

Sept. 15, 1964

A. S. CHANDLER ET AL
SHEET FEEDING APPARATUS

3,148,876

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4 Sheets-Sheet 1

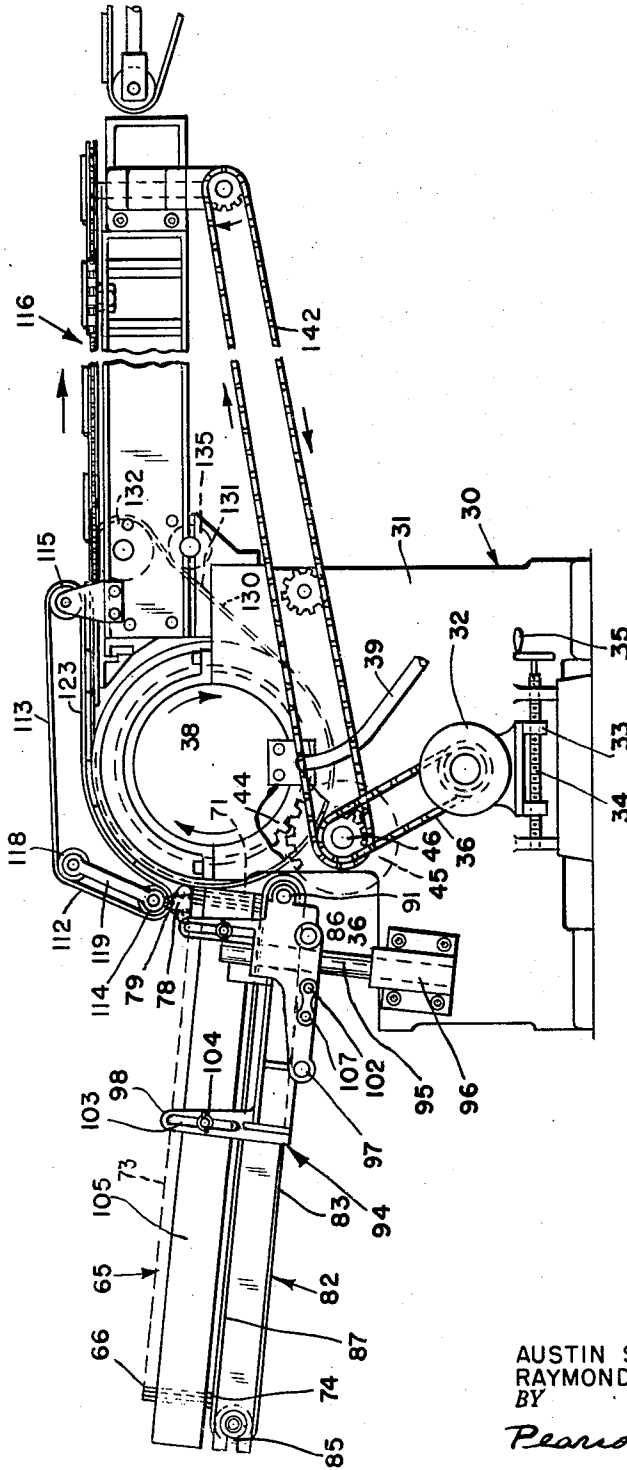


Fig. 1.

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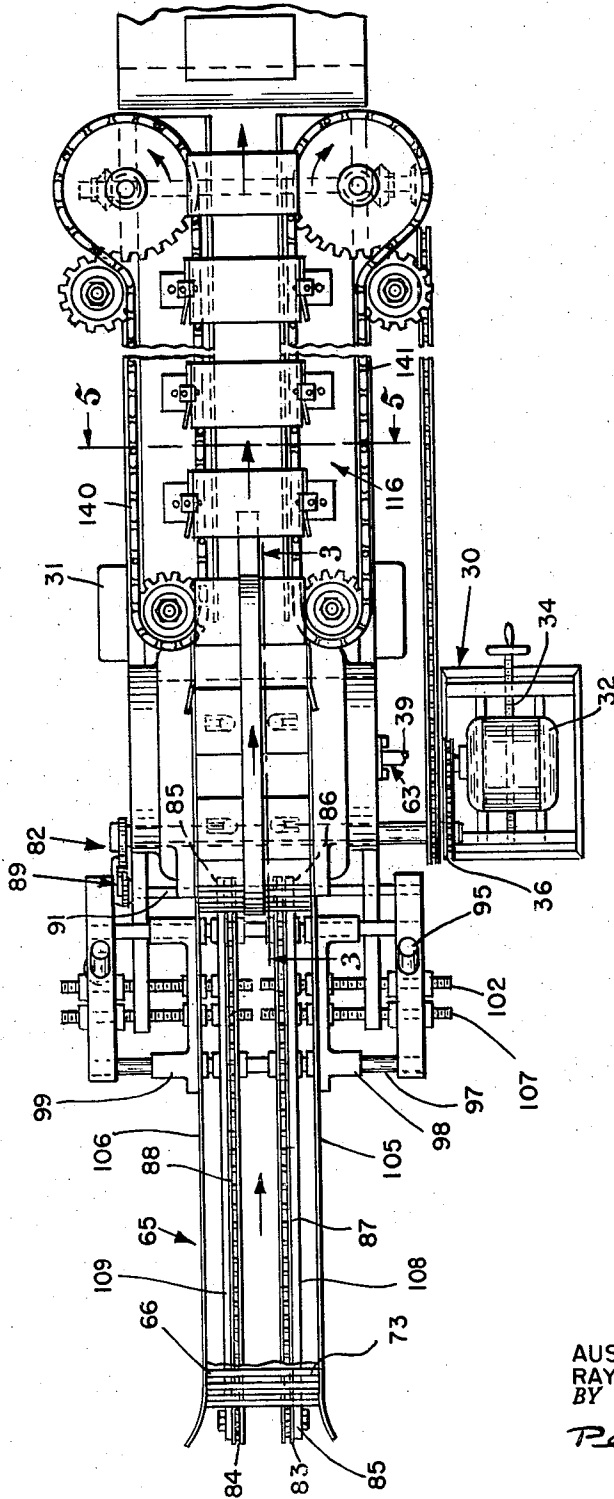


Fig. 2.

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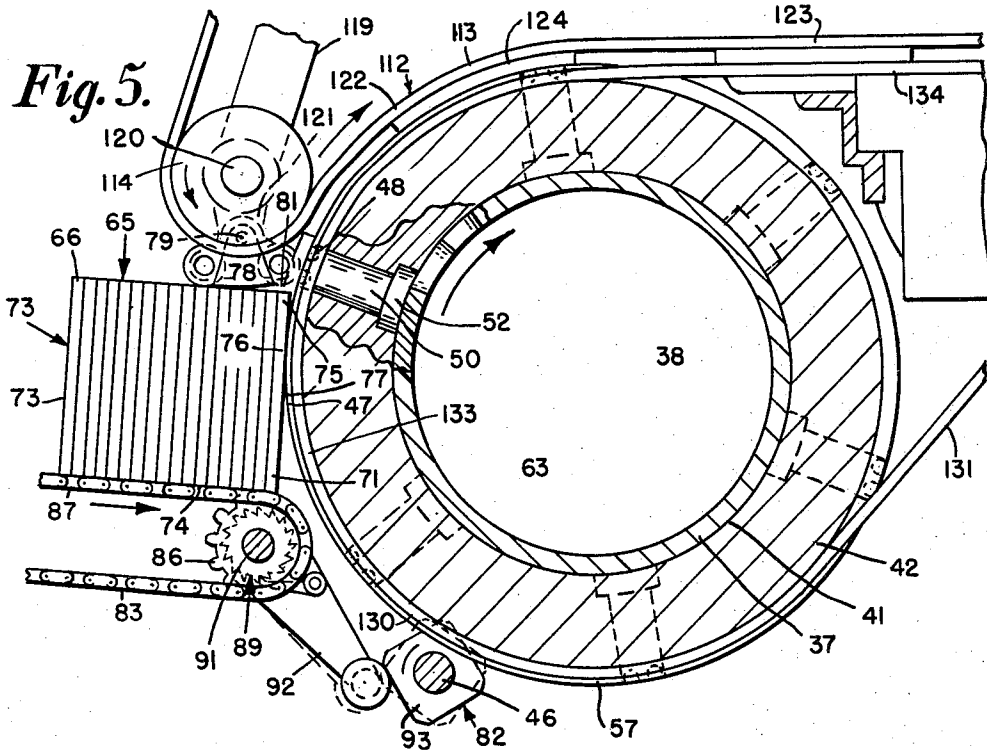


Fig. 5.

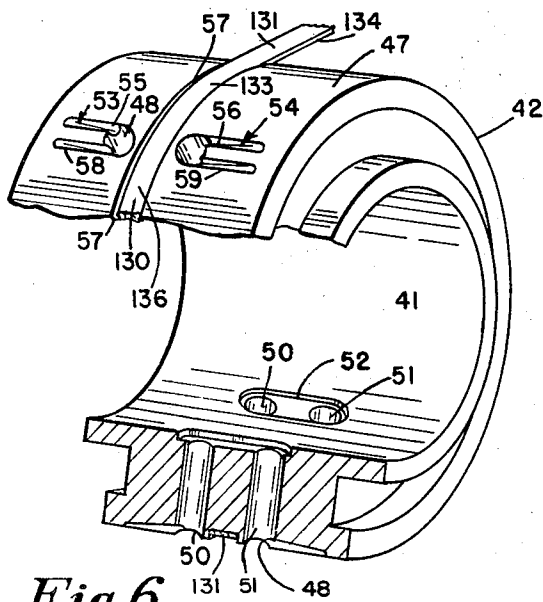


Fig. 6.

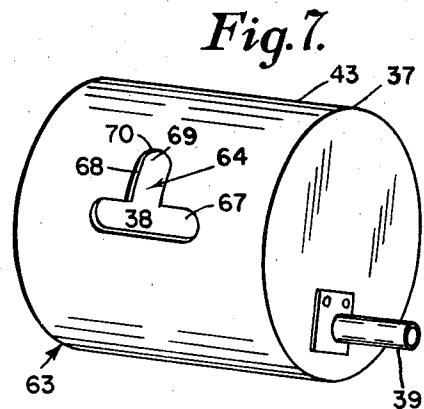


Fig. 7.

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SHEET FEEDING APPARATUS

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13 Claims. (Cl. 271-12)

This invention relates to sheet feeding apparatus of the type having a rotating feed roll with suction apertures for segregating the end sheet from a magazine and moving the sheet along a path. It especially relates to such apparatus capable of feeding flat sheets, having a smooth coated surface, rather than a rough fibrous surface, at relatively high speeds such as five hundred to one thousand sheets per minute, without malfunction.

Sheet feeding mechanism has heretofore been proposed in which an inclined, end-feed magazine feeds each successive endmost sheet into contact with the face of a suction feed roll, the suction apertures in the face of the roll gripping the leading edge portion of the end sheet and sliding the sheet through the magazine gateway. For example, in U.S. Patent 2,251,945 to Labombarde of August 12, 1941, the leading edge portion of the end sheet is pressed against the face of the roll to assume the curve of the roll, and then carried around the roll between the roll face and a curved stretch of an endless conveyor belt. At high speeds and with smooth surfaced sheets, there may be a tendency for such apparatus to fail to feed, to feed prematurely because of the pressure of the endmost sheet against the face of the roll or to double feed because of friction between the end sheet and the next succeeding sheet.

In this invention, because of the difficulty of accurately feeding smooth coated sheets, at the desired speed, individually and successively from a stack, the necessity for maintaining complete control of each sheet as it is carried around the roll face and the necessity for positively stripping the sheet from the roll to deliver it to registering mechanism, the structures of the prior art have been considerably improved. The magazine of the invention is so mounted that the sheets are supported on a lower edge in nearly vertical position to reduce sheet friction. A portion of the face of the endmost sheet, intermediate of the height of the sheet, is pressed into tangential contact with the smooth face of the suction feed roll by power operated index means so that the leading edge portion of the sheet is spaced from the face of the roll. The magazine gate is a barrier for the leading edge of the endmost sheet, when the sheet is in its normal flat plane, but suction from the feed roll draws the leading edge portion out of the plane of the sheet against the face of the roll into a position opposite the gateway of the magazine. The application of maximum suction is made substantially instantaneous by the provision of a wide suction port communicating with even wider suction apertures in the roll face, the latter being nearly as wide as the face itself, whereby the leading edge portion of each endmost sheet is positively bent away from the next succeeding sheet to reduce friction and is then carried through the gateway. A stripper belt trained around a groove in the face of the roll positively strips each sheet from the roll, while traveling at the same surface speed, to avoid marking the coating on the sheet.

The principal object of the invention is, therefore, to provide an improved sheet feeding apparatus, of the suction feed roll type, capable of handling smooth, coated sheets without misfeeding or marking the sheets when operating at high speed.

Another object of the invention is to provide a suction

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roll feed which bends the gripped portion of a sheet out of the plane of the sheet and into alignment with a magazine gateway, or sheet passage, thereby assuring single feed, breaking frictional contact with the next succeeding sheet and bending only the sheet being fed.

A further object of the invention is to provide stripping means not dependent on suction, release of suction, stationary blades or the like, but comprising a belt traveling at the same surface speed as the speed of the roll face and preferably inset in a groove in the roll face.

Still another object of the invention is to provide a novel indexing means for advancing a horizontal stack of substantially vertical sheets up to the face of a suction feed roll with the endmost sheet pressed against the roll face at a predetermined pressure.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawings and from the drawings in which:

FIG. 1 is a side elevation of sheet feeding apparatus constructed in accordance with the invention,

FIG. 2 is a plan view thereof,

FIG. 3 is an enlarged side elevation, in section on line 3-3, of FIG. 2,

FIG. 4 is an enlarged end elevation, in section on line 4-4, of FIG. 3,

FIG. 5 is a somewhat diagrammatic sectional view similar to FIG. 3 showing the feed action of the device on a still further enlarged scale,

FIG. 6 is a diagrammatic perspective view of the rotating feed roll of the invention, partly in section, and

FIG. 7 is a view similar to FIG. 6 of the stationary suction drum and transverse suction port of the invention.

As shown in the drawings, the sheet feeding apparatus of the invention includes a main frame 31 having an electric motor 32, mounted on a carriage 33 movable on threaded rods 34 by a handle 35 for adjusting the tension of drive chain 36.

A stationary, cylindrical, suction drum 37 extends across the main frame 31, the hollow interior 38 of the drum being connected by the fluid conduit 39 to a suitable source of suction, not shown, such as mill suction, suction pump and tank or the like. The interior face 41 of the rotatable feed roll 42 is adapted to revolve around the smooth exterior face 43 of the stationary drum 37, a roll gear 44 being intermeshed with a gear 45 carried by a shaft 46 and the shaft 46 being driven by the motor drive chain 36.

As best shown in FIGURES 4 and 6 the circumferential face 47 of the feed roll 42 is smooth and provided with at least one transverse suction aperture 48. Preferably, however, there are a plurality of such suction apertures spaced circumferentially around the face 47, for example six, as shown. Each aperture 48 comprises a pair of laterally spaced, radial passages, or bores, 50 and 51 joined at the inside by a lateral passage 52 and each terminating at the outside in one of two pairs 53 and 54 of shallow, tapered, transversely extending grooves, such as 55 and 56. The smooth face 47 of feed roll 42 preferably includes a central, shallow, circumferential groove 57, for a purpose to be described hereinafter. Each suction aperture 48 forms a pair of suction mouths 58 and 59 in the smooth face 47 of feed roll 42 each on an opposite side of the circumferential groove 57 and each extending from proximate groove 57 to proximate the adjacent side 61 or 62 of the face 47.

The suction control mechanism 63 includes the source of suction, the conduit 39 and suction drum 37, drum 37 having a novel suction port 64 located near the gateway of the magazine 65. It has been found that the area and width of the suction aperture 48 and the rapidity

with which suction is applied thereto are critical in the feeding of sheets at high speed from a magazine and especially so when the sheets are smooth coated. The suction aperture 48 is thus of relatively large area and nearly as wide as the face, 47 whereby a suction grip is secured across substantially the full width of the sheet.

If the suction port 64 was relatively narrow or if it was circular in configuration, the inside of aperture 48 might pass by the port without communicating sufficient suction, or with a slow gradual communication of suction, to the mouths 58 and 59 thereby failing to grip and feed the endmost sheet 71 of magazine 65. Suction port 64 is, therefore relatively wide and preferably in the form of an inverted T, the head 67 of the T forming a wide, laterally extending slot and the stem 68 of the T extending circumferentially in the direction of feed for a predetermined distance.

As best shown in FIG. 4, the special configuration of suction port 64 and of suction aperture 48 results in the creation of a wide zone of communication, indicated at 69 in FIG. 4, the instant that each passage 52 rotates around drum 37 to partially expose and communicate with the wide head 67 of the port 64. When the mouths 58 and 59 have sucked, or drawn a sheet 66 onto the face 47 of roll 42, maximum suction is no longer required and the stem 68 of the port 64 is adequate communication to aperture 48 until suction is broken at the terminal end 70 of the stem.

The magazine 65 is of the end feed type with the stack 73 of identical sheets 66, supported generally horizontally and with each sheet 66 upstanding vertically on its lower edge 74. Friction between the contacting faces of the sheets 66 is thus reduced to prevent adhesion thereof and to prevent double or triple feeding.

Each endmost sheet 71 is normally in a flat plane with the leading edge portion 75 spaced at a predetermined distance from the face 47 of roll 42 and with an intermediate portion 76 of the exposed face 77, just in advance of the leading edge portion 75, in tangential radial contact with roll face 47. The roll face 47 thus forms a movable end wall for magazine 65 but its rotary motion is not imparted to each successive end sheet 71 because the face 47 is of smooth metal and the exposed face 77 is smoothly coated.

In conventional magazines a movable gate is usually positioned to form a gateway, or sheet passage, directly opposite the leading edge of each endmost sheet for passing one sheet at a time. In the apparatus of this invention the movable gate 78 is adjustably pivoted at 79 but is positioned in the path of the leading edge of each endmost sheet 71, if the sheet were slid off the stack 73. The gate 78 forms a gateway 81 with the face 47 of roll 42 which requires each endmost sheet to be bent out of its normal flat plane by the suction from mouths 58 and 59 before the leading edge portion can pass through the gateway. Thus the leading edge portion 75 of each endmost sheet is drawn toward the face 47, and away from frictional contact with the next succeeding sheet, which is still opposed by gate 78, and the endmost sheet is then withdrawn from the stack by the rotation of, and adherence to, the suction feed roll 42. Misfeed is prevented by the rapid application of suction over a wide area produced by suction port 64 and double feed is prevented by bending each sheet out of its flat plane before slidably withdrawing the sheet from the stack.

Magazine 65 includes power actuated feed mechanism 82, the feed mechanism 82 including an endless carrier extending along the entire bottom to beyond the gateway of the magazine preferably in the form of a pair of parallel, endless chains 83 and 84. Chains 83 and 84 are trained around sprockets such as 85 and 86 with the upper stretches 87 and 88 of the chains supporting the stack 73. The upper stretches 87 and 88 are indexed toward the face 47 of feed roll 42 by a ratchet and pawl

mechanism 89 operable on shaft 91 carrying the sprockets 86, the pawl being actuated by a cam arm 92 and cam 93. Cam 93 is mounted on shaft 46 so that the continuous pressure of the endmost sheet 66, of stack 73, against the roll face 47 is maintained and the index actuation is synchronized with the speed of rotation of feed roll 42.

Magazine 65 includes the subframe 94 supported at a slight incline from the horizontal, to eliminate the need for a movable back plate bearing against stack 73, and carried by a pair of posts such as 95 slidably adjustable in brackets such as 96. Subframe 94 includes cross rods 97 carrying side wall brackets 98 and 99, the brackets 98 and 99 being laterally adjustable by the threaded cross rods 102. The brackets 98 and 99 include slots such as 103 for the set screws 104 of side wall plates 105 and 106 whereby the height of the magazine walls may be varied as well as the width thereof. A threaded cross rod 107 is provided for lateral adjustment of the spacing between the chains 83 and 84, the sprockets 85 and 86 being journaled to an elongated chain plate 108 and 109 threaded on the cross rod 107.

A traveling belt conveyor 112 is provided to hold each successive sheet 66 against the face 47 of roll 42 after segregation of the leading edge portion 75 thereof by roll 42, to assist in withdrawing the remainder of the sheet from the stack and to form the outside of a sheet path leading away from roll 42. As shown, conveyor 112 includes an endless belt 113 trained around a pulley 114 located just in rear of gateway 81, at one end and trained around a pulley 115, located beyond the entrance of a registration conveyor 116. A tension pulley 118 is mounted on an arm 119 pivotable on the cross rod 120 which carries pulley 114, the arm 119 having an extension 121 for carrying the pivotable magazine gate 78. Belt 113 thus includes the curved stretch 122 which forms the outside of the sheet path around roll 42 and the straight stretch 123 which also forms part of the outside of the sheet path. The stretches 122 and 123 advance at the same surface speed as the surface speed of face 47 and are preferably of soft friction material, such as rubber, to avoid marking the outside face 124 of each sheet 66 while advancing with, and bearing against, the same with a predetermined pressure.

The traveling belt stripper 130 assures that each successive, individual sheet 66 segregated from stack 73, through gateway 81, will be positively stripped from suction feed roll 42 without marking the exposed face 77, without scuffing the leading edge portion 75 and with complete control of the sheet from the magazine to the registration conveyor 116.

Stripper 130 includes the endless belt 131 trained around the suction feed roll 42, within the circumferential groove 57, and around the pulley 132 which is located away from roll 42 and well beyond the entrance of registration conveyor 116. Belt 131 includes the curved stretch 133 extending around roll 42 and the straight stretch 134, both forming the inside of the sheet path and paralleling the corresponding stretches of the conveyor belt 113. A tension pulley 135 is provided for maintaining the straight stretch 134 in taut condition and belt 131 is preferably of friction material such as rubber. The depth of groove 57 and the thickness of belt 131 is such that the outer face 136 of the belt is just below the level of the smooth circumferential face 47 of roll 42 whereby the curved stretch 133, although passing by the exposed face 77 of each endmost sheet, and passing by gateway 81, has no contact with the face 77 and no tendency to impart motion thereto.

In operation the magazine 65 indexes the stack 73 toward the smooth roll face 47 to press the intermediate portion 76 of each successive endmost sheet 71 tangentially against the face 47, while the gate 78 prevents the segregation of the normally flat endmost sheet. As each suction aperture 48 rotates to a position opposite gateway 81 it comes into rapid communication with suction port

64 to exert maximum suction on the leading edge portion 75 of each endmost sheet. The suction exerted, curves the leading edge portion 75 away from the next succeeding sheet, draws it against the smooth face 47 and closes the mouths 58 and 59. With the portion 75 gripped and adhered to face 47, the continued angular advance of the roll 42 withdraws the remainder of the endmost sheet from the magazine with the sheet coming between the curved stretches 122 and 133 of the belt conveyor and stripper. The sheet is then under control of the conveyor and stripper as the apertures 48 rotate beyond the stem 68 of port 64 to break the suction. The stripper 130 positively peels the sheet from the roll and with the conveyor 112, advances the sheet further along the sheet path to be received by the registration conveyor 116 or any other suitable apparatus.

Registration conveyor 116 is of the chain lug type with parallel horizontal endless chains 140 and 141 driven in timed relation with the apparatus 30 by the drive connection 142. It forms no part of this invention and is included only to show that the sheet path of the apparatus 30 overlaps the entrance of the next succeeding treatment device or carrier in order to deliver sheets thereto under complete control.

We claim:

1. Sheet feeding apparatus of the type having a sheet magazine and a rotatable sheet feed roll, said apparatus comprising magazine means for holding a plurality of flat, planar, smooth faced sheets with the intermediate portion of the exposed face of the endmost sheet in tangential engagement with said roll and with the leading edge portion of said endmost sheet spaced at a predetermined distance from said roll; a smooth, circumferential face on said roll, incapable of imparting rotary motion to said endmost sheet, said smooth face having at least one transverse suction aperture therein adapted, when suction is applied thereto, to curve said leading edge portion out of its flat plane into engagement with said smooth face, grip said portion and impart rotary motion to segregate said sheet from said magazine; a traveling belt conveyor having a curved stretch bearing against the face of said roll, said conveyor extending from said magazine to a substantial distance beyond said roll to form the outside of a sheet path; a traveling belt stripper having a curved stretch in a plane below the plane of the smooth circumferential face of said roll, said stripper belt paralleling said conveyor belt to form the inside of said sheet path for guiding each sheet segregated from said magazine away from said roll and suction control mechanism including an elongated transverse suction port fixed within said roll to communicate with said suction aperture for rapidly applying maximum suction thereto when said aperture rotates to a position opposite the said leading edge portion of each successive endmost sheet in said magazine.

2. Apparatus as specified in claim 1 wherein said face includes a circumferential groove and said traveling belt stripper is trained around said roll within said groove.

3. Apparatus as specified in claim 1 wherein said face includes a circumferential groove in the central portion thereof, said travelling belt stripper is trained around said roll in said groove and the mouth of said suction aperture extends on each opposite side of said groove substantially to the opposite sides of said face.

4. Apparatus as specified in claim 1 wherein said magazine includes an endless carrier for supporting the sheets therein and power operated means urging said carrier in the direction of the face of said roll and pressing said intermediate portion of the exposed face of each successive endmost sheet thereagainst, said intermediate portion being just in advance of said leading edge portion of said sheet.

5. Apparatus as specified in claim 1 wherein said traveling belt conveyor is of friction material for frictionally engaging the outer surface of each sheet segregated from

said magazine and completing the withdrawal of said sheet from said magazine in cooperation with the said smooth circumferential face of said roll.

6. Apparatus as specified in claim 1 wherein said magazine includes feed mechanism supporting said sheets upstanding on the lower edges thereof to reduce friction between adjacent sheets, said mechanism presenting each successive endmost sheet to the face of said roll with the upper edge portion forming said leading edge portion spaced from said roll face and with said intermediate portion just below and proximate said upper edge portion whereby said smooth face forms a movable end wall on said magazine just in advance of said leading edge portion.

7. Apparatus as specified in claim 1 wherein the face of said roll is of metal and forms a smooth, metal, a movable end wall for said magazine, tangentially contacting a portion of the exposed face of each successive endmost sheet in said magazine intermediate of the height of said sheet, said magazine includes a gate for opposing the sliding segregation of the leading edge of said sheet and said magazine includes a gateway for passing said leading edge when said leading edge is curved out of the plane of said sheet by suction exerted through said transverse suction aperture.

8. In apparatus of the type having a rotating feed roll with a transverse suction aperture for segregating a plurality of flat sheets individually and successively through the gateway of a magazine holding a stack of said sheets; the combination of a smooth circumferential face on said roll having a circumferential groove therearound; power actuated, magazine feed mechanism, including an endless carrier supporting said stack of sheets and advancing toward the face of said roll to press an intermediate portion of the exposed face of each successive endmost sheet into tangential engagement with the smooth circumferential face thereof and to space the leading edge portion of said sheet from said face; suction control mechanism including a transverse suction port within said roll, substantially coextensive in transverse dimension with said suction aperture, for rapidly communicating suction thereto when said aperture has rotated to just in advance of the gateway of said magazine exactly opposite to the said leading edge portion; a traveling belt conveyor extending from just in rear of the gateway of said magazine to beyond said roll, said conveyor having a curved stretch bearing against said smooth, circumferential face, and a traveling belt stripper having a curved stretch trained around said roll within said circumferential groove, said belt stripper cooperating with said belt conveyor to guide each successive sheet away from said roll.

9. Apparatus as specified in claim 8 wherein the endless carrier of said magazine feed mechanism comprises a pair of laterally spaced, generally horizontal, chains supporting said sheets on the upper stretches thereof, said upper stretches being indexed toward the face of said roll by power connection with said rotating feed roll and extending along the entire bottom to beyond the gateway of the magazine.

10. Apparatus as specified in claim 8 wherein said transverse suction port is the head of an inverted T shaped opening, the stem of the T overlapping the curved stretch of said endless belt conveyor for maintaining suction in the apertures in the face of said roll until a sheet has been gripped by said stretch and for then breaking said suction.

11. Apparatus as specified in claim 8 wherein each said suction aperture in the face of said roll includes two pairs of circumferentially spaced, shallow, suction mouths, each pair on an opposite side of the circumferential groove in said face, the shallow mouths of each pair extending transversely from proximate said circumferential groove to proximate the adjacent side edge of said face.

12. Apparatus for feeding a plurality of flat, smooth sheets individually and successively along a path, said apparatus comprising a rotatable feed roll having a smooth

circumferential face of predetermined length substantially greater than the corresponding dimension of a sheet to be fed thereby, said face having a plurality of transverse suction apertures spaced therearound; drive means for rotating said roll at a predetermined surface speed to advance said suction apertures along a curved stretch of said path; power actuated magazine feed means mounted along said curved stretch and pressing an intermediate portion of the exposed flat face of successive endmost sheets therein tangentially against the circumferential face of said roll with the leading edge portion thereof spaced at a predetermined distance from the circumferential face of said roll; suction control mechanism rapidly creating maximum suction in each said suction aperture; at said magazine means, gripping said leading edge portion of each said endmost sheet, curving said portion out of the plane of the sheet and advancing said sheet along said curved stretch; an endless stripper belt associated with, and traveling at the same surface speed as that of, said face for guiding the leading edge portion of each sheet, fed along said curved stretch, tangentially into a straight stretch of said path leading to a registration conveyor; a traveling belt conveyor having a curved stretch extending from said magazine means around said smooth circumferential face and bearing thereagainst for frictionally engaging and retaining said sheets on said face after segregation thereof and guiding the same to said registration conveyor, said registration conveyor, synchronized with said drive means and said control mechanism, said conveyor having register elements extending along said straight stretch and adapted to continue the advance along said path of each successive sheet received from said stripper belt.

13. Sheet feeding apparatus comprising a rotatable cylindrical feed roll having a smooth circumferential face; an automatic end feed sheet magazine pressing an intermediate portion of the exposed face of each endmost sheet therein, into tangential engagement with said smooth face and spacing the leading edge portion thereof from said smooth face; suction means on said roll to curve said leading edge portion of the exposed face of the endmost sheet out of the plane of the sheet, draw said portion into contact with said smooth face and segregate said sheet therefrom; a traveling friction belt conveyor having a curved stretch bearing against the face of said roll, said conveyor extending from said magazine to a substantial distance beyond said roll to form the outside of a sheet path; a traveling friction belt stripper having a curved stretch inset into the face of said roll, said stripper paralleling said conveyor to form the inside of said sheet path, beyond said magazine and suction control mechanism for rapidly applying maximum suction to said suction means, to positively grip each sheet, maintain said suction until said sheet is well within said path and then break said suction.

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