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Kolibas

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[54] **BOTTOM SHEET FEEDER**

[75] Inventor: **James A. Kolibas,** Broadview Heights, Ohio

[73] Assignee: **Addressograph-Multigraph Corportion,** Cleveland, Ohio

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Related U.S. Application Data

[63] Continuation of Ser. No. 228,003, Feb. 22, 1972, abandoned.

[52] **U.S. Cl.** **271/124,** 271/116, 271/167

[51] **Int. Cl.** **B65h 3/52**

[58] **Field of Search** 271/121, 124, 125, 116, 271/114, 109, 37, 38, 35, 51, 122, 123, 124, 137, 138, 167

[56] **References Cited**

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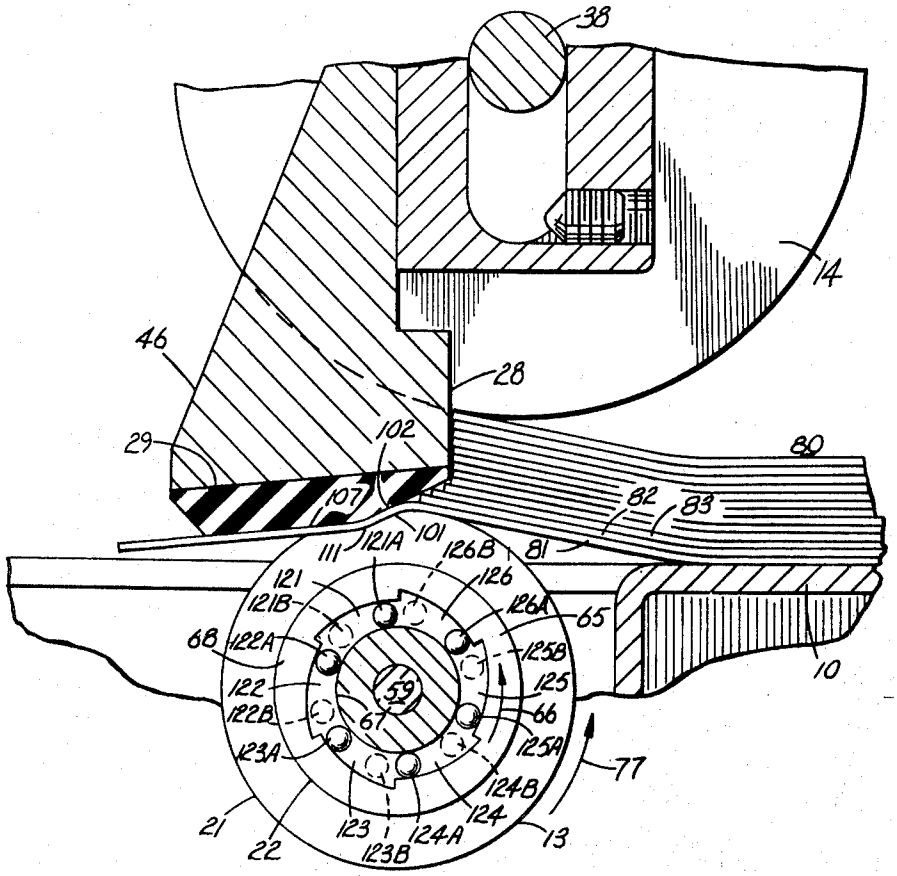
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Primary Examiner—James B. Marbert
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney, Agent, or Firm—Russell L. Root; Ray S. Pyle

[57] **ABSTRACT**

A sheet separating device is disclosed for separating and feeding forward the bottom sheet of a stack of sheets. It includes a feed roller covered with friction material in contact with the lead margin of the bottom sheet of the stack. A non-moving retard member cooperates with the feed roller in a non-contacting manner to deflect the bottom sheet into a slight channel configuration and present a barrier to all other sheets. Resting on the top of the stack at the lead margin is a follower member urged against the stack. The follower is of roller configuration and freely rotatable so that as the stack is depleted, the final sheets will be dragged frictionally towards the retard member without significant frictional resistance from the follower roller, and the last sheet will have its forward feed substantially unimpeded thereby.

7 Claims, 4 Drawing Figures



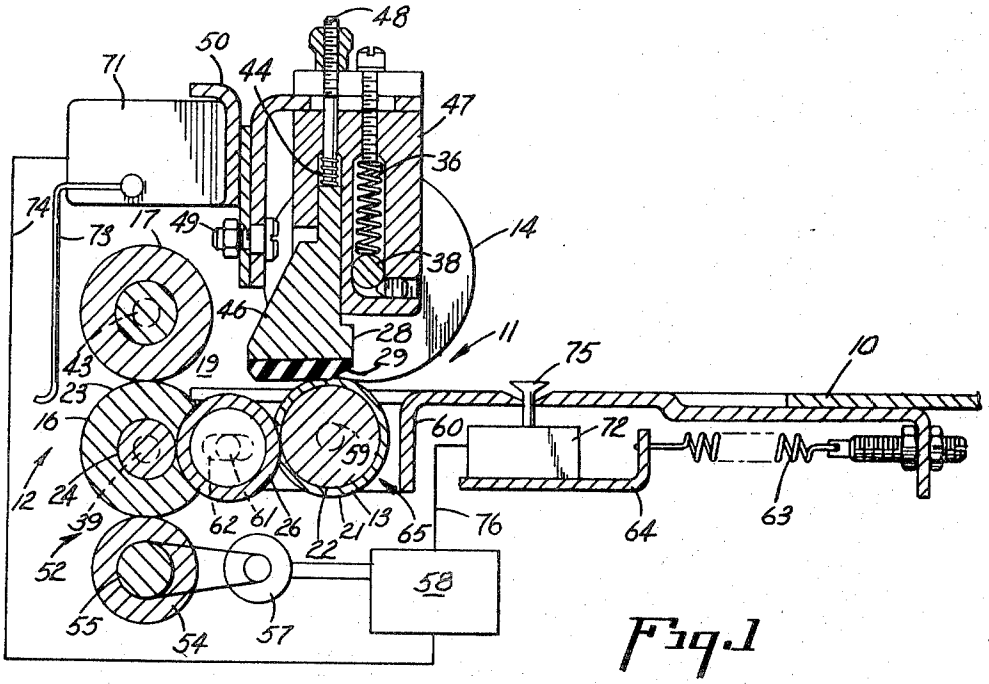

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Fig. 1

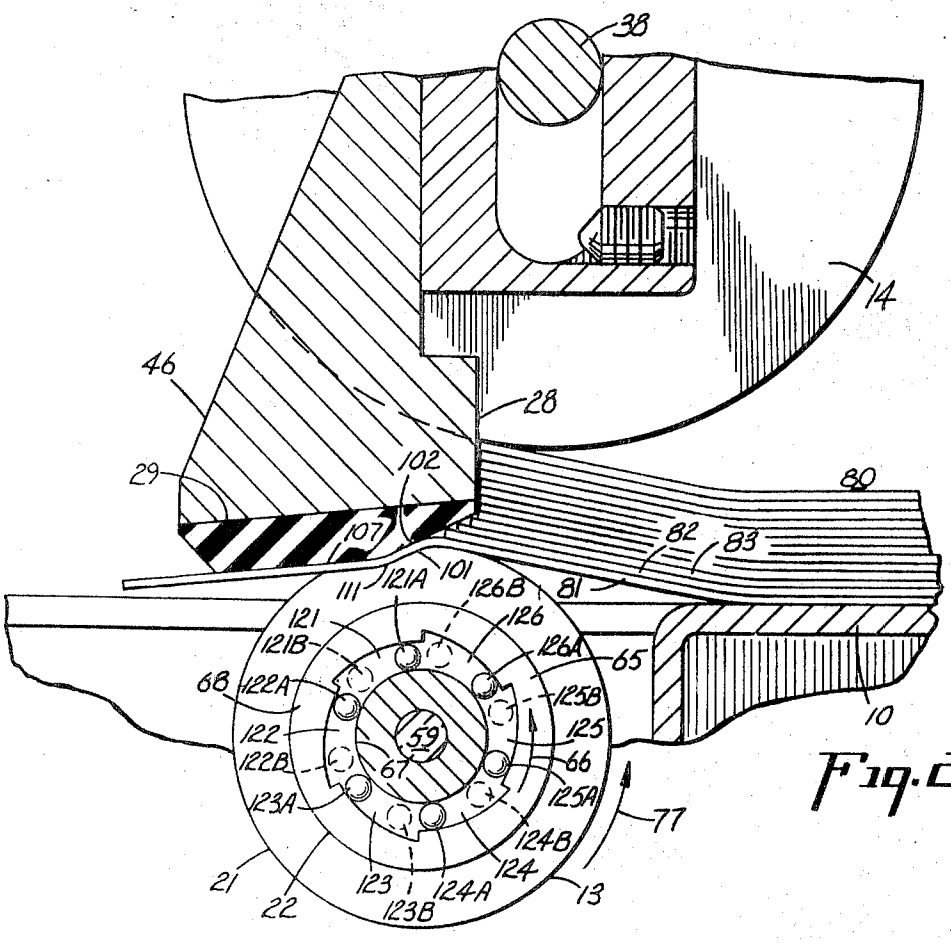

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122A
125B
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124B
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124A
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123B
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Fig. 2

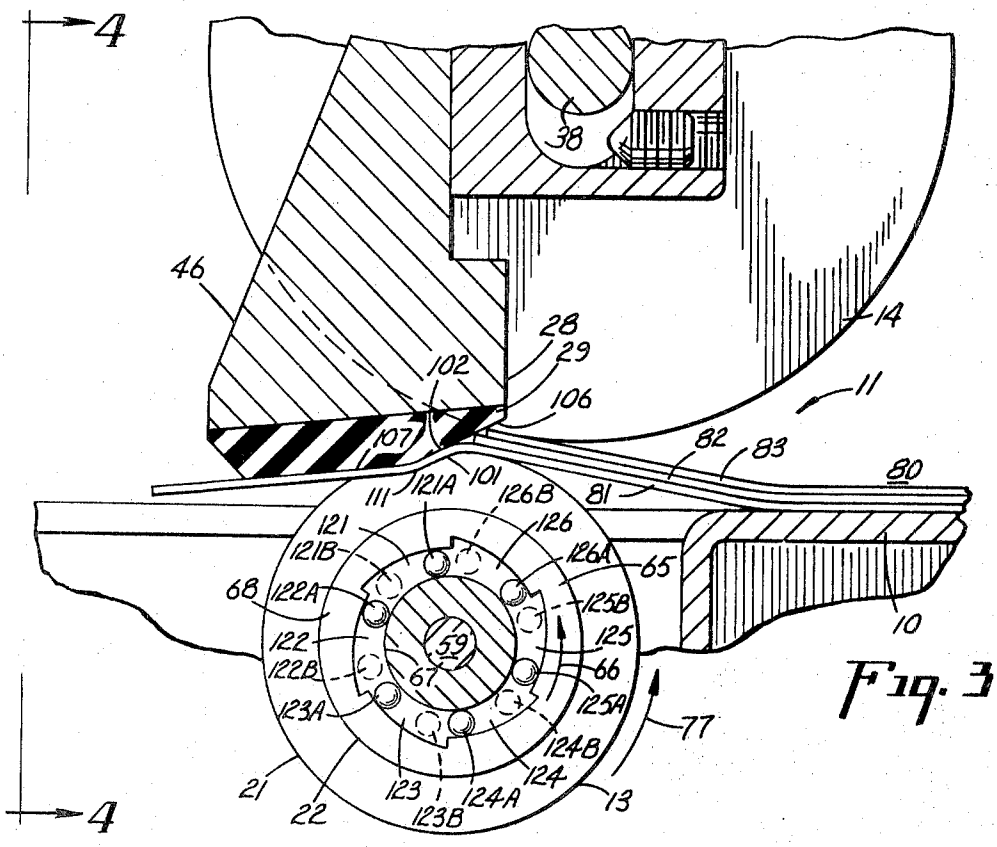

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126A
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Fig. 3

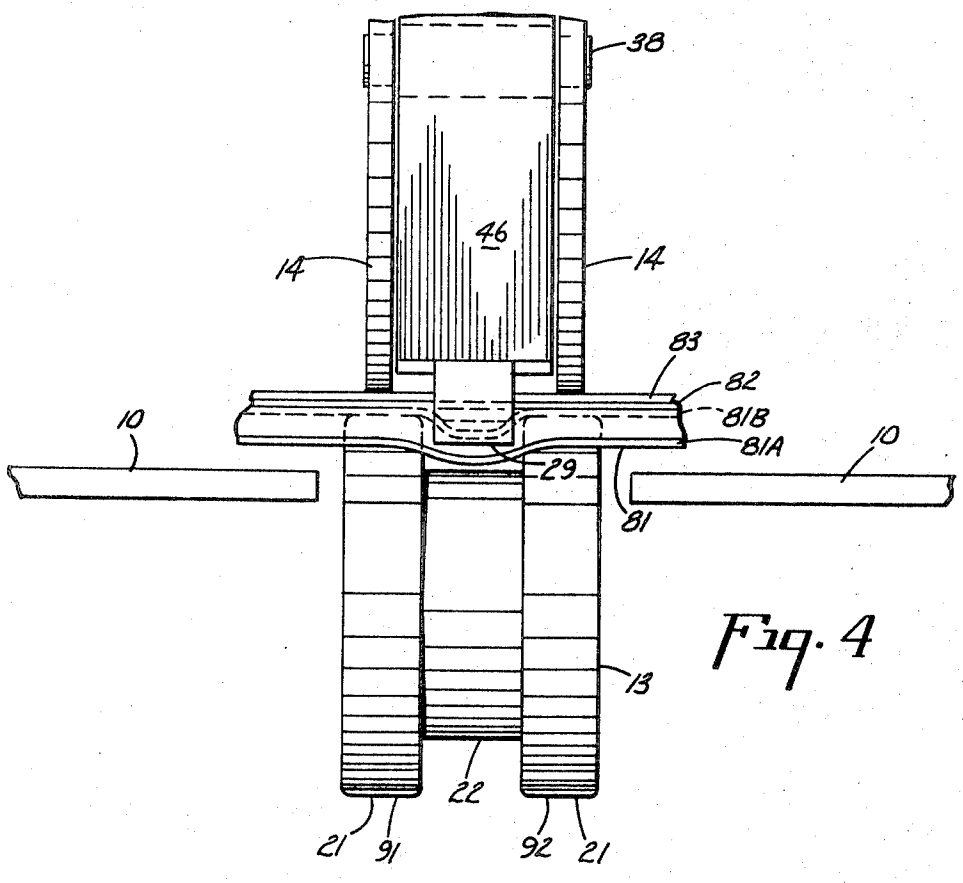

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81B
81A
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92
21

Fig. 4

BOTTOM SHEET FEEDER

RELATED CASES

This application is a continuation of my copending application Ser. No. 228,003 filed Feb. 22, 1972, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to sheet feeding apparatuses and more particularly to apparatuses for feeding the bottom sheet of a stack.

The prior art has known many types of bottom sheet feeders varying in structure from the very simple to the very complex. The complex bottom sheet feeders although reliable, were in general large, bulky and expensive. In addition, the complex bottom sheet feeders were not readily adaptable to existing equipment. The simple bottom sheet feeders known to the prior art were not reliable and exhibited problems such as double feeding and the like. In particular, folded letters, at or near the top of a stack, will tend to jam most feeders due to their tendency to unfold. Therefore, an object of this invention is to produce a bottom sheet feeder apparatus which is simple and of low cost; and capable of feeding paper after the paper has been folded by capturing and holding the lead edge of the sheet stack.

Another object of this invention is to produce a bottom sheet feeder apparatus which is reliable.

Another object of this invention is to produce a bottom sheet feeder apparatus which is easily mounted on existing machines.

Another object of this invention is to produce a bottom sheet feeder apparatus which is easily disengaged from the machine when manual feed is desired.

SUMMARY OF THE INVENTION

In order to attain the foregoing objects, there are provided first and second coaxial wheels driven in a sheet feeding direction and spaced apart and a retard member or separator projecting between the wheels and having two specifically related sloping bottom surfaces causes the sheets to abut and retard, but deflects a portion of the bottom sheet downwardly if unsupported by another sheet below as fed forward. A weighted surface, such as a large wheel, rides the top of the stack of sheets at the leading margin and turns only when the top sheet of the stack reaches the high point of the first of the sloping bottom surfaces and is dragged forward beneath the retard member.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims, taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is the preferred embodiment of the invention showing a side sectional view together with auxilliary feed wheels, such as the input feed rollers of a duplicating machine imaging device;

FIG. 2 is an enlargement of a portion of the apparatus shown in FIG. 1 with a full supply of sheets to be fed;

FIG. 3 illustrates the condition after the stack has been fed to the last few sheets; and

FIG. 4 is a view taken on line 4—4 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a sheet feeding apparatus comprising sheet holder means **10** able to hold a stack of sheets, first and second feeder means **11** and **12**, respectively, and a retard means **46.** The first feeder means **11** includes first driving means **13** which is illustrated in FIG. 1 as a forwardly driven override clutch which will drive paper sheets, but will allow the outer drive surface to exceed the speed of its drive shaft whenever an exterior force is applied, such as when a sheet of paper separated from the stack is grasped by another set of drive wheels and pulled away at a speed greater than when driven by the means **13.** The first driving roll means **13** includes first and second driving surfaces **21** and **22,** respectively. The first sheet feeder means **11** also includes first pressure means **14** which is illustrated as a pressure roll means which is able to rotate about an axis **38** and is urged by urging means **36** to press upon a paper stack placed on holder **10.** Roll members **14** are not directly driven, and simply ride the stack of sheets in a static condition. When the stack is reduced to the extent that the top sheet drops below abutment **28,** then the roll members rotate slightly with, and under drive from, the moving sheet.

In order to illustrate the capability of the feeder to operate with another processing machine, the intake feeder of a representative device is shown as a second feeder means **12.** The second feeder means **12** includes a second driving means **16** which is also illustrated as a driving roll means having a first and a second driving surface **23** and **24,** respectively. The second driving means **16** is able to rotate about an axis **39.** The diameters of the first and second driving surfaces **23** and **24** are shown as being substantially different. Consequently, the ratio of the diameter of the first driving surface **23** to the diameter of the second driving surface **24** of the second driving roll means **16** is materially greater than the ratio of the diameter of the first driving surface **21** to the diameter of the second driving surface **22** of the first driving roll means **13.** The second feeder means **12** includes second pressure means **17** which is shown as pressure roll means **17** rotatable about an axis **43** and which is engageable with the first driving roll means **16** to feed sheets therebetween. Although the driving means **13** and **16** and the pressure means **14** and **17** in the first and second feeder means **11** and **12** have been illustrated as rolls, equivalent structures such as driving belts, driving surfaces and the like are included within the definitions of driving means and pressure means.

Separation is assured by causing the bottom sheet of a supply stack to buckle downwardly, and the sheets immediately above to advance a short distance and be restrained as the bottom sheet advances. These functions are produced by portions of an element or retard member **46,** which for convenience may be termed a retard member. Member **46** is slidable within a housing **47** and adjustable by a screw **48,** and may be spring loaded, as by spring **44,** for larger range of intermixed thicknesses and weights of paper. The housing **47** is connected to a structure **50** which structure is fixed relative to the sheet holder means **10.** The housing **47** can be rotated about an axis **49** to disengage the sheet feeding apparatus when manual feeding is desired. The re-

tard member **46** has a vertical abutment wall **28** and carries as a part thereof a foot **29** to cooperate with the first feeder means **11** and the sheet holder means **10** to separate the bottom sheet of a stack. The lower portion of the foot **29** exhibits two surfaces each forming an acute angle relative to the sheet holder means **10** with the vertex thereof pointing in the direction of feed which is to the left in FIG. **1.**

The sheet feeding apparatus shown in FIG. **1** includes power means **52** which drives the first driving means **13** at a substantially less sheet-feeding speed than the second driving means **16.** In this embodiment the power means includes the axis **59** of the first driving means **13** being mounted on carrier means **60.** The power means **52** also includes idler roll means **26** having an axis **61** mounted on the carrier means **60.** The axis **61** of the idler roll means **26** is able to move relative to the first driving means **13** as indicated by the slot **62.** Urging means **63** is connected between the carrier means **60** and a support **64** which support is fixed relative to the sheet holder means **10.** The urging means **63** urges the idler roll means **26** to engage the second driving surfaces **22** and **24** of the first and second driving means **13** and **16,** respectively. The power means **52** includes motive means **57** shown as a motor connected to a pulley **55.** The pulley **55** is mounted upon a transfer roll **54** which is in contact with the first driving surface **23** of the second driving means **16.** The difference in diameters of the respective first and second driving surfaces of the first and second driving means **13** and **16** causes the first feeder means **11** to have a substantially less sheet feeding speed than the second sheet feeder means **12.**

The apparatus shown in FIG. **1** includes clutch means **65** shown in FIG. **2** to disengage the first feeder means **11** to allow the first feeder means **11** to move at a sheet feeding speed commensurate with the sheet feeding speed of the second feeder means **12** when a sheet is being engaged by the first and second feeder means **11** and **12** simultaneously. The clutch means **65** includes clutch means installed between the first driving surface **21** and the power means **52.** FIG. **2** illustrates a particular structure of a suitable clutch means **65** wherein a one-way clutch means is installed between the first and second driving surfaces **21** and **22** of the first driving roll means **13.**

A first switch means **71** having a sensor **73** is connected to a control means **58** through a conductor **74.** A second switch means **72** having a sensor **75** is connected through a conductor **76** to the control means **58.** The control means **58** is connected to the motor **57.** When a stack of sheets is placed on the sheet holder means **10,** the sensor **75** is depressed activating switch **72** and the control means **58.** The control means **58** energizes the motor **57** which rotates the second driving roll means **16** at a sheet feeding speed substantially greater than the first driving roll means **13.** The movement of the first driving roll means **13** in cooperation with the first pressure means **14** causes the bottom several sheets of a stack of sheets to abut against the foot **29** allowing only the bottom sheet to be conveyed by the first driving roll means **13.** The bottom sheet is conveyed to the second feeder means **12** wherein the second driving roll means **16** conveys the bottom sheet at a substantially greater sheet speed than the first driving roll means **13.** The clutch means **65** allows the first driving surface **21** to override and in effect disengage from the motor **57** to allow the first driving surface, which is in contact with the bottom sheet, to move at a speed commensurate with the sheet feeding speed of the second driving roll means **16.** After the bottom sheet has been fed by the second feeder means **12,** the first switch means **71** and the control means **58** deactivate the motor **57.** This can be accomplished by having the sensor **73** of the first switch means **71** responsive to the trailing edge of the bottom sheet or having the sensor **73** responsive to the leading edge of the following sheet. The differential in sheet feeding speed between the first feeder means **11** and the second feeder means **12** insures that the sheet is accelerated so that a gap will be present between the trailing edge of the first bottom shset and any subsequent sheet.

FIG. **2** illustrates an enlarged view of the first feeder means **11** comprising the first driving roll means **13,** the first pressure means **14** and the retard member **46.** A stack of sheets **80** is held by the sheet holder means **10** and comprises a bottom sheet **81,** a second sheet **82** and a third sheet **83** plus static sheets thereabove.

Intersheet forces exist between adjacent sheets in the stack and tend to keep the sheets together making sheet separation difficult. The intersheet force can include static and dynamic frictional forces in addition to electrostatic and adhesive forces and the like.

The first driving roll means **13** rotates about the axis **59** in a counterclockwise direction as indicated by the arrow **77.** The first driving surface **21** is connected to the second driving surface **22** through the clutch means **65.** The clutch means **65** includes a first driving surface ring **67** being connected to the first driving surface **21** and a second driving surface ring **68** being connected to the second driving surface **22.** The region between the first driving surface ring **67** and the second driving surface ring **68** comprises six portions **121–126** each having a distance therebetween which is tapered from one end of the portion to the other. Each portion has a bearing which is free to move within the respective portion. When the second driving surface **22** is rotated by the idler roll means **26,** the second driving surface ring **68** rotates as indicated by the arrow **66.** The movement of the second driving surface rings **67** and **68** are shown in positions **121A—126A** to engage the first driving surface **21** and cause it to rotate at the same angular speed as the second driving surface **22.** When the bottom sheet **81** is simultaneously engaged with the first and second feeder means **11** and **12,** the accelerated movement of the bottom sheet **81** rotates the first driving surface **21** at a greater angular speed than the second driving surface **22** causing the bearings to move into the phantom positions **121B—126B** wherein the bearings are no longer simultaneously abutting against the first and second driving surface rings. The movement of the bearings to the phantom positions **121B—126B** disengages the first driving surface **22** to allow the bottom sheet **81** to move at a speed commensurate with the sheet feeding speed of the second feeder means **12.**

The foot **29** is composed of a primary surface **106** (FIG. **3**) and a secondary surface **107.** The primary surface **106** forms an acute angle relative to the stack of sheets in proximity to the leading edge thereof in the order of 40°. The secondary surface **107** forms an angle relative to the sheet holder means **10** of approximately 5° which is the angle at which the bottom sheet **81** leaves the first feeder means **11** and thus serves as a

guiding surface for the sheet during departure. The first driving roll means **13** has a profile which is in the form of an arc. The profile of the foot **29** intersects the aforesaid arc of the first driving roll means **13.** The foot **29** engages with the top surface of the bottom sheet **81** to cause the bottom sheet **81** to bend at a point **111** in the direction of sheet conveyance. The extended departure guiding surface **107** of the foot perpetuates this bend, resulting in a significant degree of wrap of the lowermost sheet about the driving roll means **13.** As such it may be termed a "departure guide means" for the above purpose, and while it has been shown as integral with foot **29** of the retard member **46,** it will be appreciated that a guide surface independently supported and similarly directed would serve the purpose equally well.

FIG. **2** illustrates a first and a second friction means **101** and **102,** respectively, wherein the first friction means **101** includes the first driving surface engaging the bottom surface of the bottom sheet **81.** The second friction means **102** includes the foot **29** engaging with the top surface of the bottom sheet **81** and also engaging with the second and third sheets **82** and **83.** The second friction means **102** has a friction coefficient with paper of a value less than that of the first friction means **101** yet greater than the intersheet force between adjacent sheets. The intersheet forces cause the second and third sheets **82** and **83** to be conveyed by the movement of the bottom sheet **81.** The relationships among the first friction means **101,** the second friction means **102** and the intersheet forces cause the second and third sheets **82** and **83** to abut against the primary retard surface **106** and cause only the bottom sheet **81** to be conveyed by the first driving roll means **13.**

FIG. **4** is a view taken on line 4—4 of the enlargement shown in FIG. **2.** The first driving means **13** includes the first and second driving surfaces **21** and **22** wherein the first driving surface **21** includes the first and second driving elements **91** and **92,** respectively. The retard member **46** includes the foot **29** the latter being interdigitated with the first and second driving element means **91** and **92,** spaced in such a manner as to allow the bending and escapement of a wide variety of paper weights and thicknesses. In the illustration shown in FIG. **4** there are two driving element means **91** and **92** and a single foot **29.** The first pressure means **14** is illustrated in FIG. **4** as two pressure roll means corresponding to the first and second driving element means **91** and **92.** The leading edge of the bottom sheet **81** is illustrated as **81A** whereas the trailing edge of the bottom sheet **81** is illustrated as **81B.** The separator means **29** extends between the first and second driving element means **91** and **92** to cause the bottom sheet to be bent in a direction transverse to the direction of conveyance, forming a shallow channel extending in the direction of feed. The cooperation between the first feeder means **11,** the retard structure **46** and the sheet holder means **10** separate and bend the bottom sheet in two directions as shown in FIGS. **2, 3** and **4** to insure that a single sheet will be conveyed by the first feeder means **11.**

Since the sheet is engaged and separated at the center of the lead edge of the bottom sheet, the sheet is driven and transported forward with high frictional forces by elements **91** and **92** but with no lateral or side to side forces exerted on the sheet thereby allowing the alignment of the sheet being fed to be controlled by simple side guides before entering a second transport means.

The sheet feeding apparatus shown in FIGS. **1–4** can be installed on many existing machines. In many cases the second sheet feeder means **12** is an existing part within the structure of the machine. In such a case, only the addition of the idler roll means **26,** the first feeder means **11** and retard member **46** need be installed. In addition, after installation the apparatus can be disengaged by rotating the housing **47** about axis **49** to allow manual feeding through the second feeder means **12.**

The foregoing specification discloses a simple and highly reliable sheet feeding apparatus that can be manufactured and installed at a low cost. The apparatus contains all the advantages of a bottom sheet feeding apparatus without the size and complexity of the apparatuses of the prior art.

The wheel **14** turns only with a stack whose height is not sufficient to reach the uppermost point of surface **106.** The bottom sheets will tend to drag forward to contact surface **106,** but the sheets above will only move in a vertical direction. After the stack has been reduced to the condition shown in FIG. **3,** the rotatable mounting of wheel **14** shows its merit. A stationary weight will introduce a retard function. Wheel **14** will rotate slightly as it holds the remainder sheets tightly to the surface **21,** and allows them to advance until they are in contact with surface **106.** It will also rotate freely as the last sheet of the stack is fed forward in its turn.

The novel roll-weight action of roll **14** provides a feeder that can accommodate a mixture of sheets of a wide variety, and is not caused to malfunction by folded or thin sheets.

What is claimed is:

1. An apparatus for feeding one sheet at a time from the bottom of a stack of sheets on a support surface which comprises:

a feed roller member covered with high coefficient frictional material for contact with the lead margin of the bottom sheet of the stack;

means for driving the feed roller member in a sheet feeding direction;

a retard member, non-moving in the direction of sheet travel, disposed above the axis of the feed roller member, cooperating in a non-contacting manner with the surface of the feed roller member, and having a lead-in side so configured as to provide a stop for the lead edge of the stack directly above the feed roll member and sloped to guide a portion of the leading edge of the fed bottom sheet below the feed roller surface with a degree of overlap therewith sufficient to deflect each fed sheet into a slight channel configuration about one of said members as the fed sheet passes therebetween, said retard member presenting surfaces blocking all sheets of a stack other than the bottom sheet from being fed forward by the feed roll member;

follower means mounted adjacent the retard member at the lead-in side thereof and urged toward the feed roll member axis so as to make contact with the top of a stack of sheets on the support surface at the lead margin thereof when the latter is against said blocking surfaces to press the lead margin of the bottom sheet of such stack against the surface of the feed roller member, and also acting to urge

the sheets of said stack into frictional driving relationship with each other whereby to urge the final sheets of a stack into operative contact with said guide configuration of said retard member to insure proper feeding thereof as the stack approaches depletion.

2. An apparatus as set forth in claim **1** in which the feed roller member projects substantially above the support surface holding the stack, and in which there are departure guide means leading away from the point of conjunction of the feed roller member and the retard member in the general direction of feed, said departure guide means having a direction bending the sheet towards the support surface and producing thereby a partial wrap of the fed sheet about the surface of the feed roller member.

3. An apparatus as set forth in claim **1** in which the feed roll member is driven through an overrunning clutch whereby a sheet being fed can be carried away at a higher speed than that determined by the drive for the feed roll member.

4. An apparatus as set forth in claim **1** in which one of said members is resiliently urged towards the other to permit self adjustment of the degree of overlap between said members in response to sheet stiffness to thereby accommodate sheets of varying ranges of stiffness in a single stack.

5. An apparatus as set forth in claim **1** in which said follower means comprises a roller and includes means mounting the roller for free rotation so as to form a nip with the feed roller member as the stack approaches depletion, said roller avoiding any tendency of the follower means to resist sheet motion in a feeding direction, and allowing the last sheet to be fed forward with minimum follower restriction.

6. An apparatus as set forth in claim **5** in which the feed roller member projects substantially above the support surface holding the stack, and in which there are departure guide means leading away from the point of conjunction of the feed roller member and the retard member in the general direction of feed, said departure guide means having a direction bending the sheet towards the support surface and producing thereby a partial wrap of the fed sheet about the surface of the feed roller member.

7. An apparatus as set forth in claim **5** in which one of said members is resiliently urged towards the other to permit self adjustment of the degree of overlap between said members in response to sheet stiffness to thereby accommodate sheets of varying ranges of stiffness in a single stack.

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