United States Patent

[11] 3,583,697

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[54] SHEET FEEDING DEVICE
12 Claims, 12 Drawing Figs.

[52] U.S. Cl. 271/10, 271/21, 271/36
[51] Int. Cl. B65h 3/06, B65h 3/30, B65h 5/06
[50] Field of Search 271/10, 21, 36, 37

[56] References Cited
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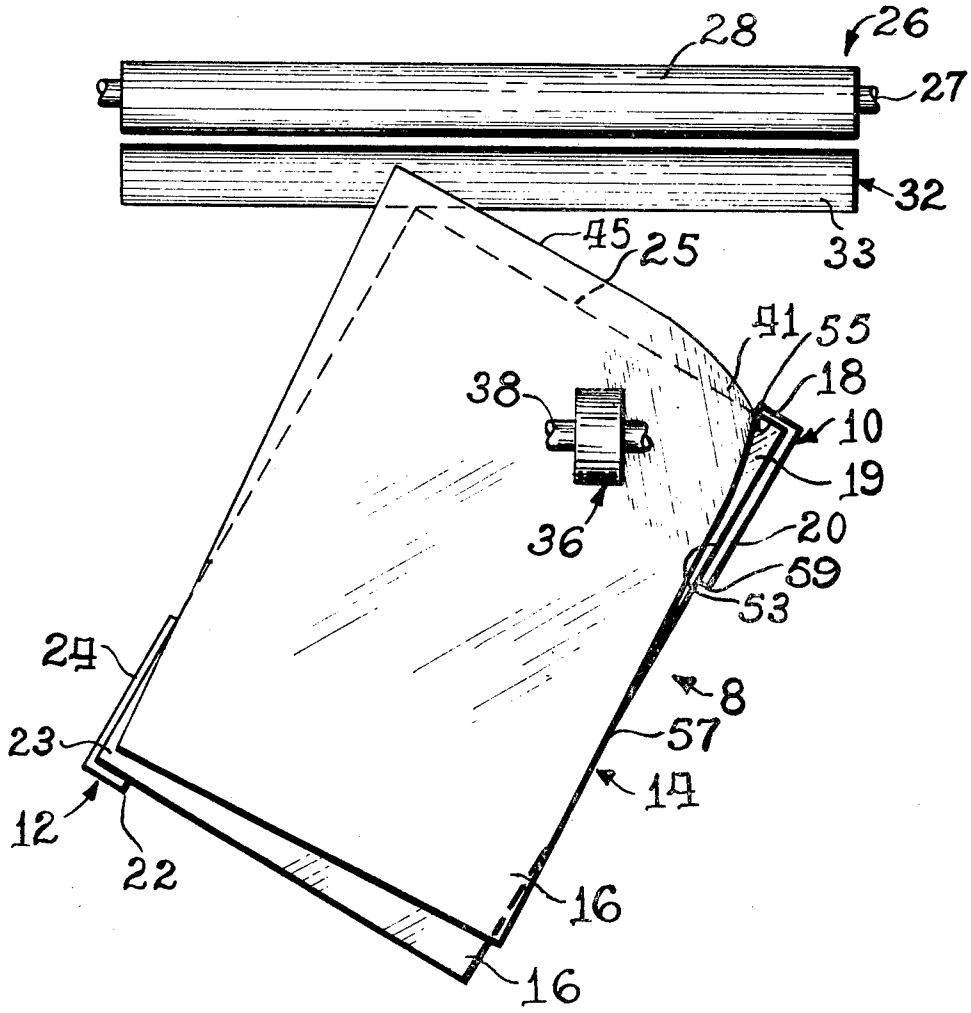
Primary Examiner—Edward A. Sroka
Attorney—Sol L. Goldstein

ABSTRACT: A sheet feeding device comprising a feed tray including a base plate and a pair of L-shaped corner elements extending therefrom in opposing relation to each other diagonally thereacross, for holding a stack of sheets therebetween, and a roller mounted off center of the stack of sheets in driving engagement with the top sheet of the stack. The leading edge of the stack is at an angle with respect to the axes of a pair of feed rollers of an infeed station, so that upon movement of the top sheet by the drive roller, the sheet engages the leading edge corner element, whereby the sheet is separated from the stack, and the sheet is rotated to ultimately assume a position whereat the leading edge thereof is in parallel alignment with the axes of the pair of feed rollers.



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SHEET 1 OF 3

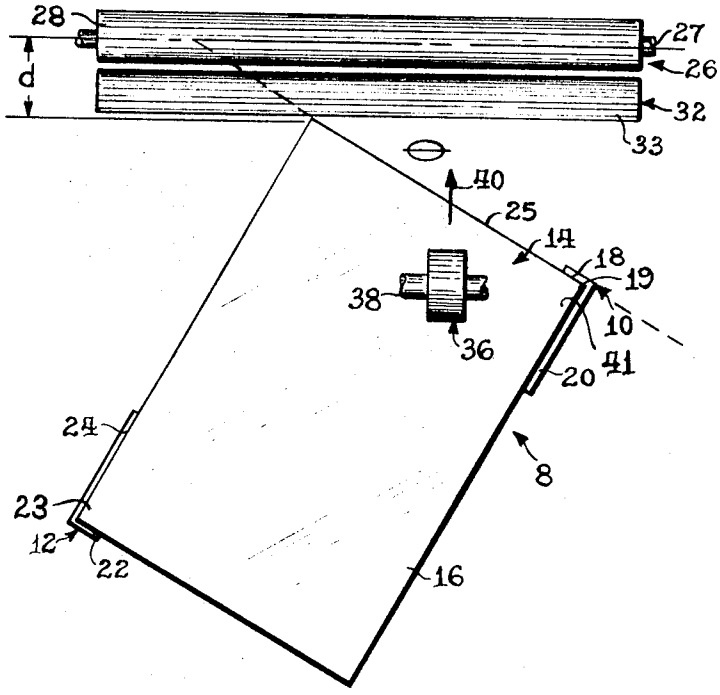

Fig 1a

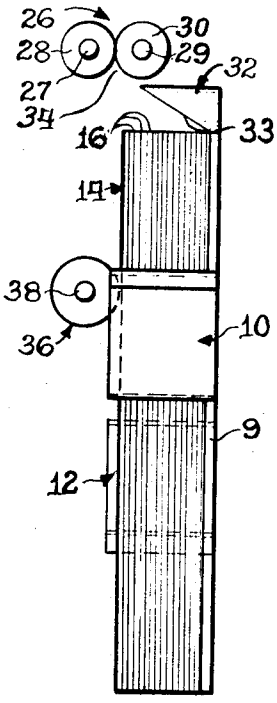

Fig 1b

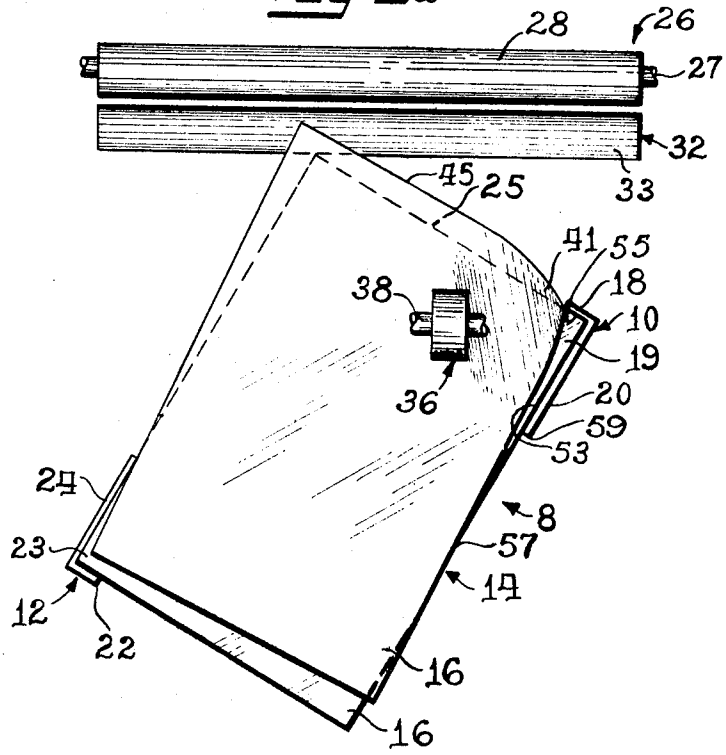

Fig 2a

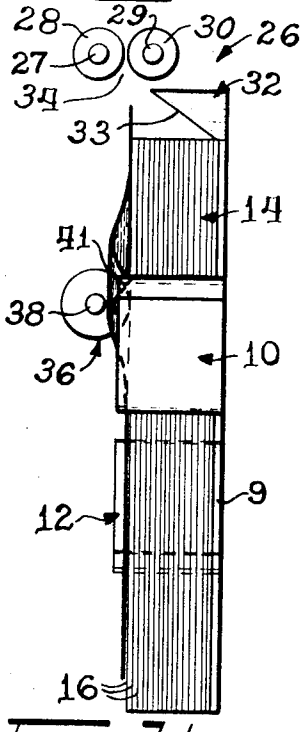

Fig 2b

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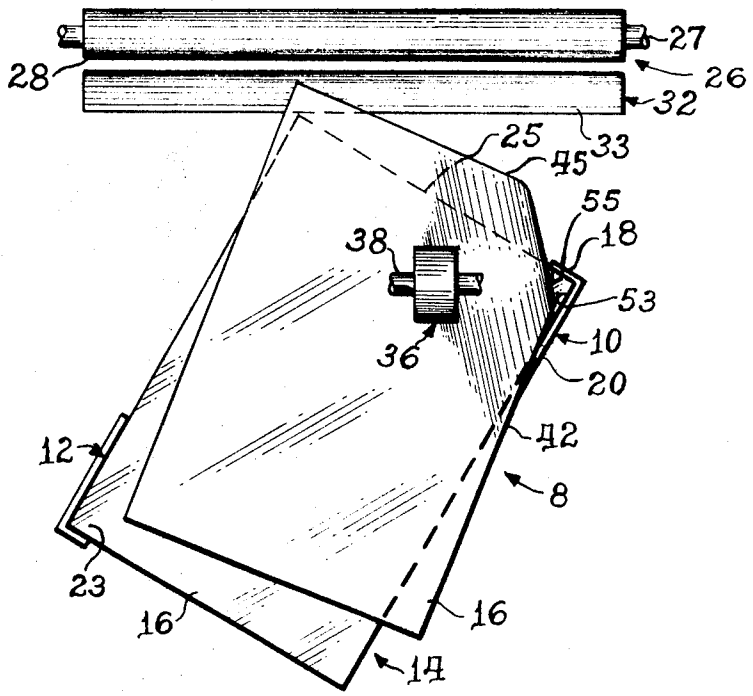

Fig 3a

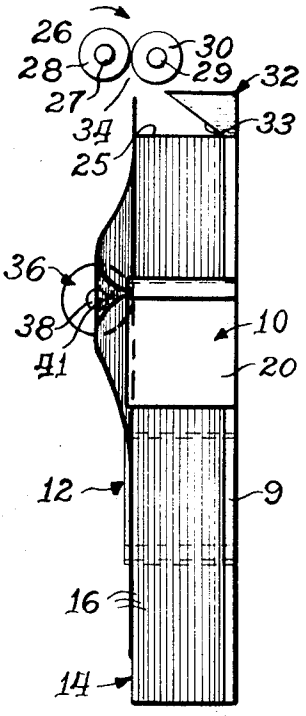

Fig 3b

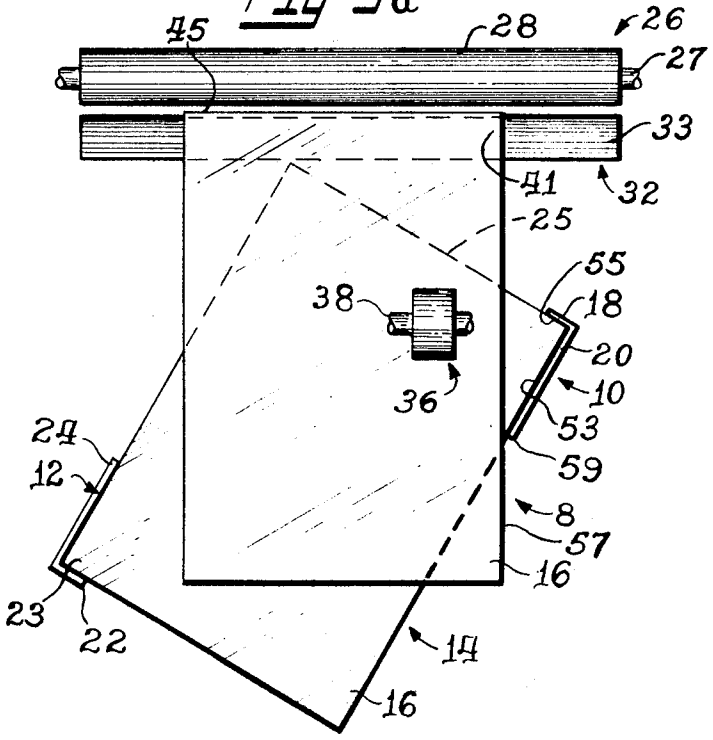

Fig 4a

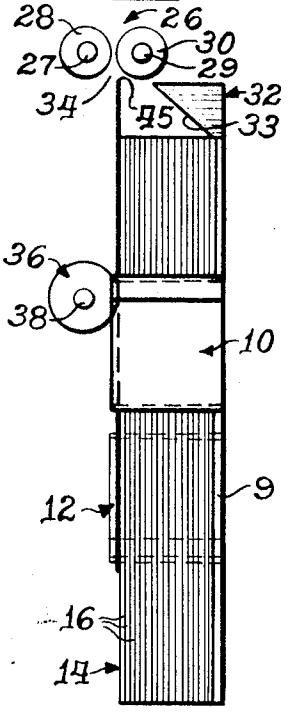

Fig 4b

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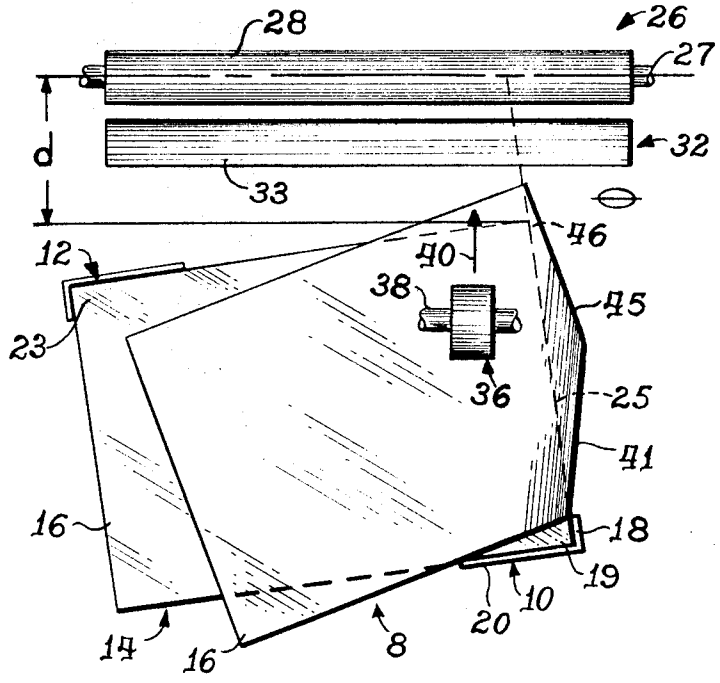

Fig 5a

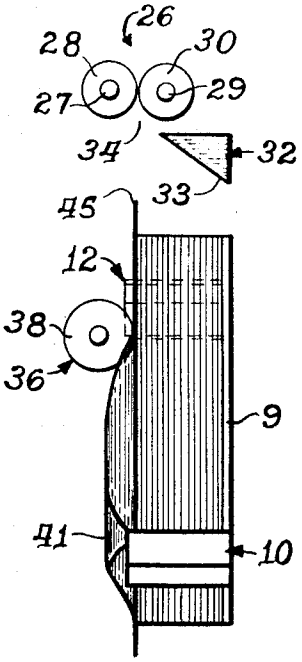

Fig 5b

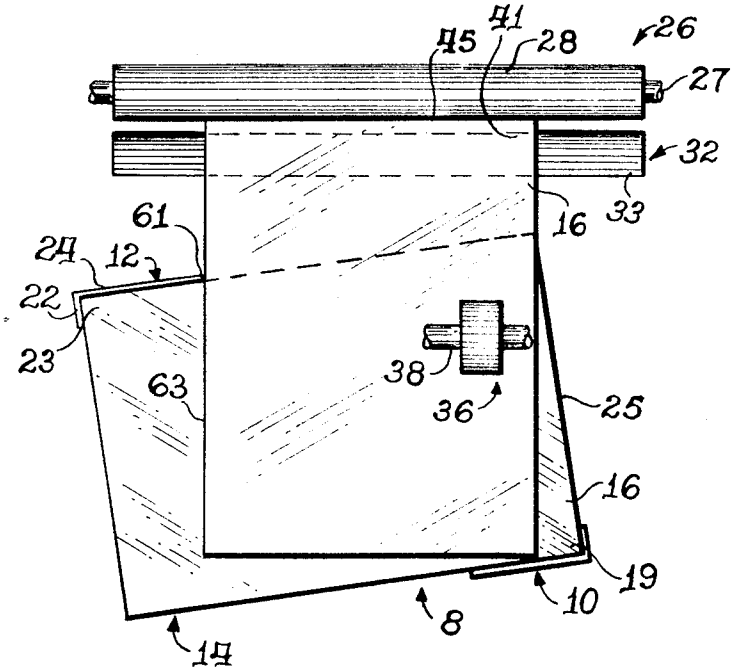

Fig 6a

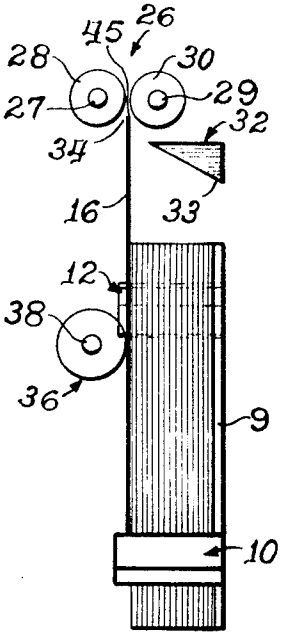

Fig 6b

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SHEET FEEDING DEVICE

BACKGROUND OF THE INVENTION

This invention relates generally to sheet feeding devices and more particularly to sheet feeding devices for use in copying machines which feed individual sheets from a stack into the machine.

For the most part, devices used for feeding a single copy sheet from a stack into a copying machine include quide means at the sides of the stack positioned so that the leading edge of the stack is in parallel relation to the axes of feed rollers which carry the sheets, one at a time, into the machine. One commonly used device includes a pair of corner engaging elements at each of the leading corners of the stack of sheets which overlap the corners of the top sheet of the stack and a pair of feed rollers positioned above the stack in driving engagement with the top sheet. Thus, as the last-mentioned feed rollers drive the top sheet forward toward the first-mentioned feed rollers, the lower sheets are restrained by a lower portion of the corner engaging elements and the top sheet is lifted by the portions of the elements extending over the corners of the top sheet, to be fed singly into the machine.

While the prior art sheet feeding devices are reliable and work well to repeatedly deliver a single sheet from a stack, they are structurally complex and expensive to fabricate.

SUMMARY OF THE INVENTION

Accordingly, it is a primary object of the instant invention to provide a new and improved sheet feeding device which is relatively simple in construction and inexpensive to produce.

It is a more specific object of the present invention to provide a new and improved sheet feeding device for use in a photocopy machine to deliver single sheets from a stack of copy sheets into an infeed station of the machine.

Briefly, a preferred embodiment of the sheet feeding device according to the invention comprises a feed tray including a base plate and having mounted thereon a pair of L-shaped corner engaging members positioned in opposing relation to each other for holding therebetween a stack of sheets. One of the L-shaped members engages a leading corner of the stack while the other member engages the trailing corner of the stack spaced from the other member diagonally across the sheets. The corner engaging members are so located that the stack of sheets is at an angle with respect to the axes of a pair of feed rollers arranged to receive a single sheet from the stack.

A single roller member is positioned above the stack in driving engagement with the top sheet thereof. The single roller is located nearer the leading edge corner engaging member so that upon operation of the roller to drive the top sheet, the last-mentioned sheet is advanced toward the first-mentioned feed rollers in a forward and turning or rotational motion. The movement of the sheet along the upstanding inside wall of the leading corner engaging element separates the sheet from the stack, and the turning or rotating motion imparted to the sheet ultimately moves the leading edge thereof into parallel relation with the axes of the feed rollers. The sheet is carried over a wedge-shaped member positioned between the stack and the feed rollers, which lifts the sheet into the nip of the last-mentioned rollers to be carried thereby through the copy machine in correct alignment.

DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention and its organization and construction may be had by referring to the description hereinafter in conjunction with the accompanying drawings, wherein:

FIG. 1*a* is a top plan view of a sheet feeding device shown holding a stack of sheets to be fed, one at a time, into a feed station;

FIG. 1*b* is a side view of the arrangement of FIG. 1*a*;

FIGS. 2*a*, 3*a*, and 4*a* are top plan views of the arrangement of FIG. 1*a* as it appears at successive stages during the feeding of a sheet from the stack into the feed station;

FIGS. 2*b*, 3*b* and 4*b* are side views of the arrangements of FIGS. 2*a*, 3*a* and 4*a*, respectively;

FIG. 5*a* is a top plan view of the sheet feeding device of FIG. 1*a*, positioned at a different angle with respect to the feed station than in FIGS. 1*a*, 1*b*—4*a*, 4*b*;

FIG. 5*b* is a side view of the arrangement of FIG. 5*a*;

FIG. 6*a* is a top plan view of the arrangement of FIG. 5*a* showing the top sheet of the stack as it appears immediately prior to entering the feed station, according to the invention; and

FIG. 6*b* is a side view of the arrangement of FIG. 6*a*.

DETAILED DESCRIPTION

Referring now to the drawings in greater detail, wherein like numerals have been employed to designate similar parts throughout the various views, there is shown a sheet feeding device according to the invention comprising a feed tray generally designated by the numeral **8** and including a base plate **9** having mounted thereon at predetermined corners thereof, at substantially right angles to the plane of the plate **9**, a pair of L-shaped corner engaging elements or brackets **10**, **12**, positioned in opposing relation to each other and holding therebetween a stack **14** of copy sheets, each sheet being designated by the numeral **16**. One of the elements **10**, engages a leading-edge corner **19** of the stack **14** and the other element **13** engages the trailing-edge corner **23** of the stack spaced from the first-mentioned corner element diagonally across the stack. The corner engaging elements **10**, **12** are positionable toward and away from each other along paths common to the directions of extension of the legs **18**, **20** and **22**, **24** thereof, respectively; (FIGS. 1*a*, 1*b* and 2*a*, 2*b*) so as to accommodate sheets of different widths and lengths. The corner elements **10**, **12** are each of a height at least equal to that of the stack of sheets.

The corner engaging elements **10**, **12** are placed so as to cause the leading edge **25** of the stack of sheets **14** to be at an angle with respect to the axes **27**, **29** of a pair of feed rollers **28**, **30** spaced from the stack and comprising an infeed station **26** of a copying machine or the like unit (not shown). The angular relationship between the leading edge **25** of the stack and the axes **27**, **29** is indicated and will be discussed hereinafter by reference to the angle θ which is the angle formed between a line drawn along the leading edge of the stack of sheets to intersect a line coextensive with the axes of rollers **28**, **30** (FIG. 1*a*).

Between the infeed station **26** and the stack **14** of sheets **16**, there is provided a wedge shaped guide member **32** having an inclined surface **33** over which a sheet being fed from the stack into the nip **34** of the feed rollers **28**, **30** passes. As will be explained in greater detail below, the guide member causes the sheet to be lifted into the nip **34** of rollers **28**, **30** to insure the feeding of a sheet into the copying machine each time one is required. The guide member **32** is especially useful for guiding lower sheets of stack **14**, which are not situated on the same plane as the nip **34** of rollers **28**, **30**.

Above the stack **14** there is provided a single drive roller **36** mounted for rotation on an axle **38**, the axle being parallel to the axes of the feed rollers **28**, **30**. The roller **36**, which has a gripping tread, is arranged for vertical movement so that it is always in driving engagement with the top or uppermost sheet of the stack **14** and serves to drive the top sheet toward infeed station **26**. As will be noted, the roller **36** is positioned to the right of center of the stack (as seen in the FIGS.) and nearer to the leading edge corner element **10**, than to element **12** of the trailing edge of the stack. The positioning of the drive roller **36** is important since by locating the roller away from the center of the sheet and toward the leading edge corner element, the driving force of the roller against a sheet causes the sheet to be moved forward into engagement with the corner element **10**

and rotationally in a counterclockwise direction as shown in the drawings, ultimately to be fed with the leading edge 25 of the sheet in parallel relation to the axes of rollers 27, 29 (FIGS. 4*a*, 4*b*).

The angle θ (FIGS. 1*a* and 5*a*) at which the leading edge of the stack 14 is positioned with respect to feed rollers 28, 30 may vary widely. In fact, the angle θ can be as great as 90°. If the angle θ is increased, the distance *d* between the leading most corner of the stack and the nip 34 of rollers 28, 30 must be increased proportionally, since the sheets fed to the feed rollers must, when at a greater angle θ from the rollers, be rotated a greater distance. While no mathematical relation has been formulated for a change in distance *d* versus a change in the angle θ, the relation therebetween is one which may be easily determined by one skilled in the art.

For purposes of affording a more complete understanding of the invention, it is advantageous now to provide a functional description of the mode in which the component parts thus described cooperate.

Referring once again to FIGS. 1*a* and 1*b* of the drawings, the stack of sheets is shown prior to the uppermost sheet 16 being fed by roller 36 from the stack. Upon receiving a signal in the copying machine or the like apparatus in which the sheet feeder according to the invention is used, roller 36 is rotated. Because the roller 36 is in engagement with top sheet 16, the sheet is driven generally in the direction of arrow 40, but in a rotating fashion.

As the sheet is rotated, corner 41 thereof is restrained against corner engaging element 10, initially at leg 18, causing the corner 41 of the sheet to be curled under (FIG. 2). The engagement and curling of corner 41 of the driven sheet 16 causes the sheet to be separated from the other sheets of stack 14.

The movement of sheet 16 continues so that the corner 41 thereof is guided along the inner walls 53, 55 of the element 10; the corner 41 being curled under more so as the sheet is rotated (FIGS. 3*a*, 3*b*). At no time, however, is the extreme corner of the sheet lifted over the element 10. There is thus no limit to the height to which elements 10, 12 can be constructed since the operation of the sheet feeding device according to the invention does not depend upon the lifting of a sheet over the corner element for separation. In fact, the element need only be of a height substantially equal to that of the stack of sheets.

The driving of sheet 16 by roller 36 against corner element 10, continues until the sheet becomes fully separated from the remaining sheets 16 of the stack 14, and ultimately by the rotation of the sheet in a counterclockwise direction as seen in the figures, the leading edge 45 of the sheet assumes a position parallel to the axes 27, 29 of rollers 28, 30 (FIGS. 4*a*, 4*b*). At this time the sheet is gripped at the nip 34 of rollers 28, 30 uniformly along leading edge 45, to be pulled by the rollers into the machine (not shown).

Often, in positioning the stack 14 of sheets as shown in FIGS. 1*a*, 1*b*—4*a*, 4*b*, the stack is located too great a distance from the nip of rollers 28, 30 of infeed station 26. In this case it may be possible that a sheet being delivered to the rollers 28, 30 will have been rotated past the point at which the leading edge of the sheet is in parallel alignment with the axes of the feed rollers, and the sheet could be fed thereto in a skewed condition.

This, however, does not occur in the embodiment of the invention as shown in FIGS. 1*a*, 1*b*—4*1*, 4*b* since upon being rotated to a position whereat the leading edge 45 of the sheet is in parallel alignment with with the axes of feed rollers 28, 30, the side edge 57 of the sheet engages end 59 (FIG. 4*a*) of leg 20 of element 10 and is thereby prevented from further rotation. The end 59 of leg 20 serves as a guiding means to ensure the correct feeding of the sheet into the feed station, and to reduce the criticality of positioning the stack with respect to infeed station 26.

It would be understood that the guidance of the sheet along the end 59 of leg 20 is not essential to the operation of the invention if the distance *d* and angle θ are chosen correctly since the sheet will have been rotated to a position whereat the leading edge thereof is parallel to and in the nip of rollers 28, 30 in the latter case. It is only where the stack is placed too great a distance from the infeed station 26 that the end 59 is effective, since the engagement of the edge 57 of sheet 16 with end 59 prevents further rotation of the sheet once the leading edge thereof is in parallel relation with respect to the axes 27, 29 of infeed rollers 28, 30.

In the case of the top sheet of a new stack 14, the sheet is substantially at the height or level of the nip of rollers 28, 30, thus the sheet merely enters the nip substantially along the same plane. When sheets have been removed from the stack 14, however, the levels of the top sheet and the roller nip 34, are unequal. Thus, the sheet is guided along surface 33 of the wedge shaped guide member 32 to be lifted into the nip 34 of the rollers.

If it is desired to eliminate guide member 32, the feed tray 8, may be mounted on an elevator or the like assembly to insure that the top sheet of stack 14 is maintained on the same plane as the roller nip 34 at all times. Other such devices may also be used to accomplish the above-described result.

Referring now to FIGS. 5*a*, 5*b*, and 6*a*, 6*b* of the drawings, there is illustrated therein a stack 14 of sheets 16 like that of FIGS. 1*a*, 1*b*—4*a*, 4*b*, secured in a feed tray 8, according to the invention. In this case, however, the feed tray is arranged so as to position the leading edge 25 of the stack 14 at an angle θ greater than the angle θ of FIGS. 1*a*, 1*b*—4*a*, 4*b*. The embodiment of FIGS. 5*a*, 5*b*, 6*a*, 6*b* is shown herein to illustrate the wide variety of angles at which the sheet feeding device according to the invention may be placed with respect to the infeed station 26 of a copying machine or the like unit.

As will be noted, the distance *d* measured between the leading most corner 46 of the stack to the axes 27, 29 of the feed rollers 28, 30 is greater than the distance *d* as illustrated in FIGS. 1*a*, 1*b*—4*a*, 4*b*. The increase in distance *d* as explained heretofore, is necessary when the angle θ is increased, to accommodate the greater rotational distance which a sheet 16 from stack 14 must traverse upon being fed into rollers 28, 30.

The operation of the sheet feeding device of FIGS. 5*a*, 5*b*, 6*a*, 6*b* is like that of FIGS. 1*a*, 1*b*—4*a*, 4*b*. Upon operating roller 36, the uppermost sheet 16 of the stack is moved toward infeed station 26, generally in the direction of arrow 40 in a turning manner.

Due to the movement of the sheet 16, the corner 41 thereof is caused to engage element 10 and thereby to be curled under as shown in FIGS. 5*a*, 5*b*. The curling of the sheet causes it to be separated from the remaining sheets of the stack 14. The sheet is also pivoted about or rotated to ultimately be positioned with the leading edge 45 thereof in parallel relation to the axes 27, 29 of feed rollers 28, 30. In positioning the stack as in FIGS. 5*a*, 5*b*, 6*a* 6*b*, wherein the angle θ is substantially greater than in the case of FIGS. 1*a*, 1*b*—4*a*, 4*b*, the stack also may be inadvertently located too great a distance from infeed rollers 28, 30. If this should occur, however, the end 61 of leg 24 of element 12 serves as does end 59 of leg 20 of element 10 in FIGS. 1*a*, 1*b*—4*a*, 4*b*, to guide the sheet 16 along edge 63 thereof to ensure that the sheet 16 enters the nip of feed rollers 28, 30 with the leading edge of the sheet parallel to the the axes of the rollers 28, 30 and not in a skewed condition with respect thereto.

Thus, the sheet feeding device according to the invention provides a simply constructed, relatively inexpensive means for feeding accurately and in correct alignment, single sheets of paper from a stack into the feed rollers of a copying machine or the like. The device requires only a single roller 36 for driving the sheet toward the infeed station 26 and the stationary base plate and bracket arrangement making up a feed tray. No complex movable parts are needed to accomplish the efficient feeding of a single sheet of paper from a stack as in prior art sheet feeding apparatus.

While a particular embodiment of the invention has been shown and described, it should be understood that the inven-

tion is not limited thereto since many modifications may be made It is therefore contemplated to cover by the present application any and all such modifications as fall within the true spirit and scope of the appended claims.

What I claim is:

1. A sheet feeding device for feeding sheets from a stack, one at a time, to an infeed station, comprising:

means for positioning said stack at an angular relationship with respect to and at a predetermined distance from said infeed station so that a line taken along the leading edge of the stack of sheets intersects a line taken along said infeed station;

sheet advancing means including a roller positioned in engagement with the uppermost sheet of said stack for imparting a forward and turning motion to said sheet to transport the latter toward said infeed station; and

restraining means positioned at a corner of the leading edge of said stack proximate to said sheet advancing means, for engaging said uppermost sheet as it is moved by said sheet advancing means thereby to aid in the separation of said sheet from said stack.

2. A sheet feeding device for feeding sheets from a stack, one at a time, to an infeed station, comprising:

means for positioning said stack at an angular relationship with respect to and at a predetermined distance from said infeed station so that a line taken along the leading edge of the stack of sheets intersects a line taken along said infeed station, said means for positioning said stack including a feed tray comprising a baseplate and a pair of corner elements being in opposing relation to each other diagonally across said base plate;

sheet advancing means positioned in engagement with the uppermost sheet of said stack for imparting a forward and turning motion to said sheet toward said infeed station; and

restraining means positioned at a corner of the leading edge of said stack proximate to said sheet advancing means, for engaging said uppermost sheet as it is moved by said advancing means, thereby to aid in the separation of said sheet from the stack, said restraining means including a first one of said corner elements located at a corner of the leading edge of said stack.

3. A sheet feeding device as claimed in claim 2 wherein said sheet advancing means includes a drive roller member mounted in driving engagement with the uppermost sheet of said stack, said drive roller being positioned nearer said first corner element to ensure the forward and rotational movement of said sheet from said stack.

4. A sheet feeding device as claimed in claim 2 wherein said first corner element is of a height at least equal to that of said stack of sheets.

5. A sheet feeding device for feeding sheets from a stack, one at a time, to an infeed station including a pair of infeed rollers mounted in driving engagement with each other, comprising:

means for positioning said stack at an angular relationship with respect to and at a predetermined distance from said infeed Station so that a line drawn along the leading edge of said stack intersects a line taken along the axis of said rollers;

sheet advancing means positioned in engagement with the uppermost sheet of said stack for imparting a forward and turning motion to said sheet toward said infeed station; and

restraining means positioned at a corner of the leading edge of said stack proximate to said sheet advancing means, for engaging said uppermost sheet as it is moved by said sheet advancing means, thereby to aid in separation of said sheet from the stack.

6. A sheet feeding device for feeding sheets from a stack, one at a time, to an infeed station, comprising:

means for positioning said stack at an angular relationship with respect to and at a predetermined distance from said infeed station so that a line taken along the leading edge of the stack of sheets intersects a line taken along said infeed station;

sheet advancing means positioned in engagement with the feed rollers uppermost sheet of said stack for imparting a forward and turning motion to said sheet toward said infeed station;

restraining means positioned at a corner of the leading edge of said stack proximate to said sheet advancing means, for engaging said uppermost sheet as it is moved by said sheet advancing means, thereby to aid in the separation of said sheet from the stack;

sheet guiding means positioned between said infeed station and said stack of sheets, for aiding in the lifting of said uppermost sheet of said stack into said infeed station.

1. A sheet feeding device for feeding sheets from a stack, one at a time, to an infeed station including a pair of feedrollers mounted feed rollers driving engagement with each other, said sheet feeding device comprising:

means for positioning said stack at an angular relationship with respect to and at a predetermined distance from said infeed station so that a line drawn along the leading edge of said stack of sheets engages a line taken along the axes of said feed rollers of said infeed station;

means positioned along the leading edge of said stack at a corner thereof for restraining the movement of said stack of sheets; and

sheet advancing means positioned in engagement with the uppermost sheet for imparting a forward and rotational motion thereto, whereby said uppermost sheet is caused to engage said restraining means and is thereby separated from the remaining sheets of said stack to ultimately be engaged by said feed rollers with the leading edge of said sheet in a parallel relationship with the axes of said rollers.

8. A sheet feeding device as claimed in claim 7 wherein said positioning means includes a feed tray comprising a base plate and a pair of L-shaped corner elements mounted on and extending upwardly therefrom substantially perpendicular to the plane of said baseplate, said corner elements being in opposing relation to each other diagonally across said baseplate, wherein said restraining means includes a first one of said L-shaped corner elements located at a corner of the leading edge of said stack, and wherein said sheet advancing means includes a single roller member positioned off center with respect to the stack, said roller member being mounted in driving engagement with the uppermost sheet of said stack, whereby upon operation of said roller, a forward and turning motion is imparted to said last-mentioned sheet.

9. A sheet feeding device as claimed in claim 8 wherein at least said first one of said L-shaped corner elements has a height at least equal to that of said stack of sheets.

10. A sheet feeding device for feeding sheets from a stack, one at a time, to an infeed station comprising:

means for positioning said stack at an angular relation with respect to and at a predetermined distance from said infeed station so that a line taken along the leading edge of the stack intersects a line taken along said infeed station;

sheet advancing means positioned off center with respect to said stack of sheets and in engagement with the uppermost sheet of said stack for imparting forward and rotational movement to said sheet; and

means mounted at the corner of the leading edge of said stack nearest said sheet advancing means for engaging said uppermost sheet as it is moved by said sheet advancing means, thereby to cause said sheet to be separated from the stack.

11. A sheet feeding device as claimed in claim 10 wherein said means for positioning said stack at an angular relation with respect to said infeed station includes guide means for engaging a side edge of said sheet being fed to ensure that the leading edge of said sheet is in parallel relation with respect to the line taken along said infeed station upon being received at said infeed station.

12. A sheet feeding device as claimed in claim 11 wherein said means mounted at the corner of the leading edge of said stack for separating said sheet from said stack includes said guide means.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,583,697 Dated June 8, 1971

Inventor(s) James R. Tippy

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 31	"element 13" should read --element 12--;
Column 3, line 54	"by the rollers" should read --by the feed rollers--;
Column 3, line 65	"41" should read --4a--;
Claim 6, line 16	after "stack" insert --and--;
Claim 6, line 14	"Claim 1" should read --Claim 7--;
Claim 7, line 3	Cancel "feed rollers" and insert --in--.

Signed and sealed this 8th day of February 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334