

March 31, 1964

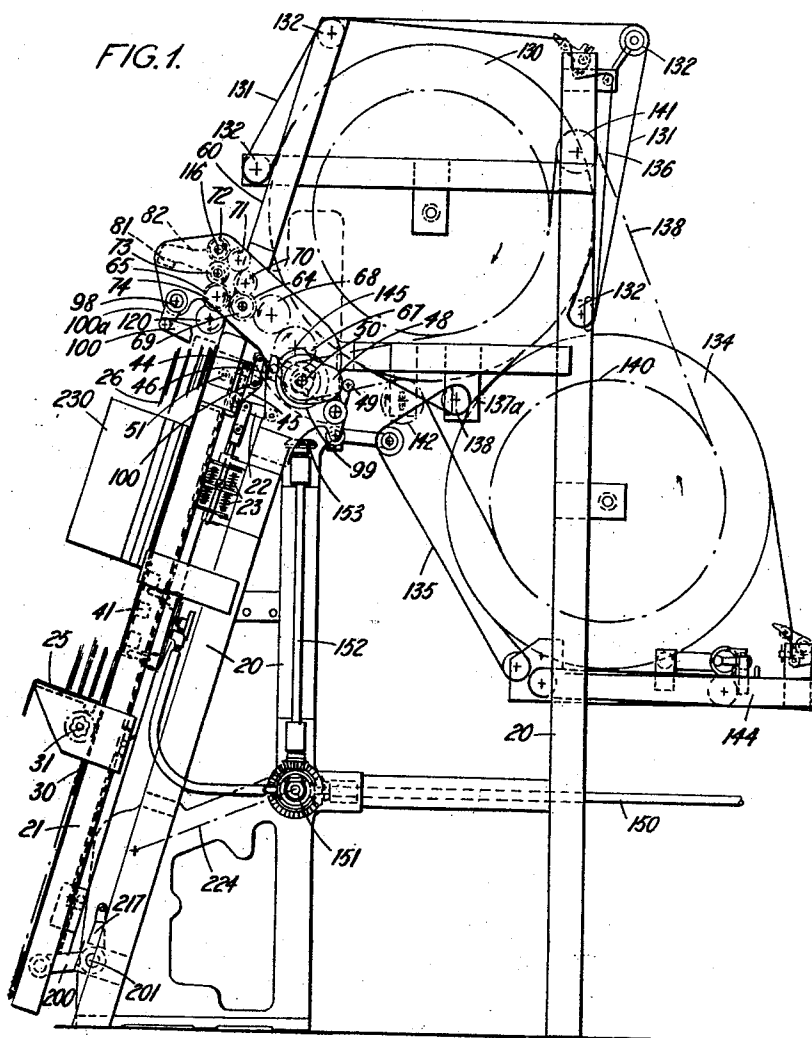
C. F. FAWDRY

3,127,166

SHEET SEPARATING AND FORWARDING MACHINE

Filed Feb. 21, 1961

8 Sheets-Sheet 1



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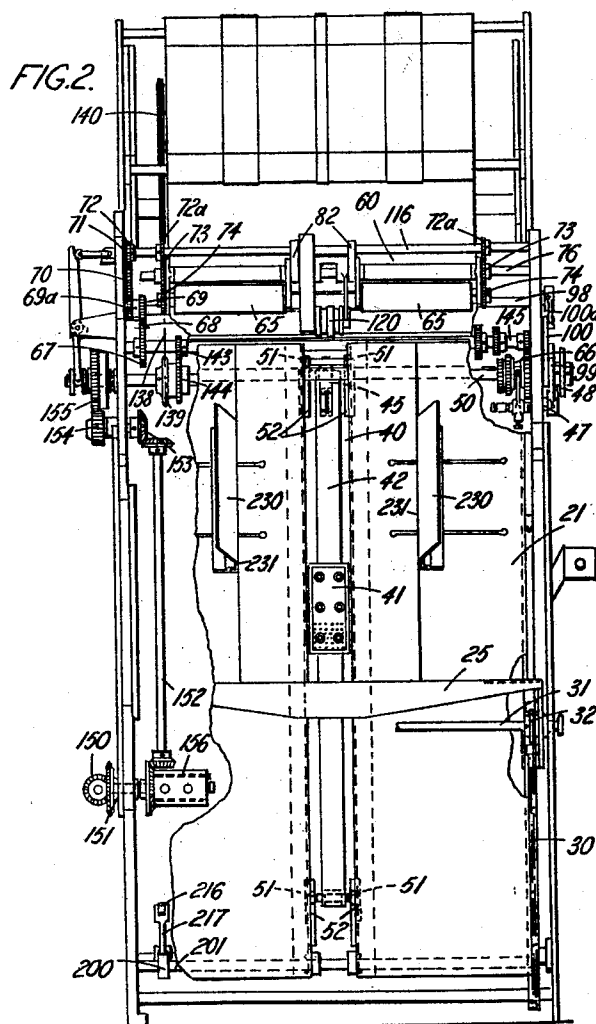
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SHEET SEPARATING AND FORWARDING MACHINE

Filed Feb. 21, 1961

8 Sheets-Sheet 2



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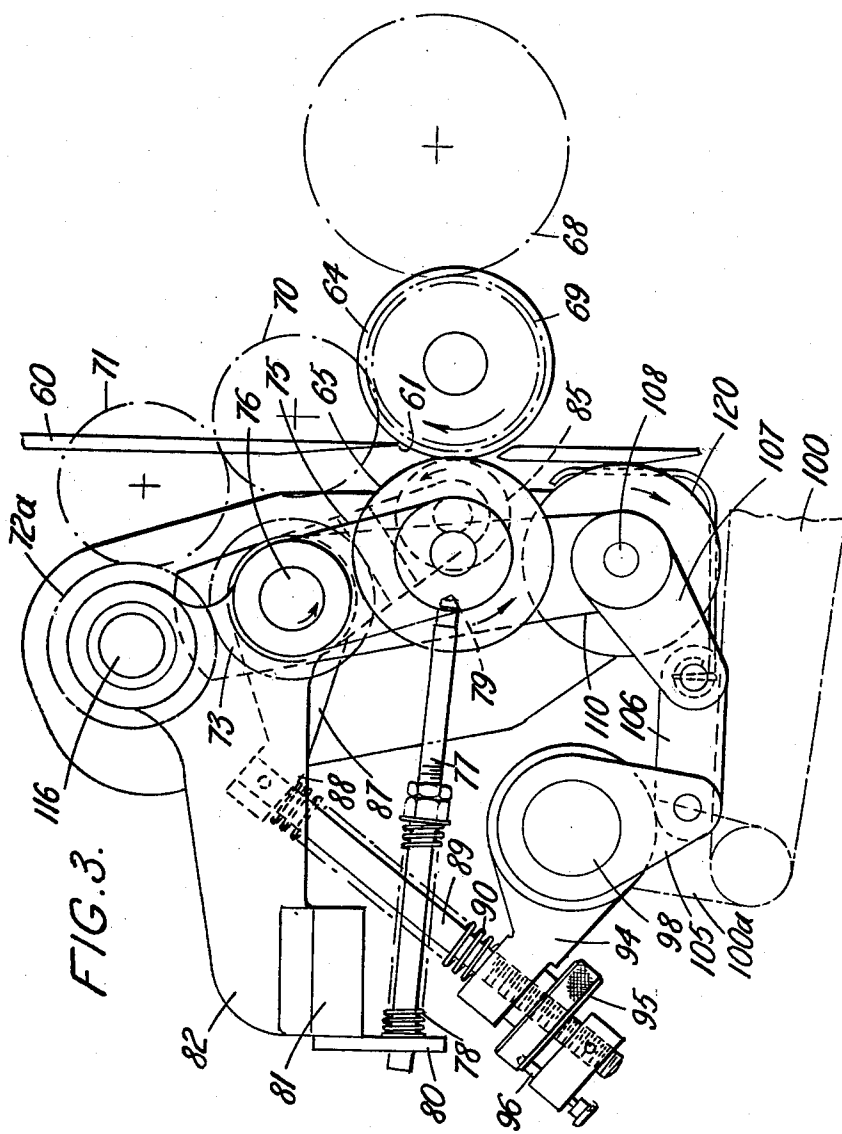
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SHEET SEPARATING AND FORWARDING MACHINE

Filed Feb. 21, 1961

8 Sheets-Sheet 3



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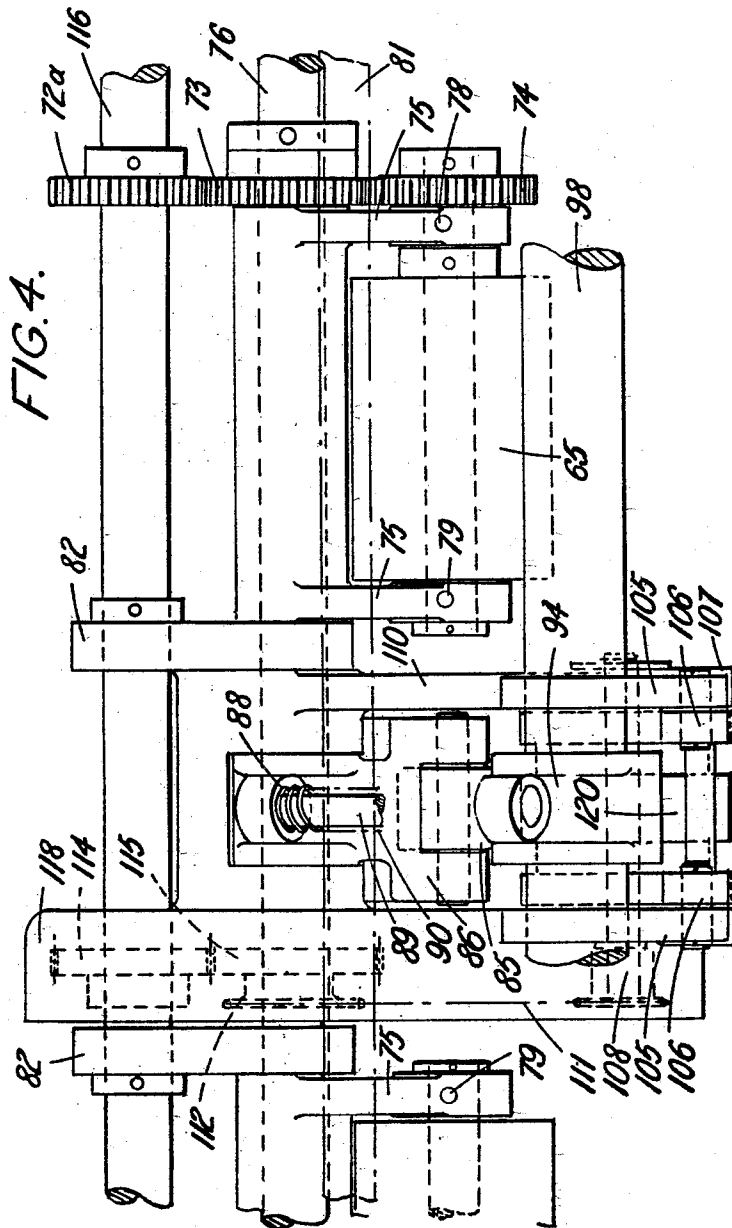
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SHEET SEPARATING AND FORWARDING MACHINE

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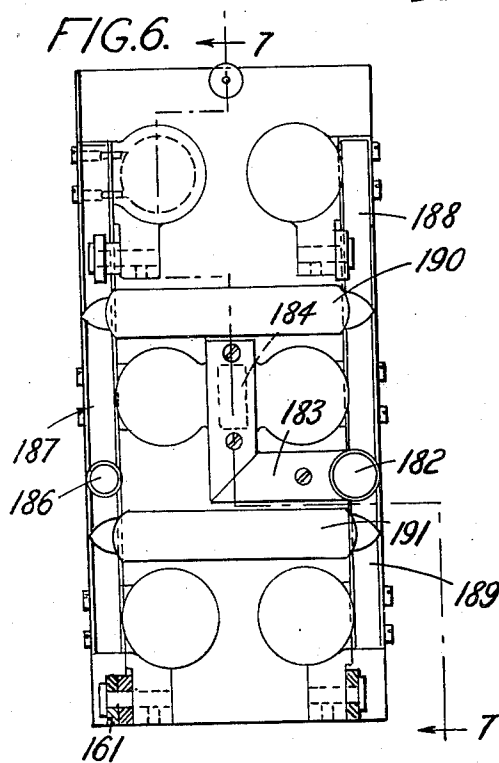
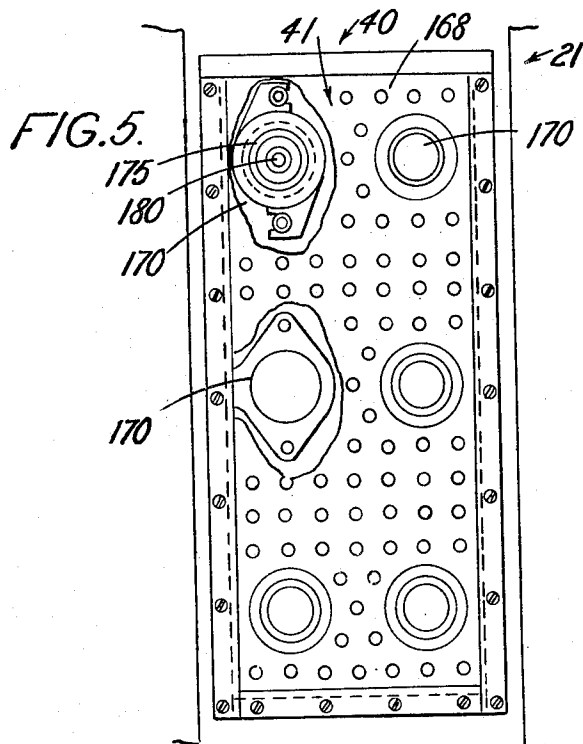
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SHEET SEPARATING AND FORWARDING MACHINE

Filed Feb. 21, 1961

8 Sheets-Sheet 5



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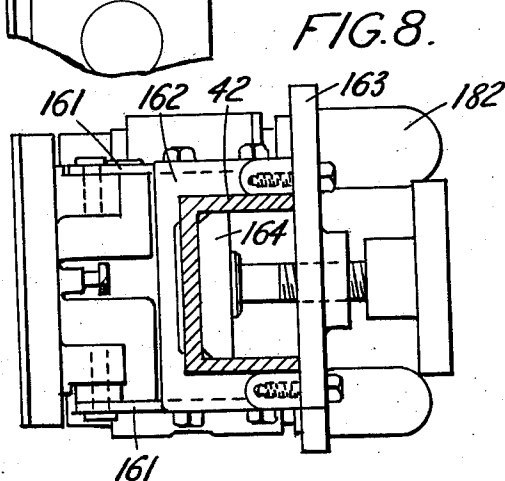
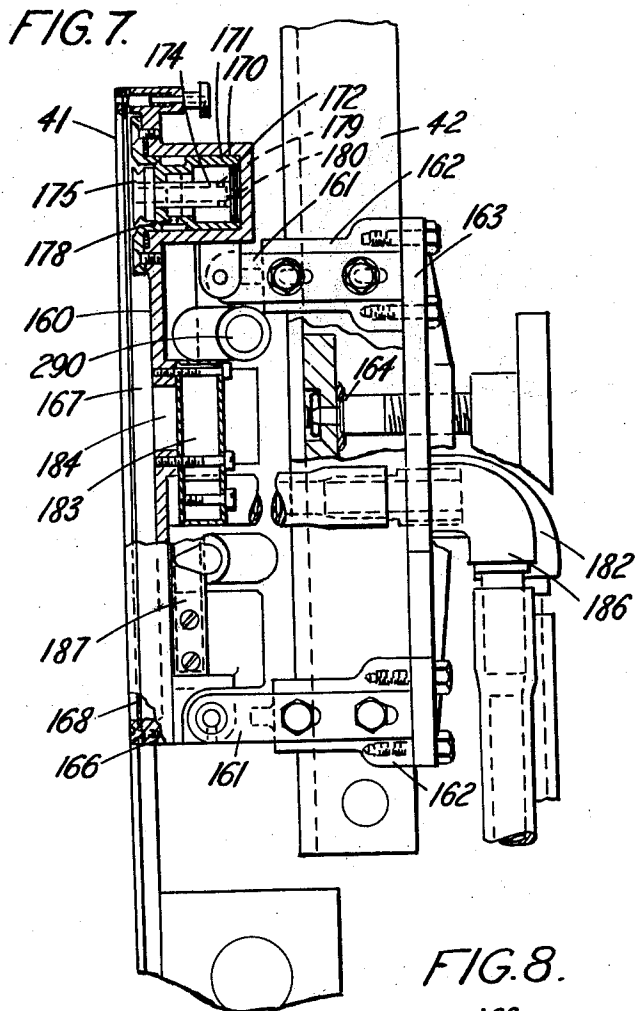
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SHEET SEPARATING AND FORWARDING MACHINE

Filed Feb. 21, 1961

8 Sheets-Sheet 6



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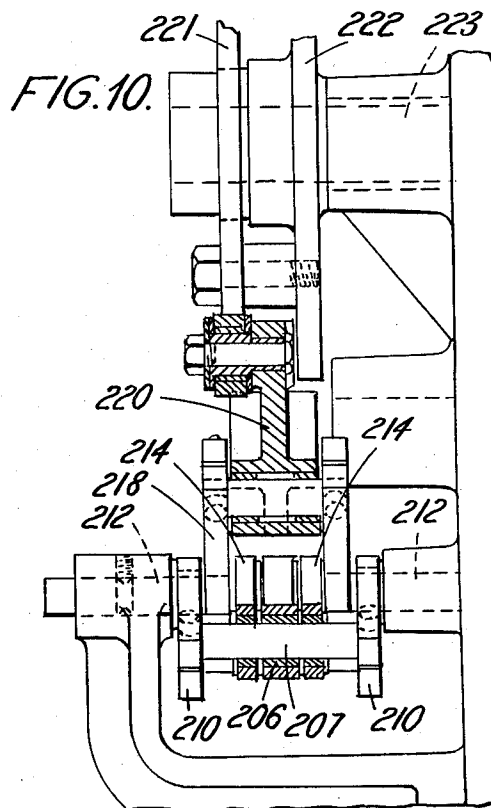
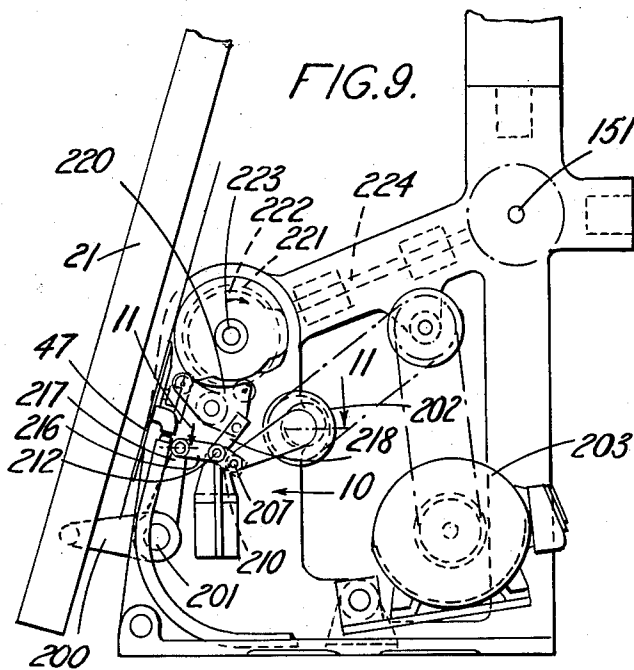
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SHEET SEPARATING AND FORWARDING MACHINE

Filed Feb. 21, 1961

8 Sheets-Sheet 7



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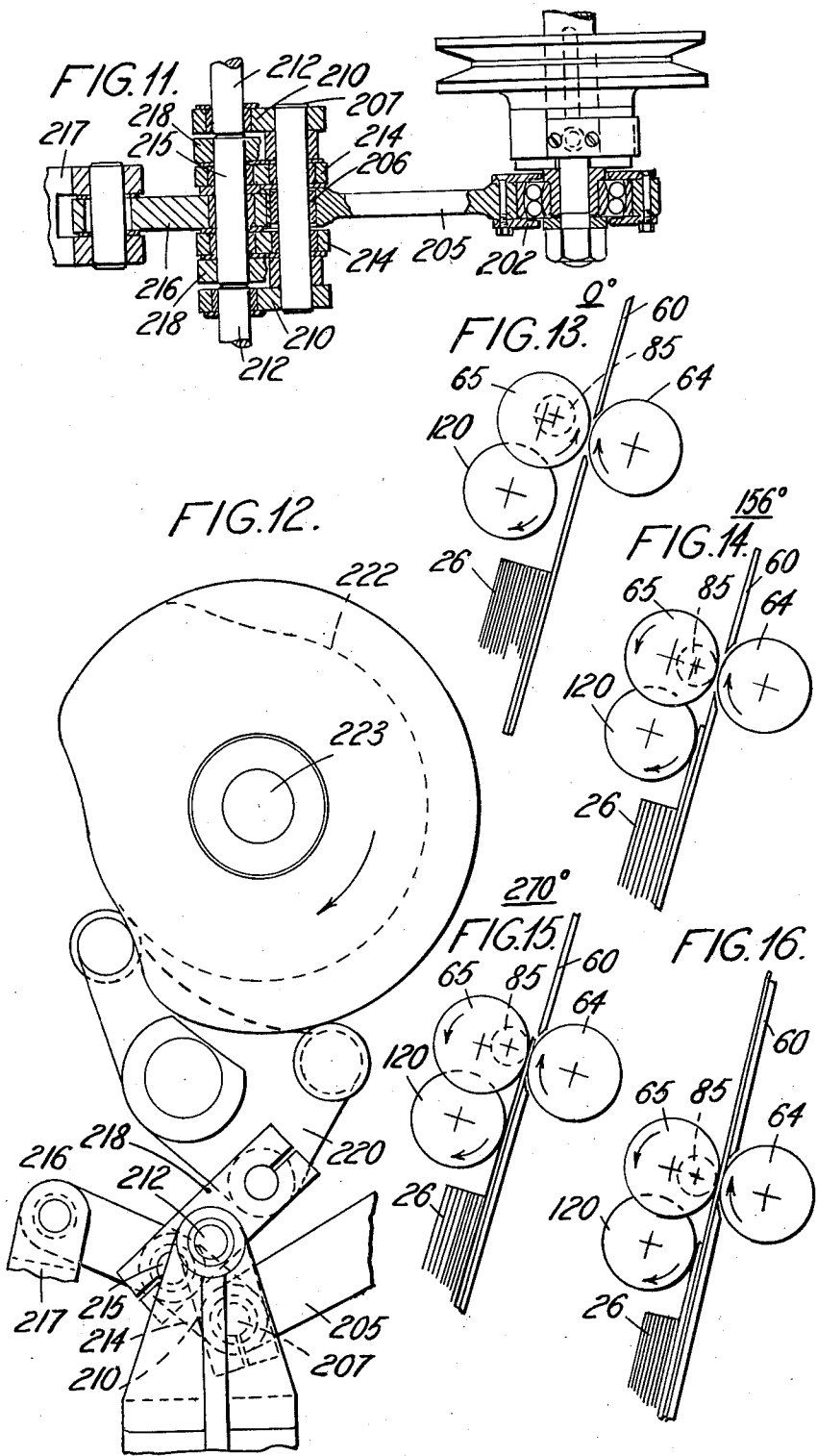
C. F. FAWDRY

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SHEET SEPARATING AND FORWARDING MACHINE

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8 Sheets-Sheet 8



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SHEET SEPARATING AND FORWARDING MACHINE

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Claims priority, application Great Britain Mar. 16, 1960
8 Claims. (Cl. 271-11)

The invention relates to a machine for separating sheets individually from a stack of sheets and for forwarding the sheets either singly or as a stream of partly overlapping sheets.

The term "sheet" is used to mean not only sheets of single thickness but also multi-ply sheet-like articles such as empty paper sacks, or sack bodies before the attachment of end closures, and in particular sacks or sack bodies having gusseted side edges.

The invention provides a machine for separating and forwarding sheets individually from a stack of sheets comprising means (e.g. including a suction gripper) for gripping in turn each sheet at one face of the stack and for forwarding or initiating the forwarding of the sheet substantially in its own plane relative to the stack and means for rejecting an additional sheet or sheets which may be adhering to the sheet as it is forwarded comprising a roller or pusher which is arranged to engage any such additional sheet and has a sheet-engaging surface which moves oppositely to the forwarding direction to tend to hold back or to return an additional sheet.

The machine may include jogging mechanism for giving to the stack an up and down jogging movement whereby pressure between the sheets due to the weight thereof is momentarily reduced or relieved during the forwarding or part thereof. The machine may be so arranged that the weight is momentarily reduced or relieved during operation of the rejecting means. Preferably the operation of the jogging mechanism is stopped for a period in each cycle of forwarding operations during which engagement of a sheet by the gripping means is effected.

It is a preferred feature of the machine that the sheets are forwarded from the under face of the stack and it is also preferred that the stack is held at a steep slope (i.e. at a small angle to the vertical) and the forwarding is effected upwardly.

The rejecting means may be a pusher which is given a reciprocatory motion but it is preferred to employ a roller driven to rotate in the direction such that its sheet engaging surface moves oppositely to the forwarding direction.

A specific construction of a machine for use in the separating and forwarding from a stack, of individual paper sack bodies will now be described by way of example and with reference to the accompanying drawings in which:

FIGURE 1 is a side view of the machine,

FIGURE 2 is a front view of the machine,

FIGURE 3 is a side view, to an enlarged scale, showing the rejection roller and associated parts,

FIGURE 4 is a front view of the mechanism shown in FIGURE 3,

FIGURE 5 is a front view of the suction gripper used in the machine,

FIGURE 6 is a rear view of the suction gripper,

FIGURE 7 is a section on the line 7-7 in FIGURE 6,

FIGURE 8 is a plan view of the suction gripper,

FIGURE 9 is a side view showing the jogging mechanism,

FIGURE 10 is a sectional view in the direction 10 in FIGURE 9,

FIGURE 11 is a sectional plan view on the line 11-11 in FIGURE 9,

FIGURE 12 is a view showing mechanism of FIGURE 9 in another position, and

FIGURES 13-16 are diagrams illustrating the cycle of operations of the rejecting roller used in the machine.

The machine forming the subject of this example is intended for separating paper sack bodies (i.e. without end closures) from a stack and forwarding them as a stream of partly overlapping bodies to a printing machine or other machine operating on individual bodies. The bodies are thickened along their side edges by folded gussets. The machine is also adaptable to the forwarding of bodies of different sizes. Furthermore the machine lends itself to the easy replenishment of the stack without interruption in the operation and it delivers the bodies at a convenient height.

The machine comprises a generally upright frame 20 on which is carried a sloping stack table 21. This table is supported at its upper end from the frame by links 22 and at its lower end by the jogging mechanism later described, the mechanism being arranged to impart a small up and down high frequency jogging movement to the table with a downward acceleration greater than that of gravity. The movement is substantially vertical. Recoil springs 23 operable in both directions are provided at each side of the machine. The table slopes upwardly at a steep angle, in this example about 17½ degrees to the vertical.

The table carries a shelf 25 for reception of a stack of sack bodies indicated diagrammatically at 26. The shelf is adjustable up and down the table for accommodation of such bodies of different size. For the purpose of effecting this adjustment there are two chains 30 fixed to the table one at each side and the shelf has a rotatable cross-shaft 31 with sprocket wheels 32 engaging the chains.

There is a central gap 40 in the table within which is located a suction gripper 41. This gripper is adjustable up and down on a channel member 42, the adjustment being to enable the gripper to be positioned at a suitable place for operation on the stack of sack bodies. The gripper, in use, is located above the shelf 25 and usually the gripper will be adjusted to operate on the lower half of a stack 26. The details of the gripper are described later. The channel member 42 and the gripper carried thereby are given an up and down sack forwarding movement by means of links 44 which connect a bracket 45 on the channel to a central arm 46 which is pivoted to the frame on shaft 47 and is rocked by a cam 48 engaging a follower 49 on an arm on the shaft. The cam is on a shaft 50 driven as later described. The channel 42 is guided by rollers 51 running in side channels 52 on the table 21.

Extending above the table 21 and as a fixed continuation thereof there is a fixed support plate 60 with a gap 61 (FIGURES 1, 3 and 13-16). Operating through this gap there is a pair of nip rolls 64, 65. The roller 64 is driven from shaft 50 by a gear train comprising a change-speed gear mechanism 66 and gears 67, 68 and 69. The gear train is continued through gears 69a, 70, 71, 72, 73, 74 (partly duplicated on each side of the machine) to drive the roll 65 which is constructed in two parts, as seen in FIGURES 2 and 4. The roll 65 is carried on arms 75 attached to sleeves free on a shaft 76, and there are spring devices 78 (FIGURE 3) which push the arms to press the roll 65 against roll 64, the devices comprising pusher rods 77 engaging in sockets 79 and reacting against pads 80 on a bar 81 carried at its ends by the main frame and intermediately by fixed brackets 82.

Located between the two parts of the roll 65 there is a drop roll 85 which co-operates with roll 64. The roll

85 is carried in a bracket 86 which is free on a fixed shaft 76. The bracket has an extension 87 with a pad 88 in which is secured a rod 89 surrounded by a spring 90. The spring acts between the pad 88 and an arm 94 and there is a nut 95 with a locking device 96 on the rod 89 for adjustably limiting the extension of the spring. The arm 94 is secured to a shaft 98 to which rocking movements are applied by means of a cam 99 (FIGURES 1 and 2) operating on a push rod 100 and arm 100a against a return spring. The cam operates to rotate the shaft 98 clockwise as seen in FIGURES 1 and 3 and so to lift the roll 85 out of engagement with the roll 64, the spring effecting the return movement. The shaft 98 also carries two arms 105 fixed to the shaft and connected by links 106 to arms 107 formed on a bracket 110. The bracket 110 is pivoted on shaft 76 and carries a shaft 108. The shaft 108 is driven by chain 111 from a sprocket 112 on shaft 76, the sprocket being driven by gears 114, 115 from rotatable shaft 116. The gears and chain are housed in a casing 118 forming part of a bracket 110.

The shaft 108 carries a rubber-covered reject roller 120 which rotates clockwise, as seen in FIGURES 1, 3 and 13-16. The roller 120 moves towards and away from the support 60 with the lifting movements of the roll 85 and in operation the nut 95 is so adjusted that when the roll 84 rests on roller 64, the roller 120 is held away from the support 60 by a distance a little more than the thickness of one body (e.g. the thickness of one and a half bodies).

Adjacent the top of the machine is a drum 130 encircled over the upper half of its circumference by endless conveyor tapes or bands 131 running over rollers 132. Below the drum 130 there is a second drum 134 against which run presser tapes 135. The presser tapes 131 and 135 are wide and engage the edges of the sack bodies as they pass around the drums. In addition there is a central narrow smoother tape 136 which engages the bodies as they pass around the drum 130 intermediate in their width and helps to keep their mouths closed. There are also narrow tapes 137 which pass around the drum 130 under the sack bodies and around a roller 137a. These tapes help to transfer the bodies from drum 130 to drum 134. The two drums are driven, in opposite directions, by a chain 138 which passes over a driving sprocket 139 rotatable on shaft 50, sprockets 140 secured to the two drums and jockey sprockets 141, 142. The sprocket 139 is driven by gears 143, 144 from shaft 145. In the operation of the machine sack bodies are fed upwards as a continuous stream over the support 60, carried round the drum 130 by bands 131, transferred to drum 134 around which they travel under bands 135 and are delivered onto a feed conveyor table 144.

The machine is driven from a shaft 150 which has a bevel gear drive to a cross-shaft 151 which in turn drives a vertical shaft 152. The shaft 152 drives the shaft 50 through bevel and spur gears 153, 154 and a clutch 155.

The shaft 151, operates a rotary valve 156 controlling the suction to the gripper 41.

The change-speed gear mechanism 66 between shaft 50 and shaft 145 enables three different ratios to be selected and permits the drive to the nip rolls, the reject roll and the drums to be varied to adapt the machine for operation on sack bodies of different lengths without having more than two sacks overlapping one another in the stream at any time.

The suction gripper 41, which will now be described in more detail, is shown in FIGURES 5-8.

The gripper comprises a body casting 160 which is attached by plates 161 to U-shaped members 162 which embrace the channel 42 and are bolted to a plate 163 which carries clamping means 164 for gripping the base of the channel, whereby the gripper may be adjusted along the channel and clamped thereto in any position of adjustment.

The casting 160 has an upstanding peripheral lip 166 defining a tray 167. A perforated plate 168 is held over the tray, the plate being interchangeable with plates having different areas of perforation or sizes of holes. In the base of the tray there are formed six cylinders 170 each containing a cylinder lining 171 in which works a piston 172 provided with a tubular piston rod 174 and a suction-gripper mouth 175. There is a suction inlet 178 into the cylinder lining and holes 179 through the walls of the piston rod leading into the interior thereof as well as a hole 180 through the piston head. In use suction is admitted at the appropriate time and controlled by valve 156 first into each of the cylinder liners 171 and by acting on the piston 172 draws the piston and gripper mouth 175 to the left, as seen in FIGURE 7, and so projects the mouth beyond the plate 168. The mouth is thereby brought into contact with the bottom sack body of the stack lying against the table which thereupon seals the mouth and so permits suction to build up between the piston and the bottom of the cylinder which draws the piston into the cylinder and causes the gripper to draw the body firmly into engagement with the plate 168, this action taking place for all six of the gripper, so that a body which may naturally be of wavy configuration is drawn flat against the plate. Suction is then applied, under control of valve 156, to the tray and by acting through the holes in plate 168 firmly holds the sack body. The suction connection to the tray is through a pipe 182, a conduit 183 and opening 184. The suction connections to the cylinders comprise a pipe 186, conduits 187, 188 and 189 and bridge connections 190, 191.

The mechanism for jogging the table 21 will now be described in more detail and is shown in FIGURES 9-11. This mechanism operates on the lower end of the table and comprises at each side of the table a lever 200 fixed to a shaft 201. Rocking movements to jog the table are given to the shaft 201 by means of a variable throw eccentric 202 driven by an independent electric motor 203. The eccentric has a strap attached to one end of a rod 205. The other end of the rod has an eye 206 fitting on a pin 207. The ends of the pin 207 fit into links 210 which connect the pin to fixed pivots 212. Accordingly the pin 207 is constrained always to move in an arc around the axis of pivots 212. Also pivoted on pin 207 are two links 214 which are connected at their other ends to a floating pin 215. This pin has a link connection 216 to an arm 217 fixed to shaft 201. The pin 215 is also connected by links 218 to a lever 220 to which a rocking motion is given by cams 221, 222 on a shaft 223 which is driven by bevel gears and a shaft 224 from shaft 151.

The purpose of the mechanism just described is to jog the table for intermittent periods in timed relation with the gripping and forwarding of the sack bodies. The timing is such that the jogging operation is stopped while the suction gripper is taking hold of a body and is stationary. The jogging then begins and after an interval the gripper begins to move. The mechanism operates in the following manner. When the parts are in the position shown in FIGURE 9, the reciprocations of rod 205 due to the rotation of the eccentric 202 merely swing the links 210, the pin 207 and the links 214 about the common axis of pivots 212 and pin 215. Accordingly no motion is transmitted to links 216 and there is no jogging action. If now the cams 221, 222 rotate to rock the lever 220 clockwise as seen in FIGURE 9, the links 218 will be lowered which in turn will lower the pin 215 so that it is no longer co-axial with pivots 212. The ends of the links 214 and 216 attached to the pin 215 will also be lowered. The mechanism will then be as shown in FIGURE 12 and reciprocation of rod 205 will, as before, cause pin 207 to swing around the axis of pivots 212 but now the swinging motion will be transmitted through links 214 and 216 and cause rocking movements of the arm 217 and jogging of the table. The timing of the cams 221, 222 is, as already explained, such that the jogging

is stopped (i.e. pin 215 is coaxial with pivots 212) during the period of a cycle in which the suction gripper is taking hold of a sack body but is in action during the remainder of the cycle.

The operation of the machine as a whole will now be briefly described. A stack, 26, of sack bodies is placed on the shelf 25 and rests against the table 21, the length of the bodies extending upwardly. (FIGURE 13 shows the relation between the top of the stack and the nip and reject rollers.) The suction gripper 41 having been adjusted to a position in which it is engageable with the lower part of the lowermost body of the stack, suction is applied to the grippers 175 so that they are projected, grip the body and draw it against the plate 168. Suction is then applied through the holes in the plate to hold the body firmly. The jogger then starts to operate and intermittently relieves the lowermost body of the weight of the remainder of the stack. The gripper 41 moves upwardly, in two stages, carrying the body and in the first stage introduces the leading edge of the body under the roll 120. The roll 85 which up to that time had been raised clear of the roller 64 is now lowered into contact with roller 64. As roll 85 is lowered, the rejection roll 120 is also lowered to a position just clear of the body raised by the gripper (FIGURE 14). If there should be a second body adhering to that body, the rejection roll will operate to return the second body downwardly to leave only a single body held by the gripper. After a dwell, the single body is then carried by the gripper upwardly to the rolls 64, 65 which take the body (FIGURE 15) and introduce its leading edge under the tapes 131. The body is then carried around drum 130, transferred to drum 134 and delivered to conveyor 144.

When the leading edge of the body has been taken by the rolls 64, 65, suction is cut off from the gripper 41 and the gripper is lowered to engage the next body. This it does and it starts to raise the next body before the first has been completely removed from the stack. Accordingly the bodies progress as a continuous stream in which the bodies partly overlap one another. One result of this is that, after a first body, there will always be a body between the roller 85 and the roll 64 as the roller 85 is lowered and likewise there will, in a correct stream, be two bodies between the roll 120 and the support 60 (see FIGURE 16). However the roll 120 will be held off at the correct distance by the roller 85 and will only contact the stream if there is an extra body.

The stack is replenished by addition of sack bodies to the top of the stack.

To locate the sides of the stack there are guides 230 on the table 21 and to assist in the separation of the sacks these guides may have, in their faces 231, nozzles for air blasts directed into the sides of the stack.

The following is a representative timing cycle for the machine described above:

0°—Gripper 41 at bottom of stroke and starting dwell of 72°. Value 156 is starting to open to admit suction to cylinders 171.

2½°—Jog completely stopped.

40°—Valve 156 starts to open to admit suction to gripper tray 167.

69½°—Jog starts.

72°—Gripper 41 begins upward stroke of 2½" to rejection roller position. (FIGURE 14.)

104½°—Jog fully on.

136°—Sack body reaches rejection position (FIGURE 14) and dwells 70° while rejection roller 120 operates. Front edge of sack should be ½" beyond centre line of rejection roller, which starts to fall on sack.

156°—Rejection roller down in operating position.

206°—Rejection ends and gripper starts further 2½" upward movement to carry sack body into nip rollers 64, 65.

246°—Suction cut off from gripper.

270°—End of upward stroke of gripper and commencement of return stroke taking 90°.

360°—End of cycle.

I claim:

1. A machine for separating and initiating the forwarding of sheets individually from a stack of sheets comprising means for supporting the stack in an upwardly sloping attitude, means for gripping the lower face of each lowermost sheet of the stack in turn, jogging mechanism for giving to the stack an up and down jogging movement whereby pressure between the sheets due to the weight thereof is momentarily reduced, the operation of the jogging mechanism, for each sheet in turn, being stopped for a period during which engagement of the sheet by the gripping means is effected and means operative during a multiplicity of cycles of up and down jogging of the sheets to move the gripping means substantially in the plane of the lowermost sheet and while gripping that sheet to initiate the forwarding of the sheet from the stack.

2. A machine for separating and initiating the forwarding of sheet individually from a stack of sheets comprising means for supporting the stack in an upwardly sloping attitude, means for gripping the lower face of each lowermost sheet of the stack in turn, the sheet gripping means comprising a main suction gripper having a plurality of orifices spread over a substantial area and at least one subsidiary suction gripper of the kind which has a sucker mouth which, when the mouth is closed by a sheet and as a result of such closure, moves in a direction perpendicular to the sheet, the movement being arranged to draw the sheet firmly into contact with the main gripper, jogging mechanism for giving to the stack an up and down jogging movement whereby pressure between the sheets due to the weight thereof is momentarily reduced and means operative during a multiplicity of cycles of up and down jogging of the sheets to move the gripping means substantially in the plane of the lowermost sheet and while gripping and sheet to initiate the forwarding of the sheet from the stack.

3. A machine for separating and initiating the forwarding of sheets individually from a stack of sheets comprising means for supporting the stack in an upwardly sloping attitude, the stack supporting means being an upwardly sloping table engaging and supporting the underface of the lowermost sheet of the stack, means for gripping the lower face of each lowermost sheet of the stack in turn, jogging mechanism operating on the table for giving to the stack an up and down jogging movement whereby pressure between the sheets due to the weight thereof is momentarily reduced and means operative during a multiplicity of cycles of up and down jogging of the sheets to move the gripping means substantially in the plane of the lowermost sheet and while gripping that sheet to initiate the forwarding of the sheet from the stack.

4. A machine for separating and initiating the forwarding of sheets individually from a stack of sheets comprising means for supporting the stack in an upwardly sloping attitude, means for gripping the lower face of each lowermost sheet of the stack in turn, jogging mechanism for giving to the stack an up and down jogging movement whereby pressure between the sheets due to the weight thereof is momentarily reduced, means operative during a multiplicity of cycles of up and down jogging of the sheets to move the gripping means substantially in the plane of the lowermost sheet and while gripping that sheet to initiate the forwarding of the sheet from the stack and means for rejecting an upper sheet, or sheets which may be adhering to the lowermost sheet as it is forwarded comprising a member having a sheet engaging surface arranged to engage the upper face of any such additional sheet and means for moving said surface oppositely to the forwarding direction.

5. A machine as claimed in claim 4 in which the rejecting means operate during the jogging of the sheets.

6. A machine as claimed in claim 4 having means for moving the sheet engaging member out of its position in sheet engagement as the leading edge of each correctly forwarded sheet reaches the engaging position and then returning the member to its additional sheet engaging position.

7. A machine for separating and initiating the forwardly of sheets individually from a stack of sheets comprising means for supporting the stack in an upwardly sloping attitude, means for gripping the lower face of each lowermost sheet of the stack in turn, jogging mechanism for giving to the stack an up and down jogging movement whereby pressure between the sheets due to the weight thereof is momentarily reduced and means operative during a multiplicity of cycles of up and down jogging of the sheets to move the gripping means upwardly while gripping the lowermost sheet to initiate the forwarding of the sheet upwardly from the stack.

8. A machine for separating and initiating the forwarding of sheets individually from a stack of sheets comprising means for supporting the stack in an upwardly sloping attitude, means for gripping the lower face of each

lowermost sheet of the stack in turn, jogging mechanism for giving to the stack an up and down jogging movement, at least the downward movement having an acceleration at least equal to that of gravity, whereby pressure between the sheets due to the weight thereof is momentarily reduced, the operation of the jogging mechanism, for each sheet in turn, being stopped for a period during which engagement of the sheet by the gripping means is effected and means operative during a multiplicity of cycles of up and down jogging of the sheets to move the gripping means substantially in the plane of the lowermost sheet and while gripping that sheet to initiate the forwarding of the sheet from the stack.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,127,166

March 31, 1964

Charles Frederick Fawdry

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 26, for "sheets", first occurrence, read -- sheet --; column 3, line 27, for "84" read -- 85 --; column 4, line 23, for "gripper" read -- grippers --; column 6, line 52, for "more" read -- move --; same column 6, line 73, and column 7, line 18, for "forwardly", each occurrence, read -- forwarding --.

Signed and sealed this 4th day of August 1964.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENN
Commissioner of Patent