

[54] **METHOD AND APPARATUS FOR DELIVERING SHEETS**

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[52] U.S. Cl. **271/182, 271/200, 271/203, 271/206**

[51] Int. Cl. **B65h 29/28**

[58] Field of Search 271/79, 68, 69, 82, 174, 271/182, 200, 202, 203, 204, 206; 198/180

[56] **References Cited**

UNITED STATES PATENTS

2,620,033	12/1952	Wood	271/79 X
2,757,610	8/1956	Gegenheimer et al.	271/79 X
2,769,634	11/1956	Koch	271/79
2,953,089	9/1960	Dudley	271/75 X
3,703,282	11/1972	Henkel	271/79

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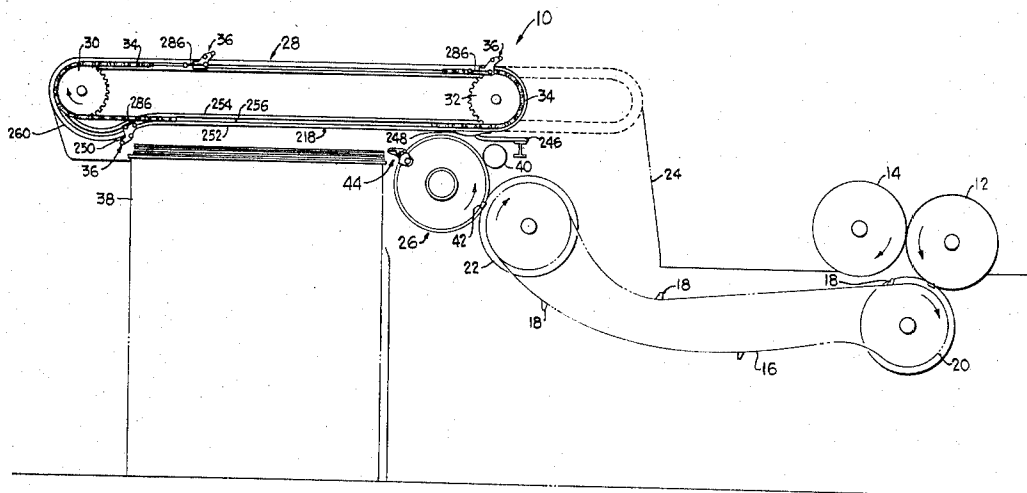
Attorney, Agent, or Firm—Stanley J. Price, Jr.

[57]

ABSTRACT

A first pair of endless chain conveyors have transverse gripper bars thereon with gripper devices that are arranged to engage the front edge of a sheet while the sheet is being printed in a printing unit. The first pair of endless chains convey the sheet to an intermediate transfer cylinder where the front edge of the sheet is transferred from the transverse gripper bars to the transfer cylinder. The tail edge of the sheet is engaged by tail edge grippers on the intermediate transfer cylinder. The front edge of the sheet is transferred from the intermediate transfer cylinder to gripper devices associated with a plurality of endless chain conveyors to which gripper devices are connected. The gripper devices convey the sheet from the transfer cylinder to the pile. A slowdown device is arranged to reduce the forward movement of the sheet as the front edge of the sheet approaches the front edge of the pile and the tail edge grippers are arranged to release the tail edge of the sheet after the front edge of the sheet has been released by the grippers on the plurality of endless chain conveyors. The plurality of endless chain conveyors are movable longitudinally relative to the transfer cylinder to thus deliver different sized sheets to a pile. The transfer cylinder is also adjustable so that sheets of different length may be transferred thereon.

7 Claims, 19 Drawing Figures



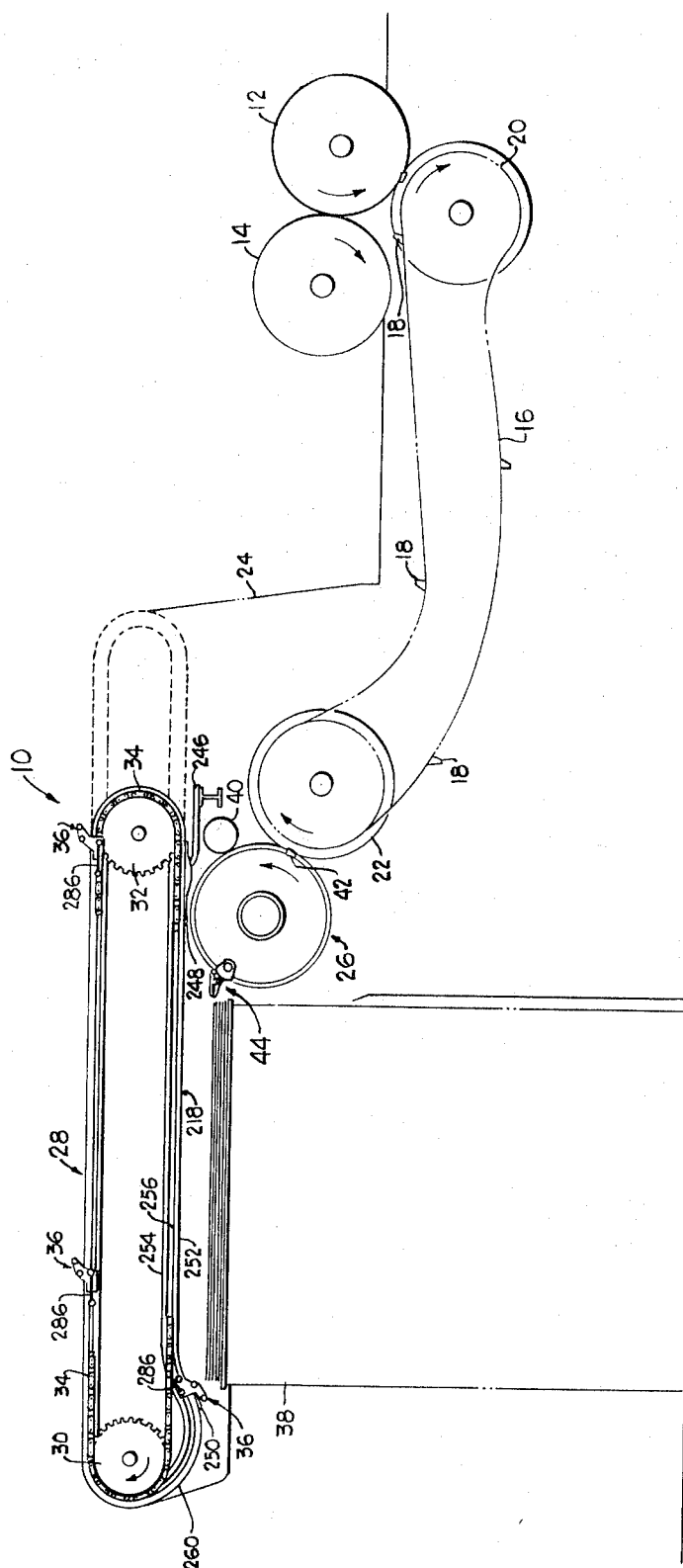


Fig. 1.

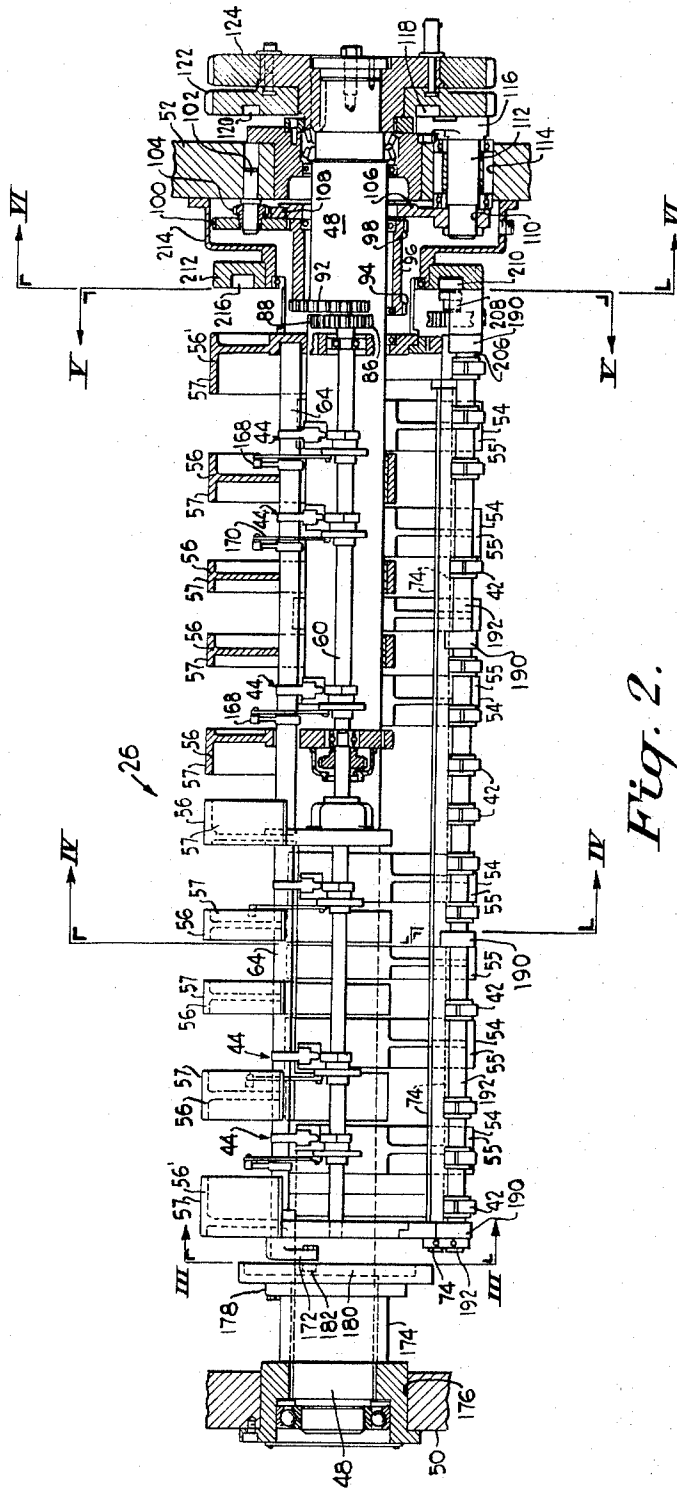


Fig. 2.

Fig. 3.

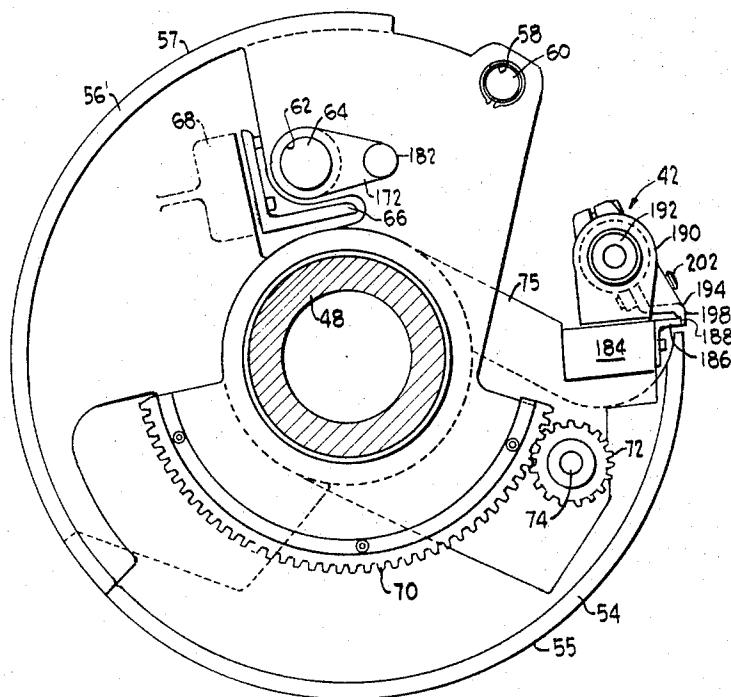
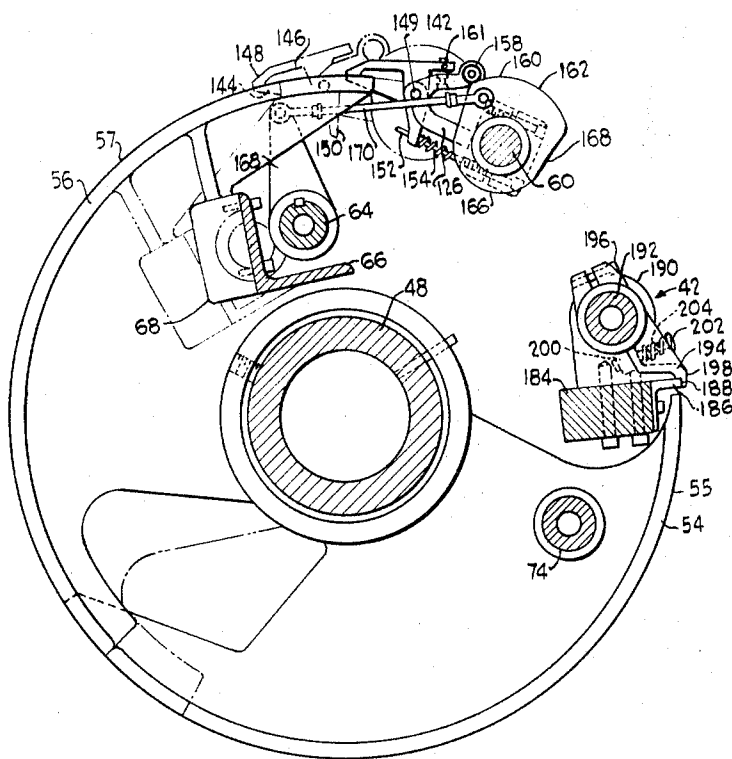
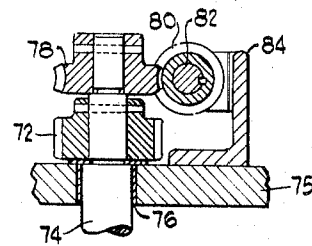
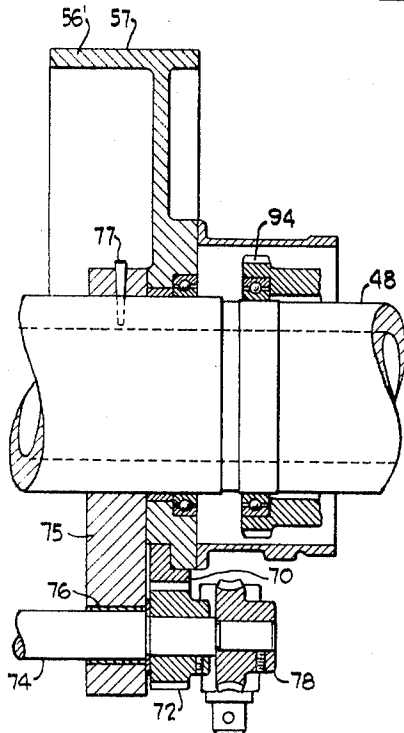
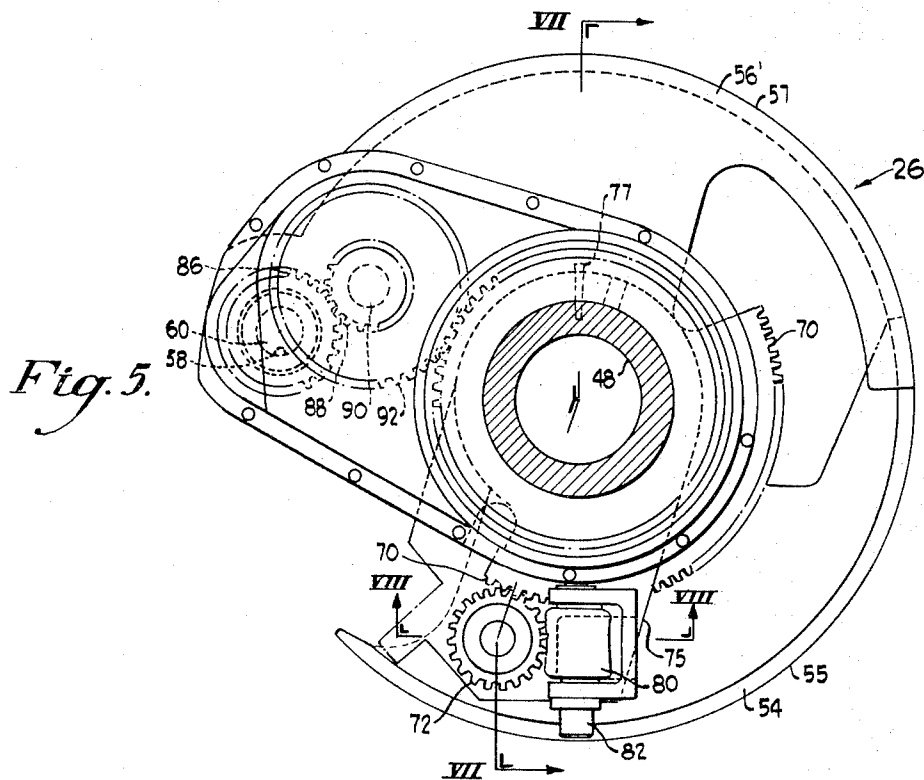


Fig. 4.





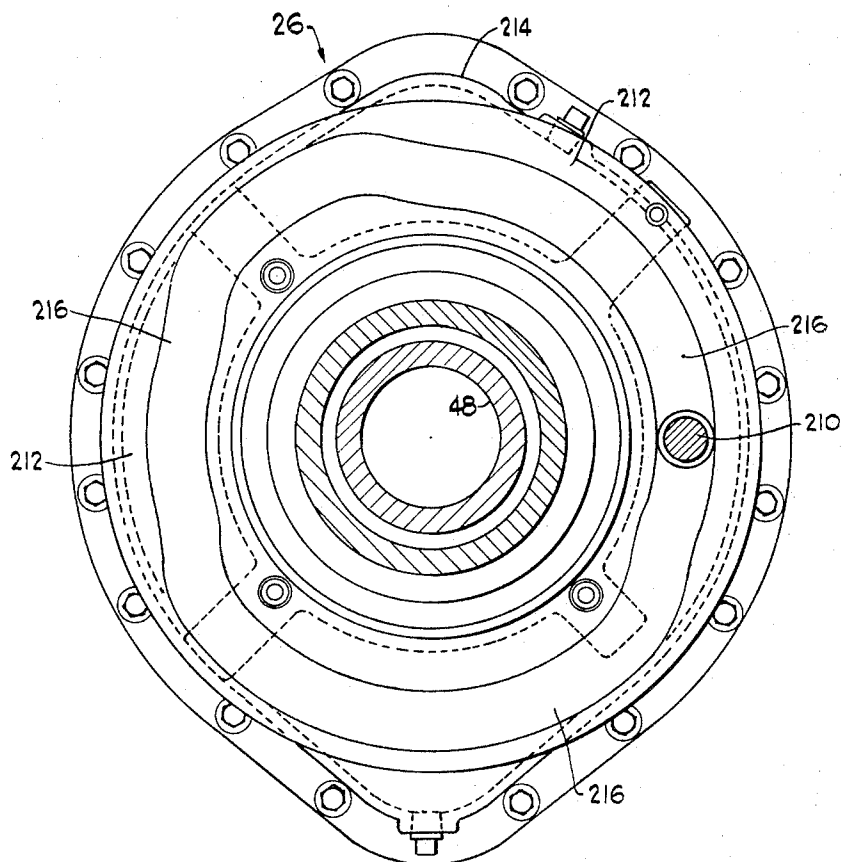


Fig. 6.

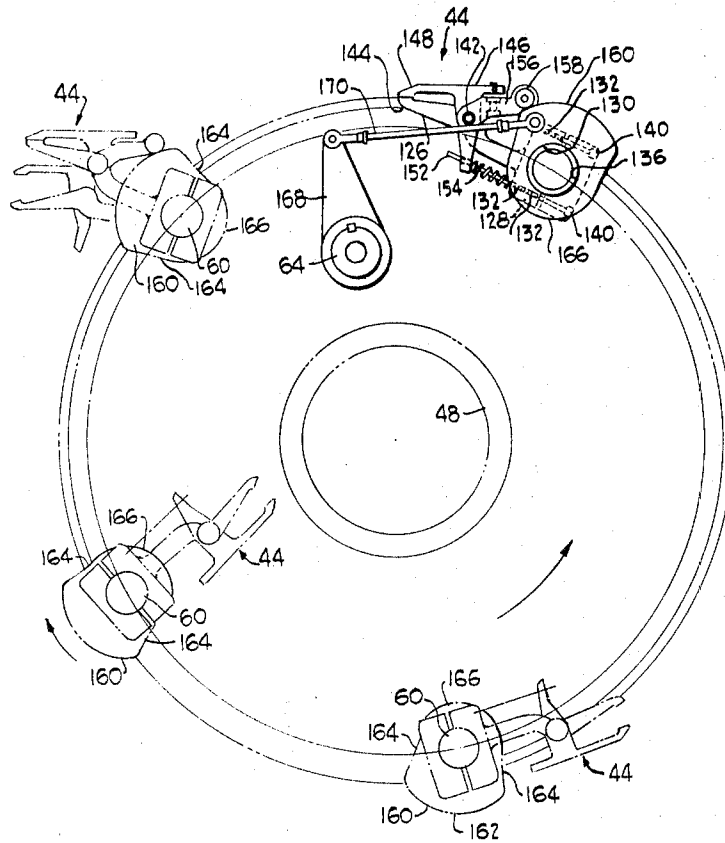
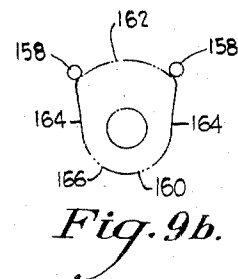
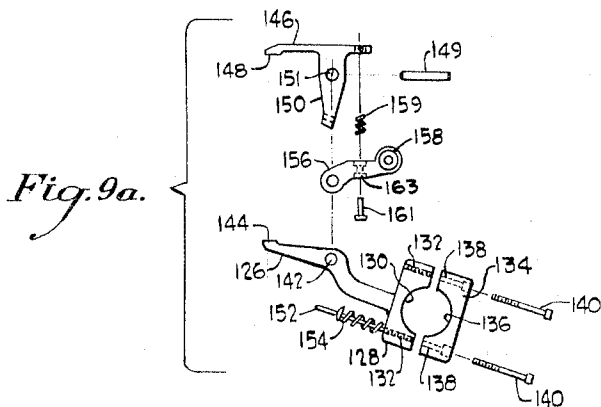


Fig. 9.



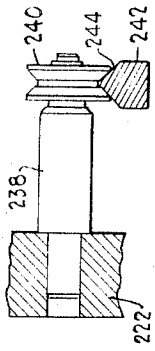


Fig. 11.

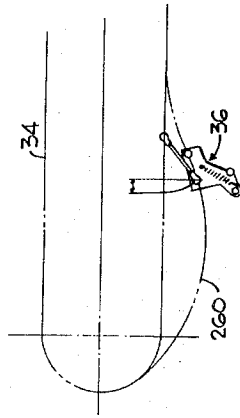


Fig. 17.

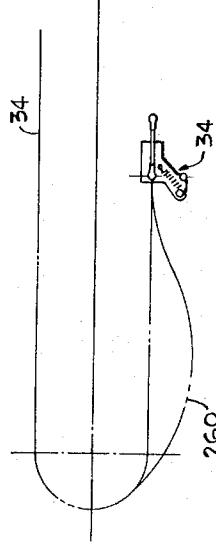


Fig. 16.

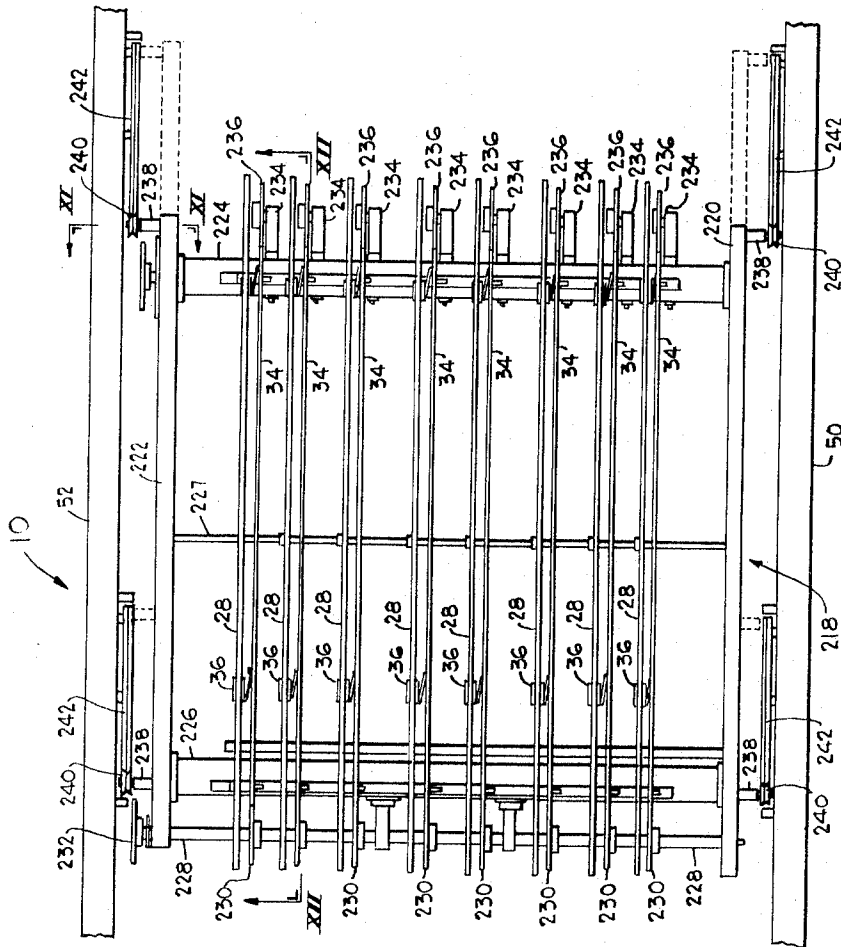


Fig. 10.

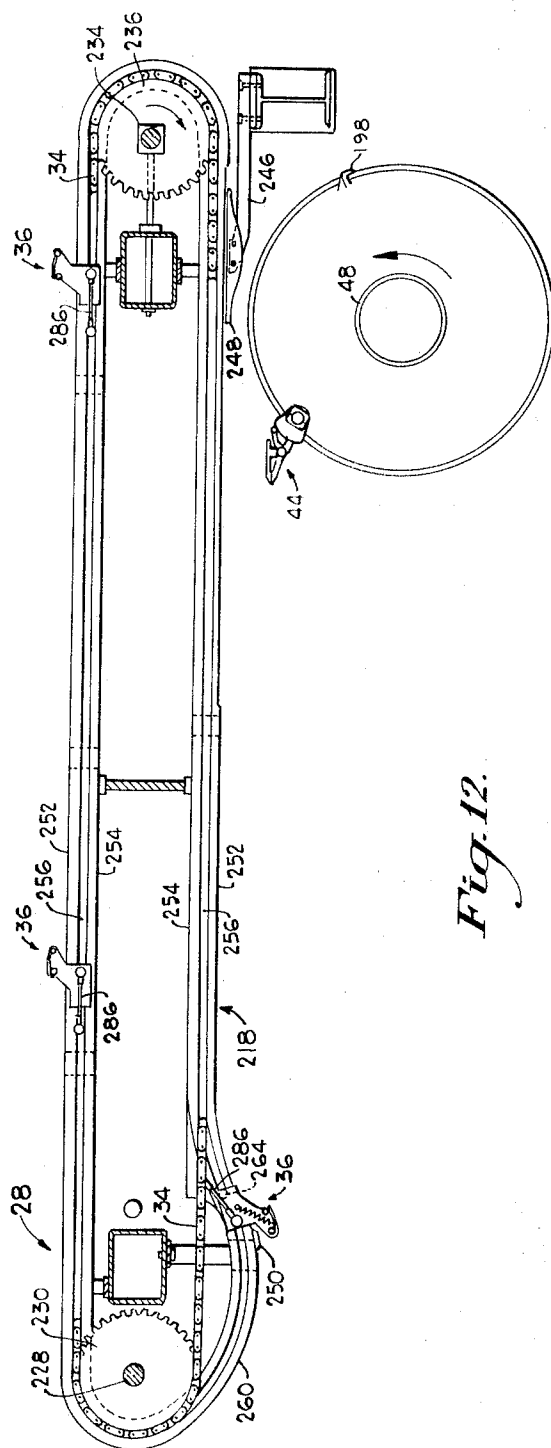


Fig. 12.

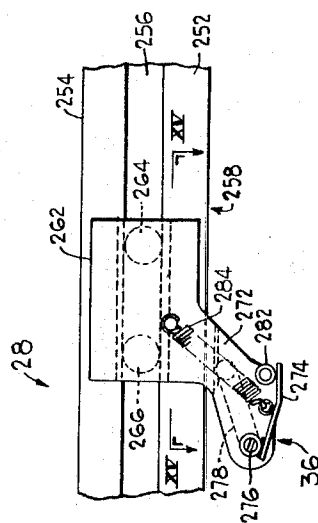


Fig. 13

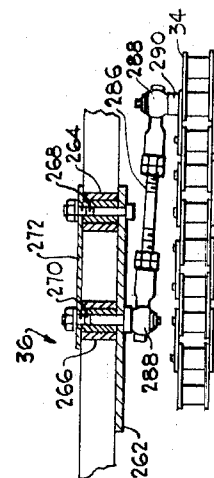


Fig. 14

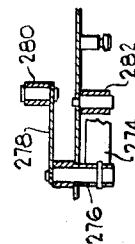


Fig. 15.

METHOD AND APPARATUS FOR DELIVERING SHEETS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a method and apparatus for delivering sheets and more particularly to a method and apparatus for delivering sheets in which the sheet is transferred to an intermediate transfer cylinder between two separate conveyor devices.

2. Description of the Prior Art

U.S. Pat. Nos. 2,093,228 and 3,378,256 illustrate apparatus for engaging the rear edge of the sheet as the sheet is conveyed by the delivery mechanism to the pile. In U.S. Pat. No. 2,093,228 the sheet is supported on an endless delivery carrier with sheet supporting surfaces thereon. The sheet is engaged by tail grippers which remove the sheets from the endless delivery carriers and deposit the sheets on one of two piles. U.S. Pat. No. 3,378,256 discloses sheet delivery slowdown apparatus in which the sheets are engaged and transported to the pile by grippers on transverse gripper bars secured to endless delivery chains. As the sheet approaches the pile, the rear end of the sheet is engaged by suction devices that slow down the sheet after the front edge is released by the grippers on the gripper bars. The suction devices travel linearly in the same direction as the sheet at a reduced velocity to slow down the sheet and thereafter the suction devices release the sheet before the sheet is deposited on the pile.

Other arrangements for preventing tail edge flutter of the sheet as it is deposited on the pile include rotary fixed vacuum discs that engage the tail edge of the sheet and reduce the forward velocity of the sheet.

Where the sheet delivery mechanism is associated with a perfecting press in which both sides of the sheet are printed in one pass through the press, it is essential to prevent disturbances of the sheet as it is deposited on the pile; otherwise markings and other types of imperfections will appear in the printed surface on the underside of the sheet as it is deposited on the pile. Suction devices, such as suction wheels and the like, are not suitable slowdown mechanisms for sheets printed on both sides because the sheets will mark where they are engaged by the suction devices. There is a need for delivery apparatus that engages both the front edge and rear edge of the sheet and reduces the forward velocity of the sheet before the sheet is deposited on the pile without imparting disturbances as tail edge flutter in the sheet during further slowdown.

The known sheet delivery devices require substantial dismantling and adjustment to deliver different sized sheets to the pile. There is also a need for a sheet delivery device that can be rapidly adjusted for delivering different sized sheets.

SUMMARY OF THE INVENTION

This invention relates to a sheet delivery mechanism for delivering sheets from a printing unit to a pile and includes a first endless conveyor with sheet engaging means thereon, an intermediate transfer cylinder rotatably mounted between the first endless conveyor and a pile of sheets. The intermediate transfer cylinder has sheet engaging means thereon. A second endless conveyor having sheet engaging means thereon is positioned adjacent to the intermediate transfer cylinder and in overlying relation with the pile. The first endless

conveyor sheet engaging means is arranged to engage the front edge of the sheet and convey the sheet from a printing unit to the intermediate transfer cylinder. The intermediate transfer cylinder is arranged to transfer the front edge of the sheet from the first endless conveyor to the second endless conveyor sheet engaging means and the second endless conveyor sheet engaging means is arranged to engage the front edge of the sheet and convey the sheet into overlying relation with the pile.

The intermediate transfer cylinder has both sheet front edge engaging devices and sheet tail edge engaging devices. The tail edge engaging devices are arranged to release the tail edge of the sheet after the front edge of the sheet has been released by the sheet engaging means on the second endless conveyor. A slowdown device is positioned adjacent the front edge of the pile and is arranged to reduce the forward speed of the second conveyor sheet engaging means. An adjustment means is also provided to move the second endless conveyor longitudinally to deliver different sized sheets to the pile.

The method for delivering a sheet from a printing unit to a pile includes engaging the front edge of the sheet by a first endless conveyor while the sheet is in a printing unit. The sheet is conveyed by the first endless conveyor to an intermediate transfer cylinder where the front edge of the sheet is transferred to sheet engaging devices on the intermediate transfer cylinder while the transfer cylinder is rotating at a preselected speed. The front edge of the sheet is thereafter transferred from the intermediate transfer cylinder to a sheet engaging means on a second endless conveyor and the sheet is thereafter conveyed by the second endless conveyor to a pile positioned therebelow and the sheet is released by the sheet engaging means on the second endless conveyor and deposited on the pile.

Accordingly, the principal object of this invention is to provide a method and apparatus for delivering a sheet in which the sheet is delivered at a high speed from a printing unit to a pile.

Another object of this invention is to provide a method and apparatus for delivering a sheet in which both the front and tail edges of the sheet are engaged by gripper devices immediately prior to the sheet being deposited on a pile.

These and other objects and advantages of this invention will be more completely disclosed and described in the following specification, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of the delivery apparatus and the relative position of the delivery apparatus to the impression and blanket cylinders of the last printing unit.

FIG. 2 is a view in section of the transfer cylinder that engages the front edge and trailing edge of the sheet and transfers the front edge of the sheet to grippers on a delivery conveyor.

FIG. 3 is a view in section taken along the line III—III of FIG. 2, illustrating the manner in which the segments of the transfer cylinder can be rotated relative to each other to adjust the peripheral distance between the sheet front edge gripper and the sheet tail edge gripper.

FIG. 4 is a view in section taken along the line IV—IV of FIG. 2, illustrating the relative position of the front edge gripper and tail edge gripper and in phantom lines an adjusted position of the tail edge gripper to reduce the peripheral distance between the respective grippers around the transfer cylinder.

FIG. 5 is a view in section taken along the line V—V of FIG. 2, illustrating the apparatus to rotate the shaft having the tail edge grippers mounted thereon.

FIG. 6 is a view in section taken along the line VI—VI of FIG. 2, illustrating the endless cam track for the cam follower connected through a lever to a shaft that is arranged to open and close the front edge grippers.

FIG. 7 is a view in section, taken along the line VII—VII of FIG. 5, illustrating another portion of the apparatus for adjusting the peripheral distance between the front edge and tail edge grippers.

FIG. 8 is a view in section taken along the line VIII—VIII of FIG. 5.

FIG. 9 is a schematic view, illustrating the path of the tail edge grippers during a single revolution of the transfer cylinder.

FIG. 9a is an exploded view of the elements of the tail edge gripper.

FIG. 9b is an enlarged view in elevation of tail edge cam illustrating in phantom the position of the cam follower where the gripper closes on the sheet and opens to release the sheet.

FIG. 10 is a top plan view of the frame having the chains and gripper guides or tracks for delivering the sheet from the transfer cylinder to the pile.

FIG. 11 is a view in section taken along the line XI—XI of FIG. 10, illustrating the manner in which the frame is adjustable longitudinally for different sized sheets.

FIG. 12 is a fragmentary view in side elevation, illustrating one of the gripper guide tracks and the relative position of the frame to the transfer cylinder.

FIG. 13 is a fragmentary view in section of a gripper positioned in the gripper guide.

FIG. 14 is a fragmentary top plan view, illustrating the manner in which the grippers are connected to the chain.

FIG. 15 is a fragmentary view in section taken along the line XV—XV of FIG. 13, illustrating in detail the actuator for opening the individual grippers.

FIG. 16 is a schematic illustration of a gripper as the gripper enters the arcuate portion of the gripper guides before the gripper begins to slow down.

FIG. 17 is a view similar to FIG. 16, illustrating the gripper in the slowed down position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, there is schematically illustrated a sheet delivery mechanism generally designated by the numeral 10 that is positioned adjacent to the delivery end of a printing press having an impression cylinder 12 and a blanket cylinder 14. An endless chain 16 has a plurality of gripper bars 18 connected thereto and is reeved about a drive sprocket 20 and an idler sprocket 22. The drive sprocket 20 is positioned adjacent to the impression cylinder 12 and the grippers on gripper bars 18 are arranged to engage the front edge of the sheet as the sheet is positioned on the impression cylinder

and being printed on the outer surface by blanket cylinder 14.

The gripper bars 18 have a velocity substantially the same as the peripheral velocity of the impression cylinder 12 as the grippers on gripper bar 18 engage the front edge of the sheet and convey the sheet along the path indicated by the chain 16 and up to the sprocket 22. The sprocket 22 is mounted on a shaft that is, in turn, supported in a delivery frame 24 that has a transfer cylinder 26 rotatably mounted adjacent thereto. A plurality of delivery chains 34 are mounted above the transfer cylinder 26 and have chain sprockets 30 and 32 with the endless chains 34 reeve therearound. Adjacent to the chains 34 are a plurality of gripper tracks 28 with the grippers 36 mounted therein. Grippers 36 are connected to the delivery chains 34 by a push rod as later explained.

The grippers 36 in the gripper tracks 28 are arranged to engage the front edge of the sheet while the sheet is on the transfer cylinder 26 and convey the sheet forwardly and deposit the sheet on the pile 38. A slitter mechanism 40 is positioned adjacent the transfer cylinder 26 and is arranged to slit the sheets longitudinally before the sheets are deposited on the pile 38. As illustrated in FIG. 1, the chains 34 and gripper tracks 28 are movable longitudinally relative to the transfer cylinder 26 to accommodate sheets of different length.

The sheet transported by the grippers on gripper bar 18 on the first chain 16 is arranged to be transferred to front edge grippers 42 of transfer cylinder 26, as schematically illustrated in FIG. 1 and illustrated in greater detail in FIGS. 3, 4, and 12. Further rotation of transfer cylinder 26 transfers the front edge of the sheet from the front edge grippers 42 on transfer cylinder 26 to the front edge grippers 36 in gripper tracks 28 associated with the second endless chains 34. The front edge of the sheet is then conveyed forwardly toward the pile 38 by the grippers 36 in gripper track 28 and the front edge grippers 36 in gripper track 28 release the sheet as it is deposited on the pile. As the tail edge of the sheet approaches the point of tangency between the transfer cylinder 26 and the first chains 16, the tail edge of the sheet is engaged by the tail edge grippers 44. The tail edge grippers 44, as illustrated in FIG. 9, move outwardly beyond the periphery of the transfer cylinder 26 while engaged to the tail edge of the sheet to slow down the sheet and release the sheet as it is deposited on the pile.

With this arrangement the sheet is first engaged by the transverse gripper bar 18 while the sheet is on the impression cylinder of the last printing unit. The sheet is conveyed by the transverse gripper bars 18 to the transfer cylinder 26. The front edge of the sheet is transferred from the gripper bars 18 to the lead edge grippers 42 in transfer cylinder 26 and the lead edge grippers 42 in transfer cylinder 26 thereafter transfer the front edge of the sheet to the front edge grippers 36 mounted in the gripper track 28, and the sheet is thereafter conveyed to the pile 38.

The tail edge of the sheet is engaged by the tail edge grippers 44 on transfer cylinder 26 and the tail edge of the sheet remains engaged by the tail edge grippers 44 until the sheet is in substantially overlying relation with the pile 38. The grippers 36 first release the sheet to deposit it on the pile and thereafter the tail edge of the sheet is released by the tail edge grippers 44 to permit

the sheet to be deposited on the pile without disturbances or flutter.

The transfer cylinder generally designated by the numeral 26 is illustrated in detail in FIGS. 2 - 9 and includes a cylinder shaft 48 rotatably journaled in side frames 50 and 52. The side of the delivery mechanism 10, including the side frame 50, will also be referred to as the operator's side of the press and the delivery mechanism and the opposite side having the side frame 52 will also be referred to as the drive side of the press.

Nonrotatably mounted on the shaft 48 are a plurality of spaced cylindrical segments 54 illustrated in FIGS. 3, 4 and 5. The spaced cylindrical segments 54 have cylindrical sheet supporting surfaces 55 and the segments 54 will also be referred to as segments or discs associated with the front edge grippers. Positioned between the cylindrical segments 54 are other cylindrical segments 56 associated with the tail edge grippers and will also be referred to as segments or discs associated with the tail edge grippers. The discs 56 also have cylindrical sheet supporting surfaces 57 and are adjustably mounted on the shaft 48. The discs 56 are arranged to rotate about the shaft 48 to increase or decrease the peripheral distance around the cylinder between the front edge grippers 42 and tail edge grippers 44.

The end discs 56' adjacent to the frames 50 and 52 are illustrated in FIGS. 3 and 5. The end discs 56' have bores 58 therethrough for receiving the tail edge gripper support shaft 60 and bores 62 to receive the tail edge gripper actuator shaft 64. The intermediate discs 56, as illustrated in FIG. 4, are connected to the end discs 56' by the angle 66 extending longitudinally in the cylinder 26 and secured to pads 68 on each of the discs 56 and 56'. With this arrangement rotation of the end discs 56' about the shaft 48 rotate all of the discs 56 and 56' the same amount, so that all of the tail edge grippers 44 remain aligned linearly in various positions of adjustment of the tail edge grippers 44 to the front edge grippers 42.

The discs 56 and 56' are rotated about the shaft by an adjustment mechanism illustrated in FIGS. 3, 5, 7 and 8. The end discs 56' include a gear segment 70 that meshes with a pair of gears 72 mounted on shaft 74. The shaft 74 is, in turn, journaled in aperture 76 in fixed shaft support 75 located adjacent the end discs 56' and nonrotatably secured to the shaft 48 by means of pin 77, as illustrated in dotted line in FIG. 5. With this arrangement the rotation of gear 72, because of its meshing relation with the gear segment 70, rotates the end discs 56' about the shaft 48 to change the peripheral distance between the tail edge grippers 44 and the front edge grippers 42. The manner in which the tail edge grippers 44 are rotated about the shaft 48 to reduce the distance between the tail edge grippers 44 and the front edge grippers 42 is illustrated in phantom lines in FIG. 4.

The shaft 74 has an adjusting gear 78 (FIGS. 7 and 8) secured to an end portion thereof adjacent the drive side of the press. The gear 78 meshes with a worm gear 80 mounted on a shaft 82. The shaft 82 is, in turn, supported on a shaft support 84 secured to the adjusting shaft support 75. The shaft 82 has an end portion arranged to be engaged by a crank to rotate the gear 80 which, in turn, through gear 78 rotates adjusting shaft 74. The rotation of shaft 74 rotates the gears 72 to thus rotate the end discs 56' and the intermediate discs 56

connected thereto to change the peripheral distance between the front edge grippers 42 and the tail edge grippers 44.

As illustrated in FIG. 9, the tail edge gripper support shaft 60 is arranged to rotate or revolve relative to the main shaft 48, so that the tail edge grippers revolve with the shaft 60 and make one complete revolution per revolution of the shaft 48. The tail edge gripper support shaft 60 and the tail edge grippers 44 revolve at a variable angular velocity during the revolution of the transfer cylinder main shaft 48 to extend the tail edge grippers beyond the periphery of the transfer cylinder 26, as later described. The rotation of the tail edge gripper support shaft 60 is controlled by a cam and gear mechanism illustrated in FIGS. 2 and 5.

Referring to FIG. 5, the tail edge gripper support shaft 60 adjacent the drive side has a spur gear 86 nonrotatably secured thereto. The spur gear 86 meshes with a spur gear of reduced diameter 88 rotatably mounted on a suitable shaft 90 positioned radially inwardly of the tail edge gripper support shaft 60. Nonrotatably secured to gear 88 is a large spur gear 92 which meshes with a ring gear 94 that extends around the transfer cylinder shaft 48. The ring gear 94 is, in turn, connected to the end of a cylindrical member 96 that has a second ring gear 98 on the outboard end adjacent the frame 52. The cylindrical member 96 is supported by bearings on shaft 48.

A spur gear 100 is nonrotatably mounted to a smaller diameter gear 104. Gear 104 is rotatably mounted to shaft 102 journaled in the side frame 52. An arm 106 extends around the transfer cylinder shaft 48 and has a gear segment 108 meshing with the spur gear 104. The arm 106 has a bore 110 through which shaft 112 extends. The shaft 112 is nonrotatably secured to the arm 106 and is rotatably journaled in bore 114 of the frame 52. A lever arm 116 is nonrotatably secured to the other end of shaft 112 and has a cam follower 118 secured thereto. The cam follower 118, in turn, positioned in the endless cam track 120 on gear 122. The gear 122 is secured to drive gear 124 which rotates therewith. The gear 122 is adjustable radially on gear 124 for different size sheets. The gear 124 is secured to the transfer cylinder shaft 48 and transmits rotation to shaft 48 at a constant angular velocity. The cam follower 118, by means of cam track 120, pivots the arm 116 to oscillate the shaft 112 and through the arm 106 with gear segment 108 and gear train 104, 100, 98, 94, 92, 88 and 86 revolves the tail edge gripper support shaft 60 at a non-uniform angular velocity to position the tail edge gripper shaft as illustrated in FIG. 9.

The tail edge grippers generally designated by the numeral 44 are illustrated in detail in FIGS. 4, 9, 9a and 9b and include a first arm 126 that has an end portion 128 with a semi-circular recess 130 having substantially the same diameter as the tail edge gripper support shaft 60 and longitudinally threaded bores 132 therethrough. A clamp end portion 134 has a similar circular recessed portion 136 and longitudinal bores 138 therethrough. The clamp end portion 134 is positioned in overlying relation to the arm end portion 128 and bolts 140 extend through the respective apertures to nonrotatably clamp the arm 126 to the tail edge gripper support shaft 60. The arm 126 has an aperture 142 intermediate the end portions and a gripper pad end portion 144 on which the tail edge of the sheet is arranged to be positioned.

A gripper arm 146 has a gripper finger end portion 148 and a dependent intermediate arm 150. The dependent intermediate arm 150 has a pivot aperture 151 therethrough arranged in overlying relation with the pivot aperture 142 in arm 126. A pin 149 extends through the apertures and pivotally connects the arm 126 to the arm 146, so that the gripper finger end portion 148 is arranged to move toward and away from the gripper pad 144. A pin 152 extends through the lower portion of arm 150 and is secured at the other end to the enlarged end portion 128 of arm 126. A spring 154 is positioned between the arm 150 and the other end portion 128 of arm 126 and is arranged as viewed in FIG. 4 to pivot the arm 146 in a clockwise direction to move the gripper finger 148 away from the gripper pad 144 to thus open the tail edge grippers 44. With this arrangement, the spring 154 continually urges the gripper finger 148 away from the gripper pad 144.

A plate member 156 is secured to the arm 146 and is arranged to pivot therewith about the pivot pin 149 and has a cam follower 158 thereon. A spring 159 is positioned on pin 161 and the pin 161 is positioned in recess 163 in plate 156. The pin 161 is secured to arm 146 and is operable to adjust the gripper 44 for different sheet thickness. The cam follower 158 is arranged to abut a surface of a cam 160 rotatably positioned on the tail edge gripper support shaft 60. With this arrangement, the spring 154 urges the gripper finger 148 toward an open position and further urges the cam follower 158 into abutting relation with the surface of the cam 160.

The cam 160, as illustrated in FIGS. 3, 9 and 9b, has a first arcuate surface 162 which is spaced a sufficient distance from the axis of shaft 60 to maintain the tail edge grippers 44 in a closed position where the gripper finger 148 abuts the gripper pad 144. The cam 160 has other cam surfaces 164, which permit the gripper finger 148 to move from a full open position to a full closed position, and a surface 166 that permits the gripper finger 148 to move into a full open position under the tension exerted by the spring 154. With this arrangement the tail edge grippers 44 are opened and closed by the relative position of the cam discs 160 associated with each tail edge gripper 44. The discs 160 are rotatably positioned on the tail edge gripper support shaft 60 so that the cams 160 can rotate about the shaft 60.

The relative position of the cams 160 on the tail edge gripper support shaft 60 is controlled by shaft 64 illustrated in FIGS. 3, 4, 9 and 9b. The tail edge gripper actuator shaft 64 has a plurality of levers 168 nonrotatably secured thereto. The levers 168 are connected at their end portion by means of rods 170 to the respective cams 160. With this arrangement rotation of shaft 64 relative to shaft 60 rotates the cam 160 to open and close the tail edge grippers 44. The shaft 64 is suitably journaled in the tail edge gripper end discs 56' and has a lever member 172 (FIGS. 2 and 3) connected to the end portion adjacent the frame 50 on the operator's side of the delivery mechanism. A cylindrical member 174 is journaled in an aperture 176 in side frame 50 and has an axial passageway to rotatably support the transfer cylinder main shaft 48. The cylindrical member 174 has an enlarged circular end portion 178 with an endless cam track 180 therein. A cam follower 182 is positioned in the cam track 180 and is rotatably connected to lever 172 that is, in turn, connected to the

end portion of shaft 64. With this arrangement, the cam follower 182 follows the endless cam track 180 in the fixed member 174 and pivots the arm 172 to thus rotate the shaft 64 with a preselected angular velocity to open the tail edge grippers 44 as the pad 144 of tail edge grippers 44 moves into underlying relation with the tail edge of the sheet and to thereafter close the tail edge grippers 44 to engage the sheet. Cam track 180 holds lever 168 stationary, as tail end gripper 44 rotates outward from transfer cylinder 26 as previously described, and cam follower 158 moves across surface 162 of cam 160. When the sheet has been conveyed to a position in substantially overlying relationship with the pile, cam follower 158 leaves cam surface 162 and tail end gripper 44 opens to release the sheet.

The sheet front edge grippers 42 are secured to a block 184 that is, in turn, secured to the nonrotatable member 74 which is pinned to shaft 48 (FIG. 7) by means of bolts. The front edge grippers include an angular member 186 having a radially extending edge portion 188 that serves as a gripper pad. Upstanding shaft supports 190 are secured to the pad 184 and have a front edge gripper pad actuator shaft 192 rotatably supported therein. The front grippers include a gripper arm 194 rotatably positioned on the shaft 192, as illustrated in FIGS. 3 and 4. The gripper arm 194 has a gripper finger 198 that is arranged to abut the gripper pad 188 to engage the front edge of a sheet therebetween. Member 200 is clampingly engaged on shaft 192 by bolts 196 and has a pin 202 connected thereto. A spring 204 is positioned between the head of the pin 202 and the surface of the gripper arm 194 for adjustment purposes.

Rotation of shaft 192 opens and closes the front edge grippers 42. The shaft 192 is journaled in the supports 190 and has an end portion 206 extending beyond the end disc 56' adjacent the frame 52 on the delivery side of the delivery mechanism. The shaft end portion 206 is nonrotatably connected to a lever mechanism 208 that has a cam follower 210 rotatably secured thereto. A cam member 212 (FIGS. 2 and 6) is nonrotatably secured to a housing 214 which is, in turn nonrotatably secured to the frame 52. The cam member 212 has an endless cam track 216 in which the cam follower 210 connected through lever 208 to shaft 192 is positioned.

Rotation of the transfer cylinder main shaft 48 moves the cam follower 210 in the cam track 216. The configuration of cam track 216 opens the front edge grippers 42 as the front edge grippers approach the point of tangency between the sprocket 22 and transfer cylinder 26 and close the front edge grippers 42 on the front edge of the sheet as the sheet is transferred thereto from the transverse gripper bars 18 on chain 16. Thereafter, the cam track 216 maintains the grippers closed and in engagement with the sheet front edge portion until the transfer cylinder has revolved to a position where the grippers 36 are tangent to the transfer cylinder 26. At that location the cam track 216 opens the front edge grippers 42, so that the front edge of the sheet may be transferred to the grippers 36.

Referring to FIGS. 10 and 12 there is illustrated in top plan and side elevation a frame member generally designated by the numeral 218 that includes a side member 220 adjacent the press operator's side frame 50 and a side member 222 adjacent the drive side frame 52. The frame 218 has transverse members 224

and 226 secured to the respective side members 220 and 222 in spaced relation to each other. An intermediate support member 227 is also positioned between side members 220 and 222. A sprocket drive shaft 228 is suitably journaled in the side frame members 220 and 222 in spaced relation to each other. A plurality of sprockets 230 are mounted on the sprocket drive shaft 228 for rotation therewith. Sprocket 232 connected to the end portion of shaft 228 is suitably connected to a drive mechanism and is arranged to rotate at a preselected linear speed.

Extending rearwardly from the transverse member 224 are a plurality of sprocket supports 234 on which are rotatably mounted idler sprockets 236. A plurality of endless chains 34, previously described, are reeved about drive sprockets 230 and idler sprockets 236. The endless chains 34 are arranged to be driven at a preselected speed that is coordinated with the press speed. Positioned adjacent to the respective chains 34 are a plurality of endless gripper tracks or guides 28 in which the grippers generally designated by the numeral 36 are positioned. As later described, the grippers 36 are connected to the adjacent endless chains, so that the endless chains 34 propel the grippers 36 in the gripper tracks 28.

The frame 218, which supports the endless chains 34 and gripper tracks 28, is movable longitudinally relative to the transfer cylinder 26, as illustrated in FIG. 12. The frame 218 has laterally extending shafts 238 with rollers 240 rotatably mounted thereon. The rollers 240 have annular V-shaped recessed portions therein. As illustrated in FIG. 11, the rollers 240 are supported on members 242 that have an upstanding pointed portion 244 extending into the annular V-shaped recessed portions of rollers 240. The members 242 are, in turn, supported by the side frames 50 and 52. With this arrangement the frame 218 is movable longitudinally relative to the side frames 50 and 52 and the transfer cylinder 26 mounted thereon. The longitudinal adjustment of the frame 218 with the sheet delivery mechanism positioned thereon permits adjustment for delivery of different sized sheets without relative movement of the transfer cylinder 26.

As illustrated in FIG. 12, a beam member secured to the frames 50 and 52 has a forwardly extending arm 246 on which cam members 248 are positioned. The cam members 248 are arranged to open and close the grippers generally designated by the numeral 36 so that the grippers 36 engage the leading edge of the sheet as it is transferred by the transfer cylinder 26. It should be noted that the cam member 248 remains fixed relative to the transfer cylinder 26 and longitudinal movement of frame 218 does not change the location at which the grippers 36 open to engage the sheet. Secured to the frame transverse member 226 are cam members 250 which are arranged to open the grippers 36 and release the front edge of the sheet as the sheet is deposited on the pile. It should be noted that the cam actuator 250 for opening the grippers 36 moves longitudinally with the frame 218.

One of the gripper tracks 28 is illustrated in detail in FIG. 12 and includes an outer rail 252 and a parallel inner rail 254 with a space 256 therebetween. The endless gripper track 28 has an intermediate lower portion 258 along which the gripper 36 is conveyed to a front portion generally designated by the numeral 260. The intermediate lower portion 258 is at substantially the

same elevation as the lower strand of endless chain 34 and the gripper track front portion 260 deviates downwardly along an arcuate path from the path followed by the chain 34. The gripper 36 positioned in the gripper track thus follows the downwardly extending arcuate track front end portion 260 and, as later explained, slows down the forward velocity of the sheet as it is released.

The gripper 36 is illustrated in detail in FIGS. 13 - 17 and includes a first plate member 262 with a pair of rollers 264 and 266 positioned in the track opening 256. The rollers have shafts 268 and 270 that are secured to a second plate 272 on the opposite side of the gripper track 28. With this arrangement the plate 262 follows the path of the gripper track 256. The plate 262 has a depending arm portion 272 with a gripper finger 274 pivotally secured thereto about pivot pin 276. A lever 278 is connected through pivot pin 276 to gripper finger 274 and has a cam follower 280 secured to the end portion thereof. A gripper pad 282 is secured to the plate depending arm portion 272 and the gripper finger 274 is arranged to abut the pad 282 and hold the front edge of the sheet therebetween. A spring 284 is connected to the gripper 274 and plate 262 to urge the gripper finger 274 into abutting relation with the gripper pad 282. With this arrangement the lever 278 through cam follower 280 is arranged to move the gripper finger 274 away from the gripper pad 282 in response to cam surfaces 248 and 250.

The grippers 36 are connected to the respective adjacent chains 34 by an adjustable push rod 286 connected through ball type joints 288 to respective shafts 290 on chain 34 and shaft 270 on grippers 36. With this arrangement the grippers 36 are propelled by the respective adjacent chains 34 and open adjacent the transfer cylinder 26 to engage the front edge of the sheet and propel the sheet toward the front edge of the frame 218 where the cam 250 opens the grippers 36 and releases the sheet.

The grippers 36 by following the arcuate portion 260 of the cam track are arranged to slowdown the forward movement of the sheet as the chains 34 continue to move at the same velocity. As the gripper 36 is pushed into the arcuate portion 260 of track 256 one end of the rod 286 follows the chain path while the other end of the rod follows the arcuate portion 260 of the cam track. The counterclockwise motion of the push rod, as illustrated in FIGS. 16 and 17, slows down the entire gripper assembly relative to chain speed because the gripper assembly traverses a greater linear distance than the propelling chain reeved about sprockets 230 and 236.

In addition, the two rollers 264 and 266 in the gripper assembly 36 follow the arcuate downwardly extending portion of the gripper track 260 and pivot the entire gripper 36 in a counterclockwise direction about the end of the push rod 286 that follows the cam or arcuate portion 260 of the cam track. The slowdown of the gripper 36 is accomplished by a combination of the push rod 286 pivoting counterclockwise and the gripper assembly 36 also pivoting counterclockwise. This slowdown of the grippers is arranged to match the slowdown of the tail grippers 44; thus maintaining the sheet straight as it is brought over the pile. The conveyor grippers 36 release the sheet first and then the tail end grippers 44 release the tail of the sheet thereafter. This

permits the sheet to be deposited on the pile without flutter and the like.

According to the provisions of the patent statutes, I have explained the principle, preferred construction and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiments. However, it should be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A sheet delivery mechanism for delivering sheets from a printing unit to a pile comprising,
 - a first endless conveyor having sheet engaging means thereon,
 - an intermediate transfer cylinder rotatably mounted between said first endless conveyor and a pile of sheets, said intermediate transfer cylinder having sheet engaging means thereon,
 - said sheet engaging means includes sheet front edge engaging devices and sheet tail edge engaging devices,
 - a second endless conveyor having sheet engaging means thereon positioned adjacent to said intermediate transfer cylinder and in overlying relation with said pile,
 - said first endless conveyor sheet engaging means arranged to engage the front edge of a sheet and convey said sheet from a printing unit to said intermediate transfer cylinder,
 - said intermediate transfer cylinder arranged to transfer the front edge of the sheet from said first endless conveyor to said second endless conveyor sheet engaging means,
 - said second endless conveyor sheet engaging means arranged to engage the front edge of said sheet and convey the sheet into overlying relation with said pile,
 - said intermediate transfer cylinder arranged to engage the sheet front edge transferred from said first endless conveyor sheet engaging means with said sheet front edge engaging devices and transfer said sheet front edge to said second endless conveyor sheet engaging means while said sheet tail edge remains engaged by said intermediate transfer cylinder sheet tail edge engaging devices, and
 - means to release said sheet front edge from said second endless conveyor sheet engaging means while said sheet tail edge remains engaged by said intermediate transfer cylinder sheet tail edge engaging means.
2. A sheet delivery mechanism as set forth in claim 1 which includes,
 - means to reduce the forward speed of said second endless conveyor sheet engaging means while said sheet tail edge remains engaged by said intermediate transfer cylinder sheet tail edge engaging devices.
3. A sheet delivery mechanism as set forth in claim 1 which includes,
 - means to move said second endless conveyor toward

and away from said intermediate transfer cylinder so that sheets of different length may be delivered from said printing unit to a pile.

4. A sheet delivery mechanism as set forth in claim 3 which includes,
 - first actuating means fixedly mounted relative to said intermediate transfer cylinder, said first actuating means operable to actuate said second conveyor sheet engaging means for engaging the front edge of a sheet transferred from said intermediate transfer cylinder,
 - second actuating means fixedly mounted relative to said second endless conveyor, said second actuating means operable to actuate said second conveyor sheet engaging means to release the front edge of a sheet when said sheet is in overlying relation with a pile.
5. A sheet delivery mechanism as set forth in claim 1 which includes,
 - means to reduce the forward speed of said second endless conveyor sheet engaging means as said second endless conveyor sheet engaging means approaches the front edge of the pile.
6. A method for delivering a sheet from a printing unit to a pile comprising,
 - engaging the front edge of a sheet by a first endless conveyor while said sheet is in a printing unit,
 - conveying the sheet by said first endless conveyor to an intermediate transfer cylinder,
 - transferring the front edge of said sheet to sheet engaging devices on said intermediate transfer cylinder,
 - engaging the front edge of the sheet by said sheet engaging devices on said intermediate transfer cylinder,
 - engaging the tail edge of the sheet by other sheet engaging devices on said transfer cylinder,
 - rotating said transfer cylinder at a preselected speed,
 - transferring the front edge of the sheet from said intermediate transfer cylinder to sheet engaging means on a second endless conveyor,
 - engaging the front edge of said sheet by said sheet engaging means on said second endless conveyor,
 - conveying said sheet on said second endless conveyor to a pile positioned therebelow,
 - disengaging said sheet front edge from said second endless conveyor sheet engaging means and depositing said sheet on a pile, and
 - maintaining the tail edge of the sheet engaged by said sheet engaging devices on said sheet transfer cylinder until said sheet front edge portion is disengaged from said second endless conveyor sheet engaging means.
7. A method for delivering a sheet from a printing unit to a pile as set forth in claim 6 which includes,
 - reducing the forward speed of said sheet as the front edge of the sheet approaches the front edge of the pile.

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