Oct. 4, 1966 A. W. GRISWOLD 3,276,770

SHEET FEEDING APPARATUS

Filed Sept. 8, 1964 3 Sheets-Sheet 1

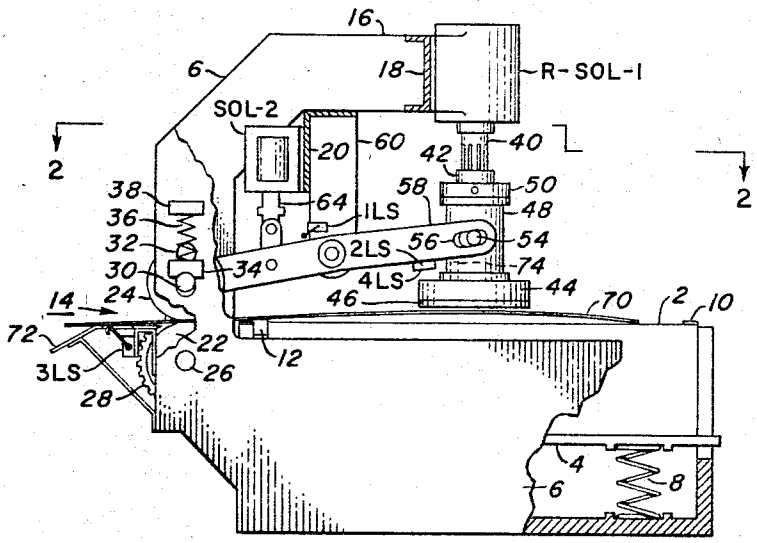


FIG. 1

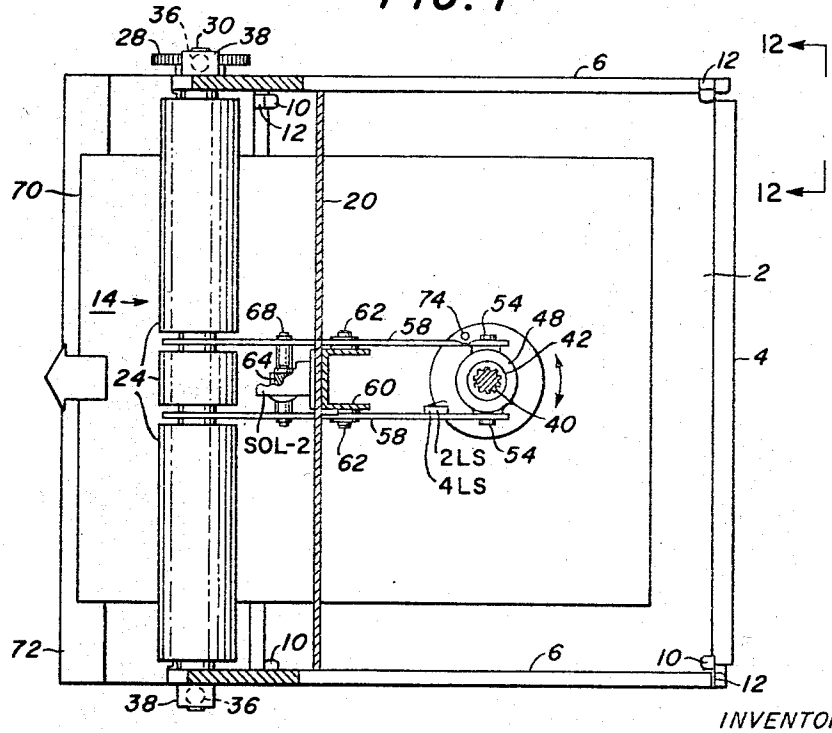


FIG. 2

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Oct. 4, 1966 A. W. GRISWOLD 3,276,770

SHEET FEEDING APPARATUS

Filed Sept. 8, 1964 3 Sheets-Sheet 2

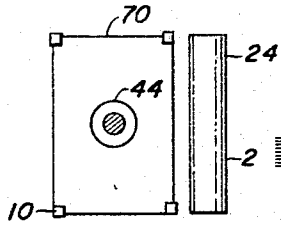


FIG. 3

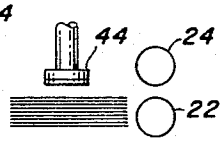


FIG. 4

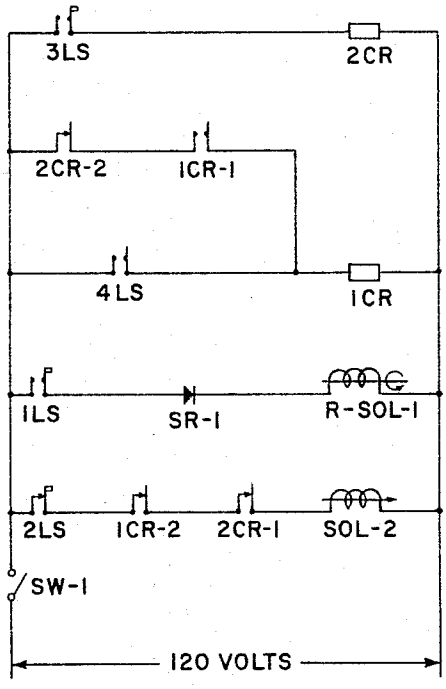


FIG. 11

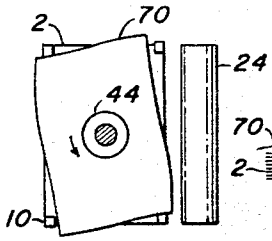


FIG. 5

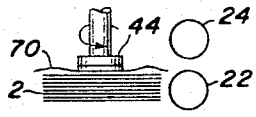


FIG. 6

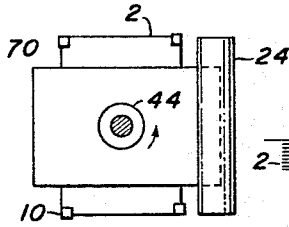


FIG. 7

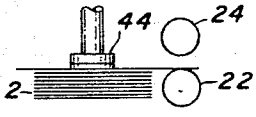


FIG. 8

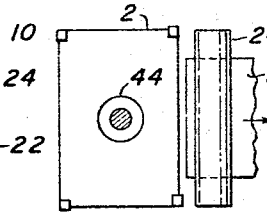


FIG. 9

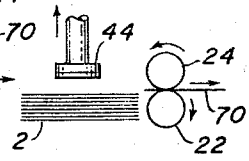


FIG. 10

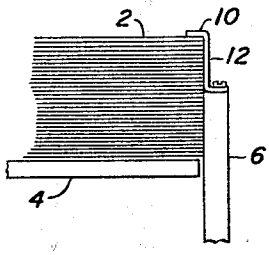


FIG. 12

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Oct. 4, 1966 A. W. GRISWOLD 3,276,770

SHEET FEEDING APPARATUS

Filed Sept. 8, 1964 3 Sheets-Sheet 3

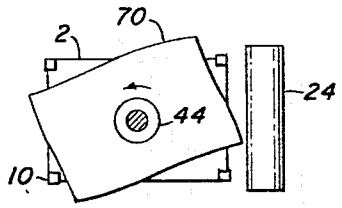


FIG. 13

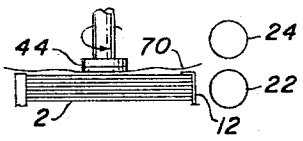


FIG. 14

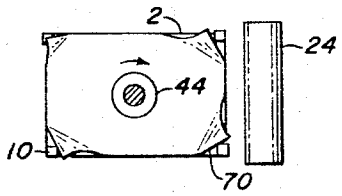


FIG. 15

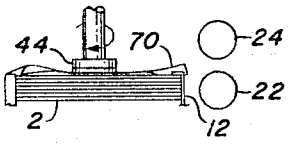


FIG. 16

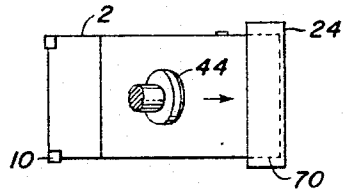


FIG. 17

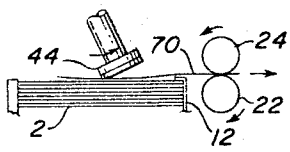


FIG. 18

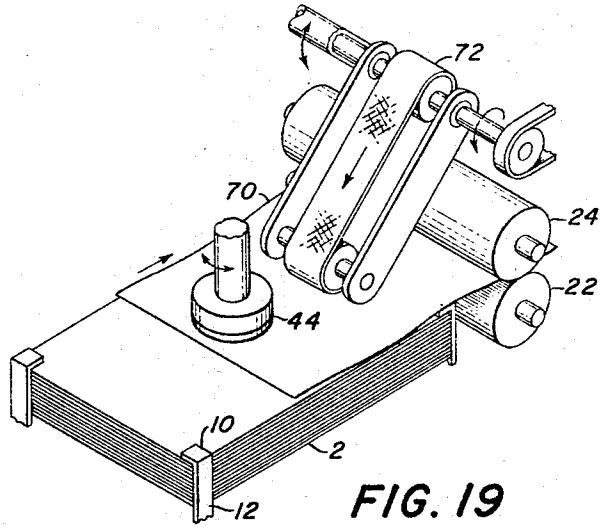


FIG. 19

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United States Patent Office

3,276,770

Patented Oct. 4, 1966

3,276,770

SHEET FEEDING APPARATUS

Augustus W. Griswold, Rochester, N.Y., assignor to Xerox Corporation, Rochester, N.Y., a corporation of New York

Filed Sept. 8, 1964, Ser. No. 394,780
6 Claims. (Cl. 271—10)

This invention relates to a sheet feeding device and, particularly, to apparatus for seriatim sheet feeding from a stack of sheets.

Sheet feeding of paper or other types of sheets has always been impaired by the problem of adjacent sheets sticking to one another and interfering with the uniform feeding of single sheets. The sheets tend to stick together because of the surface condition of the sheets, foreign material on the surface of the sheets tending to adhere to adjacent sheets, and static electricity which can build up on the surface of a sheet and attract adjacent sheets. Most prior art sheet feeding devices are of the type which frictionally force the top sheet to shear from the top of the stack by applying friction in the direction of sheet feeding. The sheet is forced to slide along the top of the stack either breaking the adhesion between the sheets or dragging subsequent sheets away from the stack. These types of devices have not been completely satisfactory because of the lack of reliability in consistently feeding a single sheet at a time. Applicant's invention overcomes the problem of adhesion between the sheets and reduces the frictional contact between the sheets to a minimum. Rather than applying a frictional pushing or dragging force against the top sheet applicant's invention utilizes a rotating frictional disc which applies a twisting force to the top sheet of the stack. Means provided at the corner of the sheet cause the sheet to buckle and separate from the stack thus reducing the adhesion between the adjacent sheets.

In one embodiment the top sheet is rotated through an arc to a pair of feed rollers. In another embodiment the top sheet is rotated through an arc a distance sufficient to break the frictional contact between sheets and rotated back to its original position for subsequent feeding. During separation, there is no sliding frictional movement of the sheet in the direction of sheet feeding, thus subsequent sheets are not urged in the direction of sheet feeding and do not tend to follow the sheet being fed. By the rotational movement and the buckling effect produced on the top sheet and subsequent sheets which tend to rotate with the top sheet the sheets are fanned out and separated, one from the other. The fanning of the various sheets breaks any adhesion or stickiness or static electricity between the various sheets permitting the sheets to be easily fed one at a time from the stack.

It is the primary object of this invention to improve sheet separating devices to facilitate seriatim feeding of sheets from a stack.

It is also an object of this invention to improve sheet feeding devices to break any adhesion or stickness between the various sheets of a stack prior to sheet feeding.

It is a further object of this invention to provide a simple and economically constructed device that separates sheets from a stack, one at a time, with a simple rotary motion of a friction member.

These and other objects of the invention are attained by means of a rotating disc placed on the center of a stack of sheets and rotated in contact with the top sheet to frictionally rotate the top sheet so that the corners of the sheet are caused to buckle by corner posts positioned in interference relationship with the rotation of the sheet, thus breaking the adhesion and frictional forces between the various sheets.

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 side view of one embodiment of sheet feed apparatus with portions broken away to show internal construction of the apparatus;

FIG. 2 is a top sectional view of the apparatus taken along lines **2**—**2** of FIG. 1;

FIGS. 3 and 4 are a top and side schematic view, respectively, of the friction disc and rollers of the apparatus in a position prior to feeding a sheet from a document stack;

FIGS. 5 and 6 are a top and side schematic view, respectively, of the friction disc and rollers of the apparatus in a position wherein the friction disc is rotating and buckling the top sheet of a document stack;

FIGS. 7 and 8 are a top and side schematic view, respectively, of the friction disc and rollers of the apparatus in a position wherein the friction disc has rotated the top sheet of a document stack to be fed by the feed rollers;

FIGS. 9 and 10 are a top and side schematic view, respectively, of the friction disc and rollers of the apparatus in a position wherein the friction disc is being removed from the sheet stack and the top sheet is being fed by the feed rollers;

FIG. 11 is a schematic electrical wiring diagram of the apparatus shown in FIG. 1;

FIG. 12 is an enlarged view of the corner posts and snubbers taken along line **12**—**12** of FIG. 2;

FIGS. 13 and 14 are a top and side schematic view, respectively, of a second embodiment of the apparatus with the friction disc in a rotated position;

FIGS. 15 and 16 are a top and side schematic view, respectively, of a second embodiment of the apparatus with the friction disc returned to its original position;

FIGS. 17 and 18 are a top and side schematic view, respectively, of a second embodiment of the apparatus with the friction disc pivoted forward to advance the top sheet for feeding;

FIG. 19 is an isometric representation of an alternative apparatus for advancing a separated sheet from the stack.

Referring to FIGURES 1 and 2 there is seen one embodiment of a sheet feeder constructed in accordance with the present invention. A stack of sheets, indicated generally as **2**, is supported on a tray or platform **4** within a pair of side frame members **6**. The platform **4** is urged upward by an arrangement of compression springs **8**, only one of which is shown. The sheet stack is restrained in its upward movement by snubbers **10** overlapping each corner of the stack. The snubbers **10** are mounted on corner posts or sheet buckling means **12** which retain the stack and produce buckling of individual sheets prior to feeding, as explained below. The snubbers **10** restrain the stack and hold the top sheet at a proper level for separation and feeding to a pair of feed rollers generally designated **14**.

The side frames **6** extend upward at the rear of the machine to two arms **16** which extend out over the stack towards the front of the machine. A support member **18** extends across the stack between the two arms **16** and supports a rotary solenoid R–SOL–**1** over the center of the stack. A second support member **20** extends across the stack and is supported by the arms **16**. A second solenoid SOL–**2** is mounted on the support member **20** approximately midway between the two sides of the stack.

The feed rollers **14** consist of a drive roll **22** and a pressure roll **24** both journaled in the side frame members **6**. The drive roll **22** is journaled in a stationary position at a level so that a sheet extending outward from the top of the stack would lie on the top of the drive roller. The

drive roller is constructed of an outer shell of resilient material mounted on a shaft **26**. One end of the shaft **26** extends through one of the side frames **6**, and has a drive gear **28** mounted thereon. The gear **28** may either mesh with a corresponding gear on the piece of equipment into which the apparatus is to feed sheets, or may be coupled to some source of power such as an electric motor. The pressure roller **14** is of the same general construction as the drive roller **22** except that the resilient outer covering is mounted on shaft **30** and is split into three sections thus exposing two portions of shaft **30** adjacent to the center of the rollers, as seen in FIG. 2. The shaft **30** is slidably mounted in a slot **32** in each of the side frames **6** and is journaled in movable bearings **34**. The movable bearings **34** are urged downward by springs **36** pressing against the bearings **34** and retaining members **38**. Thus the pressure roller **24** is urged into contact with the drive roller **22**.

The shaft of the rotary solenoid R–SOL–**1** mounted directly above the center of the document stack has a splined shaft **40** extending downward towards the document stack. The shaft **40** is rotatable through an arc of 90° upon actuation of the solenoid. A splined sleeve **42** mates with the splined shaft **40** to be slidable along the length of the shaft. The splined sleeve **42** has a friction disc **44** secured to the bottom thereof to be movable with the sleeve along the shaft. The friction disc **44** has a material **46**, such as rubber, secured to the bottom thereof to be in contact with the top of the stack when the sleeve **42** is moved downward along the shaft **40**. The material **46** must be such that it has a coefficient of friction with the material of the sheets that is greater than the coefficient of friction between successive sheets. The sleeve **42** is moved longitudinally along the shaft **40** by means of a collar **48** surrounding the sleeve **42**. The sleeve **42** is loosely journaled in the collar **48** so that the sleeve is rotatable with shaft **40** upon actuation of the solenoid SOL–**1**. The collar **48** is held on sleeve **42** by means of a flanged collar **50** secured to the sleeve **42** above the collar **48** and a thrust washer **52** between the collar **48** and the friction disc **44**.

The entire friction disc assembly, including the splined sleeve **42**, is moved longitudinally along the shaft **40** by means of a pair of projections **54** extending outwardly from the side of the collar **48** and mating with a pair of elongated slots **56** in the two arms of a yoke member **58**.

The yoke member **58** is pivotally mounted on a support member **60** extending downward from the frame arms **16**. A pair of pivot pins **62** support the yoke from the support member **60**. The yoke member **58** extends past the pivot pins **62** to the pressure rollers **24**. The ends of the arms of the yoke **58** are slotted to engage the shaft **30** of pressure roller **24** at the two slots in the resilient cover of the pressure roller **24**. At a point between the pivot pins **62** and the shaft **30** the yoke **58** is attached to the actuating arm **64** of solenoid SOL–**2** by means of linkage member **66** and pin **68**. Actuation of the solenoid SOL–**2** produces a pivoting motion of the yoke **58** about the pivot pins **62**, thus lowering the friction disc **44** and raising the pressure roller **24**. When the solenoid SOL–**2** is de-energized the compression spring **36** forces the pressure roller **24** downward into contact with the drive roll **22** causing the yoke **58** to pivot about pins **62** and thus raising the friction disc **44**. The embodiment shown herein utilized solenoids to actuate the various components of the apparatus. It would be within the ability of one skilled in the art to provide mechanical linkages or a combination of electrical components and mechanical linkages to perform the same function.

Operation

A stack of paper or other material is inserted into the document tray by depressing the tray and sliding the paper beneath the friction disc **44** and the snubbers **10**. The documents are placed in the tray with the width of the sheets extending from the front to the back, i.e., in the direction of document feeding. Therefore, when a sheet is rotated 90° it is running lengthwise to the direction of feeding and the leading edge extends over the edge of the stack as illustrated in FIGURES 11 and 12. The insertion of documents is most easily accomplished when the friction disc is in an elevated position as illustrated in FIGURES 3 and 4.

Referring now to the schematic FIGURES 3 through 10 and the schematic wiring diagram, FIGURE 11, it is seen that the solenoid SOL–**2** is energized upon actuation of the on-off switch SW–**1**. Actuation of the solenoid SOL–**2** pivots the yoke **58** in a clockwise direction as seen in FIGURE 1 and depresses the friction disc **44** to the position shown in FIGURES 5 and 6. The upward movement of the left-hand portion of the yoke **58** actuates a normally open switch **1LS** positioned on the support member **60**. Closing of the switch **1LS** energizes the rotary solenoid R–SOL–**1** when the friction disc is depressed to the proper feed level. The pressure between the friction disc and the stack is controlled by the springs **8** urging the support plate **4** and the stack upward to the feeding position.

With the friction disc **44** in the depressed position and the rotary solenoid actuated, the friction disc rotates the top document **70** as shown in FIGURES 5 and 6. The corners of the document are forced against the corner posts **12** causing the sheet to buckle, breaking the frictional contact between successive sheets. Normally, only the top sheet is rotated since the coefficient of friction between the friction pad **46** and the sheet is greater than the coefficient of friction between two sheets. However, if two sheets are tending to stick together the buckling produced by the corner posts to separate the two sheets reducing the friction between them and insuring that only one sheet is rotated into a feeding position.

Continued rotation of the friction disc **44** through a 90° arc causes the top sheet of paper to rotate to the position shown in FIGURES 7 and 8 wherein the leading edge of the sheet rests on the feed roller **22** between the feed roller and the pressure roller **24**. At this point a normally closed switch **2LS**, mounted above the pressure disc **44**, is actuated by a pin **74** extending upward from the disc **44**. The contacts of the switch **2LS** are in the circuit to the solenoid SOL–**2**, thus, upon actuation of the switch the contacts open de-energizing solenoid SOL–**2**. With the solenoid SOL–**2** de-energized the compression springs **36** force the pressure roller **24** down into contact with the document **70** and force the document against the feed roller **22**. The feed roller **22** is continuously rotating and immediately drives the sheet **70** forward over a guide tray **72**. As the pressure roller **24** is lowered into the drive position the disc **44** is raised away from the document stack permitting the rotated document **70** to be fed by the feed rollers. The downward movement of the lefthand side of the yoke **58** releases switch **1LS** de-energizing rotary solenoid R–SOL–**1** permitting the disc **44** to rotate to its original position under a spring action built into the solenoid.

A second switch **4LS** is mounted on the yoke **58** in the same position as the switch **2LS** and is actuated by the pin **74** at the same time the switch **2LS** is actuated. Actuation of the switch **4LS**, upon 90° rotation of the disc **44**, closes the normally open contacts of the switch **4LS**, energizing relay **1CR**. Energization of relay **1CR** closes normally open contacts **1CR–1** providing a holding circuit for the relay **1CR** and opens normally closed LCR–**2** in the circuitry to solenoid SOL–**2**. Opening of the contacts **1CR–2** prevents the solenoid SOL–**2** from being actuated when the switch **2LS** is released by the return of disc **44** to its original position. Both solenoids R–SOL–**1** and SOL–**2** are prevented from being energized during the time that the feed rollers are feeding a sheet by the action of a switch **3LS** mounted beneath the guide

tray **72** and having an actuating arm extending up into the path of travel of the sheet **70**. When a sheet actuates switch **3LS** the normally open contacts of the **3LS** switch are closed energizing relay **2CR**. Energization of relay **2CR** opens normally closed contacts **2CR–1** in the circuitry to solenoid **SOL–2** and opens normally closed contacts **2CR–2** in the holding circuit to relay **1CR**. With the relay **1CR** de-energized, by opening contacts **2CR–2** in the holding circuit, the entire system is conditioned for the feeding of another sheet upon the release of switch **3LS** by the sheet **70**. When the sheet being fed has passed the switch **3LS** the contacts of that switch open de-energizing relay **2CR** causing the contacts **2CR–1** to revert to their normally closed position thus again energizing solenoid **SOL–2**. Energization of solenoid **SOL–2** pivots the yoke member **58** causing the cycle to be repeated.

A schematic representation of an alternative form of the apparatus is shown in FIGS. 13 through 18. In this form of the apparatus the friction disc **44** rotates the sheet in one direction a distance sufficient to cause the sheet to buckle against the corner posts **12** and to slide free of the snubbers **10**, as seen in FIG. 13. Counter rotation of the friction disc **44** causes the sheet to rotate back against the snubbers **10** and either slide over the snubbers or abut the snubbers and buckle over them to the original position. The sheet **70** is now above the snubbers **10** and is free to be advanced to the free rollers.

From this position with the single sheet of paper separated from the main stack and resting on the snubbers **10** the sheet may be advanced by any number of means such as feed rollers, a gripper bar or a friction drive. In the embodiment shown herein, the friction disc **44** is used to advance the sheet to the feed rollers **22** and **24**. As seen in FIGS. 17 and 18 a simple forward motion of the friction disc **44** will slide the sheet **70** forward between the rollers **22** and **24** while the main stack is restrained by the corner posts **12**. The friction disc **44** is then elevated away from the sheet and the rollers are closed to drive the sheet from the stack. Alternative forms for advancing the sheet to the feed rollers or to a gripper bar may be used. For example, as seen in FIG. 19, when the friction disc **44** is elevated away from the stack a continuously rotating friction belt **72** may be lowered into contact with the top sheet to provide the forward movement of the sheet to the feed rollers. Also, since the sheet is resting on the top of the snubbers **10**, it is possible to have a gripper mechanism advance between the sheet and the stack and withdraw the sheet **70**. After the friction disc **44** has advanced sheet **70**, as shown in FIGS. 18 and 19, the apparatus is again ready to feed the next sheet. That is, friction dics **44** returns to the position shown in FIGS. 3 and 4 and the entire sequence is repeated.

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

I claim:

1. Apparatus for separating individual sheets from a stack for sheet feeding including:

support means adapted to contain a stack of sheets,

a rotatable friction member mounted above the support means and adapted to be moved into and out of contact with the top of a sheet stack on the support means,

means to rotate the friction member when the friction member is in contact with the stack,

and retaining means positioned beside the corners of the sheet stack in interference relationship with rotational movement of the sheets in the stack to produce buckling and separation of individual sheets rotated by the friction member.

2. Apparatus for separating individual sheets from a stack of sheets including:

a sheet stack support plate having biasing means urging the plate upwards against the weight of the sheet stack,

snubber means positioned above and extending over the corners of the support plate to restrain the top of the stack in a fixed position against action of the biasing means,

a rotatable friction pad operatively positioned above the sheet stack and movable into and out of contact with the top sheet of the stack,

means to rotate the friction pad when the pad is in contact with the top sheet of the stack to impart rotational movement to the top sheet,

and corner posts positioned adjacent to the sheet stack in interference relationship with rotational movement of the sheets in the stack to produce buckling of individual sheets upon rotational movement thereof to thereby separate the top sheet from the remaining sheets on the stack and to remove the top sheet from beneath the snubbers.

3. The apparatus of claim **2** further including means to counter rotate the friction pad to return the top sheet to a position in alignment with the stack above the snubbers and means to impart a forward movement to the top sheet after its return.

4. Sheet feeding apparatus for seriatim sheet feeding from a stack of sheets including:

a sheet stack support plate having biasing means urging the plate upwards against the weight of the sheet stack,

snubber means positioned above and extending over the corners of the support plate to restrain the top of the stack in a fixed position against action of the biasing means,

a rotatable friction pad operatively positioned above the sheet stack and movable into and out of contact with the top sheet of the stack,

means to rotate the friction pad when the pad is in contact with the top sheet of the stack to impart rotational movement to the top sheet,

corner posts positioned adjacent to the corners of the stack in interference relationship with rotational movement of the sheets in the stack to produce buckling of individual sheets on rotational movement thereof to thereby separate the top sheet from the remaining sheets on the stack and to remove the top sheet from beneath the snubbers,

sheet feeding means positioned adjacent to the stack to receive sheets rotated by the friction pad,

and means to operate the sheet feeding means in timed relation to the movement of the friction pad into and out of contact with the top sheet.

5. Sheet feeding apparatus for seriatim sheet feeding from a stack of sheets including:

a sheet stack support plate having biasing means urging the plate upwards against the weight of the stack,

snubber means positioned above and extending over the corners of the support plate to restrain the top of the stack in a fixed position against action of the biasing means,

a rotatable friction pad operatively positioned above the sheet stack and movable into and out of contact with the top sheet of the stack,

means to rotate and counter rotate the friction pad when the pad is in contact with the top sheet of the stack to impart rotational movement to the top sheet and to return the top sheet to its original position after separation for subsequent feeding,

corner posts positioned adjacent to the corners of the stack in interference relationship with rotational movement of the sheets in the stack to produce buckling of individual sheets on rotational movement thereof to thereby separate the top sheet from

the remaining sheets on the stack and to remove the top sheet from beneath the snubbers,

and sheet feeding means to remove the sheet from the stack after the sheet has been removed from beneath the snubbers.

6. Sheet feeding apparatus for seriatim sheet feeding from a stack of sheets including:

a sheet stack support plate having a biasing means urging the plate upwards against the weight of the sheet stack,

snubber means positioned above and extending over the corners of the support plate to restrain the top of the stack in a fixed position against the action of the biasing means,

corner posts positioned adjacent to the corners of the stack in interference relationship with rotational movement of the sheets in the stack to produce buckling of individual sheets on rotational movement thereof to thereby separate the top sheet from the remaining sheets on the stack and to remove the top sheet from beneath the snubbers,

a rotational friction member positioned above the support plate and adapted to be moved between an operative position wherein the member contacts the top sheet of the stack and an inoperative position wherein the member is not in contact with the sheet stack,

means to rotate the friction member when it is in the operative position to thereby impart rotational movement to the top sheet of the stack,

sheet feed rollers including a drive roller and a pressure roller adapted to be separated for receiving sheets to be fed and to be brought into contact for feeding sheets inserted between the rollers,

said sheet feed rollers being mounted sufficiently close to the sheet stack so that sheets rotated by the friction member extend between the drive roller and the pressure roller when they are in a separated position,

and control means to synchronize the movement of the friction member between the operative and inoperative positions and the feed rollers between the separator and contact positions.

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ROBERT B. REEVES, *Primary Examiner.*

HADD S. LANE, *Examiner.*

Dedication

3,276,770.—*Augustus W. Griswold*, Rochester, N.Y. SHEET FEEDING APPARATUS. Patent dated Oct. 4, 1966. Dedication filed Sept. 16, 1976, by the assignee, *Xerox Corporation.*

Hereby dedicates to the Public the remaining term of said patent.

[*Official Gazette December 7, 1976.*]