drive a motor (not shown) which rotates a threaded shaft S' within threaded opening **120***a* in base plate **120**). The upper end of shaft S is secured to platform **121** to drive it upward until the topmost sheet of the stack abuts against pivoted plate portion **123***a* to drive it clockwise, and thereby cause microswitch **123***d* to deenergize the motor which operates platform **121.** Alternatively, the infeed hopper arrangement **14** of FIG. **1** may be used with the top feeder of FIG. **4** by appropriate modification of the platform **121,** plates **123***a* and **124** and picker wheel **19** to accomplish the weight relieving advantages of the hopper assembly of FIG. **1** in a top feed apparatus.

It can be seen from the foregoing description that the present invention provides a novel feeding and separating mechanism capable of feeding and stacking single sheets from a large stack of sheets which may contain sheets of dissimilar sizes, thicknesses and finishes and, in fact, may even be slightly or partially mutilated without any effect whatsoever upon the separation operation. The primary distinctions between the feeding and separating device described herein over conventional apparatus are:

a. no adjustment is required for any of the machine components to individually feed sheets of differing sizes, thicknesses, weights or finishes of paper, plastic or other flat material; also, the sheets may be fed in stacks containing sheets of either uniform or differing characteristics or sizes with equal success;

b. the intermixed stock may vary in thickness, over a wide range. For example, those embodiments already developed are capable of handling sheets of thicknesses at least within the range from 0.002 to 0.021 inch and are capable, for example, of accommodating sheets which may vary in width in the range from at least 2.5 to 7 inches and in the range from at least 2.5 to 24 inches in the direction of travel;

c. non-uniform and non-square-edged stock may be fed with equal success;

d. no special car need be given to a stack of sheets, and more specifically, preliminary jogging or preparation of the stock is not required;

e. the successful feeding and separation of documents can be seen to be carried out without the need for any critically adjusted knife edges or slits, nor supplementary air pressure or vacuum sources, as are typically required in conventional structures;

f. the proper selection and combination of the materials from which the driving and stripping rollers are formed virtually eliminates double stock feeding, thereby eliminating the necessity for the provision of a doubles detector and other associated circuitry; and

g. the design of the apparatus is such that there is no mutilation, bending or curling of the sheets during any phase of the feeding, separating and stacking operations and the apparatus is virtually "jam-free" throughout the entire operation.

It should further be noted that the simplicity in design and operation of the device lends itself readily for feeding of stock from either a bottom load or top load input device.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appending claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. Apparatus for feeding sheets arranged in a stack in a predetermined direction, which sheets are intermixed in said stack and may be of different sizes, shapes, thicknesses, finishes and quality of condition, said apparatus comprising an infeed hopper;

said hopper including first and second plate means for supporting said stack, and an outfeed opening defined by adjacent ends of said first and second plate means;

said first plate means engaging the first sheet to be feed from said stack and said second plate means engaging the leading edges of at least some of the sheets in said stack, wherein the leading edges of said sheets are those edges which first pass out of said hopper when moving in said predetermined direction;

said first plate means having a first surface portion whose downstream end lies adjacent said outfeed opening and whose upstream end is remote from said outfeed opening, and a second inclined surface portion having a downstream end joined to the upstream end of said first furface portion with the junction defining an angle of greater than 90°, and an upstream end remote from said first surface portion, wherein the upstream end of said second surface portion remote from said junction lies a spaced distance from the plate of said first surface portion;

the upstream end of said first plate means second surface portion engaging the trailing edges of the sheets near the bottom of said stack as the sheets are fed through the outfeed opening whereby these sheets are relieved of the weight of the rearward end of the stack;

said second plate means having an inclined supporting surface aligned at an angle relative to an imaginary vertical line to remove a substantial portion of the weight of the stack from the forward ends of the bottom-most sheets;

the end of said second plate means adjacent said first plate means lying a spaced distance from the downstream end of said first plate means first surface portion to define a narrow outfeed passageway therebetween;

said first support plate first surface portion having an opening;

advancing means protruding through said opening for advancing at least that sheet in said stack engaging said first plate means toward said outfeed opening and for simultaneously moving the trailing edge downstream along said first and second surface portions and away from the remainder of said stack so as to remove the rearward weight of said stack from said sheet engaging the first plate means to facilitate movement of said sheet through said outfeed passageway.

2. The apparatus of claim **1** wherein said advancing means is comprised of a rotating member whose periphery is provided with a raised surface portion for simultaneously jogging at least the bottom portion of said stack and for advancing at least the bottom sheet of said stack when said raised surface portion enters said opening.

3. The apparatus of claim **2** wherein said member is comprised of an annular shaped roller rotatable substantially about its central axis; said raised surface portion being formed of a material having a durometer which is greater than the durometer of the remainder of said periphery.

4. The apparatus of claim **2** wherein said member is comprised of an annular shaped roller rotatable substantially about its central axis; said raised surface portion being formed of a material having a coefficient of friction which is greater than the coefficient of friction of the remainder of said periphery.

5. The apparatus of claim **4** wherein the circumferential length of said raised portion is selected so that the

leading edge of said sheet being fed by said raised portion passes through the outfeed opening before being disengaged from the surface of said raised portion.

6. The apparatus of claim **1** wherein at least one portion of the surface of said second supporting means is provided with means adapted to increase the sliding friction between said one surface portion and the leading edges of said stack of sheets as said sheets move generally downwardly to reduce the amount of weight imposed upon the bottom sheet in said stack by the remainder of said stack.

7. The apparatus of claim **6** wherein said one surface portion is roughened.

8. The apparatus of claim **6** wherein said one surface portion is corrugated.

9. The apparatus of claim **6** wherein said one surface portion has a step-like contour.

10. The apparatus of claim **6** wherein said one surface portion has a saw-toothed surface contour.

11. The apparatus of claim **6** wherein said raised surface portion repeatedly urges said stack upwardly each time said raised surface portion enters said opening to urge the leading edges of said sheets upwardly and against said second supporting means one surface portion to assure release of the weight of said leading edges of said stack from the bottom sheet.

12. The apparatus of claim **6** wherein the circumference of said roller is preferably greater than the length of the shortest document processed by said apparatus with the said length being in the feed direction.

13. The apparatus of claim **1** further comprising means loosely suspended from said second supporting plate and positioned adjacent said outfeed passageway for preventing said sheets in passing through said passageway in a skewed manner.

14. The apparatus of claim **1** further comprising drive rollers positioned adjacent to and downstream of said outfeed opening;

stripper rollers positioned adjacent to said drive rollers;

means for rotating said drive and stripper rollers in opposite directions;

said drive and stripper rollers being positioned to receive sheets delivered through said outfeed opening by said advancing means for separating said sheets and feeding the sheets, one at a time, toward a stacking location.

15. The apparatus of claim **14** wherein said first plate means further comprises a third surface portion extending downstream of said outfeed opening said third surface portion having an opening;

said drive rollers protruding through said opening;

said first and third surface portions being joined to one another adjacent said outfeed opening by a short inclined surface positioned therebetween and forming a continuous surface between the first and third surface portions to cause the leading edge of sheets approaching the outfeed opening to droop downwardly to facilitate their engagement with the drive rollers.

16. Apparatus for advancing sheets from a stack to an outfeed location whereby said sheets are delivered to said outfeed location in sequential fashion whereby the trailing edge of the sheet last advanced to the outfeed location is separated from the leading edge of the next sheet to be delivered to said outfeed location by at least a small distance, said apparatus comprising:

an infeed hopper for supporting a plurality of sheets generally arranged in a stack;

said hopper having an outfeed passageway at one end thereof through which at least the bottom sheet may pass;

the base of said hopper having an opening;

means protruding at least partially through said opening for intermittently advancing at least the bottom sheet of said stack toward said outfeed passageway;

continuously rotating drive means positioned adjacent said passageway for slidably engaging the bottom sheet in said stack and advancing at least the bottom sheet or bottom-most sheets fed thereto toward said outfeed location;

continuously rotating stripper means positioned adjacent said outfeed passageway and said drive means and rotating in a direction opposite said drive means for permitting only a single sheet passing between said stripper means and said drive means to be advanced toward said outfeed location;

said stripper means and said drive means being adapted to cooperatively cause the sheet or sheets fed therebetween to assume an undulating shape in a direction transverse to the forward feed direction of said sheets to stiffen said sheet or sheets and thereby facilitate the respective driving and stripping functions of said driving means and stripping means whereby only the sheet fed toward said outfeed location is the sheet which makes sliding engagement with said drive means and regardless of that fact, that only a single sheet may pass between said drive means and stripper means.

17. The apparatus of claim **16** wherein said drive means and said stripper means each include at least one annular shaped roller, said rollers having surfaces along their annular peripheries of differing coefficients of friction with the coefficient of friction of said drive means roller being greater than the coefficient of friction of said stripper means roller;

said rollers being offset relative to one another in a direction transverse to the feed direction and the distance between the centers of rotation of said rollers being separated by a distance which is less than the sum of their respective radii.

18. The apparatus of claim **17** wherein the near edges of said rollers which are closest to one another are closely spaced to pinch the sheet or sheets passing through said drive means and stripper means between said closely spaced peripheral edges.

19. The apparatus of claim **17** wherein each of said drive and stripper rollers are respectively mounted upon drive and stripper shafts;

said rollers being adjustably positioned along their associated shafts to accommodate sheets of varying thicknesses and to allow for adjustment of said rollers to compensate for normal wearing thereof.

20. The apparatus of claim **17** wherein the stripper means comprises means for pivotally mounting the stripper roller;

the angle of said mounting means and an horizontal plane being chosen to prevent bouncing of said stripper wheels and prevent wedging of sheets between said stripper and drive rollers.

21. The apparatus of claim **17** wherein the stripper means comprises means for pivotally mounting said stripper roller;

said drive and stripper rollers being respectively mounted upon drive and stripper shafts;

said stripper roller mounting being adapted to support said stripper shaft;

stripper and drive pulleys being respectively mounted upon said stripper and drive shafts;

means for rotating one of said shafts;

resilient belt means being entrained about said drive and stripper pulleys for imparting rotation to the remaining one of said shafts and for urging said shafts toward one another.

22. The apparatus of claim **16** wherein said drive means is positioned to make sliding engagement with the first sheet advanced thereto from said stack before said stripper means makes sliding engagement with said first sheet regardless of whether one or more sheets of said stack are advanced toward said stripper means and drive means.

23. The apparatus of claim **16** where at least the peripheral portions of said drive means roller and said stripper means roller are made of materials of differing durometer with the durometer of said drive means roller material being greater than the durometer of the remaining roller.

24. The apparatus of claim **16** wherein the stripper means roller is provided with a convex periphery which is curved in a direction lateral to the movement of said sheets.

25. The apparatus of claim **16** wherein the drive means roller is provided with a convex periphery which is curved in a direction lateral to the movement of said sheets.

26. The apparatus of claim **16** including means for pivotally suspending said stripper means roller, said suspending means being adapted to bias said stripper means roller toward said drive means.

27. The apparatus of claim **16** further comprising accelerating means positioned between said drive means and said outfeed location and including continuously rotating cooperating rollers for receiving a sheet delivered thereto by said drive means and advancing the sheet toward said outfeed location at an increased velocity.

28. The apparatus of claim **27** wherein the accelerating means is preferably positioned at a predetermined distance from said drive means, wherein said predetermined distance is less than the length of the shortest document accepted by said apparatus, with said length being measured in the direction of movement, to cause engagement between a sheet delivered from said drive means and said accelerating means cooperating rollers before said sheet is disengaged by said drive means.

29. The apparatus of claim **27** wherein one of said cooperating rollers is an idler roller;

means for rotating the remaining cooperating roller at a rotational speed greater than the rotational speed of said drive means roller.

30. The apparatus of claim **27** further comprising single power drive means;

means coupled between said power drive means and said accelerating means for rotating said accelerating means;

clutch means coupled between said accelerating means and said drive means for selectively rotating said drive means when said clutch means is engaged;

means coupling said drive means to said stripper means for rotating said stripper means when said clutch means is engaged.

31. The apparatus of claim **30** further comprising brake means coupled to said stripper means and being energized to brake said stripper means and said drive means when said clutch means is disengaged.

32. The apparatus of claim **31** further comprising means for sensing the gap between the trailing edge of a document being advanced by said acceleration means and the leading edge of the next document being advanced toward said acceleration means for generating a pulse;

means for counting said pulses;

settable means coupled to said counter for disengaging said clutch and energizing said brake means when said count advances to the setting (n) of said settable means to slow the movement of the (n+1) document toward said acceleration means while permitting the nth document to reach said outfeed location.

33. The apparatus of claim **31** further comprising means for sensing the gap between the trailing edge of a document being advanced by said acceleration means and leading edge of the next document being advanced toward said acceleration means for generating a pulse;

means for counting said pulses;

settable means coupled to said counter for engaging said clutch and energizing said brake means when said counter advances to one less (n−1) than the setting (n) of said settable means to slow the movement of the (n+1) document toward said acceleration means while permitting the nth document to reach said stacker;

gate means positioned between said acceleration means and said outfeed location, said gate means comprising a pivotally mounted gate having a first position for preventing sheets advanced toward said gate means from being deflected toward said outfeed location and a second position for permitting sheets advanced toward said gate means to be deflected toward said outfeed location;

said gate means including relay means coupled between said gate and said settable means for moving said gate to said second position after said pulse representing the (n−1)th document is generated, and for moving said gate to said first position after the pulse representing the nth document is generated;

said settable means including means for deenergizing said brake and disengaging said clutch a predetermined time delay after said relay means has operated said gate to said second position;

said relay means being adapted to return said gate means to said first position after said counting means generates a pulse representing the nth document.

34. The apparatus of claim **16** further comprising deflecting means positioned between said drive means and said outfeed location for substantially simultaneously deflecting each sheet leaving said drive means toward said outfeed location and for preventing said sheets striking said deflection means from moving toward said outfeed location in a skewed manner.

35. The apparatus of claim **16** wherein drive means comprise at least one drive roller having an annular groove around its periphery;

said stripper means comprising at least one roller having a curved periphery and being positioned at least partially within the groove formed in said drive roller whereby the distance between the centers of said drive and stripper rollers is less than the sum of the outer radii of said drive and stripper rollers.

36. The apparatus of claim **16** wherein drive means comprise at least one drive roller having a plurality of annular grooves around its periphery;

said stripper means comprising at least two roller having curved peripheries separated by a central gap, each of said peripheries being positioned at least partially within associated grooves of said drive roller whereby the distance between the centers of said drive and stripper rollers is less than the sum of the outer radii of said drive and stripper rollers.

37. Apparatus for feeding sheets in a forward feed direction from an infeed to an outfeed location on a single sheet basis comprising:

feed means for advancing sheets from said infeed toward said outfeed locations in said forward feed direction as said sheets engage said feed means;

stripper means and drive means positioned between said infeed and outfeed locations and adjacent said feed means; said stripper and drive means cooperating to constrain sheets to pass therebetween whereby opposite surfaces of the sheets fed therebetween are engaged by said drive and stripper means;

said drive and stripper means each having rollers arranged in staggered fashion, the peripheries of the stripper rollers extending between the peripheries of the feed rollers to cause said sheets fed therebetween to assume an undulating configuration for stiffening said sheets as they pass through said drive means and stripper means;

means for rotating said stripper means rollers and said drive means rollers in opposite directions to cause said stripper means rollers to tend to urge sheets in the reverse direction;

the peripheral surfaces of said drive means rollers having a higher coefficient of friction than those of the stripper means rollers to cause single sheets passing between said drive and stripper means to be fed in the forward feed direction while multiple sheets passing between said drive and stripper means are caused to be stripped by said stripper means to cause the sheets between the drive and stripper means to be advanced to said outfeed location in the order of their relative position to the feed means with the sheet first engaging the feed means being the first to be advanced to the outfeed location.

38. The apparatus of claim **37** wherein said stripper means is further comprised of a swingeable support means pivoted at a first end thereof and having means at the opposite end for rotatably mounting said stripper means rollers to enable said stripper means rollers to "float" relative to said drive means.

39. The apparatus of claim **38** wherein said drive means further comprises means for driving said stripper means rollers without interfering with the "floating" mounting of said stripper means rollers.

40. The apparatus of claim **39** wherein both the pivot point and center of rotation of said stripper means rollers are located to one side of the plane of movement of said sheets to eliminate "bouncing" of said stripper means rollers.

41. The apparatus of claim **40** wherein the support means is aligned relative to the plane of movement of the sheets so that an imaginary straight line between said pivot point and the center of rotation of said stripper means rollers forms an angle of greater than 0° and less than 90° with the plane of movement of said sheets.

42. The apparatus of claim **37** wherein said stripper and means has at least two rollers;

said rollers being positioned so that the near edges of adjacent drive and stripper means rollers pinch a sheet as it passes therebetween so that each sheet is "pinched" in a minimum of two locations whereby said pinching action promotes the undulated configuration which a sheet assumes and further facilitates both the "stripping" and feeding operations.

43. Apparatus for feeding sheets arranged in a stack in a predetermined direction, which sheets are intermixed in said stack and may be of different sizes, shapes, thicknesses, finishes and quality or condition, said apparatus comprising:

means for supporting said stack in an inclined fashion with the leading edges of each sheet being inclined downwardly and positioned below their associated trailing edges;

said hopper comprising an inclined bottom plate for supporting said stack and engaging at least the bottom-most sheet in the stack;

an inclined front plate;

the lower end of said front plate being positioned above said supporting plate for forming a feed opening therebetween to permit the passage of sheets therethrough; abovu said opening;

said said front plate engaging the leading edges of those sheets in the stack positioned above said opening;

said front plate being aligned to form an angle with an imaginary vertical line to remove at least a portion of the weight of the stack from those sheets whose leading edges are positioned below the lower end of said front plate;

the portion of said support plate remote from said opening being inclined upwardly and away from said opening for supporting the upstream end of said stack;

said support plate having an opening positioned between said feed opening and the inclined portion of said support plate;

advancing means protruding through said opening for jostling said stack and advancing sheets from the bottom of said stack toward said feed opening;

said support plate inclined portion and advancing means cooperating to move the trailing edges of the advanced sheets downstream of the rearward end of the stack so as to be substantially relieved of the weight of the stack to facilitate feeding of the sheets through said feed opening.

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