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Brock

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[54] **REVERSE BUCKLE FEEDER**

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[52] **U.S. Cl.** **271/21**

[51] **Int. Cl.** **B65h 3/06**

[58] **Field of Search** 271/21, 22, 19, 20, 24, 271/25

[56] **References Cited**

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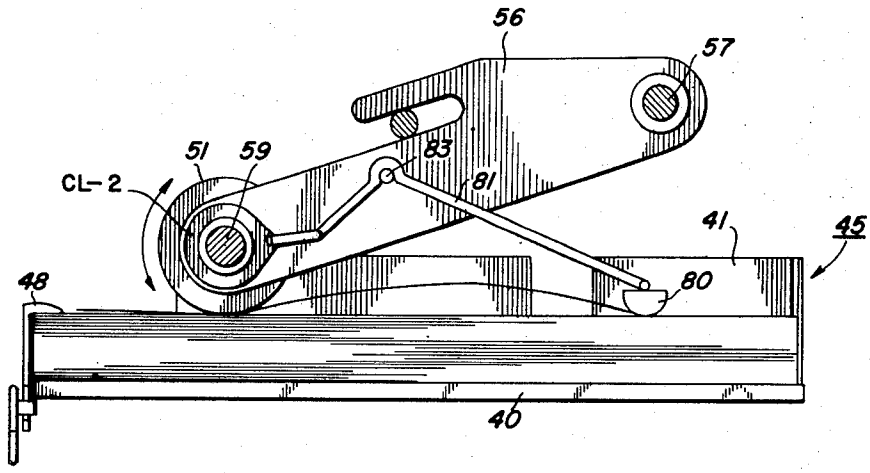
Primary Examiner—Evon C. Blunk
Assistant Examiner—James W. Miller

[57] **ABSTRACT**

Apparatus for improving the sheet feeding capability of a reverse buckle feeding mechanism. A pair of feed rolls are placed in contact with the top sheet in a supply stack and are arranged to first move the sheet rearwardly for a short distance and then forward the sheet from the stack in the opposite direction. A stack retaining bar is pivotally mounted in a lever arm to be moved into and out of pressure contact with the main body of the supply stack behind the feed rolls. Control means are operatively associated with the lever arm to move the retaining bar into pressure with the stack when the top sheet therein is moved rearwardly thereby creating a separating buckle in the sheet. The pressure on the bar is then released as the top sheet is forwarded from the stack.

6 Claims, 3 Drawing Figures



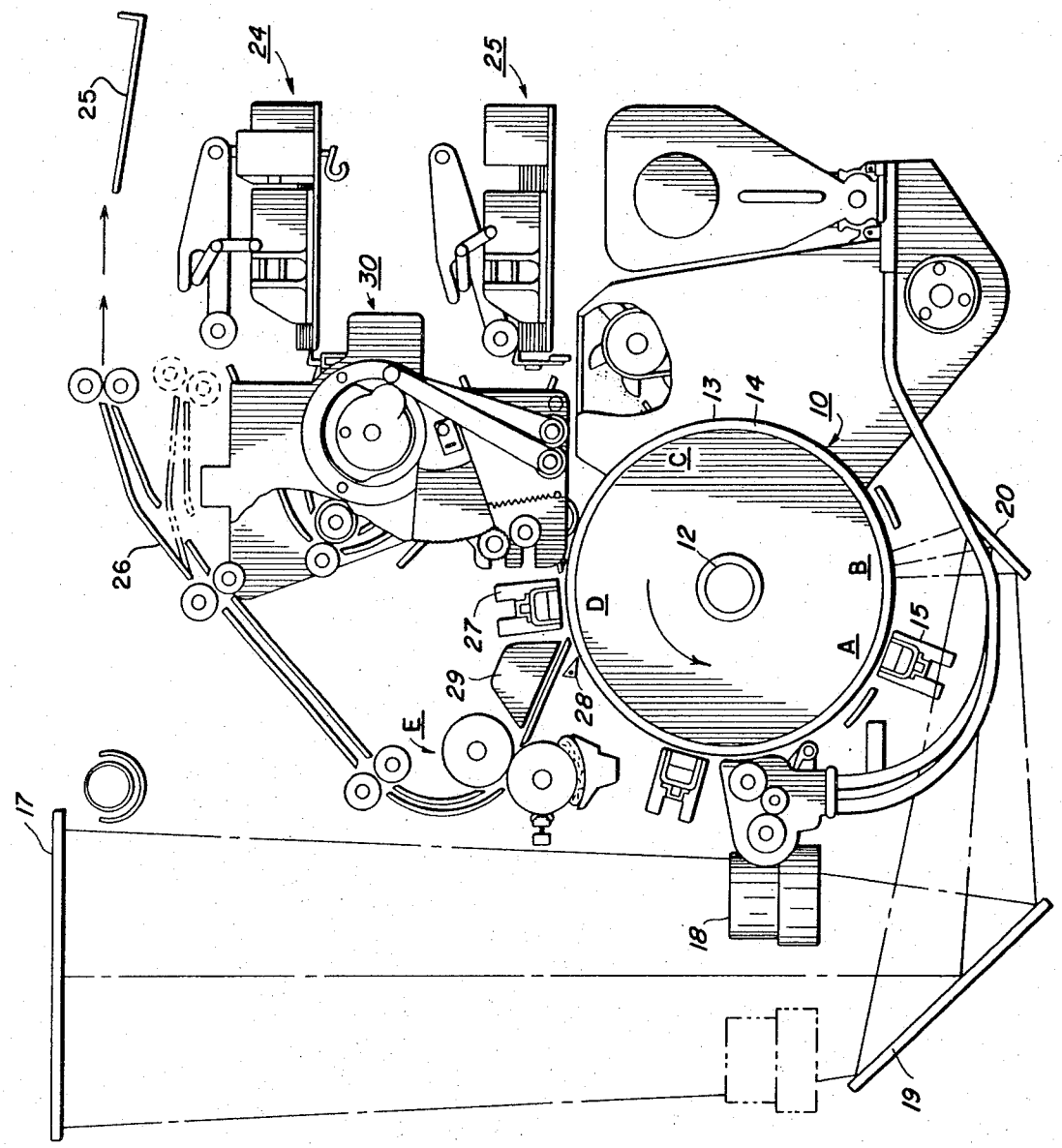


FIG. 1

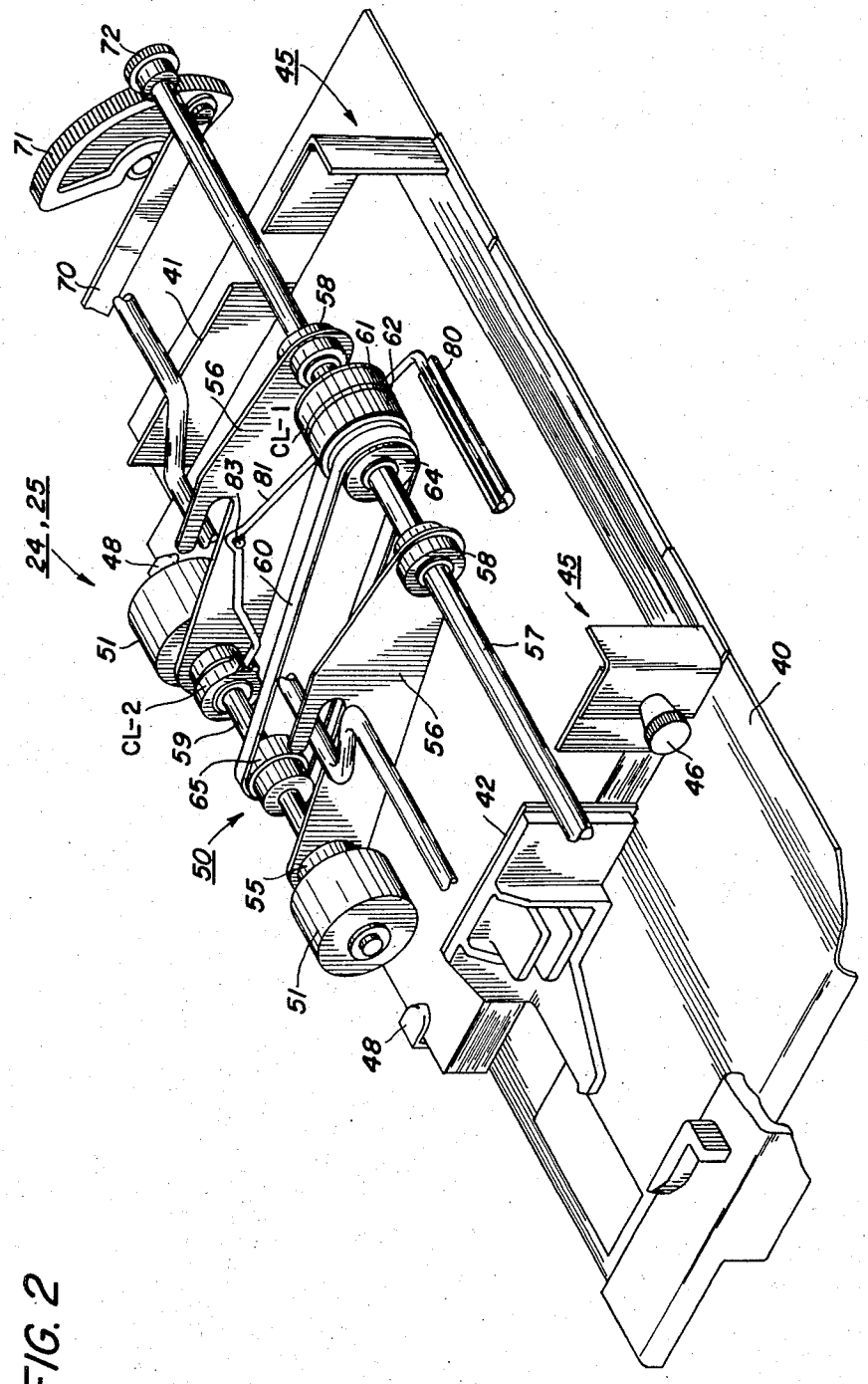

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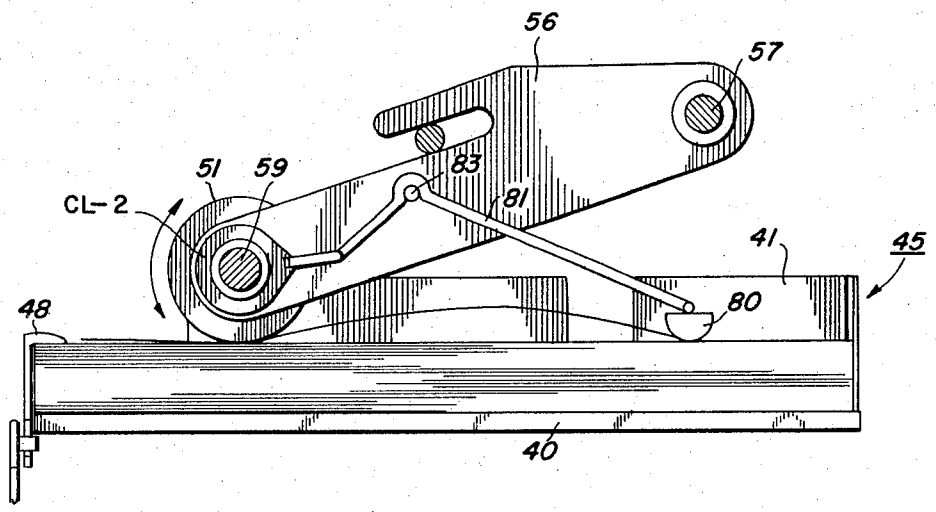
FIG. 2

FIG. 3



REVERSE BUCKLE FEEDER

This invention relates to apparatus for separating and forwarding individual sheets of material from a supply stack and, in particular, to apparatus for improving the feeding of individual sheets from a stack utilizing the reverse buckle sheet separating technique.

In many automatic copying machines in use today, a toner image of an original to be reproduced is created upon a moving photosensitive plate and the image is then transferred to a sheet of final support material, such as paper or the like, to form the desired copy. Conventionally, cut sheets of support material are stored within the confines of the copying machine in a stack configuration with the individual sheets being separated and forwarded from the stack into an image transfer station in registration with the toner image created on the plate surface. One prevalent method of separating and forwarding individual sheets from a stack is by means of the reverse buckle feeding technique. In reverse buckle feeding, the top or bottom sheet in the supply stack is first moved rearwardly, that is, in opposition to the intended direction of sheet feeding, against a retaining element, as for example, the rear wall of the stack support tray, whereby a separating buckle transverse to the field direction is formed in the sheet. Once separated, the sheet is then forwarded along the desired path of travel into subsequent sheet handling means. For further details concerning the utilization of a reverse buckle feeder in an automatic copying machine, reference is had to U.S. Pat. No. 3,645,615 which issued in the name of Spear.

Restraining the rear margin of the copy sheet during the reverse buckle feeding cycle has not proven to be a totally effective method of accomplishing sheet separation in that occasional double sheet feeds or misfeeds occur which necessitate a machine stoppage. It has been found that the rear edge of the sheet in process can "walk" up the rear margin retaining element during operation which, in turn, changes the buckling forces acting upon the sheet, adversely effecting the buckling characteristics of the system. The term sheet buckling force as herein used refers to the force required to cause the sheet in process to be buckled when moved rearwardly against the restraining member. It has been found that the most effective sheet separation is achieved when the initial buckling force is relatively high in comparison to the normal force exerted on the sheet by the feed mechanism, as for example, feed rolls or the like which impart the desired motion to the sheet. As can be seen, if the sheet in process is allowed to move rearwardly during the buckling operation, the initial buckling force is dramatically reduced thus increasing the probability of a misfeed or the occurrance of a double sheet feed.

Similarly, the size of the buckling zone, that is, the area in which the buckle is created, also has a pronounced effect on buckling forces. Generally, the smaller the buckling region, the higher the initial buckling forces will be. In sheet feeding devices which are specifically designed to handle various size sheets, the front margin of the stack is generally fixed in relation to subsequent sheet handling and registration devices. It is therefore impractical to advance the forward margin of the stack in order to hold the buckling zone constant when a change in sheet size is required. As a consequence, the position of the rear margin of the stack must be changed to accommodate various size sheets thus changing the size of the buckling zone and the buckling characteristics of the system.

It is therefore an object of the present invention to improve reverse buckle feeding devices.

A further object of the present invention is to improve the reliability of reverse buckle feeders.

Yet another object of the present invention is to provide a reverse buckle feeder capable of delivering a relatively high uniform buckling force to a sheet in process regardless of the size of the sheet acted upon.

A still further object of the present invention is to increase the buckling forces in a reverse buckle feeder without increasing the normal feeding forces required of the system.

These and other objects of the present invention are attained by means of a reverse buckle feeding system having means for supporting a stack of cut sheets of support material within a supply tray, sheet feeding and separating means, preferably in the form of a feed roller mechanism, for engaging the top sheet in the stack, drive means associated with the feeding and separating means for imparting a first rearward motion to the top sheet in the stack and then a forwarding motion whereby the sheet is advanced from the stack along a predetermined path of travel, a stop bar pivotally mounted to move into and out of contact with the top sheet in the stack at a point rearward from the sheet feeding and separating means in regard to the predetermined forwarding path of travel and control means operatively connected to the drive means for placing the bar into pressure contact with the top sheet when the drive means imparts a rearward motion to the sheet and removing the bar from in pressure contact with the sheet when the drive means imparts a forwarding motion thereto.

For a better understanding of the invention as well as other objects and further features thereof reference is had to the following detailed description of the invention to be read in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic side elevation of an automatic copying machine employing the apparatus of the present invention;

FIG. 2 is an enlarged perspective view in partial section showing the supply tray and reverse buckle sheet separating and feeding mechanism employing the teachings of the present invention;

FIG. 3 is a partial end view of the sheet separating and feeding mechanism illustrated in FIG. 2 showing the reverse buckle feed mechanism of the present invention.

Referring now to FIG. 1, there is illustrated a schematic representation of an automatic xerographic reproducing machine employing the sheet separating and forwarding mechanism of the present invention. It should be noted that the apparatus of the present invention will be explained in conjunction with the reusable xerographic copying process. However, it should be clear to one skilled in the art that the apparatus of the present invention is not so limited in its usage and that the invention has wider application in the paper handling art in any environment requiring the separating and forwarding if individual sheets of material from a support stack.

Because the xerographic copying process is well known and used in the art, the processing steps herein

employed will be only briefly described in reference to FIG. 1. Basically, the heart of the machine involves a photosensitive plate 10 which is formed in a drum configuration. The drum is mounted upon a horizontally aligned support shaft 12 and caused to rotate in the direction indicated so that the photosensitive plate surface thereon passes sequentially through a series of processing station. The photosensitive plate basically consists of an outer layer 13 of photoconductive material, such as selenium or the like, that is placed over a grounded substrate 14.

In operation, the plate is initially charged to a uniform potential at a charging station A by means of a corona generator 15. The uniformly charged plate surface is then moved into an imaging station B wherein a flowing light image of an original document, which is supported upon transparent viewing platen 17, is projected onto the photoconductive plate surface by means of a moving scanning less element 18 and a pair of mirrors 19 and 20. As a result of the imaging process, a latent electrostatic image, containing the original subject matter, is recorded upon a photoconductive plate. The latent image is next transported on the drum surface through a developing station C wherein the latent image is rendered visible by the application of specially prepared charged toner particles to the plate by cascading the material thereof.

The now visible toner image is then advanced on the moving drum surface into an image transfer station D. As will be explained in greater detail below, individual sheets of final support material are fed sequentially from either one of two supply tray areas, an upper supply tray 24 and a lower supply tray 25 via a sheet registering and forwardly mechanism 30 into the transfer station is synchronous moving contact with the visible image carried on the plate. The support sheet and the charged toner image on the drum surface are moved together under a transfer corona generator 27 which serves to electrically transfer the toner image from the plate surface onto the contacting side of the support sheet. The image sheet is then stripped from the drum surface by a pick off finger 28 and directed along a stationary vacuum transport 29 into the nip of a heat pressure roll fusing system E. For further details concerning this type of fusing device, reference is had to U.S. Pat. No. 3,498,596 which issued in the name of Moser.

As noted above, the automatic copier herein described has the capability of producing either single sided copy, that is, copy bearing a toner image on one side thereof, or double sided copy. In the single sided copying mode of operation, the final support sheets are fed from either one of the two supply trays directly into the image transfer station via the sheet forwardly and registering mechanism 30. Upon the accomplishment of the transfer step, the image sheet is passed through the fuser roll assembly and forwarded directly into a collecting tray 25 where the copies are stored and held until such time as the operator removes them. On the other hand, when a two sided copying mode of operation is selected, movable transport 26 in the paper path, is lowered to the dotted line position as shown in FIG. 1 and the upper supply tray, which has been previously emptied of all support materials is automatically prepared to accept the copy sheet directed therein. The copy sheets are fed from the lower support tray through the image transfer station and the image fusing station and ultimately are delivered into the upper support tray area where the once imaged copy sheets are stored until the machine is further programmed for a second copy run. Upon the initialization of the second copy run, the movable transport 26 is once again raised to a solid line position as shown in FIG. 1 and the once imaged copy sheets are fed again directly from the upper supply tray through the transfer and fusing stations wherein a second image is created on the opposite or previously non-imaged side of the sheet. After fusing, the two sided copy sheet is fed directly into the copy tray in a manner herein described above.

The individual supply trays 24 and 25 are movably supported in the machine frame upon a pair of rail members (not shown) and are capable of being moved in a horizontal direction between a first operative sheet feeding position and a second loading position. When in the operative position, as shown in FIG. 2, the sheet supply trays are supported adjacent to the sheet registering and forwarding apparatus 30 wherein sheets forwarded from either tray are directed into a pair of sheet registering rolls which align the sheet prior to them being forwarded into the transfer station. For further details concerning this type of sheet registering and forwarding apparatus reference is herein had to U.S. Pat. No. 3,601,392 issued to Caldwell et al.

Both the upper supply tray and the lower supply tray as well as the sheet separating and forwarding mechanism utilized in conjunction therewith are of similar construction and therefore only one of the trays will be described in greater detail wherein. The supply tray includes a horizontal support platform 40 upon which is mounted a fixed right hand margin guide 41 and an adjustable left hand margin guide 42. A pair of rear edge retaining elements, generally referenced 45, are slidably mounted within the two side margin guides. A thumb screw 46 is provided, which passes through a slotted hole (not shown) formed in the side wall of each margin guide, thus allowing the retainers to be moved parallel to the side margins of the stack so that sheets of various lengths can be accommodated within the tray without altering the front margin position thereof. A pair of weighted snubbers or front margin retaining elements 48 are movably supported at the forward edge of the horizontal support platform 40 which serve to hold the front margin of the stack at a predetermined position during the sheet separating and forwarding operations. The snubbers are adapted to move downwardly under the influence of gravity as the supply of sheets within the stack becomes depleted.

To feed individual sheets of final support material one at a time from each of the individual supply trays, there is provided at sheet separating and feeding means generally reference 50 consisting of a pair of driven feed rollers 51 supported in a self aligning manner within floating bearings secured to a shaft 59. The shaft 59, in turn, is secured in bearing blocks 55 mounted in the front or free end of two support arms 56. The opposite end of each support arm is pivotably supported upon a drive shaft 57 in bearings 58. The drive shaft, in turn, is journaled at both ends in the machine frame at a point above the individual supply trays thereby permitting the feed rollers to rest under their own weight in contact with the uppermost sheet in a stack.

As individual sheets are fed from the stack, the freely mounted, self adjusting feed rolls move downwardly into contact with the next subsequent sheet to be fed from the stack. Each feed roller is operatively con-

nected to the drive shaft by means of a clutch and pulley arrangement. The prescribed sheet feeding motion is translated to the rollers through the clutch and pulley in proper timed relation with the creation of a toner image on the photoconductive drum surface wherein the advancement of individual sheets from the supply stack is coordinated with the movement of the drum surface so that the individual sheets of support material fed into the transfer station are placed in overlying contact with the toner image on the plate surface. The motion of the drive shaft **57** is transmitted to the feed roller drive shaft **59** via an electromagnetic clutch CL-1 and a timing belt **60**. The clutch includes a drive unit **61** pinned to the drive shaft and a driven unit **62** which is rotatably supported upon the drive shaft within the roller bearing. A timing pulley **64** is locked to the driven end of the clutch and is operatively connected to a second drive pulley **65**, which is pinned to the feed roller drive shaft, via the timing belt.

At the beginning of each sheet feeding cycle, the feed rollers are rotated in a direction to cause the leading edge of the top most sheet to be moved rearwardly from beneath the front edge of the retaining members. The trailing edge of the sheet, however, is held stationary as will be explained in greater detail below so that a separating buckle transverse to the sheet feed direction is formed in the rear portion of the sheet body. Upon the rearward movement of the uppermost sheet, the free floating front margin retaining snubbers are dropped down into contact with the second sheet in the stack and function to hold the front edge of the stack in alignment as the uppermost sheet is fed therefrom. Upon the creation of the separating buckle, the direction of the feed rollers is then reversed and the now separated sheet driven over the top of the retaining elements into the sheet registering apparatus. The rear surfaces of the front margin retaining snubbers are tapered into a knife edge configuration to facilitate forwarding of the sheets thereover.

As explained in greater detail in the previously noted Spear patent, the drive shaft **57**, associated with the two feed roller assemblies, is driven from the machine's main drive assembly via a segmented gear, a cam and cam linkage arrangement. A control cam (not shown) is locked to the main machine drive system and operates through cam linkage **70**, segmented gear **71** and pinion **72** to impart a prescribed motion to the sheet feeding drive shaft. The prescribed motion translated to the drive shaft through the control cam system rotates the shaft first in one direction for a portion of a sheet feeding cycle and in the opposite direction for the remainder of the cycle. As can be seen, the drive shaft is thus locked to the main drive system and is continually turned in timed relation with the drum surface when the machine is in operation. Through means of the clutching arrangement herein described only a portion of the shaft's total motion, however, is imparted to the feed roll during each paper forwarding cycle.

In practice, the clutch CL-1 is energized as the feed roll drive shaft approaches the mid-point of the prescribed motion, that is, the point at which the direction of the shaft rotation is reversed. The timing is such as to cause the feed rolls to pull the uppermost sheet on the stack from beneath the retaining member **70** via the clutch and belt arrangement. The distance that the leading edge of the sheet is moved is controlled so that it is insufficient to push the sheets from beneath the feed rollers but sufficient to form a separating buckle in the sheet. The clutch is held energized through the mid-point of the cycle. As the direction of the feed roll rotation is reversed, the separated sheet is forwarded by the rollers into subsequent sheet handling means associated with the sheet registering apparatus. At this time, the electromagnetic clutch is de-energized and the feed rollers are placed in an idle condition which allows the trailing portion of the sheet to be pulled thereunder. The clutch will remain idle until such time as another sheet feeding cycle is initiated.

As best seen in FIGS. **2** and **3**, a stack retaining element constructed of a rubber bar **80** is herein provided which is arranged to contact the uppermost sheet in the stack at a predetermined point to the rear of the feed rollers. The bar extends transverse to the direction of sheet feeding and is supported within a lever arm **81** that is pivotally mounted in the feed roll support arm **56** by means of a pin **83**. The opposite end of the lever arm is operatively connected to a one way clutch CL-2 mounted upon the feed roll drive shaft **59**. The lever is constructed of a spring steel or any other similar material capable of being resiliently deformed under a predetermined load.

In practice, the one way clutch is arranged to be activated or locked when the feed roll drive shaft **59** is rotated in a counterclockwise direction, that is, in a direction so as to move the uppermost sheet in the stack in a rearward direction. With the clutch locked, the retaining bar **80** is forced downwardly via the lever arm **81** into pressure contact with the stack. The spring tension of the lever arm is regulated so that the arm will be bent as the locked clutch continues to rotate in a counterclockwise direction so as to deliver a constant holding force against the uppermost sheet in the stack. In order to develop a maximum buckling force, which as previously noted is required for efficient and repeatable sheet separation, the force delivered by the arm is set at the maximum pressure allowable without damaging the support sheets.

As can be seen, the present lever arm arrangement is adapted to hold the retaining bar at a fixed position in regard to the feed rollers and thus create a fixed buckling or sheet separating zone. As the top sheet in the stack is moved rearwardly by the feed rolls, a buckle, as shown in FIG. **3**, is created therein which separates the top sheet from the remainder of the stack. At the same time, the leading edge of the sheet is pulled from beneath the lead edge retaining snubbers thus placing the sheet in a condition to be forwarded from the stack.

Upon the reversal of the direction of rotation of the feed rollers, shaft **59** is caused to drive in a clockwise direction thus unlocking or inactivating the one way clutch and releasing the holding pressure exerted upon the retaining bar **80**. As the feed rolls continue to deliver a forwarding motion to the now separated uppermost sheet in the stack, the sheet is pulled from beneath the unloaded retaining bar and forwarded over the front edge retaining snubbers into subsequent sheet handling means associated with the sheet registering and forwarding mechanism **30**.

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

What is claimed is:

1. Apparatus for separating and forwarding individual sheets from a supply stack including:

sheet feeding means for engaging the top sheet within a stack for moving said sheet in a first direction toward the rear of said stack and then in the opposite direction along a predetermined path of travel;

holddown means for contacting the top sheet in said stack;

lever means connected at one end to said holddown means and at the opposite end to said sheet feeding means;

control means interposed between said lever means and said sheet feeding means including a one way clutch arranged to force said holddown means into pressure contact against the stack when said sheet feeding means moves said sheet in a rearward direction and to release said holddown pressure when said sheet feeding means moves said sheet in the opposite direction.

2. The apparatus of claim 1 wherein said lever means is formed of a spring material capable of deforming when the contacting pressure exerted by the hold down means on the stack exceeds a predetermined pressure.

3. The apparatus of claim 1 wherein said sheet feeding means consists of at least one feed roller being arranged to continually ride in contact with the last sheet in said stack.

4. The apparatus of claim 1 further including retaining means for supporting the leading edge of said stack in alignment during the separation and feeding of a sheet therefrom.

5. Apparatus for separating and forwarding individual sheets from a supply stack including:

feed rolls being arranged to contact the top sheet in a supply stack;

drive means operatively connected with said feed rolls for rotating the feed rolls in a first direction whereby the top sheet in said stack is moved rearwardly and then rotating the feed rolls in the opposite direction wherein the top sheet in said stack is moved in a forward direction;

a stack holddown element mounted upon the free end of a lever arm in contact with the stack at a point rearward of said feed rolls in relation to the direction of sheet movement; and

clutch means operatively associated with said feed rolls for controlling the movement of said lever arm to position said holddown element in pressure contact with said stack when the feed rolls are moved in a rearward direction and to release said pressure from said holddown means as said feed rolls are driven in a forward direction.

6. The apparatus of claim 5 wherein said feed rolls are pivotally mounted above the supply stack upon a pivot arm, said pivot arm further rotatably supporting said lever arm wherein the distance between said feed rolls and hold down element remains constant as the contents of the supply stack are depleted.

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