Jan. 10, 1967 J. E. KNECHT 3,297,318

MEANS AND METHOD FOR STACKING SHEETS OF PAPERBOARD OR CARDBOARD

Filed March 26, 1964 4 Sheets-Sheet 1

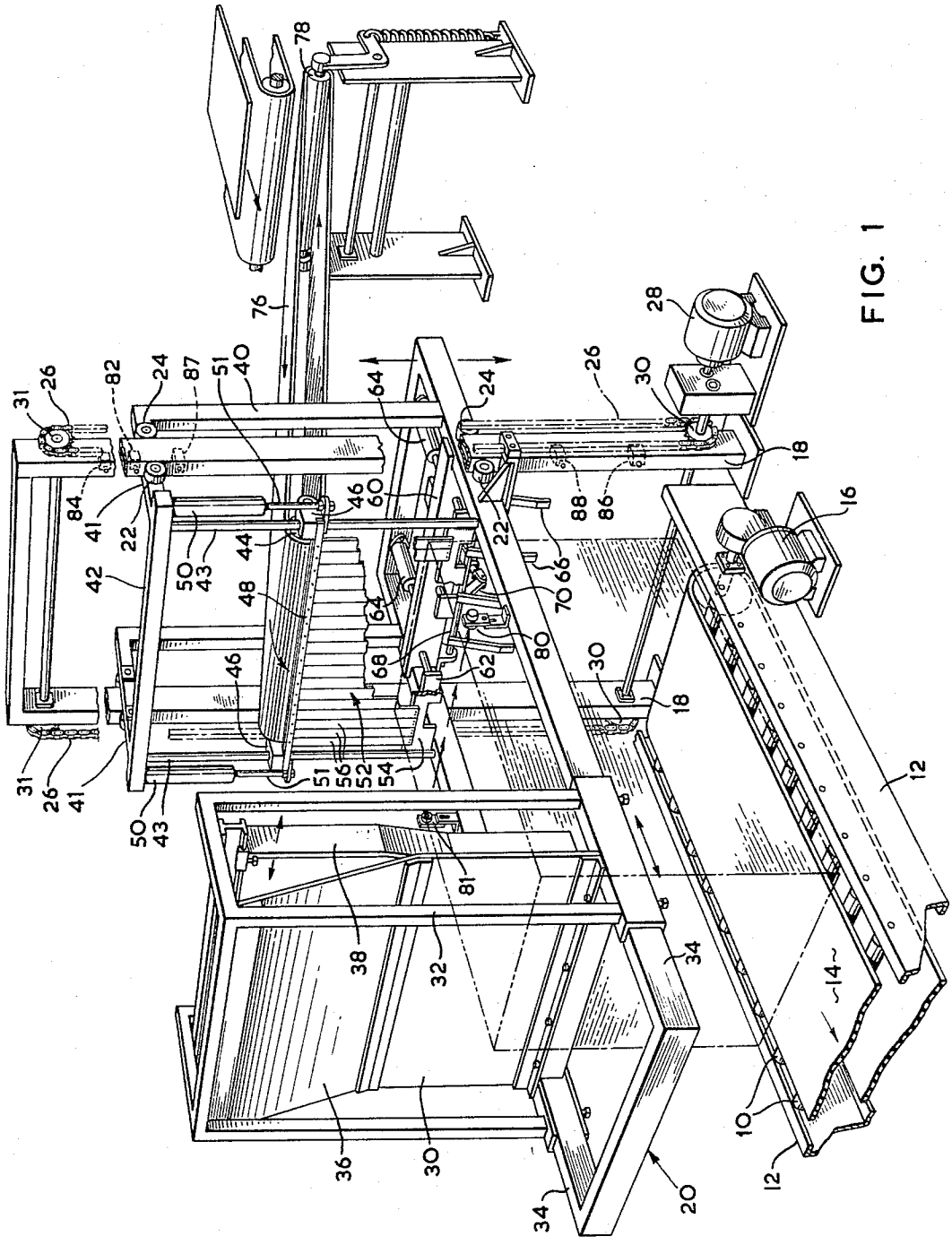


FIG. 1

INVENTOR
JOHN E. KNECHT

BY~ Fetherstonhaugh & Co.
ATTORNEYS

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MEANS AND METHOD FOR STACKING SHEETS OF PAPERBOARD OR CARDBOARD

Filed March 26, 1964 4 Sheets-Sheet 2

FIG. 2

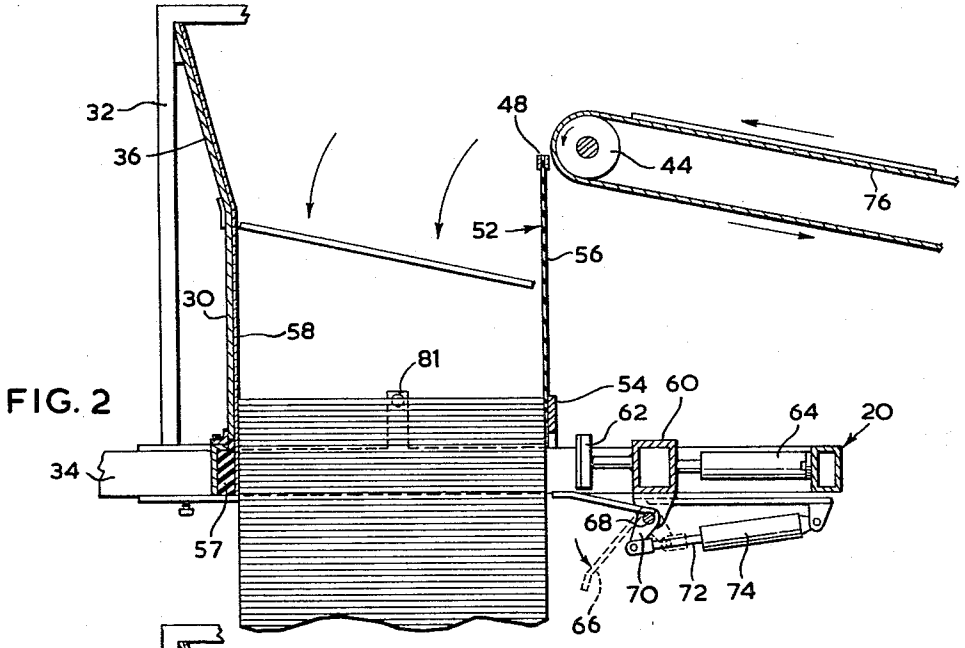
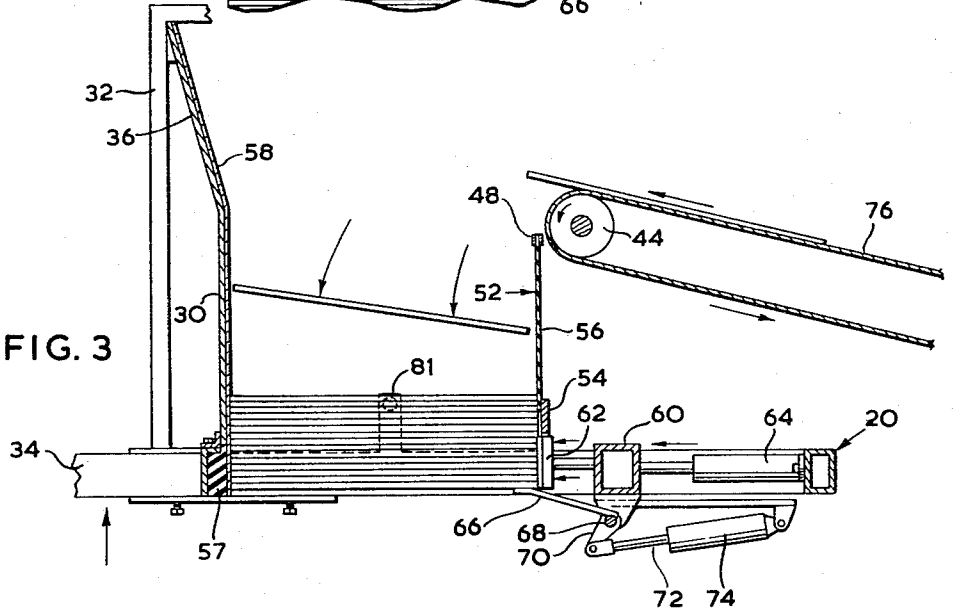
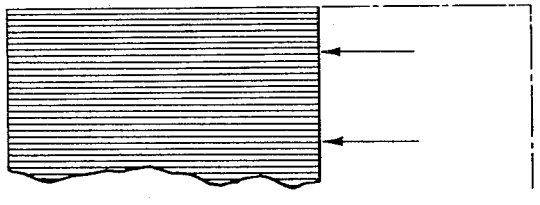


FIG. 3





INVENTOR
JOHN E. KNECHT

BY~ Fetherstonhaugh & Co.
ATTORNEYS

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MEANS AND METHOD FOR STACKING SHEETS
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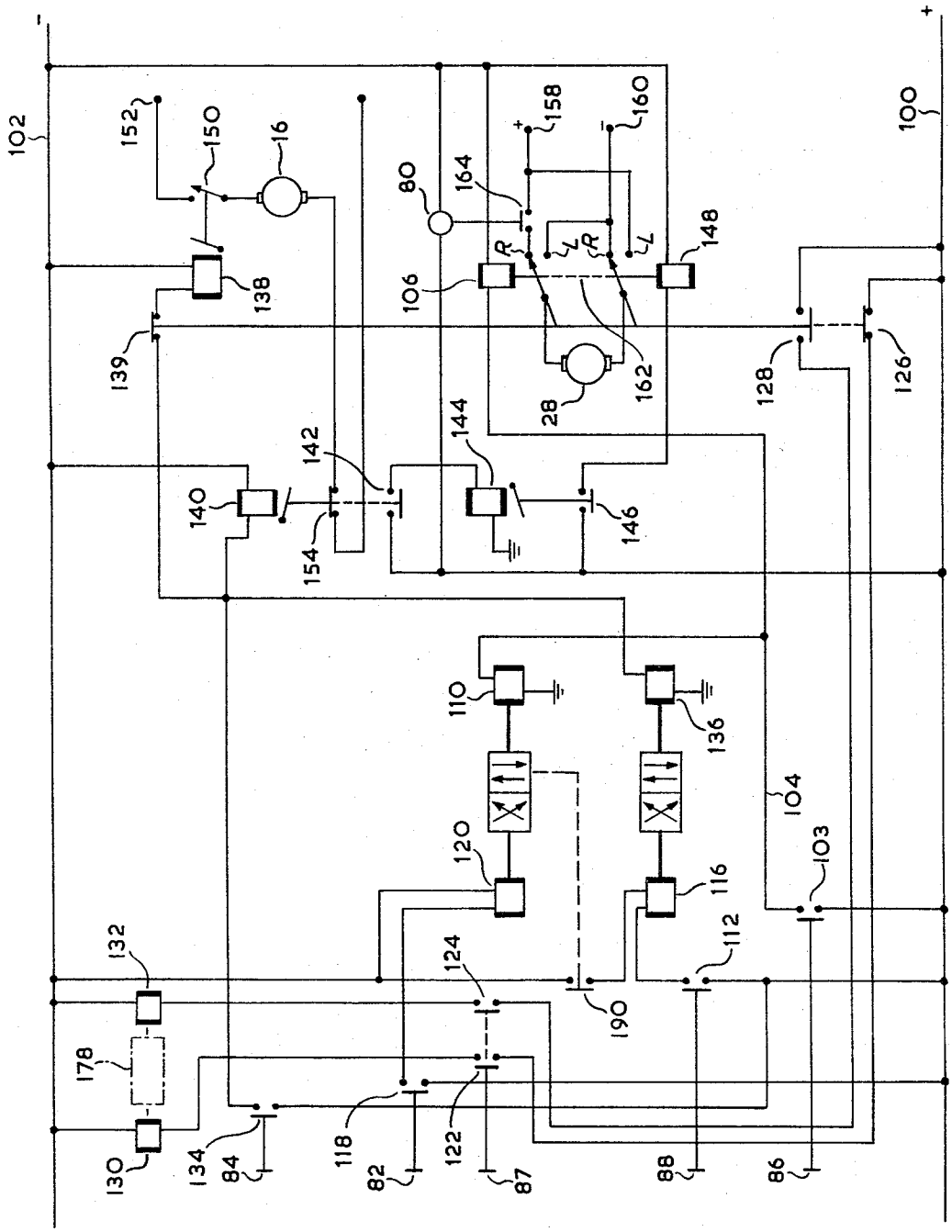


FIG. 4

INVENTOR
JOHN E. KNECHT
BY Fetherstonhaugh & Co.
ATTORNEYS

Jan. 10, 1967 J. E. KNECHT 3,297,318

MEANS AND METHOD FOR STACKING SHEETS OF PAPERBOARD OR CARDBOARD

Filed March 26, 1964 4 Sheets-Sheet 4

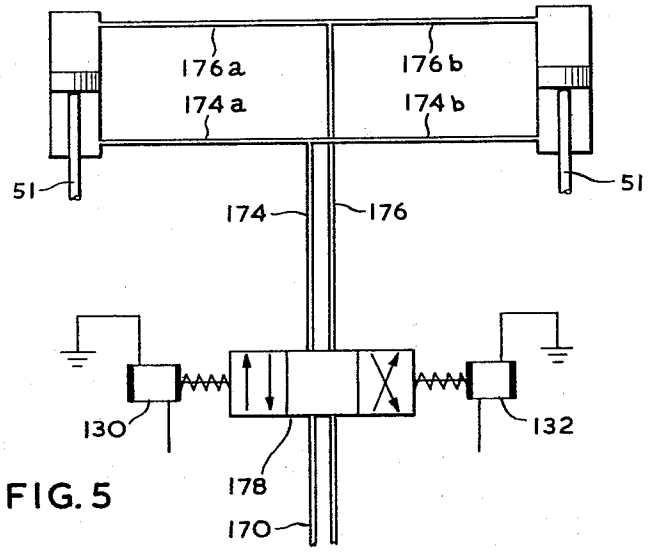


FIG. 5

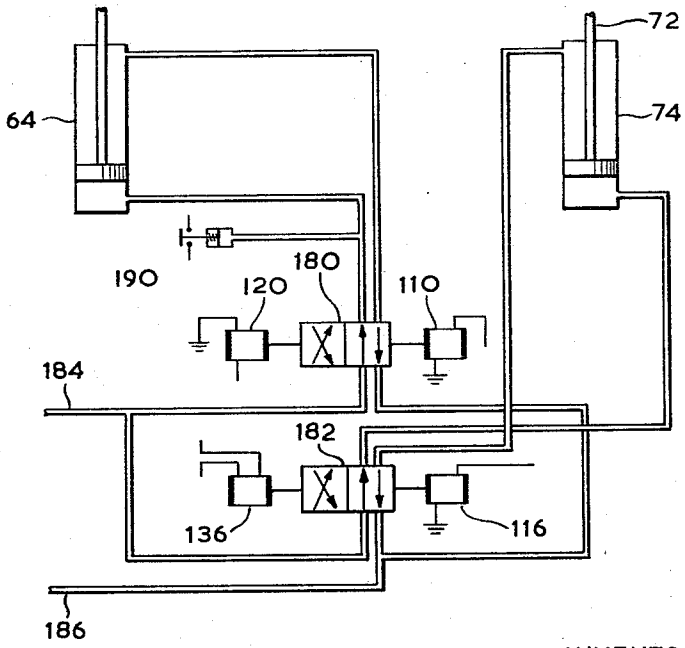


FIG. 6

INVENTOR
JOHN E. KNECHT
BY~ Fetherstonhaugh & Co.
ATTORNEYS

United States Patent Office

3,297,318
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3,297,318

MEANS AND METHOD FOR STACKING SHEETS OF PAPERBOARD OR CARDBOARD

John E. Knecht, Pointe Claire, Quebec, Canada, assignor to Bathurst Paper Limited

Filed Mar. 26, 1964, Ser. No. 354,959
13 Claims. (Cl. 271—68)

This invention relates to means and a method for stacking sheets of paperboard or cardboard, and processing such sheets after they are stacked.

Where "sheets" are referred to herein, it is assumed that such sheets are flat, usually although not necessarily, rectangular and made of cardboard or paperboard.

This invention deals with the stacking of sheets being continually supplied to the stacking location. Machines are well known which will stack sheets travelling on a conveyor and delivered to the stacking location. However, machines of this type presently in use are not adapted to allow the removal of a pile of stacked sheets without interruption of the stacking operation. Machines have been proposed which interposed a part of the machine which formed a shelf between sheets in a stack, at a predetermined height, whereby to support the stack thereabove, while stacked sheets below said shelf are removed. However, such latter machines have shown a tendency to jam sheets during the interposition procedure or conversely the sheets have jammed the interposition mechanism.

It is therefore an object of this invention to provide means and a method for clamping a sheet or sheets located a predetermined distance above the base of a continually rising stack by pressure applied on opposed sheet edges. The sheet or sheets so clamped therefore act as a shelf for the sheets being added at the top of the stack, while the stacks of sheets below those clamped may be removed. Means are provided allowing return of the clamped sheets to the height of the original stack base, to form the base of a new stack, whereby the procedure may be cyclically repeated and the above operations are performed without interruption of the addition of the sheets to the top of the stack.

In the drawings:

FIGURE 1 shows a perspective view of the device, and

FIGURES 2, 3, 4, 5 and 6 indicate operation of the device.

In the drawings, the sheet stacking operation is performed on a stacking surface wherefrom the stacks of sheets may be removed during the operation of the device. In the preferred embodiment, this surface takes the form of parallel rollers **10** mounted on opposed members **12** to form, collectively, a base for a rising stack of sheets and a path for removal of a stack of sheets. The upper flight of a belt **14** overlies the rollers and forms a frictional base for sheets stacked thereon and, driven by motor **16**, provides the means to move a stack along the conveyor when required. The motor **16** is normally off and is turned on and off by means to be discussed hereafter.

The direction of movement of the upper flight of belt **14** defines an "up-conveyor" and "down-conveyor" direction, and at the up-conveyor end a pair of standards **18** extends upwardly from the base on opposite sides of the conveyor. A frame **20**, of generally rectangular shape in plan view, is mounted to be vertically movable on the standards. This may be done in any desired manner, but in the preferred embodiment there are provided rollers **22** adapted to roll on the down-conveyor side of the standards and rollers **24** adapted to roll on the up-conveyor side. Such construction effectively rollably connects the frame **20** to the standard.

The height of the frame **20** relative to the rollers **10** is controlled in any desired manner, such as by a pair of chains **26** connected between sprockets **30** and the shaft of motor **28** at the bottom of the standards **18** and sprockets **31** rotatably mounted adjacent the top of standards **18**. The operation of the motor **28** is controlled as hereinafter described.

The frame **20** provides a guide for a stack of sheets continually rising, by the successive addition of sheets to the top, with each sheet lying on and parallel to the one below. Such guide comprises, in the preferred form, a backstop **30** of generally vertical orientation and facing the up-conveyor direction. The backstop **30** is mounted on a subframe **32**, which is constructed to be slidable and therefore adjustable in the conveyor direction on the side members **34** of frame **20**.

The backstop **30** extends vertically for the lower portion of its height, and the upper portion **36** is sloped upwardly and in the down-conveyor direction. Side walls **38** extend a short distance in the up-conveyor direction from adjacent each end of the backstop **30** and are spaced to provide side guides for the corresponding edges of the sheet when such sheets are stacked adjacent thereto with one edge aligned with and adjacent to backstop **30**. To assist in the guiding function, the side walls **38** are shaped to slope outwardly and upwardly adjacent the sloped portion **36** of the backstop **30** and to extend thence upwardly to ensure that sheets may be received between the side walls **38** and guided into the desired alignment by the sloping walls **36** and the vertical portion of backstop **30**. The side walls **38** are mounted on the subframe **32** to be adjustably slidable, transversely, relative to the conveyor, to allow adjustment of the side walls to the desired sheet width.

Standards **40** extend upwardly from the frame **20**, adjacent the main standards **18** but on the up-conveyor side thereof, with projections **41** extending in the down-conveyor direction between standards **18**, and a cross-member **42** is attached to projection **41** at the outer extremity thereof and projecting on each side of the standards **41**. A roller **44**, carrying one end of a conveyor belt for sheets, extends between the standards **40** and is rotatably mounted on blocks **46**, which are slidably mounted on rods **43** which extend vertically between projections **41** and frame side members **34**, and the opposed blocks are jointed and rigidly connected by a crossbar **48**.

Cylinders **50** are mounted on the projections of cross-member **42**, and the corresponding piston rods **51** are connected to crossbar **48**.

Such cylinders **50** form the height control for the roller **44**, relative to the cross-member **42**. The cylinder rods **51** controlled through hydraulic lines as shown will be described hereinafter.

Extendable members **56**, defining a vertical guide surface **52** facing backstop **30**, connect the crossbar **48** to a cross-member **54** mounted on the frame **20** adjacent the base of the rods **43**. In the preferred embodiment these extendable members **56** comprise relatively wide resilient rubber strips with their flat sides facing the backstop, which strips stretch or contract to extend across the space between crossbar **48** and cross-member **54**.

The bottom portion of the side of backstop **30** facing cross-member **54** is made of sponge rubber **57**, and the entire surface of the backstop, including such sponge rubber, is covered with frictional material such as cotton belting **58**.

Opposite the sponge rubber **57** rectangular areas of the cross-member **54** are cut away to allow the movement therethrough of clamping members to described.

A crossbar **60** is mounted on the frame **20** on the side of main standards **18** remote from backstop **30** to

slide reciprocally in the travel position between a retracted and an extended position. Mounted on cross-piece **60**, slidable in the conveyor direction relative to frame **20** and oriented to face the backstop **30**, are a number of clamping plates **62** shaped to pass through the cut-away portions of cross-member **54**, and mounted to move from a position on the side of cross-member **54** remote from the backstop **30**, in the retracted position of the crossbar **60**, and a position just slightly projecting from the cross-member **54** toward the backstop **30** in the extended position.

Pistons and piston cylinders **64** pneumatically actuable, in a manner to be described, mounted on the frame **20**, are connected by their rods to move the clamping plates **62** and crossbar **60** between extended and retracted positions. Pneumatic lines to be described, are provided to control the movements of the pistons **64** and such lines are connected to a source and exhaust through a reversing valve controlled by a limit switch to be described.

Fingers **66** are pivotally mounted by means of shaft **68** on crossbar **60**, which fingers are connected to move from a retracted position clear of a stack guided by backstop **30** and surfaces **56** to an extended position adapted to bear upwards on and support sheets held by the clamping plate **62**.

Fingers **66** are all keyed to or otherwise rotatable with a common shaft **68** for common rotary movement, and an arm **70** projects radially from the common shaft **68** and is connected to be rotated by a piston rod **72** slidable and movable by piston cylinder **74** which are swingably mounted on the crossbar **60**.

Pneumatic supply and return lines, interchangeable by a reverse valve, are connected to the cylinders **74** and are connected to actuate the cylinders **74** and piston rod **72** to operate the fingers either to a retracted or to an extended position, in a manner to be described.

Belt **76** is connected at one end to roller **44** and at the other end to a roller **78**. The roller **78** is resiliently mounted on a base in any desired manner, such as the one shown, to be biased away from frame **20** but movable theretowards, against the bias, to conform with movements of roller **44**.

A photocell **80** is mounted on frame **20** and located a predetermined but adjustable height above the side members **34** of frame **20**, and a light source **81**, similarly mounted, is placed across the frame from the cell to define a light path therebetween. The location of source **81** and cell **80** is such that a stack of sheets will interrupt the photocell light path. The photocell **80** is connected to the control for motor **28** in such a way (to be described) that during the period of intermittent raising of frame **20** when the path from light source to photocell is interrupted, the motor **28** is switched on, and when the path is clear, the motor is switched off. Thus, when moving under control of the photocell, the motor keeps the frame in position relative to the top of the stack.

Limit switch **82** is located on main standards **18** toward but below the top thereof, to be operated to actuate supply to cylinders **64** to cause the clamping plates **62** to be moved from retracted to extended position to bear on one edge of the sheets and to press the edge against the cotton belting **58** overlying sponge rubber backing.

Limit switch **87** is located below limit switch **82**, at the desired height to decrease the relative height of rollers **44** to the top of the stack, during the upward travel of the frame **20** and to increase such relative height during the downward travel of frame **20**.

Limit switch **84** is located above limit switch **82** and is connected to actuate cylinder **74** to rotate fingers **66** up under the lowermost clamped sheet for support thereof and also actuates the motor driving belt **14** to move conveyor and sheets stacked thereon clear of the conveyor. Limit switch **84** also acts, after a sufficient time delay to allow the portion of the stack resting on rollers **10** to be moved out from under the clamped stack, to reverse motor **28** to lower the frame **20** and clamped sheets.

As the frame **20** approaches its lowermost position, it strikes limit switch **86**, designed to cause clamping plates **62** to move to the retracted position with fingers **66** still extending horizontally, allowing the stack of sheets to fall to and rest again on the conveyor belt **14**. Limit switch **86** also acts to reverse motor **28** to again cause the motor to move upwardly.

Limit switch **88** acts soon after the commencement of the upward travel to allow cylinder **74** to rotate fingers **66** to the retracted position soon after the frame is sufficiently high above belt **14** to allow such rotation without clashing with the rollers **10**.

The method by which the limit switches **82–87–84–86–88** control the operation will now be described. Many types of limit switches could be provided, all within the scope of the invention. Similarly the methods of utilizing such limit switches to control the elements shown are well known and the functions of the controls operated by the limit switches are described, but it is understood that any one of a number of such controls might be employed.

Limit switch **82** is located to correspond to the desired unit stack height and is near the upper limit of frame travel. Switch **82** operates controls during the upper travel of frame **20** to supply fluid to energize cylinder **74** to move clamping plates **62** forward.

Limit switch **84** is located to set the upper limit of frame **20** and is located sufficiently high above limit switch **82** to allow the fingers **66** to move from retracted to extended position clear of the upper sheet of the unit stack. Actuation of limit switch **84** by the upward travel of frame **20** (*a*) energizes cylinder **74** to rotate fingers **66** up under the lowermost clamped sheet; (*b*) energizes motor **16** to move belt **14** and thereby to move the unit stack from beneath the frame, and (*c*) with a suitable time delay reverses the motor **28** to lower the frame.

Limit switch **87** controls the differential height between the top of the stack and the roller **44** as already described.

Limit switch **86** is located to correspond to the lower limit of frame movement where the clamped sheets are low enough to be set on the rollers **10**. Actuation of limit switch **86** by the downward movement of frame **20** retracts the clamping plates **62** and fingers **66**, the latter still in extended position, and reverses the operation of motor **28** to cause the sequential upward motion of frame **20**. The retraction of clamping plates **62** releases the formerly clamped sheets on to rollers **10** to form the base of a further stack.

Limit switch **88** is located above the limit switch **86** connected to cause the fingers **66** to rotate from extended to retracted position without contacting rollers **10**. Actuation of limit switch **88** by the upward movement of frame **20** causes the energization of cylinder **74** to move the fingers from extended to retracted position.

The reason for having greater height between the roller **44** and the top of the stack, at lower stack heights is to ensure that the sheets strike backstop **30** before brushing the top of the stack, and therefore settle vertically onto the stack top. This is done because in many applications of the invention (such as when it is employed in stacking the output of a printer-slotter), ink, not as yet dry, is on the sheets. Such ink will not be smeared when the sheets drop vertically onto the stack, but might well be smeared if brushed horizontally by a sheet. By height control and control of belt **76** smearing may be avoided. However as the stack approaches its full height, the angle of inclination of the sheets, as determined by the angle of belt **76**, is such that the sheets tend to carry across to the backstop without the lead edge of the sheet dropping down to smear the printing at the top of the stack, and under these conditions the difference in height between roller **44** and the top of the stack can be decreased. Hence the hydraulic control or cylinder **50** to move rods **51** downwardly is used.

This lowering, where possible, is desirable since it permits a given stack height to be built up with a lower

maximum height of roller **44**. Another feature of the height control is that the maximum height of roller **44** above the top of the stack must not be so great as to allow the sheets to "tumble" before reaching the stack.

During the downward travel of the stack and the frame **20**, the cylinders **50** are hydraulically actuated in the opposite direction so that the roller **44** is again raised to its greater height relative to the top of the stack.

The control circuitry will now be described as shown in FIGURES 4, 5 and 6.

Limit switch **86** is arranged, when actuated, to close a normally open line **104** from the positive supply **100** through relay **106** to ground **102**. Line **104** on the negative side of switch **103** is also connected through the solenoid of a relay **110** to ground.

Limit switch **88** is arranged, when actuated, to close normally open switch **112** which connects the positive line through the solenoid of relay **116** and through switch **190** to ground.

Limit switch **82** is arranged, when actuated, to close the normally open switch **118** to connect the solenoid **120** between the positive line and ground.

Limit switch **87** is arranged, when actuated, to close normally open switches **122** and **124**. Positive line **100** is connected through a normally open switch **126**, switch **122** and relay **130** to ground. The positive line **100** is also connected through a switch **128** through normally open switch **124** and relay **132**, in series, to ground. Switches **126** and **128** are ganged and arranged so that when one switch is open the other is closed, for a purpose to be hereinafter described.

Limit switch **84**, when actuated, closes normally open switch **134** which connects the positive line:

(a) Through relay **136** to ground.

(b) Through switch **139** and relay **138** to ground, and

(c) Through relay **140** to ground.

Relay **140**, when energized, closes normally open switch **142** which connects the positive line through relay **144** to ground. Relay **144** when energized closes normally open switch **146** which connects the positive line through a relay **148** to the negative line. Relay **138**, when energized, closes a normally open switch **150** which connects one terminal of a power supply **152** through motor **16** and normally closed switch **154** to the other terminal of the motor power supply **156**. Relay **140** when energized opens normally closed switch **154**.

The control of motor 28

Power for motor **28** is carried through terminals **158** and **160** for connection to the positive and negative power sources for the motor **28**, and motor **28** will usually be a D.C. motor for directional control hence terminal **158** will be positive and **160** will be negative. A switch **162** is operable between two sets of terminals, the upper set marked R, which connect one terminal of motor **28** to **158** and the other terminal to terminal **160** and to the other terminals L which reverse the connections for the motor whereby its rotation will be reversed. The motor connection from positive terminal **158** which is unique to the corresponding terminal R is broken by a normally closed switch operated by the photo cell **80**. The position of switch **162** may be caused to move to the "raise" position by the relay **106**, and to move towards the "lower" position by relay **148**.

In operation, therefore, as the downwardly moving frame **20** closes limit switch **86**, switch **103** is closed energizing relay **106** to move the switch **162** to the raise position. Assuming that photo cell **80** is now energized because there are no cards between the source **81** and the cell **80**, switch **164** will remain open leaving the motor off until the cards rise to include the photo cell light path. When the cards cut off the light path, the switch **164** will close and the motor **28** will raise the frame **20** until photo cell **80** is again energized and this intermittent operation will continue until the frame reaches its upper position. However, it will be noted that switch **162** controls the position of ganged switches **126** and **128** and that when switch **162** moves to the raise position switch **128** is opened and switch **126** is closed. The closing of switch **126** completes the circuit from the normally open switch **122** to the positive line. Thus when the rising carriage reaches switch **87**, switch **122** is closed, energizing relay **130** to be discussed hereafter. Switch **124** is also closed by the actuation of limit switch **87** but relay **132** is not energized since switch **128** will then be open. As frame **20** continues to rise, when limit switch **84** is closed relay **140** is energized, closing (after the design time delay) switch **142**, energizing relay **144**, closing switch **146** and energizing relay **148** which moves the switch **162** from the raise to the lower position. This will cause the motor **28** to reverse and lower the frame **20** and this lowering is now independent of the operation of the photo cell. At the same time it will be noted that switch **128** is now closed and switch **126** open so that the descending frame passing limit switch **87** will close the circuit to relay **132** but will not close the circuit to relay **130**. The downward motion of the frame **20** will continue until limit switch **86** is again closed which will again reverse the position of switch **162** and cause the motor **28** to raise the carriage subject to the position of switch **164** determined by photo cell **80**. Switch **162** is connected to operate switch **139** whereby when switch **162** is in the raise position switch **139** is closed and when switch **162** is in the lower position switch **139** is open.

Braking means, not shown, will be provided associated with the motor, for preventing the falling of the frame **20** during times or in the event that motor **28** is not energized.

Differential control

As seen in FIGURE 5, relays **130** and **132** control the position of a reversing valve **178**, which may connect a hydraulic source **170** either to a line **174** or a line **176**, depending on which relay is energized, and the arrangement of valve **178** is such that when neither solenoid is energized, the valve assumes a neutral position shutting off both lines **174** and **176** from the source and pump. It will also be seen that whichever line is connected to the source, the other line will be connected to the sump. Line **174** is divided to form two lines **174***a* and **174***b* connected (when line **174** is a source line) to raise the two piston rods **51** (see FIGURE 1), while line **176** divides into two lines **176***a* and **176***b* active when line **176** is the source to lower the two piston rods **51**. The valve **178** may be adjusted so that, when actuated by a relay, it will remain in position long enough to effect the desired raising or lowering motion or alternatively the limit switch **87** may be so designed and the length of piston stroke under upward or downward operation may be made adjustable to control the differential raising and lowering and allow adjustment of the amount thereof.

The effect of the apparatus is that when the rising carriage depresses switch **87**, switch **126** is closed, energizing relay **130** to connect source **170** to lines **176** to lower the pistons and reduce the spacing between the roller **44** and the top of stack. Relay **132** is not then energized because switch **128** is open. On the other hand, when the carriage is passing downwardly and operates limit switch **87**, switch **128** is closed and switch **126** is open, whereby limit switch **87**, by closing switch **124**, energizes solenoid **132** and by the operation of valve **178** raises the pistons and again increases the spacing between the roller **44** and the top of the stack.

Operation of clamping plates 62 and fingers 66

Relays **110** and **120** are connected to operate control valve **180** located between a pneumatic supply and the cylinder **64** which controls the position of the clamping plate **62**. As the frame **20** is rising, limit switch **82** is closed to energize relay **120** which moves a reversible valve **180** to a position to connect a pneumatic supply line

184 connected to a source (not shown) to the rear of cylinder 64, while the front of cylinder 64 is connected by the same valve to exhaust line 186, actuating the piston in cylinder 64, to move the clamping plates 62 forward. Due to the design of switch 180, operated by the relays 120 and 110, the switch remains in this position until the energization is reversed by the other relay 110. Relay 110 is energized during the downward motion of the frame 20 as it passes limit switch 86 and relay 110 thereby reverses the position of switch 180 and by the connection of source line 184 to the forward portion of cylinder 64 acts to retract the rod operated by cylinder 64 and hence the clamping plates 62. Valve 180 is connected to operate a switch 190, so that, when valve 180 is in position to move clamping plates 62 to clamping position, switch 190 is open, and when valve 180 is in position to move plates 62 to retracted position, switch 190 is closed.

Operation of fingers 66

The fingers 66 are operated in a similar manner due to a valve 182 which may connect to either line of the cylinder 74, a source line 184 or return line 186. The rising carriage actuates limit switch 88, energizing relay 116 (switch 190 then being closed) to move piston rod 72 in a direction away from the stack, retracting the fingers 66. As in valve 180, the valve 182 remains in this position until switch 84 is closed, energizing relay 136 to reverse the position of valve 182 and thereby to move piston rod 72 toward the stack to rotate fingers 66 forwardly.

Operation

The general operation of the device is therefore as follows: Initially frame 20 will be assumed at its lowermost position with clamps 62 retracted and fingers 66 in extended position, although they are clear of the extended or existing stack location. The motor 28 for raising frame 20 is stationary as there should, at this time, be an uninterrupted light path between source 81 and photocell 80 maintaining switch 164 open. Sheets are supplied to belt 76 from a source of such sheets to be stacked, such as a printer-slotter. It will be noted that, assuming a constant supply to belt 76 if belt 76 is operating rapidly, the sheets will be spaced one from another on the belt, but if the belt is run slowly, the sheets will appear on belt 76 in shingle formation. Either way the sheets are fed off the end of belt 76 and move over to the back stop 30, then falling into a stack on rollers 10 under the guidance of back stop 30 and surfaces 56.

When the height of the sheets rises to interrupt the light path to cell 80, allowing switch 164 to close, switch 162 is then in the raised position, energizing motor 28 to raise the frame 20. As the motor 28 is adjusted to operate at a predetermined rate faster than the rate of rise of the stack, the motor 28 is then intermittently turned on and off by the control of cell 80 to maintain the frame 20 rising at a rate averaging out to the rate of rise of the stack. When frame 20 reaches limit switch 88, switch 112 is closed thereby, and relay 116 is energized (switch 190 being then closed) to move piston rod 72 to the right and move the fingers 66 to the retracted position. The frame 20 continues to rise at a rate determined by the raising motor 28 until switch 87 is closed by frame 20, which energizes relay 130 but not relay 132 to connect the source of hydraulic pressure to line 176 to lower rods 51 to reduce the spacing between the roller 44 and the top of the stack.

When the still rising stack reaches the desired height for a unit stack of sheets, limit switch 82 is operated by frame 20 to energize relay 120 which moves switch 180 to connect the pneumatic source line 184 to the end of cylinder 64 to advance plates 62 forward to clamp the sheets opposite the plates 62 between them and the back stop 30, whereby such sheets operate to act as a shelf for the still falling sheets still being delivered by belt 76. At the same time the movement of switch 180 opens switch

190. The frame 20 continues to rise until sufficient clearance exists between frame 20 and the top of the unit stack to allow easy removal of the latter and to allow operation of the fingers 66 to extended position. The frame 20 next operates limit switch 84 which closes switch 134 which actuates relay 138, closing normally open switch 150 and energizing motor 16 to move belt 14 carrying out the unit stack from the stacking location. Limit switch 84 is designed, or the apparatus may be otherwise designed, to maintain switch 150 closed in sufficient time to remove the unit stack on rollers 10. At the same time the closure of switch 134 actuates relay 136, which acts to connect pneumatic source line 184 to the rear of cylinder 74 to advance rod 72 toward the stack and to rotate the fingers 66 to the extended position. Thus any sheets imperfectly or partially clamped by clamping plates 62 are straightened and held firmly in position by fingers 66.

At the same time the closure of switch 134 has operated time delay relay 140, which after a suitable time to allow the fingers 66 to operate and the unit stack to be removed, closes switch 142 and energizes relay 144 to operate switch 146 which energizes relay 148 which operates switch 162 to reverse the operation of motor 28 and to cause it to lower frame 20. (It will be noted that the basic requirement for operation of motor 28 is that time delay relay 140 allow sufficient time for removal of the unit stack before switching motor 28 to move frame 20 downwardly. In the preferred embodiment it will be noted that the switching for motor 28 is such that the frame travels upwardly during this interval. It will be realized, with the proper changes in circuitry, that the circuit may provide that the motor halts after the operation of limit switch 84, for the duration of the time delay interval, before causing frame 20 to travel downward.)

At the same time relay 140 is connected to open normally closed switch 154, halting the operation of motor 16, the time allowed by the delay relay being sufficient to allow removal of the stack. As the downwardly moving frame 20 passes limit switch 84 it will be noted that no further effect will take place as the fingers are already advanced, the motor is already reversed and the motor 16 will not operate a second time since interlock means are provided in the form of switch 139, operable by motor switch 162 when in the lower position to open the circuit to relay 138.

As the frame passes limit switch 82 no effect is created on the clamping plates which are already advanced. As the frame continues downwardly, it actuates limit switch 87 and switches 122 and 124 are again closed. However, only solenoid 132 is energized, which has the effect of reversing the position of switch 178 to connect the source to lines 174 and to again raise the rods 51 to increase the distance between the roller 44 and the top of the stack. As the frame passes limit switch 88 no effect is caused upon the fingers 66 since, although switch 112 is closed, there is provided a switch 190 which is ganged to the position of valve 180 to be open when the clamps 62 are advanced, and thus fingers 66 may only be retracted when the clamps are retracted and therefore only during the upper travel of the frame 20. The frame continues downwardly to lower the frame 20 with the clamped sheets to a position just above the rollers 10. In this position frame 20 operates limit switch 86, energizing relay 106 to reverse the motor and energizing relay 110 to retract the clamping plates (closing switch 190) and allowing the formerly clamped sheets to rest on the rollers 10 now allowing the frame 20 to rise under the control of photocell 80 in the manner already described.

As already described, when the frame 20 has risen sufficiently above the rollers 10 for fingers 66 to be retracted, this is accomplished by limit switch 88 since switch 190 is now closed by the position of valve 180 to the right in the drawings. It will be noted that, in

accordance with the above described operation, a stack of sheets has been formed, removed and a new stack started without the necessity of halting the delivery of sheets by belt **76** from the supply.

The cycle as now described is repeated.

What I claim as my invention is:

1. Means for the continuous stacking of sheets comprising: a frame having mounted thereon, first guide extents extending generally vertically; second guide extents spaced from said first guide extents, arranged and oriented to guide sheets into position with one edge extending along said first guide extent and the other edge extending along said second guide extent, whereby sheets may be stacked one on the other with the edges in such relationship; clamping surfaces mounted on said frame to move from a retracted position clear of such stack to an extended position to clamp sheets in said stack between such clamps and said first guide extents; base for supporting sheets stacked between said first and second extents, and means for gradually raising said frame relative to said base.

2. Means for the continuous stacking of sheets comprising: a surface; a generally vertical guide extent extending upwardly relative to said surface, designed and constructed to form a guide for one edge of sheets stacked on said surface; means for supplying such sheets, and progressively arranging them in a stack on said surface, with one edge of each sheet adjacent said guide extent; means for progressively raising said guide extent as said stack grows in height; clamping means vertically movable with the guide extent movable from a retracted position free of the edges of sheets opposed to those adjacent said guide extent, to an extended position whereat pressure is exerted by said clamping means on certain of said opposed edges to clamp them against said guide extent.

3. Means as claimed in claim **2**, including means, actuable when said stack has reached a predetermined height relative to said surface, to actuate said clamping means.

4. Means as claimed in claim **3**, including means actuable when said stack has reached a greater predetermined height, to cause removal of the stack supported by said surface and to lower the stack supported by said edge and clamping means toward said surface.

5. Means as claimed in claim **4**, including means actuable on the lowering of said stack to a predetermined height to move said clamping means to the retracted position.

6. Means as claimed in claim **1**, including means actuable after operation of said clamping means from retracted to extended position, to move a supporting surface into position, bearing upwardly on the lowermost clamped sheet.

7. Means as claimed in claim **2**, including means actuable after operation of said clamping means from retracted to extended position, to move a supporting surface into position, bearing upwardly on the lowermost clamped sheet.

8. Means for stacking similar sheets aligned with one another on a base surface, with one edge of such sheets adjacent a side surface which is arranged and oriented to extend roughly transversely to said sheets when so stacked; clamping means, designed and constructed to move between a retracted position clear of said stack and an extended position, and in said extended position to exert pressure on edges of stacked sheets opposed to edges of the same sheets adjacent said side surface, whereby such same sheets are clamped between said side surface and said clamping means, said clamping means being normally retracted, means actuable when such stack has reached a predetermined height above said surface for moving said clamping means from retracted to extended position.

9. Means as claimed in claim **8**, wherein means are provided for raising said side surface and clamping means together during a period where the whole of said stack bears on said surface; means are provided for lowering said side surfaces and clamping means together a predetermined time after said clamping means have moved to the extended position, and means are provided for moving said clamping means to the retracted position when said clamping means and support together have reached a predetermined location adjacent said base surface.

10. A method of stacking sheets, comprising the steps of: continually stacking said sheets in aligned relationship and with the flat sides of such sheets in contact, by continually adding sheets to the top of such stack; when such stack reaches a predetermined height, clamping sheets spaced from the bottom of said stack by opposed edges, and continuing to add sheets to the top of said stack during the period of clamping, the sheets beneath said clamped sheets being removed from said stack during said period of clamping.

11. A method as claimed in claim **10**, wherein said clamped sheets and sheets thereabove are not lowered for a predetermined time interval after said clamping step.

12. A method as claimed in claim **11**, wherein said sheets beneath said clamped sheets are removed during said predetermined interval, and thereafter said clamped sheets are lowered to the vicinity of the original location of the bottom of said stack, where said clamping is released.

13. A method of stacking sheets, comprising the steps of: continuously stacking said sheets in aligned relationship and with the flat sides of such sheets in contact, by continually adding sheets to the top of such stack; when such stack reaches a predetermined height, clamping sheets spaced from the bottom of said stack by opposed edges, and continuing to add sheets to the top of said stack during the period of clamping, said clamped sheets and sheets thereabove being raised for a predetermined distance after said clamping step.

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M. HENSON WOOD, JR., *Primary Examiner.*

J. N. ERLICH, *Assistant Examiner.*