# United States Patent [19]

**Patel**

[11] **3,857,558**

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[54] **PAPER CASSETTE DESIGN WITH IRREGULAR BOTTOM**


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[52] **U.S. Cl.**..... **271/22,** 271/127, 271/170

[51] **Int. Cl.**..... **B65h 3/06,** B65h 3/46

[58] **Field of Search**..... 271/21, 22, 23–25, 271/109, 126, 127, 170



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,350,089 | 10/1967 | Niccoli | 271/21 |
| 3,503,603 | 3/1970 | Dvorak | 271/23 |
| 3,687,448 | 12/1970 | Vora | 271/21 |



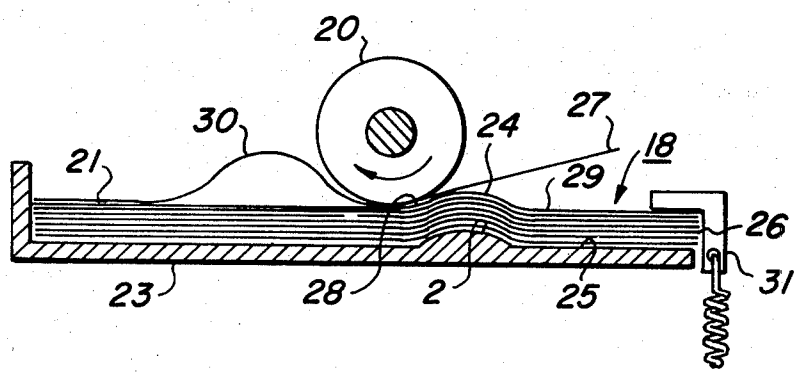
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[57] **ABSTRACT**

A sheet feeding apparatus as provided wherein the surface for supporting a stack of sheet material includes an inclined surface portion positioned between the leading edge of the stack and the feeding means. The inclined surface coacts with the feeding means to elevate the leading edge of the top most sheet away from the next adjacent sheet as it is fed from the stack. Preferably the sheet feeding apparatus comprises a reverse buckle type sheet feeder. The sheet feeding apparatus is adapted to elevate the leading edge of the top most sheet as it is being fed to thereby improve sheet separation and reduce jamming propensity.


**10 Claims, 4 Drawing Figures**



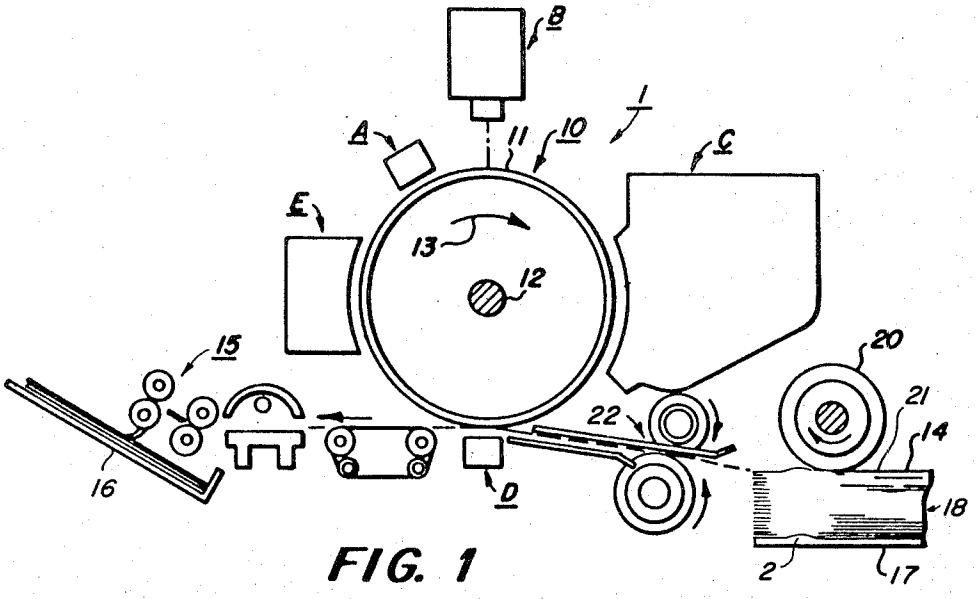



FIG. 1

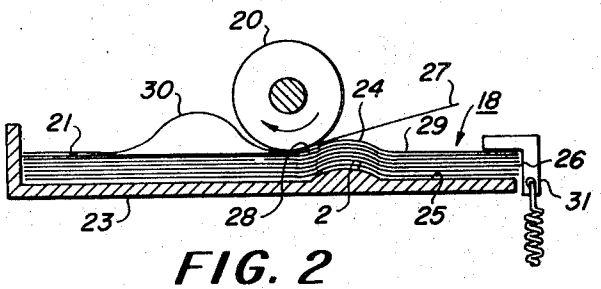



FIG. 2

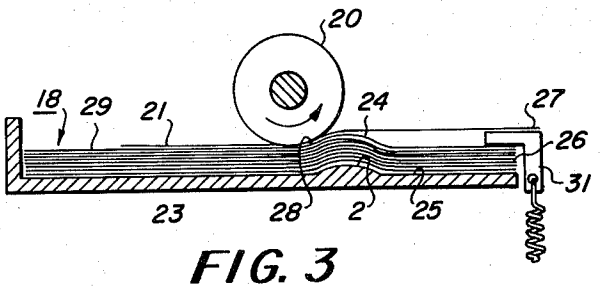



FIG. 3

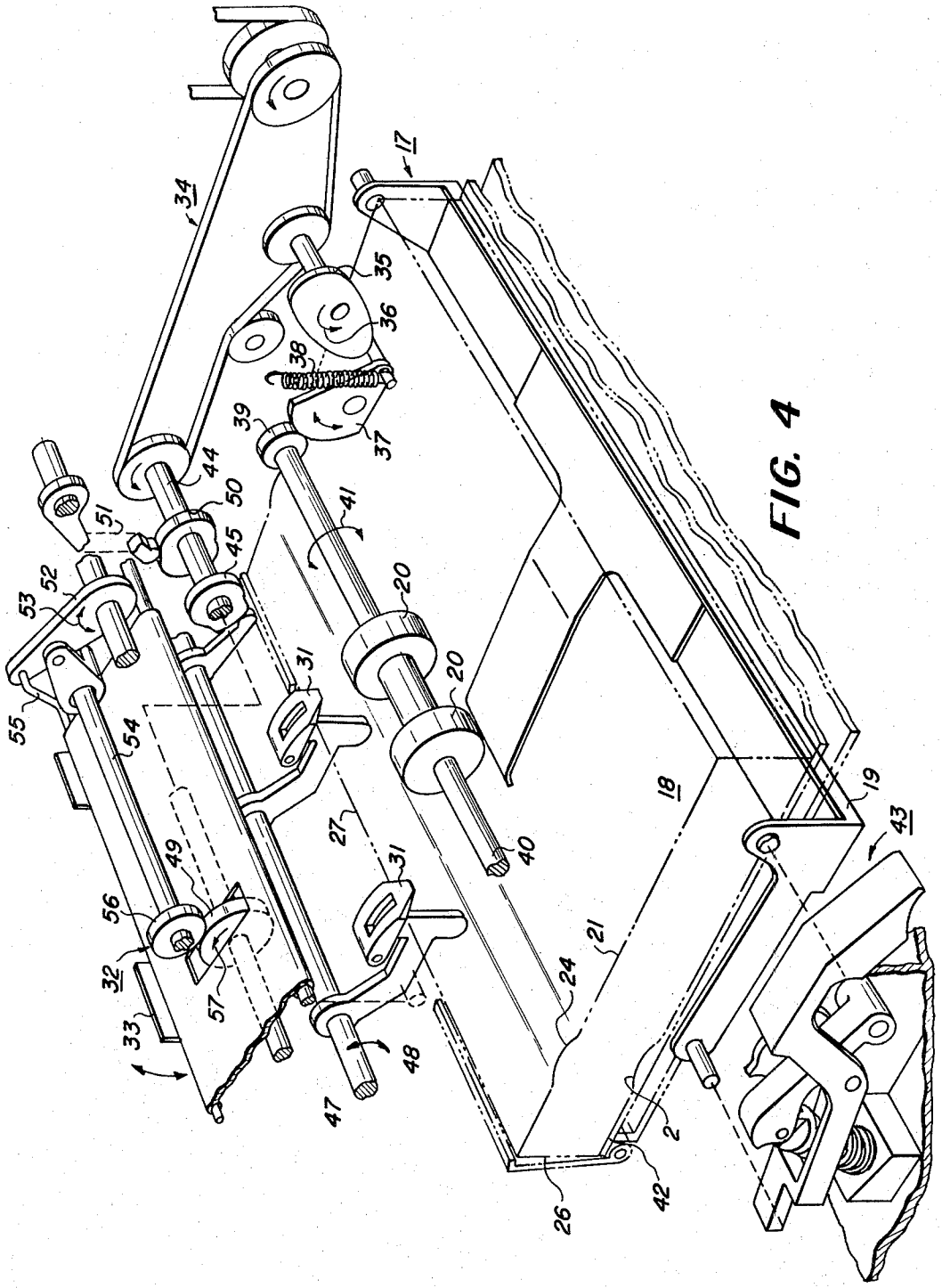

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FIG. 4

# PAPER CASSETTE DESIGN WITH IRREGULAR BOTTOM

## BACKGROUND OF THE INVENTION

This invention relates to a sheet feeding device which is suitable for use in an automatic reproducing machine, for example, a xerographic copier. The apparatus of this invention is adapted to feed individual sheets successively from a stack to a suitable mechanism which is to operate on the sheets. The invention is particularly directed to a sheet feeding apparatus of a type in which one sheet of the stack is reverse buckled to detach it from the other sheets and when so detached is fed from the stack. In accordance with this invention means are provided for increasing the elevation of the leading edge of the sheet as it is fed from the stack thereby reducing the propensity for jams to occur, such as those that occur due to the interaction of front edge snubber tabs and the lead edge of the top most sheet.

In a reverse buckle sheet feeder the rear margin of the stack is supported against the rear wall of a sheet support tray, so that the sheets are free to move only in a forward direction. Feeding means are then brought into operative contact with the uppermost sheet in the stack and a motion imparted to the sheet to first drive the sheet rearwardly against the restraining force of the rear wall of the tray. As a consequence, a longitudinal buckle is formed in the body of the sheet causing the sheet to be separated from the stack. Once separated the direction of sheet motion is reversed and the sheet is advanced forwardly through an opening in the tray and cleared therefrom prior to instituting a subsequent feeding cycle.

U.S. Pat. Nos. 1,054,637 granted 1913, 3,350,089 granted 1967, 3.417,988 granted 1968 and 3,687,448 granted 1972 all show and describe reverse buckle sheet feeding apparatuses wherein the support tray includes a discontinuity in the supporting surface which deforms the sheet material supported thereon. The discontinuities are employed for a variety of reasons including breaking up the stack to provide better separation and or for maintaining normal distribution of forces on each sheet of the stack regardless of the height of the stack. In each of the apparatuses disclosed in the above-noted patents the discontinuity is present below or behind the feed roll and, therefore, the discontinuities do not serve to elevate the leading edge of the top most sheet as it is being fed from the stack as in accordance with the present invention.

## SUMMARY OF THE INVENTION

In accordance with this invention a sheet feeding apparatus is provided including means for supporting a stack of sheet material wherein the support means includes at least one inclined surface for deforming the sheet material supported thereon and feeding means arranged to contact the top most sheet of the stack for feeding the sheet from the stack. In accordance with this invention the inclined surface is positioned between the leading edge of the stack and the feeding means so that the inclined surface coacts with the feeding means to elevate the leading edge of the top most sheet away from the next adjacent sheet as it is fed from the stack. Preferably the sheet feeding apparatus comprises a reverse buckle type sheet feeder and the feeding means comprises one or more rolls. It is also preferred to employ front edge snubber tabs to maintain the alignment of the stack. The stack supporting means preferably comprises a tray or cassette wherein the inclined portion represents a bump in the bottom of the tray or cassette. Preferably the inclined surface or bump comprises a curved operative surface which deforms the stack so as to provide a raised portion in the top most sheet of the stack. The feed roll by contacting the top most sheet behind the raised portion, when viewed in the direction of feeding, coacts with the raised portion to elevate the lead edge of the top most sheet so that it will readily separate from the stack and pass over front snubber tabs. It is an object of this invention to provide an improved sheet feeding apparatus.



It is a further object of this invention to provide a sheet feeding apparatus which is adapted to elevate the leading edge of the sheet being fed.

It is a further object of this invention to provide an apparatus as above which provides improved sheet separation and reduces jamming propensity.

It is a further object of this invention to provide an apparatus as above wherein sheet separation is accomplished by reverse buckling.

These and other objects will become more apparent from the consideration of the following description and drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows schematically an exemplary xerographic reproducing machine with which the sheet feeder of this invention is employed.

FIG. **2** shows a side view in partial cross-section of the sheet feeding apparatus of this invention during reverse buckling of the sheets.

FIG. **3** shows a side view in partial cross-section of the sheet feeding apparatus in accordance with this invention, during forward feeding of the sheet.

FIG. **4** shows a perspective view of a sheet feeding apparatus in accordance with this invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. **1** there is shown by way of example an automatic xerographic reproducing machine **1** which incorporates the improved sheet feeding apparatus **2** of the present invention. The reproducing machine **1** depicted in FIG. **1** illustrates the various components utilized therein for producing copies from the original. Although the sheet feeding apparatus of the present invention is particularly well adapted for use in an automatic xerographic reproducing machine **1** it should become evident from the following description that it is equally well suited for use in a wide variety of machines requiring single sheet feeding and is not necessarily limited in its application to the particular embodiment shown herein.

The reproducing machine illustrated in FIG. **1** employs an image recording drum-like member **10,** the outer periphery of which is coated with a suitable photoconductive material **11.**

Since the practice of xerography is well-known in the art, the various processing stations for producing a copy of an original are herein represented in FIG. **1** as blocks A to E. Initially the drum **10** moves photoconductive surface **11** through charging station A. In

charging station A an electrostatic charge is placed uniformly over the photoconductive surface **11** of the drum **10** preparatory to imaging.

Thereafter, the drum **10** is rotated to exposure station B where the charged photoconductive surface **11** is exposed to a light image of the original input scene information, whereby the charge is selectively dissipated in the light exposed regions to record the original input scene in the form of a latent electrostatic image. After exposure, drum **10** rotates the electrostatic latent image recorded on the photoconductive surface **11** to development station C wherein a conventional developer mix is applied to the photoconductive surface **11** of the drum **10** rendering the latent image visible.

The developed image on the photoconductive surface **11** is then brought into contact with a sheet **14** of final support material within a transfer station D and the toner image is transferred from the photoconductive surface **11** to the contacting side of the final support sheet **14.** The final support material may be paper, plastic, etc., as desired. After the toner image has been transferred to the sheet of final support material **14** the sheet with the image thereon is advanced to a suitable fuser **15** which coalesces the transferred powder image thereto. After the fusing process the sheet **14** is advanced by rolls **15** to catch tray **16** for subsequent removal therefrom by the machine operator. The residual toner particles remaining on the photoconductive surface **11** after the transfer operation are removed from the drum **10** as it moves through cleaning station E.

The copier in accordance with this invention can also have the capability of accepting and processing copying sheets of varying lengths. The length of the copy sheet, of course, being dictated by the size of the original input scene information, recorded on the photoconductive surface **11.** To this end the paper cassette **17** is preferably provided with an adjustable feature whereby sheets of varying length and width can be conveniently accommodated therein. In operation the cassette **17** is filled with a stack of final support material **18** of preselected size and the cassette **17** is inserted into the machine by sliding along a base plate **19** as shown in FIG. **4,** which guides the cassette **17** into operable relationship with a pair of feed rolls **20.** When properly positioned in communication with the feed rolls **20** the top most sheet of the stack **21** is separated and forwarded from the stack into the transfer station D by means of registration rolls **22.**

It is believed that the foregoing description is sufficient for purposes of the present application to illustrate the general operation of an automatic xerographic copier **1** which can embody the teachings of the present invention.

Referring now to FIGS. **2** and **3** the operative elements of the present apparatus **1** are shown. In accordance with this invention the sheet feeding apparatus **1** includes means **23** for supporting a stack of sheet material **18.** The term stack as it is employed in the present application includes the single last sheet which remains after the stack has been depleted and is not meant to be limited to a plurality of sheets. A feeding means such as rolls **20** is arranged to contact the top most sheet **21** of the stack **18.** It is essential in accordance with this invention that the support means **23** include an inclined surface **2** which is adapted to deform the stack **18** to provide a protuberance **24** in the top most sheet **21** of the stack. The inclined surface portion **2** is located on the support surface **25** at a position between the leading edge **26** of the stack **18** and the feeding means or feed rolls **20** as shown and closely adjacent to the feed roller. The feed rolls **20** coacts with the protuberance **24** caused by the inclined surface **2** so as to elevate the leading edge **27** of the top most sheet **21** as it is fed from the stack **18** thereby providing an improved separation and improved clearance between the leading edge of the sheet so that the sheet can be fed over front snubber tabs or other like obstructions. Preferably the inclined portion **2** has a curved convex shape which provides a smoothly deformed surface or protuberance **24** in the top most sheet **21.** By positioning the feed rolls **20** closely adjacent to the leading upwardly rising portion **28** of the protuberance **24** in the top most sheet the greatest advantage is taken of the beam strength of the sheet **21** for elevating the leading edge **21** thereof. In the most preferred embodiment of this invention the nip formed between the roll **20** and the top most sheet **21** is immediately adjacent the leading upwardly rising portion **28** of the protuberance **24,** for example, preferably within about one-half inch and more preferably within about one-fourth inch. This deflection of the sheet in the immediate area of the protuberance **24** provides the improvement in the elevation for the leading edge **27** of the top most sheet **21.**

It is also preferred in accordance with this invention that the inclined surface **2** and protuberance **24** associated therewith be positioned sufficiently close to the leading edge **26** of the stack **18** so that the leading edge **27** of the top most sheet **21** after deformation about the protuberance is elevated from the next adjacent sheet **29.** This distance, of course, depends on the beam strength of the sheet **21** being processed. If the inclined surface **2** is positioned too far rearwardly from the leading edge **26** of the stack **18,** the beam strength of the sheet **21** will not be sufficient to maintain its leading edge **27** elevated from the next adjacent sheet **29.** Preferably the leading upwardly rising portion **28** of the protuberance **24** is positioned within about 8 inches of the leading edge **26** of the stack **18** and more preferably within about 4 inches.

The invention is particularly applicable to a reverse buckle type sheet feeder as shown in FIGS. **2** and **3.** In operation, the feed rolls **20** during the first segment of feeding cycle feed the top most sheet **21** rearwardly so as to form a buckle **20** which is effective to separate the top most sheet from the next adjacent sheet **29.** As shown in FIG. **3,** following the buckling operation, the feed rolls **20** are reversed to feed the top most sheet **21** in the forward direction away from the stack **18.**

The elevation of the leading edge **27** of the top most sheet **21** during the feeding operation as shown in FIGS. **2** and **3** is sufficient to help enable the leading edge of the sheet to clear any obstructions such as front snubber tabs **31** at the leading edge **26** of stack **18.** The increased elevation provided in accordance with this invention for the leading edge **27** of the sheet **21** makes it significantly easier to clear any such obstructions and significantly reduces the tendency for snubber jams to occur, and permits broader tolerances for the thicknesses of the tips of the snubbers **31** thereby providing a substantial cost reduction.

Referring now to FIG. **4** a specific embodiment of a sheet feeding apparatus in accordance with this invention is described. The apparatus is similar in many respects to those described in U.S. Pat. application, Ser.

No. 255,355 now U.S. Pat. No. 3,773,316, filed May 22, 1972, and U.S. Pat. No. 3,731,915 issued to Guenther in 1973. The apparatus includes a pair of feed rolls **20** usually made of rubber or similar material mounted in cooperative relation to each other in front of snubber tab members **31** which assist in separating the forwardly moving sheet **21** from the remainder of the stack **18.** However, it will be appreciated that one feed roll **20** in lieu of two will operate satisfactorily. The feed rolls **20** advance the top most sheet **21** of the stack **18** over the tab members **31** and between the forwarding rolls **32** until the leading edge **27** of the advancing sheet engages the registration member or gate **33.** This is achieved by a suitable endless belt or chain drive **34** which rotates the cam **35** in the direction of arrow **36.** Sector gear **37** is resiliently maintained in engagement with the cam **35** by means of a suitable spring member **38.** The cam **35** drives the sector gear **37** in an oscillating fashion. The sector gear **37** meshes with a pinion gear **39** to rotate the pinion gear in counterclockwise and clockwise directions. Since the pinion gear **39** and feed rolls **20** are secured to a common shaft **40,** the feed rolls rotate in conjunction with the pinion gear as indicated by arrow **41.** The feed rolls **20** are in intermittent rotation and are adapted to engage the top most sheet **21** of the stack **18** disposed in the tray member or cassette indicated generally at **17.** The tray member **17** includes a pivotable base plate **42** on which the stack **18** of sheet material is disposed. Biasing means generally indicated at **43** is mounted to engage the base plate **42** to move it in an upwardly and downwardly direction. The base plate **42** is adapted to pivot so that the top most sheet **21** of the stack **18** engages the feed rolls **20** which are fixably attached to shaft **41** and remain stationary relative thereto. Drive **34** rotates shaft **44** having cam **45** mounted thereon. Cam **45** in turn drives cam follower **46** which is mounted on a common shaft **47** with the tab members **31.** Tab members **31** thereby pivot in synchronism with the feed rolls **20** to engage and disengage the top most sheet **21** of the stack **18** at the appropriate time, i.e., shaft **47** rotates in both a clockwise and counterclockwise direction as indicated by arrow **48.** Preferably, tab members **31** are self-aligning, i.e., they are suitably secured to shaft **47** to be vertically movable and laterally pivotable to position their horizontal surface squarely on the top most sheet **21** of the stack **18.** Registration roll **49** is mounted on shaft **68.** Cam **50** mounted in shaft **44** drives cam follower **51** which in turn causes connecting link **52** to pivot in the direction of arrow **53.** Link **52** has shaft **54** and rod **55** affixed thereto. In this way shaft **54** which has forwarding roll **56** mounted thereon is adapted to move forwarding roll **56** into and out of engagement with an advancing sheet **21** passing over forwarding roll **56.**

The advancing sheet **21** moves between the closely spaced forwarding rolls **32** and the leading edge portion thereof engages registration gate **33.** Thereafter link **52** pivots to move forwarding roll **56** downwardly into engagement with the advancing sheet **21** and the registration gate **33** downwardly to disengage from the leading edge **27** portion of the advancing sheet. The sheet **21** is thereupon transferred to the image transfer station D as in FIG. **1** in a timed relationship with the image on the drum **10.** It will be appreciated that the operation of the sheet feeding apparatus is controlled by driving means **34** which in turn engages the copier input drive via a suitable clutch (not shown) actuated by a suitable solenoid (not shown) that is activated by the optical scanning system. In this manner the sheet feeding apparatus is maintained in a timed relationship with the image on the drum **10** to insure registration of the advancing sheet with the image. In accordance with this invention the base plate **42** includes the inclined portion **2** which deforms the stack **18** to provide the protuberance **24** in the top most sheet **21** which is located closely adjacent to the feed rolls **20.**

In operation the base plate **42** is moved in an upwardly direction by biasing means **43** to move the top most sheet **21** into engagement with the feed rolls **20.** The feed rolls **20** are rotated in a counterclockwise direction to move the uppermost sheet **21** in the stack **18** in a rearwardly direction. The rearward movement of the sheet **21** produces a buckle **30** therein and facilitates the separation thereof from the remainder of the sheets from the stack. During this portion of the operation the forwarding rolls **32** are spaced apart from one another and the registration gate **33** is pivoted in an upwardly direction to its operable position. As the sheet **21** moves rearwardly it flips from beneath the snubber tab members **31** and the tab members drop down onto the next adjacent sheet **29** of the stack **18.** Then the direction of rotation of the feed rolls **20** is reversed and the sheet **21** is advanced in the forward feeding direction over the tab member **31** until the leading edge **27** thereof engages the registration gate **33.** The protuberance **24** caused by the inclined surface portion **2** in the base plate **42** coacts with the feed rolls **20** during the forward feeding portion of the cycle to provide increased elevation of the leading edge **27** of the sheet **21.** This enables the sheet to readily pass over the snubber tabs **31** and substantially reduces the propensity for snubbing jams. The forwarding rolls **32** are spaced apart from one another to allow the sheet **21** to be interposed therebetween. The leading edge **27** of the advancing sheet **21** abuts the registration gate **33** and a buckle is produced therein which removes any sideways skewing of the sheet. This insures that the image transferred from the drum will be appropriately oriented on the sheet **21.** After the leading edge **27** of the sheet **21** has engaged the gate member **33** and produced the slight buckle therein, the gate member is moved in a downwardly direction. The forwarding roll **56** also moves in a downwardly direction to contact and position the sheet in engagement with registration roll **49** rotating in the direction of arrow **57** for a continuing advancement of the sheet **21.** As the forwarding roll **56** moves in a downwardly direction to move the sheet **21** into engagement with the registration roll **49** the tab members **31** pivot base plate **42** in a downwardly direction by applying a force of sufficient magnitude to overcome the resilient force exerted thereon by biasing means **43.**

In this way the feed rolls **20** only rotate about shaft **40** and do not translate relative to the machine frame, whereas the stack **18** disposed on the base plate **42** is pivoted into and out of engagement with the feed rolls **20.**

In accordance with this invention the term forwardly indicates the direction in which the sheet **21** is to be fed from the stack **18** whereas the term rearwardly indicates the opposite direction.

The inclined surface in accordance with this invention may be a homogeneous portion of the supporting

surface or it may be integrally connected thereto as desired. Preferably the inclined portion extends transverse to the direction of sheet feeding so as to completely traverse the sheets of the stack. Preferably the inclined surface lies parallel to the axis of the feed rolls.

The patents and applications referred to specifically in the detailed description of this application are intended to be incorporated by reference into the description.

It is apparent that there has been provided in accordance with this invention a sheet feeding apparatus which fully satisfies the objects, means and advantages set forth hereinbefore. While the invention has been described in conjunction with specific embodiments therefore it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, it is intended to embrace all such alternatives, modifications and variations as fall within the spirit and broad scope of the appended claims.

What is claimed is:

**1.** A sheet feeding apparatus comprising: support means for supporting a stack of sheet material on top thereof, said support means including at least one inclined surface for deforming said sheet material supported thereon to form a protuberance in the top most sheet, means coacting with said protuberance for elevating the leading edge of said top sheet as it is fed from said stack, said elevating means including feeding means arranged to contact the top most sheet of said stack for feeding the top most sheet from said stack, said inclined surface being positioned between the leading edge of said stack and said feeding means.

**2.** An apparatus as in claim **1** wherein said protuberance includes a leading upwardly rising portion and wherein said feed means is positioned closely adjacent to said upwardly rising portion.

**3.** An apparatus as in claim **2** wherein said inclined portion has a convexly curved shape which provides a smoothly deformed surface which constitutes said protuberance.

**4.** An apparatus as in claim **2** wherein said feeding means comprises at least one roll.

**5.** An apparatus as in claim **4** wherein said elevating means includes means to deflect said sheet in the area of said protuberance to elevate the leading edge thereof, said deflecting means comprising the nip formed between said roll and said top most sheet with said nip being positioned immediately adjacent the leading upwardly rising portion of said protuberance.

**6.** An apparatus as in claim **5** wherein said nip is within about one-half inch of said upwardly rising portion of said protuberance.

**7.** An apparatus as in claim **5** wherein said inclined surface and associated protuberance are positioned sufficiently close to the leading edge of said stack so that the leading edge of said top most sheet after deflection about said protuberance is elevated from the next adjacent sheet as it is fed from said stack.

**8.** An apparatus as in claim **7** wherein the leading upwardly rising portion of said protuberance is positioned within about 8 inches of the leading edge of said stack.

**9.** An apparatus as in claim **8** wherein said sheet feeding apparatus comprises a reverse buckle sheet feeder wherein said feed roll is adapted to advance said top most sheet first rearwardly to form a buckle and then forwardly to feed said sheet from said stack.

**10.** An apparatus as in claim **9** further including snubber means contacting the leading edge of said top most sheet.

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