June 3, 1969 W. F. BISHOP ETAL 3,447,798

APPARATUS FOR FEEDING SINGLE SHEETS

Filed May 3, 1967 Sheet 1 of 2

Fig. 2.

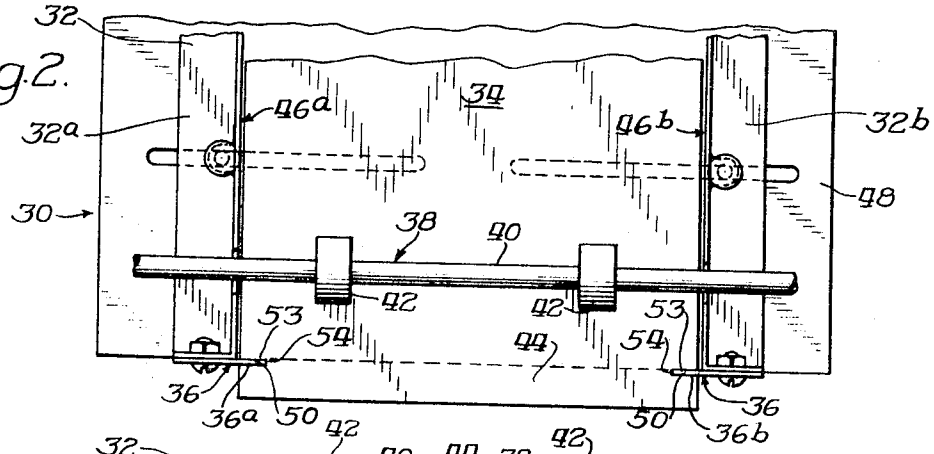


Fig. 1.

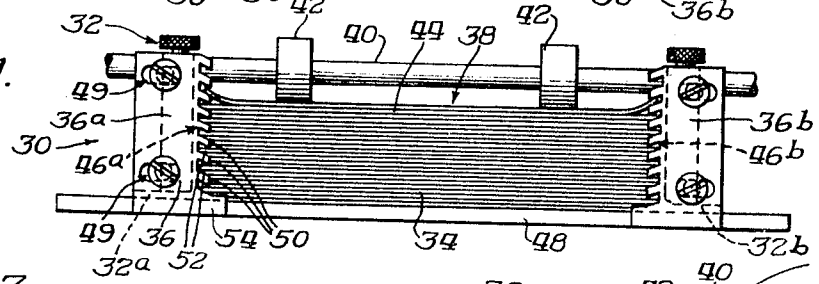


Fig. 3.

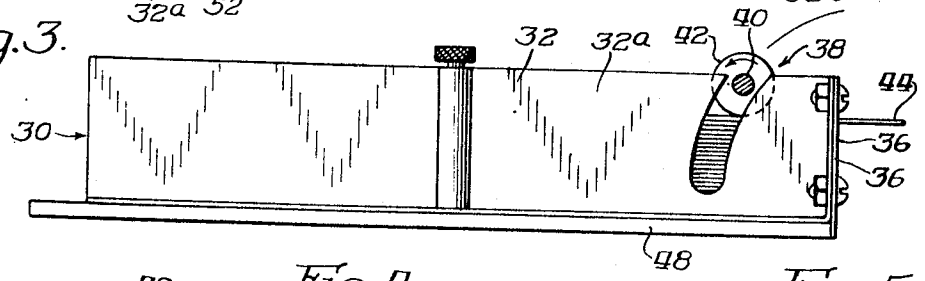


Fig. 4.

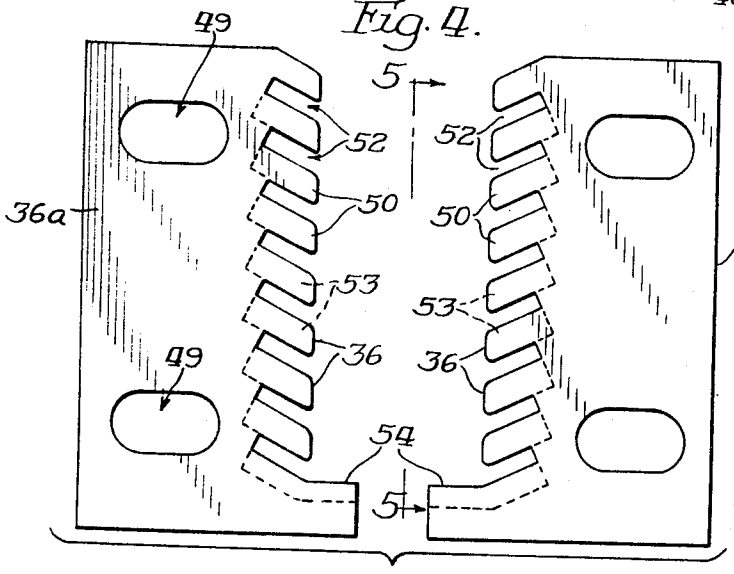
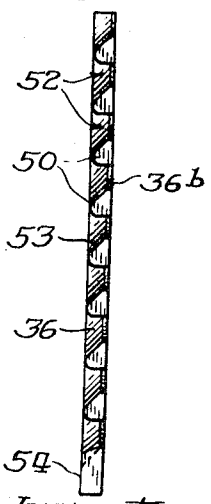


Fig. 5



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Fig. 6.

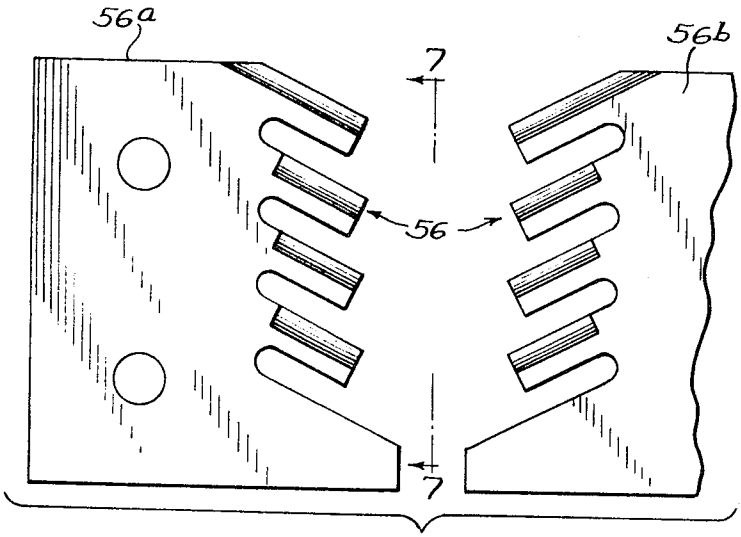


Fig. 7.

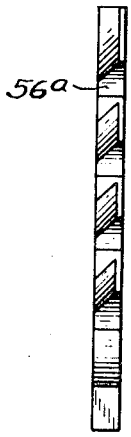


Fig. 8.

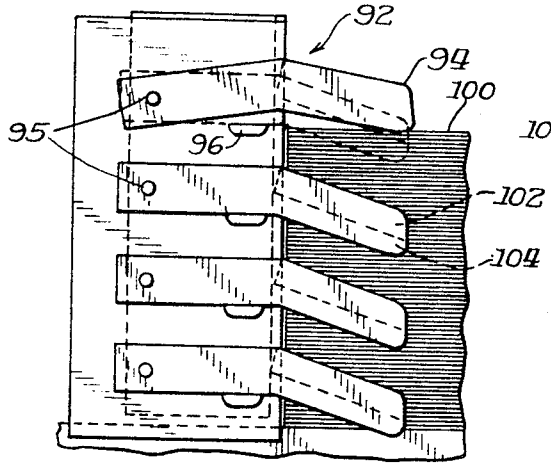
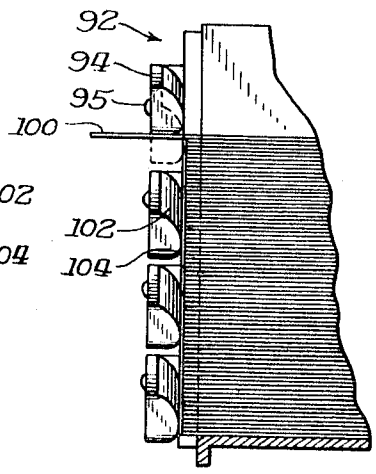


Fig. 9.



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APPARATUS FOR FEEDING SINGLE SHEETS

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Int. Cl. B65h 3/06, 3/46
U.S. Cl. 271—21
8 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for feeding single sheets from a stack of sheets, including a spaced pair of fixed sheet separators each having a comb-like configuration with a number of teeth, each tooth blocking a minor area of the front of the stack of sheets. Individual sheets are vertically buckled and fed through restricted downwardly sloping passageways between the teeth.

The present invention relates to a device for insuring that only one sheet is fed at one time from a stack of sheets. Such devices have important applications for use with duplicating and other reproducing apparatus into which individual sheets of paper must be fed. The application Ser. No. 635,889 of even date by Walter F. Bishop also relates to this art.

Sheet feeding is conventionally accomplished by a driving member frictionally engaging the topmost sheet of the stack of sheets and forcing the sheet forward past an obstruction. The obstruction, or sheet separator, is provided to block the forward edge of the stack of sheets so that only the topmost sheet is moved. Various types of sheet separators have been previously developed. However, prior sheet separators have generally been of the "pin" type, which must be vertically movable, or have required special sheet driving arrangements, or have had other disadvantages. The present invention provides effective sheet separation by employing sheet separators which are of simple and rugged construction and very low cost, yet provide effective feeding of only individual sheets. The sheet separators may be fixed integral units and do not require any moving parts. A plurality of teeth project inwardly and downwardly to define a plurality of sheet stops blocking the edges of the stack of sheets. The teeth are spaced apart to define a plurality of restricted sheet feeding passageways for individual sheets therebetween, which teeth vertically deflect the edges of sheets fed against them through the passageways.

Further objects, features and advantages of the invention pertain to the particular arrangement and structure whereby the above mentioned aspects of the invention are attained. The invention will be better understood by reference to the following description and to the drawings forming a part thereof which are substantially to scale, wherein:

FIGURE 1 is a front elevational view of an exemplary embodiment of the invention;

FIGURE 2 is a top plan view of the embodiment of FIGURE 1;

FIGURE 3 is a side view of the embodiment of FIGURES 1 and 2;

FIGURE 4 is a front elevational view of the sheet separator in FIGURES 1 through 3;

FIGURE 5 is a side view of the sheet separator of FIGURE 4;

FIGURE 6 is a rear elevational view of an alternate sheet separator in accordance with the invention;

FIGURE 7 is a side view of the sheet separator of FIGURE 6;

FIGURE 8 is a front elevational view of a further sheet separator in accordance with the invention; and

FIGURE 9 is a side view of the sheet separator of FIGURE 8.

Referring first to FIGURES 1 through 3, there is shown a sheet feeding apparatus **30** in accordance with the present invention. The sheet feeding apparatus **30** includes a pair of sheet side guides **32** laterally containing a stack of paper sheets **34** therebetween. Partially obstructing the forward end of the stack **34** is a spaced pair of exemplary sheet separators **36** in accordance with the invention. Each sheet separator has a plurality of teeth spaced apart to define sheet stops and sheet feeding passageways therebetween. These passageways provide restricted feeding of individual sheets therethrough.

Preferably, the sheets are fed through the pair of sheet separators **36** by a frictional sheet drive **38**. The sheet drive **38** here comprises a conventional rotary powered drive shaft **40** upon which is axially fixed a pair of cylindrical frictional drive wheels **42**. Such sheet drives are known in the art and accordingly need not be described in detail herein. The shaft **40** is biased downwardly so that the drive wheels **42** continuously frictionally engage the surface of the uppermost sheet **44** of the stack **34** as the stack is lowered by progressive feeding of sheets. Preferably, the shaft **40** is at a fixed spaced distance from the pair of sheet separators **36**.

The side guides **32***a* and **32***b* may be of generally conventional construction and accordingly need not be described herein in detail. They are preferably positioned to provide parallel spaced vertical surfaces **46***a* and **46***b* parallel the direction of feeding of the paper so as to contain the stack **34** laterally, but provide an open forward edge for paper feeding. Preferably, the side guides are mounted on a platen **48** in such a manner as to be laterally adjustable to accommodate varying widths of paper by changing the distance between the surfaces **46***a* and **46***b*.

The respective left and right sheet separators **36***a* and **36***b* are preferably mounted in a vertical plane at the forward edge of the respective side guides **32***a* and **32***b* and perpendicular thereto. They are preferably rigidly fixed to the side guides by bolts, rivets, welding, adhesive or other suitable conventional fastening arrangements. The teeth of each sheet separator preferably extend ⅛ to 1/16 inch toward one another into the paper containing area between the side guides to define a plurality of sheet stops blocking the outside edges of the stack of sheets **34**. The separators are positioned so that the roots of the teeth are generally aligned with the vertical surfaces **46***a* or **46***b* of the side guides. Elongated mounting slots **49** in each sheet separator provide for slight adjustments in the mounting position of each sheet separator on its side guide.

Referring now to the specific sheet separators **36***a* and **36***b*, shown in detail in FIGURES 1, 4 and 5, it will be appreciated that various of the features are common to the other embodiments of sheet separators disclosed herein. Accordingly, the description of the sheet separators **36***a* and **36***b* is intended to be equally applicable to said embodiments where appropriate. The specific dimensions given herein are provided merely by way of example.

The vertical extent of the sheet separators **36***a* and **36***b* is approximately equal to that of the side guides and preferably at least equal to or greater than the maximum height of the stack of paper to be fed. The sheet separators **36***a* and **36***b* are preferably an allochiral or mirror image pair, each separator performing identically at opposite sides of the stack of sheets **34**. Accordingly, only one sheet separator **36***a* need be described herein.

The sheet separator **36***a* is a unitary comb-shaped thin planar member which contains here eight teeth or fingers **50** and is 1 5/32 inch high overall. It will be appreciated that the number of fingers will vary with the desired height of the separator since preferably the entire vertical extent of the inside edge of the separator is toothed. The teeth **50** have sheet feeding passageways **52** between each tooth. Each passageway **52** provides an unobstructed opening from the paper feeding area through the sheet separator. All of the passageways **52** are of preferably equal dimensions and equally spaced apart. Preferably the passageways **52** and the teeth **50** are approximately equal dimensions. The passageways **52** are even and are defined by opposing parallel surfaces on adjacent teeth **50**. A perpendicular distance of .047 inch between parallel surfaces is suitable for both the teeth **50** and the passageways **52**. The sheet separator **36***a* has downwardly pitched teeth **50** and passageways **52**.

A bottom tooth **54** is vertically larger and extends horizontally into the paper feeding area a substantially greater distance further than the other teeth **50**, here by 1/8 inch. It provides a more positive stop or block to the stack of sheets **34** at the bottom of the stack. This is advantageous because of the increased tendency for double feeding of sheets as the feeding of sheets approaches the bottom of the stack of sheets. The upper surface of the bottom tooth **54** is horizontal rather than downwardly pitched. It may be seen that the sheet separators are preferably mounted so that only an upper portion of the bottom tooth **54** projects above the surface of the platen **48** into the paper feeding area.

As may be particularly seen in FIGURE 5, each tooth **50** is preferably upwardly beveled or sloped over its inside face **53** by approximately 45°. The stack of sheets is retained against the inside face **53**. This sloping inside face **53** urges the top sheet over the top of the tooth **50** when the top sheet is fed against the tooth.

The downward pitch or angle of the entire tooth **50** causes the tooth to abut a greater vertical extent of the stack of sheets for a given tooth thickness than if the tooth were horizontal. Here the pitch of the tooth **50** is approximately 27° below the horizontal. This downward pitch insures that all of the sheets in the stack are abutted by at least one tooth **50** even though the teeth are spaced apart. It may be seen that the lowermost portion of each tooth **50** at its outer end lies below the uppermost portion of the immediately underlying tooth **50** at its root. Thus the vertical portion of the stack abutted by a tooth somewhat overlaps the coverage of the immediately adjacent teeth. This tooth pitch also insures that the outer edge of each sheet must deflect upwardly to pass through a passageway **52**. This deflection or buckling of the sheet edge assists in sheet separation. Preferably the lateral dimensions between the innermost ends of the passageways **52** on the opposing sheet separators **36***a* and **36***b* provide a distance slightly greater than the width of the sheet to be fed. However, it will be appreciated that this distance need not be linear since the edges of the top sheet tilt upwardly to pass through the passageways **52** as shown in FIGURE 1.

In the operation of the sheet feeding apparatus **30**, the teeth **50** provide a slight obstruction to the forward movement of any of the sheets in the stack **34**. The sheet drive **38** engages and forces forward the uppermost or top sheet **44**. As the forward edge of the top sheet **44** is forced against the tooth **50** immediately in front of it, it is vertically deflected and forced upwardly over the inside face **53** of that tooth **50** until it is free to pass through the passageway **52** immediately above that tooth. Because of the pitch of each tooth, the outermost edge of the top sheet **44** is deflected upwardly to a greater extent than the rest of the top sheet, and the top sheet **44** is accordingly buckled laterally as well as vertically. Due to the obstruction provided by the tooth and this distortion or buckling of the sheet, the topmost sheet **44** readily separates from the immediately underlying sheet.

Because of the very limited vertical extent of the obstruction provided by an individual tooth **50**, the top sheet **44** does not have to buckle or distort or be force fed to any substantial extent. The top sheet flicks over only the single tooth **50** which is immediately in front of it and is guided restrictively through the passageway **52** immediately above that one tooth. Consequently, there is no danger of a sheet folding over or otherwise misfeeding. Also, only the outer edges of the sheet must distort during feeding, as there is no obstruction of any of the sheets except at their outside edges.

Turning now to the embodiment of the invention illustrated in FIGURES 6 and 7, it may be seen that a sheet separator pair **56** illustrated therein is basically similar to the sheet separator pair **36**. However, the rear or sheet abutting surface of each sheet separator **56***a* and **56***b* differs from the corresponding inside face **56** of the sheet separator pair **36** in that each tooth is only beveled to define an upward sloping surface along its top edge rather than over the full vertical height of the tooth.

FIGURES 8 and 9 illustrate a further pair of sheet separators **92** in accordance with the invention. The teeth **94** of each of the sheet separators **92** are each pivotally mounted adjacent their outer ends by rivets or other suitable pivotal fasteners **95**. The teeth **94** are otherwise basically similar to those of the sheet separators described above. Each tooth **94** is held in its normal parallel spaced apart position by means of underlying stops **96**. The stops **96** may be knock-outs, pins, etc.

As shown in FIGURE 9, when a top sheet **100** is fed, the operation is essentially the same as that previously described for other embodiments of the invention. However, the top sheet **100** here may push upwardly the immediately overlying tooth **94** from its normal position as illustrated in dotted outline. This reduces the amount of deformation, buckling or wedging exerted upon the top sheet **100**. If the top sheet engages the tooth **94** at the principal upwardly sloping rear surface **102** thereon, the tooth will remain in position and a sheet will rise and feed over it. However, if the top sheet **100** strikes the rounded lower rear surface **104** of the tooth, the tooth will pivotally rise up above the plane of the top sheet **100** rather than provide an obstruction.

The construction of any of the above described sheet separators is extremely simple and economical. They may be stamped, cast or machined from sheet metal, plastic or any other suitable materials. It will be appreciated that various of the configurations and features taught herein may be combined to form other sheet separators.

It may be seen that there has been described herein improved apparatus for feeding individual sheets from a stack of sheets, which apparatus is extremely simple, reliable and effective and may be manufactured at low cost in various forms. The apparatus described herein is presently considered to be preferred; however, it is contemplated that further variations and modifications within the purview of those skilled in the art can be made herein. The following claims are intended to cover all such variations and modifications as fall within the true spirit and scope of the invention.

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

1. Apparatus for feeding individual sheets from a stack of sheets, said apparatus having a spaced pair of side guides adapted to contain a stack of sheets therebetween and means for feeding said sheets from said stack, wherein the improvement comprises:

a pair of fixed sheet separators,

each said sheet separator having a comb configuration with a plurality of teeth projecting inwardly and downwardly between said side guides to define a

plurality of sheet stops blocking the feeding of sheets and vertically deflecting the edges of sheets urged thereagainst by said feeding means,

said teeth being spaced apart to define a plurality of sheet feeding passageways therebetween,

said sheet feeding passageways being adapted to provide restricted and vertically deflected sheet feeding therethrough.

2. The apparatus of claim 1 wherein said feeding means includes rotary frictional drive means at a preset fixed distance from said sheet separators for engaging and moving the uppermost sheet of a stack of sheets through said sheet separators.

3. The apparatus of claim 1 wherein said teeth have vertically inclined beveled surfaces for vertically deflecting upward sheets urged thereagainst.

4. The apparatus of claim 1 wherein said sheet feeding passageways are generally parallel to one another and incline downwardly from said side guides.

5. The apparatus of claim 1 wherein said teeth are movable.

6. The apparatus of claim 1 wherein each of said teeth is independently pivotable vertically about an axis outside of said side guides.

7. The apparatus of claim 1 wherein the principal portion of said teeth are substantially identical and the lowermost tooth projects inwardly of said side guides a substantial distance beyond the other said teeth.

8. Apparatus for feeding individual sheets from a stack of sheets, said apparatus having means for supporting a stack of sheets, and sheet driving means for moving the top sheet of said stack of sheets forward, wherein the improvement comprises:

a pair of fixed vertical abutment means spaced at each side of the stack of sheets,

said abutment means having plural projections extending substantially horizontally and downwardly in front of said stack of sheets,

said projections being vertically spaced apart to define downwardly sloping sheet feeding spaces therebetween,

each individual projection being positioned to obstruct the forward movement of only a minor portion of the sheets in the stack of sheets, and being positioned to vertically deform and deflect an adjacent moving top sheet into a sheet feeding space, and

adjacent projections on said abutment means partially overlapping in vertical sheet obstructing extent.

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RICHARD E. AEGERTER, *Primary Examiner.*