

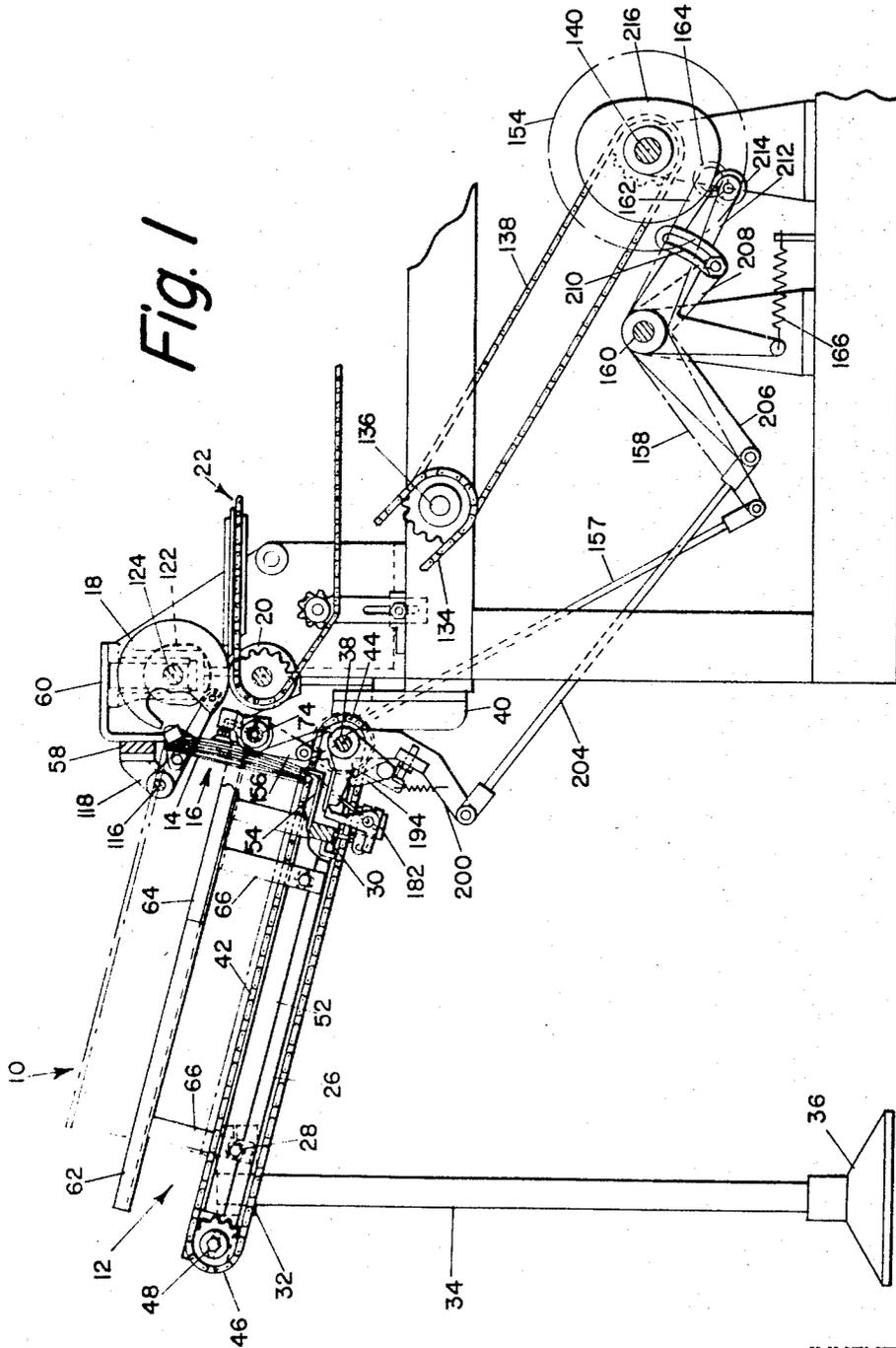
Feb. 25, 1969

J. W. SCULLY
CARTON BLANK FEEDING

3,429,570

Filed Feb. 23, 1966

Sheet 1 of 3



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Sheet 2 of 5

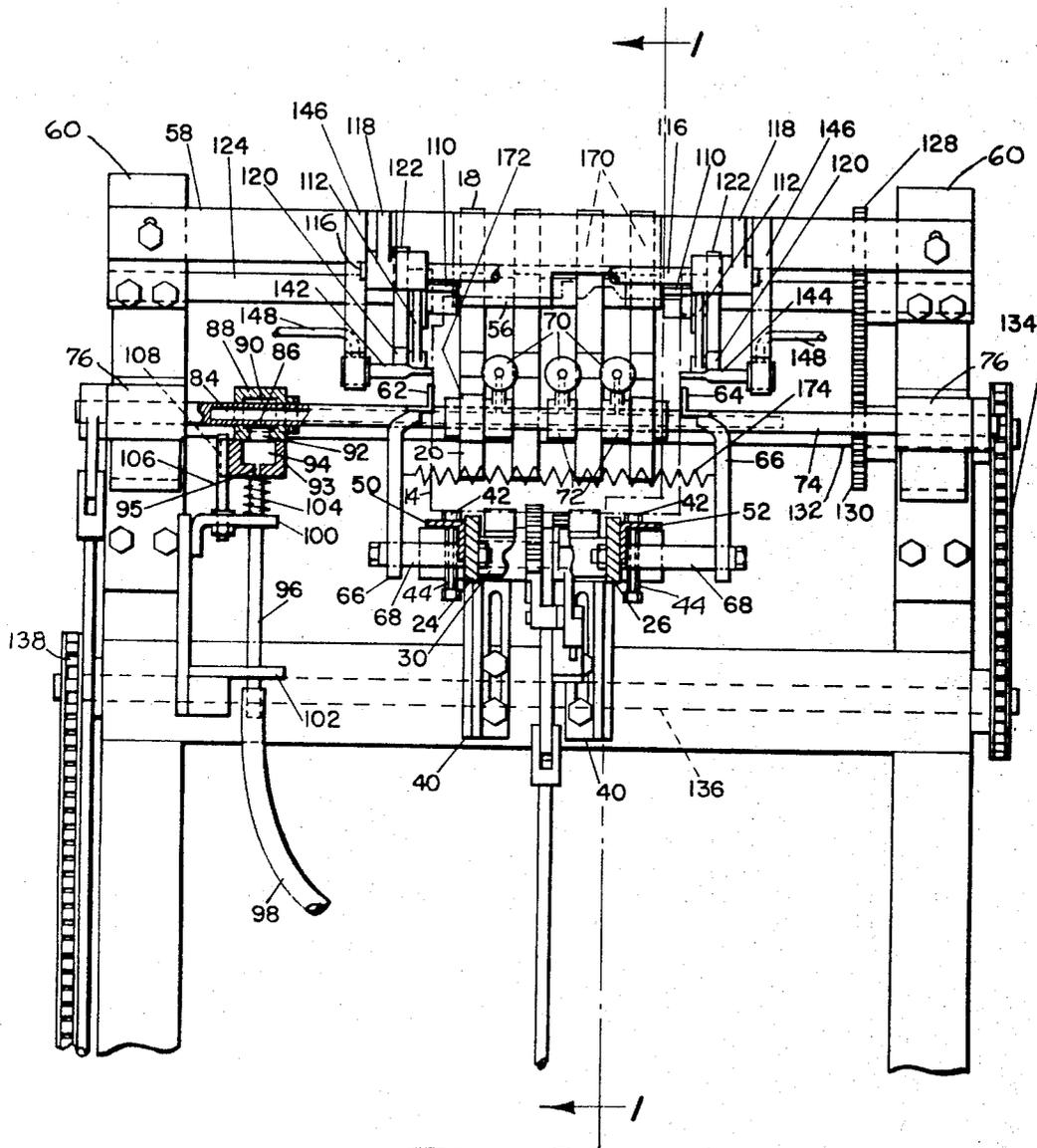


Fig. 2

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Sheet 3 of 5

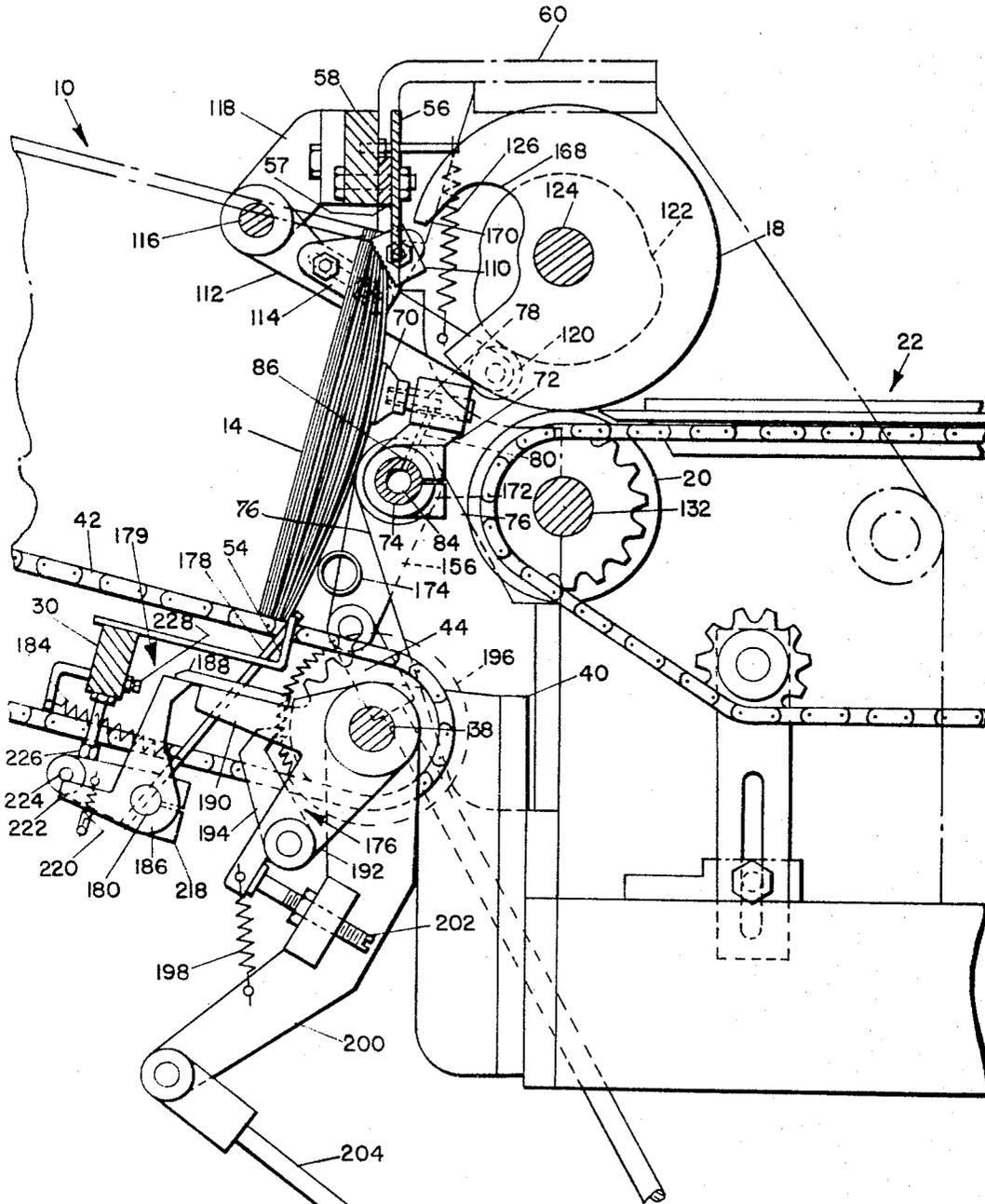


Fig. 3

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Sheet 4 of 5

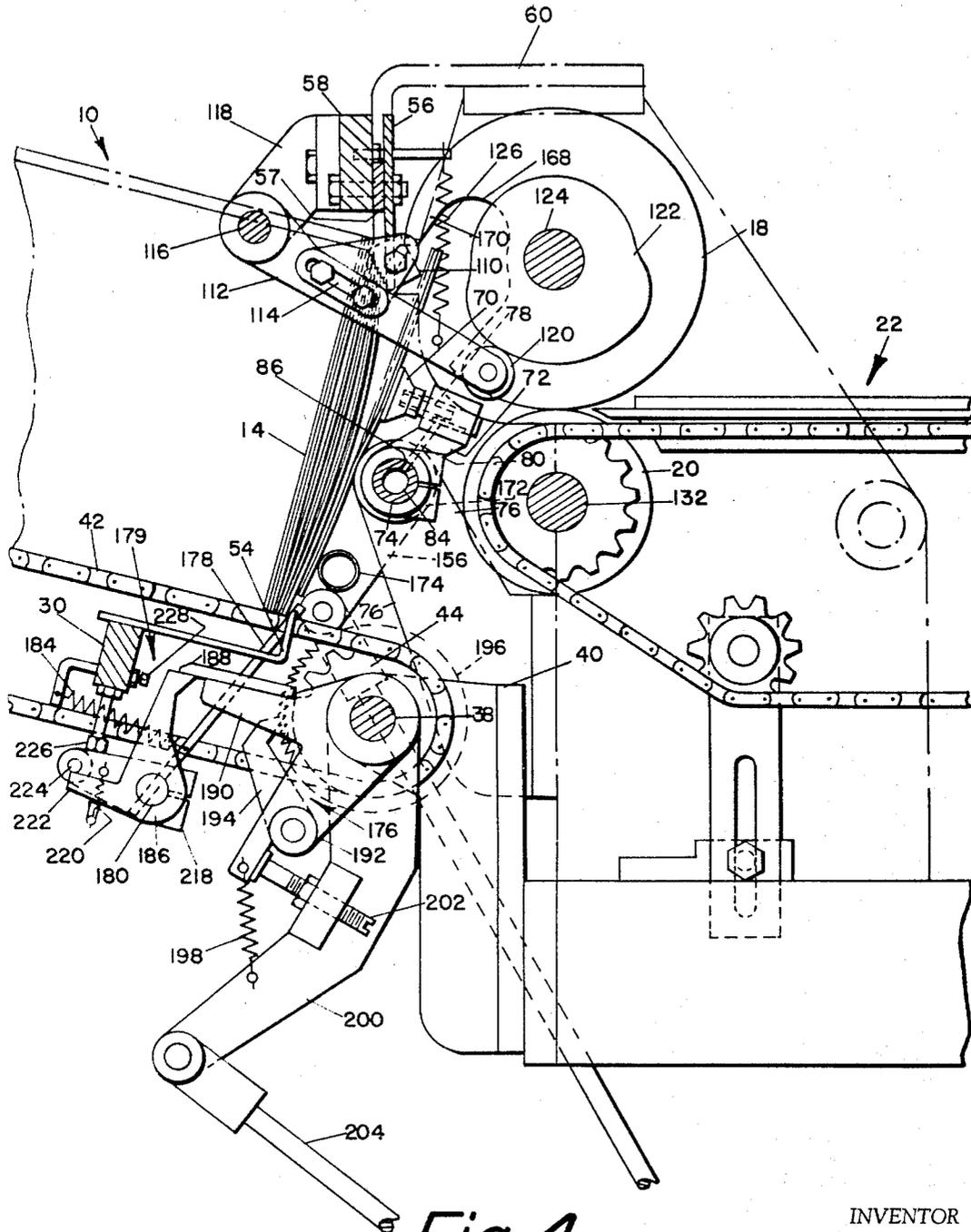


Fig. 4

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Sheet 5 of 5

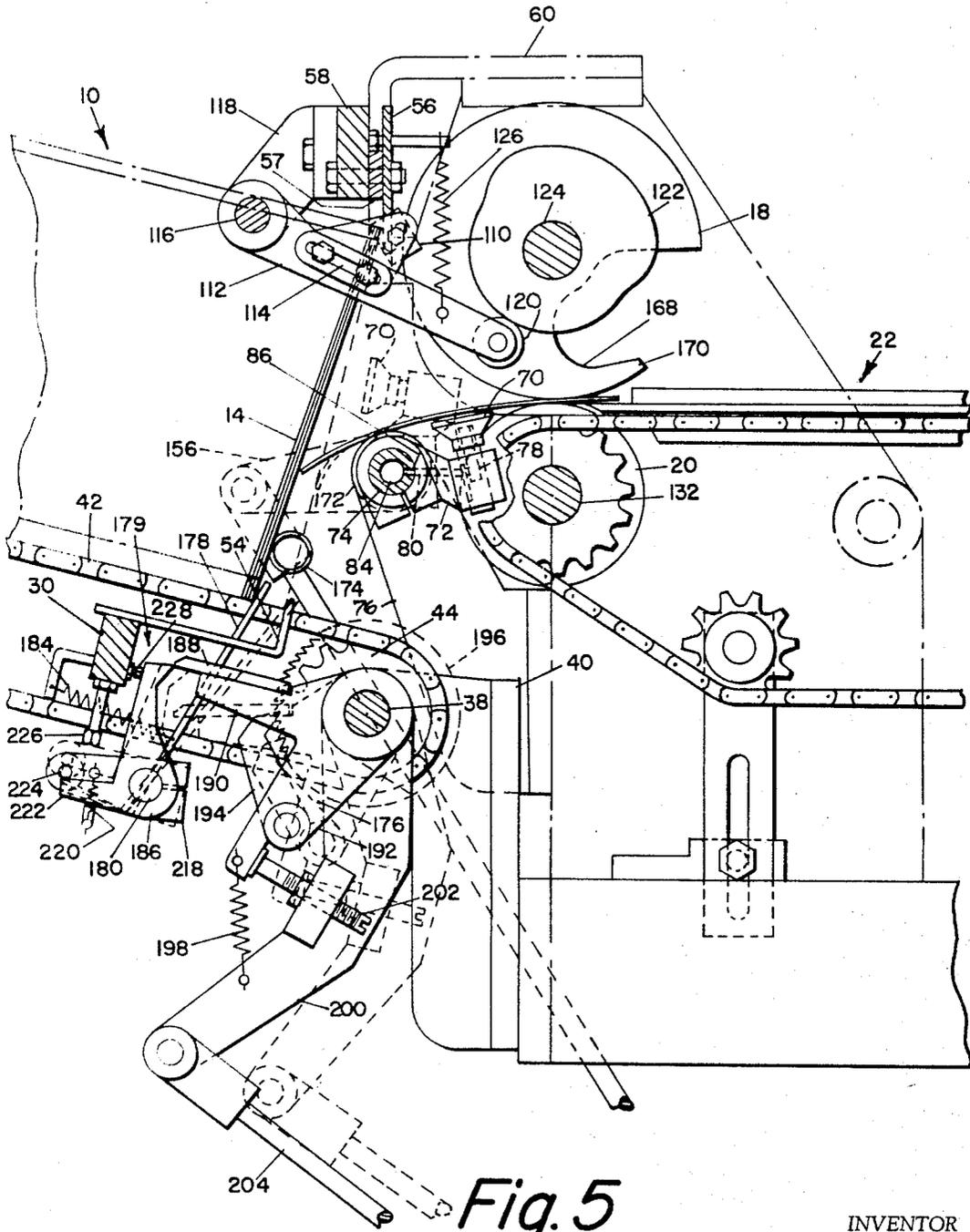


Fig. 5

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3,429,570

CARTON BLANK FEEDING

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U.S. Cl. 271-12

16 Claims

Int. Cl. B65h 3/08, 5/06

ABSTRACT OF THE DISCLOSURE

A stack of carton blanks are advanced on edge to blank withdrawing and transferring means. The upright blanks at the forward end of the stack are pressed down at a forwardly and downwardly inclined angle to cause the upper portions of the blanks to fan out and slidingly separate and to cause the foremost blank to bow out forwardly into operative position to be engaged and withdrawn in a manner such as to assure withdrawal of but one blank at a time from the stack.

This invention relates to a packaging machine and more particularly to carton blank feeding apparatus for a packaging machine.

The invention has for an object to provide a novel and improved construction of carton blank feeding apparatus in which provision is made for transferring successive carton blanks from a stack thereof to the packaging machine and which is characterized by novel and improved structure capable of operation at higher speeds than prior feeding apparatus of this character.

The invention has for a further object to provide novel and improved carton blank feeding apparatus of the character specified wherein novel provision is made for removing successive foremost carton blanks in the stack in a manner such as to assure withdrawal of but one blank at a time from the stack.

The invention has for a still further object to provide a novel and improved carton blank feeding apparatus of the character specified which is capable of successfully withdrawing successive foremost carton blanks from the stack which are either flat or which may assume a slightly curved contour in the stack as received from the manufacturer.

With these general objects in view and such others as may hereinafter appear, the invention consists in the carton blank feeding apparatus and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings illustrating the preferred embodiment of the invention:

FIG. 1 is a side elevation of carton blank feeding apparatus embodying the present invention, some of the parts being shown in cross section as seen from the line 1-1 of FIG. 2;

FIG. 2 is a front elevation of the same, some of the parts being shown in cross section;

FIG. 3 is a detail view at a larger scale showing the blank withdrawing and transfer mechanism;

FIG. 4 is a view similar to FIG. 3 showing the parts in another position of operation; and

FIG. 5 is another view similar to FIG. 3 showing the parts in still another position of operation.

In general the present invention contemplates novel carton blank feeding apparatus of the type wherein successive foremost carton blanks are withdrawn from a stack thereof and transferred to feed rolls to be delivered to a packaging machine such as a container forming machine or the like. In practice, the stack may be supported in a magazine disposed in a substantially horizontal posi-

tion and preferably in a downwardly inclined position with the carton blanks resting on edge in the magazine and extended substantially vertically or at right angles to the stack support. The withdrawing and transferring mechanism comprises suction elements mounted to engage and withdraw successive foremost carton blanks and to transfer the blanks into a position to be engaged by feed rolls. Provision is also made for advancing the stack along the inclined support to compensate for the carton blanks withdrawn from the stack so as to maintain the front end of the stack in operative relation to the withdrawing mechanism.

One of the problems encountered in feeding carton blanks of the type which comprise flexible cardboard sheets of a more or less semirigid nature is that the suction elements might withdraw more than one carton blank at a time which was due to a slight adhesion of the blanks caused by the action of the printing ink when the carton blanks are printed, and also by the inherent adhesion caused by a slight vacuum created between adjacent blanks which are closely pressed together.

In accordance with one feature of the present invention, novel provision is made for initially separating a group of the foremost carton blanks in the magazine so as to break such adhesion of contiguous blanks and to assure that only one carton blank at a time is removed from the stack. This is accomplished in the present apparatus by applying downward pressure at an angle to the top edges of the foremost group of blanks to effect a fanning action wherein adjacent blanks may slide apart slightly relative to each other to break any physical adhesion between the blanks and also to cause the foremost group of blanks to bow or curve forwardly to present the endmost blank into operative relation to the suction elements. Provision is also made for directing streams of compressed air against the sides of the foremost group of blanks in order to counteract any tendency of contiguous blanks to stick together by vacuum.

Another problem encountered in feeding carton blanks of a flexible and semirigid nature is that one batch of carton blanks received from the manufacturer may be substantially straight and flat while another batch may be slightly curved lengthwise thereof. As a result, it was difficult to present the different foremost blanks in the stack in a consistently uniform position relative to the suction elements and the fanning elements. The expedient of fanning and bowing forwardly the foremost group of blanks in the stack also enabled either the straight or the curved blanks to be successfully handled and presented in a consistently uniform position relative to the suction elements and the fanning elements to be withdrawn from the stack.

In accordance with another feature of the present invention, the inclined position of the magazine tends to urge the stack forwardly against stops provided at the front end of the magazine so that when the stack is bodily moved forwardly to compensate for the withdrawn blanks, the front end of the stack moved into uniform engagement with the stops without the use of a rear backing plate or pusher plate, usually provided to urge the stack forwardly. This feature also causes the upper portion of the stack to tilt forwardly against the upper stop to present the upper ends of both flat or curved blanks in a uniform position against the stop to be fanned and bowed into operative position to be engaged by the suction elements. This expedient also permits the blanks in the stack to be maintained in a relatively loose condition so as to facilitate withdrawal thereof.

Referring now to the drawings and particularly to FIG. 1, 10 represents a stack of carton blanks supported on edge in a downwardly inclined magazine indicated generally at 12. In general, in the operation of the apparatus,

successive endmost carton blanks 14 are withdrawn from the stack 10 by suction elements indicated generally at 16 and are transferred by the suction means into a position to be operatively engaged by upper and lower feed rolls 18, 20 respectively. The feed rolls 18, 20 are arranged to deposit successive carton blanks in predetermined spaced relation onto a conveyor 22 forming a part of a container forming machine.

The downwardly inclined magazine 12 which may be disposed at an angle of about 15° relative to a horizontal plane includes spaced side rails 24, 26 connected at their outer ends by a tie rod 28 and at their inner ends by a tie bar 30. The tie rod 28 at the outer end of the magazine is supported by a bracket 32 which is adjustably clamped to an upright column 34 having a base portion 36 resting on the floor. The inner or forward ends of side rails 24, 26 are supported by a shaft 38 which extends through openings provided with bushings in the side rails and which is mounted to rotate in spaced bearing brackets 40 secured to and mounted for vertical adjustment in the frame of the container forming machine.

The carton blanks 14 are made of the usual carton board which is of a more or less semirigid character, and the lower edges of the blanks in the stack rest on the upper runs of spaced chains 42 arranged to run over sprockets 44 keyed to the shaft 38 and over idler sprockets 46 which are mounted for rotation on similar studs 48 adjustably secured to the outer ends of the side rails 24, 26 respectively. The upper runs of the chains 42 are supported on angle members 50, 52 also secured to the side rails 24, 26 as shown.

The front end of the stack 10 is retained in the inclined magazine 12 by stop members 54 against which the lower ends of the carton blanks are urged, and by a stop or retaining plate 56 which engages the upper ends of the carton blanks. The stop members 54 are adjustably secured to the tie bar 30 extending between the side rails, and the retaining plate 56 depends from and is secured to the inner face of an elongated transverse bar 58, a spacer 57 being provided between the bar and the plate. The bar 58 is secured to angle brackets 60 attached to the frame of the machine. The sides of the stack are supported by guide rails 62, 64 secured to brackets 66 attached to and upstanding from lateral extensions 68 from the side rails 24, 26. One side rail 62 extends the full length of the magazine, and the other side rail 64 extends from the forward end of the magazine a short distance rearwardly leaving the remainder of the stack unsupported along this side and providing an open area for convenience in loading the magazine with carton blanks.

From the description thus far, it will be seen that the stack 10 of carton blanks 14 is supported in the inclined magazine 12 with the front end of the stack retained by upper and lower stops 56 and 54, respectively, the tilted position of the stack causing the upper portion of the stack to bear against the upper stop whether the blanks are flat or curved as described. As herein shown, the suction elements 16 comprise suction cups 70 adjustably mounted in spaced arms 72 clamped to a hollow rocker shaft 74 journaled in spaced brackets 76 attached to the machine frame.

Each suction cup 70 has a passageway 78 which communicates with a passageway 80 formed in the arm 72. The passageway 80 in the arm communicates with the passageway 84 in the hollow shaft 74 through a radial port 86 in the shaft. A cylindrical valve 88 adjustably mounted on and arranged to rock with the hollow rocker shaft 74 is provided with an internal groove forming with the shaft an annular chamber 90 which is in communication with the passageway 84 in the shaft through a radial port 86. A stationary valve block 93 has a concave upper surface which fits snugly against the underside of the cylindrical valve 88 and is also provided with a chamber 94 in communication with the annular chamber 90 through a narrow slot 92 formed in the cylindrical valve

88. The valve block 93 is provided with a pipe 96 in communication with the chamber 94 through a passageway 95 and the lower end of the pipe is connected by a flexible tube 98 to a suitable source of vacuum. The pipe 96 extends through openings in upper and lower supporting brackets 100, 102, attached to the machine frame and a coil spring 104 interposed between the upper bracket 100 and the underside of the block 93 is arranged to maintain the stationary valve block 93 in substantially airtight engagement with the circumference of the cylindrical valve 88. A guide pin 106 upstanding from the bracket 100 is engaged with a slotted portion 108 of the block 93 to maintain the valve block 93 in parallel alignment with the cylindrical valve 88. The slot 92 is in communication with the chamber 94 to provide vacuum to the suction cups 70 when the latter are rocked in a counterclockwise direction to their blank receiving position, as shown in FIG. 3, and the slot 92 is rocked out of the chamber to cut off the vacuum when the rocker shaft 74 is rotated a short distance in a clockwise direction after the foremost carton blank has been withdrawn from the stack as shown in FIG. 4.

As herein illustrated, the suction cups 70 are spaced from the front of the stack when the carton blanks 14 are in their normal or unbowed position as shown in broken lines in FIG. 5. In order to fan the foremost group of carton blanks in the stack forwardly to present the foremost blank into operative engagement with the suction cups 70, a pair of spaced and angularly arranged fanning elements 110 carried by spaced arms 112 are arranged to be rocked downwardly into engagement with the upper front corner or upper edges of the foremost group of blanks in the stack to apply downward pressure at an angle. Each fanning element 110 comprises a serrated pad secured to a triangular plate 114 adjustably secured to its arm 112. Each arm is pivotally mounted on a rocker shaft 116 journaled in spaced brackets 118 attached to the transverse bar 58. Each arm 112 is provided with a cam roll 120 which cooperates with its individual cam 122 fast on a shaft 124 on which the upper feed roll 18 is mounted. Each arm 112 is urged into engagement with its cam by a spring 126. The shaft 124 which is arranged to make one revolution each cycle of operation of the apparatus is connected by spur gears 128, 130 to a shaft 132 on which the lower feed roll 20 is mounted. The shaft 132 journaled in the machine frame is connected by a chain and sprocket drive 134 to an intermediate shaft 136 which in turn is connected by a chain and sprocket drive 138 to a cam shaft 140 forming a part of the container forming machine.

In operation, the arms 112 are rocked downwardly each cycle of operation to present the serrated fanning pads 110 against the upper front corner or edge of the stack, the serrated pads being arranged at an angle of about 45° with relation to the front corner of the stack, and during the continued downward movement of the pads, the foremost group of blanks are fanned to separate adjacent blanks longitudinally and to bow them forwardly to present the foremost blank into operative engagement with the suction cups as shown in FIG. 3.

Provision is also made for directing streams of air against opposite sides of the forward end of the stack so as to further assist in separation of adjacent blanks in the fanned and bowed group of blanks whereby to prevent withdrawal of two or more blanks by the suction cups. As herein shown, air jets 142, 144 are supported in brackets 146 attached to and extending from the transverse supporting bar 58. Each jet is connected by a flexible hose 148 to a regulated source of compressed air. In practice, the air is discharged from the jets 142, 144 for a predetermined time each cycle of operation during the fanning operation and the withdrawal of the foremost carton blank after which the air is discontinued. This may be accomplished in any suitable manner,

such as by a cam operated air valve, not shown, connected in the supply line.

As illustrated in FIG. 1, the shaft 74 on which the suction cups are mounted is arranged to be rocked each cycle of operation by a cam 154 fast on the cam shaft 140 and by linkage including an arm 156 fast on the shaft 74 connected by a link 157 to one arm 158 of a two-armed lever pivotally mounted on a shaft 160. The second arm 162 of the two-armed lever is provided with a cam roll 164 cooperates with the cam 154. A spring 166 connected to the arm 162 is arranged to hold the roll against its cam.

In operation, the vacuum is on to the suction cups 70 when they are in their blank receiving position, as shown in FIG. 3, and when the cups are rocked in a clockwise direction, the initial rocking movement operates to pull the upper edge of the blank out from under the lower edge of the upper retaining plate 56 and also to lift the blank upwardly a short distance to remove the lower edge of the blank from the lower stop or retaining member 54. It will be observed that the upper retaining plate 56 is disposed in a vertical plane so that only the upper corner or edge of the stack engages the plate when the blanks are in their straight or unbowed condition and that when the fanning pads 110 effect forward bowing of the foremost blanks, the face of the upper portion of the blank will bow against and be moved down toward the lower edge of the retaining plate to facilitate removal of the blank by the suction elements from under the retaining plate. The initial rocking movement, which may be between 10° and 15° of arcuate movement, frees the blank from the magazine and presents the upper edge of the blank into the path of a cutout or opening 168 formed in each of the continuously rotated feed rolls 18. It will be understood that both the upper and lower feed rolls 18, 20 comprise a plurality of laterally spaced rolls as shown in FIG. 2. When the suction cups arrive at the approximate position shown in FIG. 4, the vacuum is cut off from the suction cups in the manner previously described to free the blank. During the continued rotation of the feed rolls curved fingers 170 defined by the cutouts 168 and the circumference of the rolls engage the leading end of the blank and guide it forwardly and downwardly to a horizontal position to be engaged between the upper and lower rolls 18, 20 as shown in FIG. 5. At this time, it will be observed that the suction cups 70 are rocked to their extreme clockwise position between the laterally spaced feed rolls and the trailing portion of the blank rests against and rides over laterally spaced rollers 172 mounted on the hollow shaft 74. It will be understood that also at this time the fanning pads 110 have been rocked upwardly and that the remaining blanks in the stack have assumed their normal unbowed position so that the extreme trailing end of the blank bears against the front of the stack. Thus, in operation, it will be seen that when the leading end of the blank is being advanced between the feed rolls 18, 20, the trailing portion of the blank resting on the rollers 172 and bearing against the front of the stack is subjected to a curving action opposite to that of those blanks which may have been deposited in the stack in a slightly bowed or curved condition, such action tending to flatten out such curved blanks. During continued rotation of the feed rolls 18, 20, the blank is deposited on the conveyor 22, and the suction elements 70 are rocked back to their initial position. It will be understood that the rotation of the feed rolls 18, 20 is timed to cooperate with the operation of the suction cups so as to arrive into a position to engage the upper end of the blank when the latter is withdrawn from the stack.

As illustrated in FIG. 4, when the suction cups 70 release the withdrawn blank in the position shown in broken lines, the blank is free to drop out of the path of the cutout 168, and in order to maintain the freed blank in its elevated position to be engaged by the cutout, a coil

spring 174 supported and stretched across the front of the stack serves to press the lower portion of the blank against the front of the stack, as shown, to prevent downward movement of the released blank.

Provision is made for automatically advancing the stack in the magazine to compensate for the blanks withdrawn by the suction elements 70. In practice, it is preferred to maintain the foremost group of blanks in the stack in a relatively loose condition as distinguished from a tightly pressed condition such as might render it difficult to withdraw the endmost blank from the stack. In the illustrated embodiment of the invention, the forward tilt of the stack is arranged to maintain the upper ends of the more or less loosely confined blanks in engagement with the upper retaining plate 56 by gravity in a consistently uniform position relative to the fanning elements 110 whether the carton blanks in the stack are flat or slightly curved rearwardly at their upper ends as described. Such forward tilting and the manner of advancing the stack is such as to maintain the front end of the stack in a relatively loose condition and also eliminates the use of a backing element usually provided at the rear of the stack to effect advance of the stack against the retaining elements.

As herein shown, the lower edges of the blanks in the stack 10 rest upon and are in frictional engagement with the spaced chains 42 of the magazine only, the bottom of the stack being free of engagement with adjacent supporting elements of the magazine. The chains 42 are arranged to be moved a predetermined distance by means of a pawl and ratchet mechanism indicated generally at 176 in response to detecting means in the form of an elongated finger 178 which is arranged to control latch mechanism indicated generally at 179. The latch mechanism 179 is arranged to prevent operation of the pawl and ratchet mechanism until a selected number of blanks have been withdrawn from the stack as detected by the finger 178. The finger 178 is mounted fast on a rocker shaft 180 supported in brackets 182 secured to and depending from the tie bar 30. The detecting finger is resiliently urged against the lower front end of the stack by a spring 184 connected between the finger and a stud carried by the tie bar 30. The rocker shaft 180 also carries a latch 186 forming a part of the latch mechanism 179 and which is arranged to cooperate with a latch member 188 carried by one arm 190 of a bell crank forming a part of the advancing mechanism. The bell crank is loosely mounted on the shaft 38 which carries the sprockets 44 and the second arm 192 of the bell crank carries a pawl 194 for cooperation with a ratchet 196 fast on the shaft 38. The pawl 194 is pivotally mounted and is resiliently urged into engagement with its ratchet by a spring, not shown, coiled about its pivot pin. The arm 192 is connected by a spring 198 to a cam operated arm 200 also loosely mounted on the shaft 38. A stop screw 202 carried by the arm 200 is arranged to engage an extension of the bell crank arm 192. The cam operated arm 200 is connected by a link 204 to one arm 206 of a two-armed lever pivotally mounted on the shaft 160, the second arm 208 of which is provided with an arcuate slot 210 for adjustably connecting the arm 208 to a cam lever 212 loosely mounted on the shaft 160 and provided with a cam roll 214 for cooperation with a cam 216 fast on the cam shaft 140.

As herein illustrated, the latch 186 is loose on the detecting finger shaft 180, and the shaft also carries a lever 218 fast thereon. The lever 218 is connected by a spring 220 to an extension 222 of the latch, the extension bearing against a stop pin 224 carried by the lever 218. The lever 218 is arranged to engage an adjustable stop screw 226 carried by the tie bar 30 to limit the clockwise movement thereof. An adjustable stop screw 228 also carried by the tie bar is arranged to engage the latch 186 to limit the counterclockwise movement thereof.

As illustrated in FIG. 3, when the stack 10 is in its fully advanced position against the lower retaining members

54, the detecting finger 178 resiliently urged into engagement with the front of the stack is arranged to maintain the latch 186 in a position to prevent counterclockwise rocking of the bell crank carrying the pawl 194, the latch member 188 engaging the top of the latch 186 as shown. During continued withdrawal of successive carton blanks the detecting finger is gradually moved in a counterclockwise direction by virtue of the spring 184 until it reaches a position shown in FIG. 5 where the latch 186 is moved out of the path of the latch member 188. At this time the bell crank carrying the pawl 194 is free to rock in a counterclockwise direction with the cam operated arm 200, the pawl riding over one or more teeth of the ratchet 196. Thus, during clockwise movement of the mechanism the pawl will effect an increment of rotation to the shaft 38 and the chains 42 to advance the stack. Also, during such clockwise movement, the latch member 188 will engage the latch 186 to rock it in a counterclockwise direction until the member 188 is moved to a position above the latch 186 whereupon the latter will be resiliently rocked under the member 188 to be reset.

From the above description it will be seen that in operation the stack 10 is advanced along the magazine 12 by frictional engagement with the chains 42 and that the incremental advance of the stack with relation to the number of blanks withdrawn from the stack may be adjusted in a manner such as to maintain the forward end of the stack in a relatively loose condition. Thus, in practice, when the magazine is in its fully loaded position, for example, the stack will be advanced after approximately eight carton blanks have been withdrawn. Thereafter, when the blanks in the magazine have been reduced by about one half the advancing mechanism may operate after about four carton blanks have been withdrawn because of the reduced gravitational pressure of the stack. Thus, the stack is never advanced to a degree such as to cause compression of the blanks so that the blanks are always maintained in a relatively loose condition to facilitate withdrawal thereof. It will also be seen that novel provision is made for physically separating the foremost group of carton blanks in the stack by fanning and bowing forwardly the foremost blanks to present the endmost blank into engagement with the suction elements which operate to withdraw and transfer successive endmost blanks to a position to be engaged between the feed rolls 18, 20, thus assuring that but one blank at a time is withdrawn from the stack during the operation of the machine. It will also be seen that the provision of air jets for directing streams of air against the sides of the blanks at the forward end of the stack tends to destroy any vacuum which might exist between adjacent blanks. Furthermore, it will be observed that the withdrawing movement of the suction elements 70 is relatively short, that is, the suction cups travel through an arc of between 10° and 15° to present the blank into position to be engaged by the feed rolls, at which time the suction is cut off. As a result, the present blank withdrawing and transfer mechanism is capable of relatively higher speeds than prior devices of this type wherein the arcuate movement of the suction elements extends through about 90°.

In the above description the feeding apparatus has been described as adapted for feeding carton blanks to a container forming machine. However, it will be apparent that the present apparatus may also be used with advantage for feeding flexible sheet material other than carton blanks. Such sheet material may vary in thickness within wide limits as long as it maintains its flexibility and semirigid characteristics so as to be capable of being bowed or flexed by the fanning elements in the manner defined. Also, in the illustrated embodiment of the invention the magazine is shown as tilted at an angle of about 15°. However, in practice, this angle may be varied and in some instances the magazine may assume a horizontal position.

While the preferred embodiment of the invention has been herein illustrated and described, it will be under-

stood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In sheet feeding apparatus, in combination, means for supporting a stack of sheets on edge, means for withdrawing successive foremost sheets from the stack, and means engageable at a forwardly and downwardly inclined angle with the upper forward end of the stack for fanning a group of the foremost sheets to slidably separate the same and to effect forward bowing of the endmost sheet into operative relation to said withdrawing means whereby to assure withdrawal of but one sheet at a time by said withdrawing means.

2. In a sheet feeding apparatus, in combination, means for supporting a stack of bendable sheets on edge, means for withdrawing successive foremost sheets from the stack, and means for applying downward pressure at a forwardly inclined angle to the upper edges of a group of the foremost sheets to bow the same forwardly and to present the endmost bowed sheet into operative relation to said withdrawing means.

3. In sheet feeding apparatus, in combination, means for supporting a stack of flexible semirigid sheets on edge including upper and lower stationary retaining elements at the forward end of the stack, means for withdrawing successive foremost sheets from the stack, and means engageable at a forwardly and downwardly inclined angle with the top of the forward end of the stack for fanning a group of the foremost sheets to slidably separate the same and to simultaneously bow the foremost sheets forwardly to present the endmost sheet into operative relation to said withdrawing means whereby to assure withdrawal of but one sheet at a time by the withdrawing means.

4. Sheet feeding apparatus as defined in claim 3 wherein the sheet separating means further includes means for directing streams of air against the sides of the bowed sheets.

5. Sheet feeding apparatus as defined in claim 3 wherein the withdrawing means includes suction elements, and means for moving said suction elements to pull the upper end of the endmost sheet forwardly from behind the upper retaining elements and to lift the lower end of the sheet upwardly to free the sheet from the lower retaining elements.

6. Sheet feeding apparatus as defined in claim 3 wherein the stack supporting means comprises a magazine arranged in a forwardly and downwardly inclined plane whereby the front of the stack supported therein bears against the retaining elements by gravity in a manner such as to maintain the sheets in a relatively loose and freely withdrawable condition.

7. Sheet feeding apparatus as defined in claim 6 wherein the forward incline of the stack causes the upper edges of said group of foremost sheets to be maintained in a consistently uniform position against the upper retaining element and in operative relation to said fanning elements whereby to render the apparatus capable of handling both flat sheets and curved sheets contained in the stack.

8. Sheet feeding apparatus as defined in claim 3 wherein the fanning means comprises serrated pads arranged at said forwardly and downwardly inclined angle with respect to the upper front edge of the stack, and means for moving said pads into and out of engagement with said foremost group of sheets.

9. In a sheet feeding apparatus, in combination, means for supporting a stack of flexible semirigid sheets on edge including upper and lower stationary retaining elements at the forward end of the stack, means for withdrawing successive foremost sheets from the stack, means engageable at a forwardly and downwardly inclined angle with the top of the forward end of the stack for fanning a group of the foremost sheets to slidably separate the same and to simultaneously bow the foremost sheets forwardly to present the endmost sheet into operative relation to said

withdrawing means whereby to assure withdrawal of but one sheet at a time by the withdrawing means, and means for advancing the stack toward said retaining means to compensate for the sheets withdrawn from the stack.

10. Sheet feeding apparatus as defined in claim 9 wherein the advancing means comprises means movable in frictional engagement with the lower edges of the sheets in the stack whereby to limit the advancing pressure during the forward movement of the stack against said retaining means so as to maintain the sheets in a relatively loose and non-compressed condition to facilitate removal of the foremost sheets from the stack.

11. Sheet feeding means as defined in claim 9 wherein the stack advancing means is operative in response to detecting means including a finger engageable with the front of the stack, said detecting finger being movable rearwardly upon withdrawal of a number of successive sheets to effect operation of said advancing means.

12. In sheet feeding apparatus, in combination, means for supporting a stack of flexible semirigid sheets on edge including upper and lower stationary retaining elements at the forward end of the stack, means for withdrawing successive foremost sheets from the stack, and means engageable at a forwardly and downwardly inclined angle with the top of the forward end of the stack for fanning a group of the foremost sheets to slidingly separate the same and to simultaneously bow the foremost sheets forwardly to present the endmost sheet into operative relation to said withdrawing means whereby to assure withdrawal of but one sheet at a time by the withdrawing means, means for receiving and advancing said withdrawn sheets comprising upper and lower feed rolls, the upper roll having a cutout in the circumference thereof providing a curved finger arranged to engage and guide the upper end of a withdrawn sheet between said rolls, said withdrawing means comprising suction elements connected to a source of vacuum and movable through a relatively short distance to present the withdrawn sheet into the path of the opening in said upper roll.

13. Sheet feeding apparatus as defined in claim 12 wherein the vacuum to said suction elements is discontinued to free the sheet prior to engagement of the withdrawn sheet by said rolls, and means for maintaining the sheet in operative position to be engaged by said upper roll after discontinuance of said vacuum.

14. Sheet feeding apparatus as defined in claim 13 wherein the sheet engaged by said rolls is subjected to a reverse curving action during its advance by engagement with guide rolls and the front of the stack whereby to

flatten any sheets which may initially be curved in the opposite direction.

15. In carton blank feeding apparatus, in combination, a magazine for supporting a stack of carton blanks on edge and in a forwardly tilted position, upper and lower retaining elements at the front of the stack, blank withdrawing means including rockingly mounted suction elements normally spaced from the front of the stack, means engageable at a forwardly and downwardly inclined angle with the top of the forward end of the stack for fanning a group of the foremost blanks to slidingly separate the same and to simultaneously bow the group forwardly to present the endmost blank into operative engagement with said suction elements, and means for bodily advancing the stack to compensate for withdrawn blanks.

16. In carton blank feeding apparatus, in combination, means for supporting a stack of carton blanks on edge and in a forwardly tilted position including retaining means at the forward end of the stack, means for withdrawing successive foremost blanks from the stack, and means for bodily advancing the stack to compensate for withdrawn blanks, said advancing means including means in frictional engagement with the lower edges of the blanks to limit the advancing pressure against said retaining elements during the forward movement of the stack whereby to maintain the blanks in a loose and non-compressed condition, said stack advancing means including a pair of spaced endless chains, the lower edges of the blanks resting on the upper runs of said chains, pawl and ratchet means for effecting incremental advance of said chains, latch means for preventing operation of said advancing means, and control means including a detecting finger engageable with the front of the stack and movable rearwardly upon withdrawal of successive blanks to release said latch means and permit operation of said advancing means after a number of blanks have been withdrawn.

References Cited

UNITED STATES PATENTS

2,530,670	11/1950	Von Hofe	271—31
2,639,916	5/1953	Anness	271—10
2,764,408	9/1956	Weiler	271—12

FOREIGN PATENTS

714,009	8/1954	Great Britain.
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U.S. Cl. X.R.

271—27