March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 1

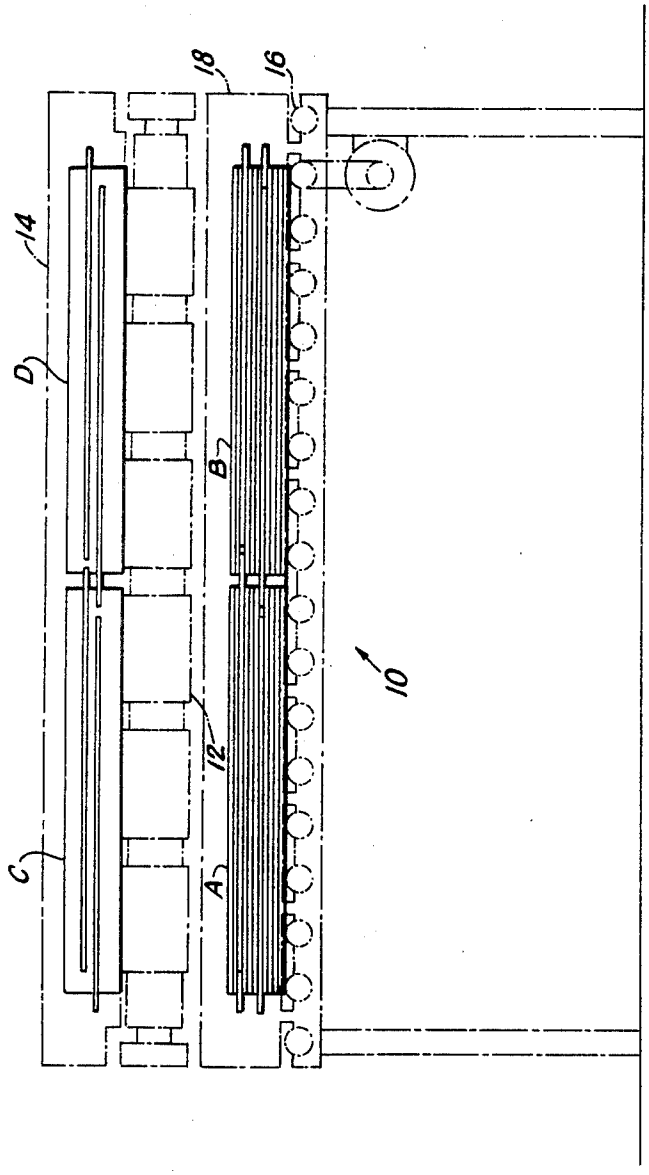


FIG. 1

INVENTOR.
MIRCEA CALISTRAT

BY Boyce C. Dant
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 2

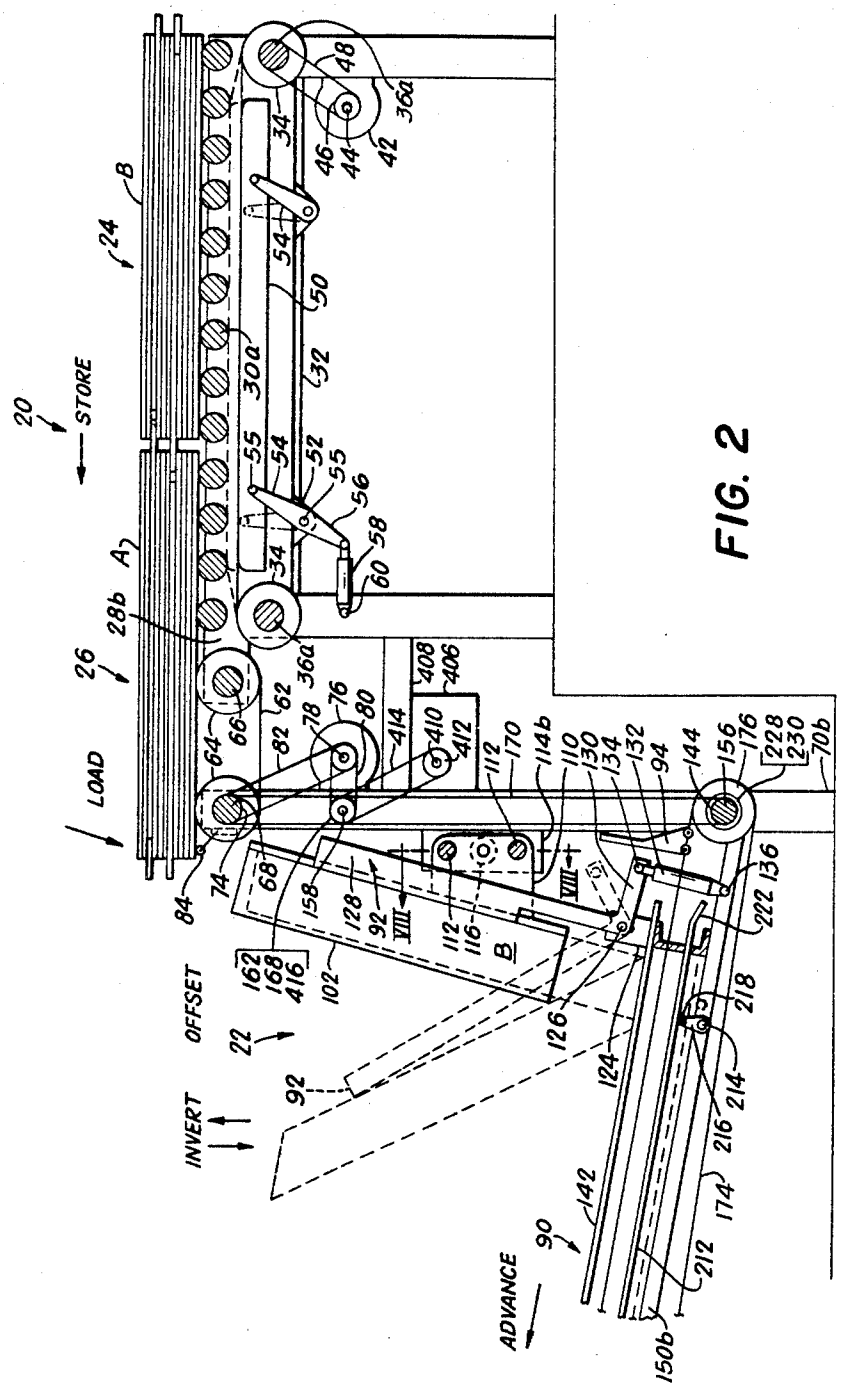


FIG. 2

INVENTOR.
MIRCEA CALISTRAT
BY Bayer C. Dent
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 3

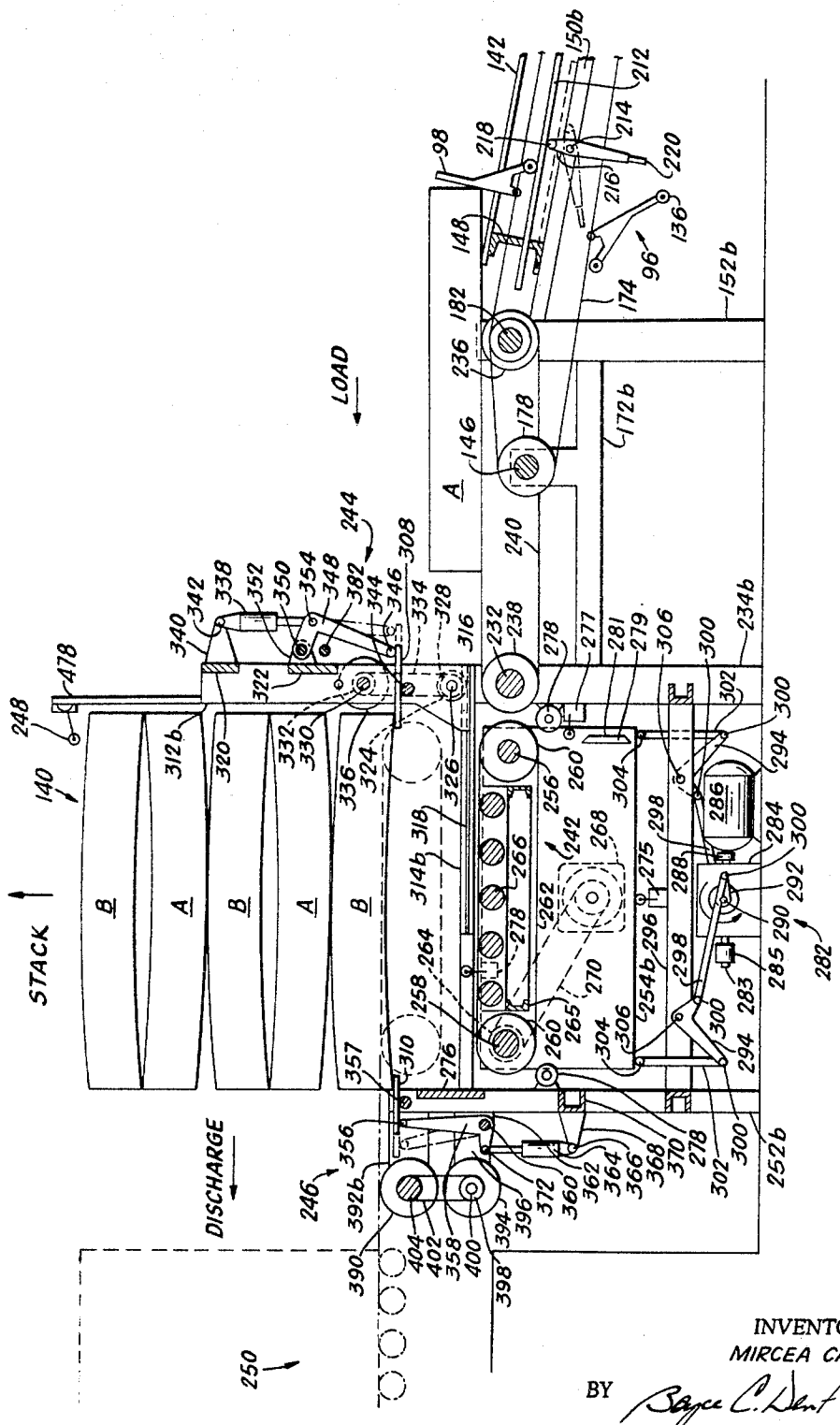


FIG. 3

INVENTOR.
MIRCEA CALISTRAT
BY Bayer C. Dent
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 4

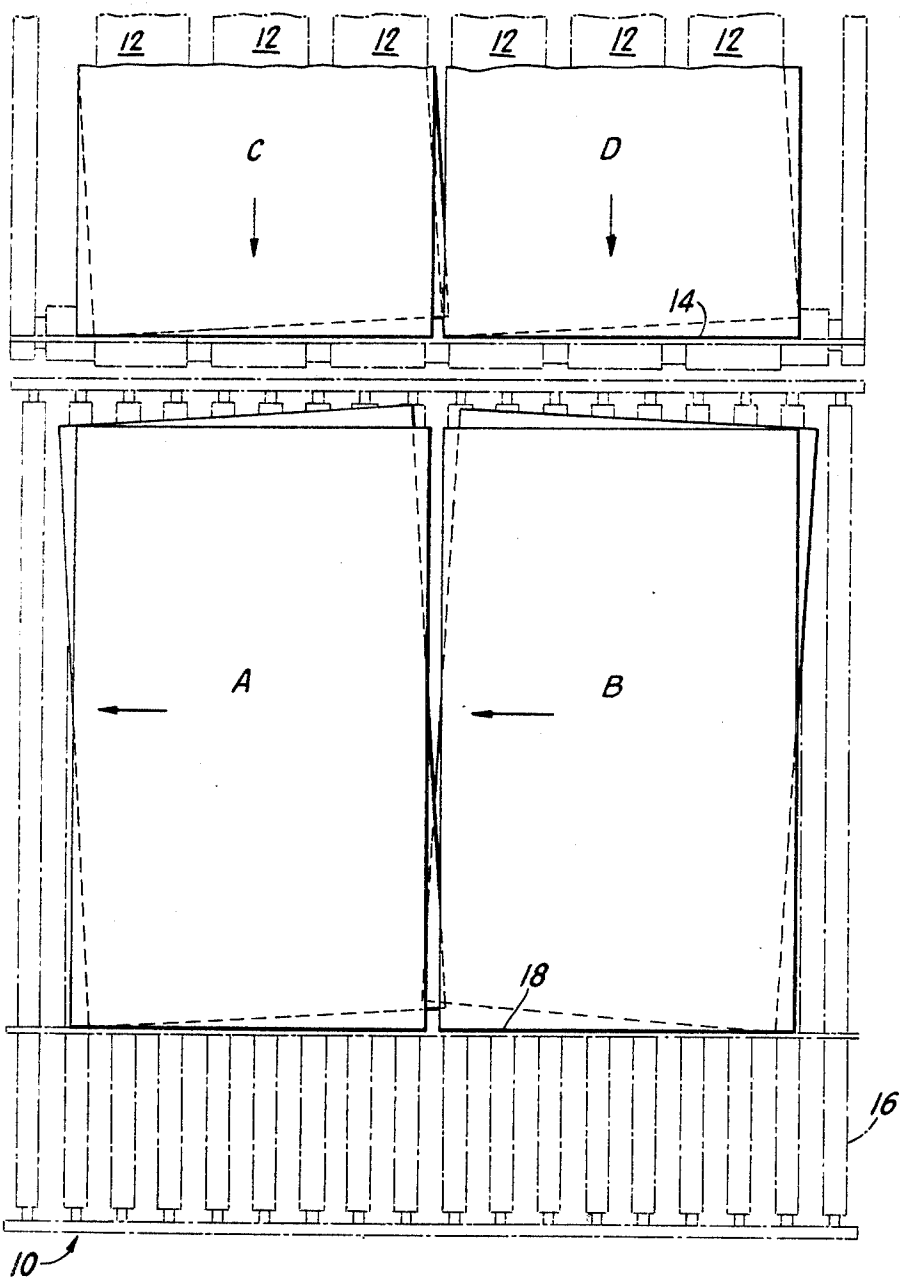


FIG. 4

INVENTOR.
MIRCEA CALISTRAT
BY Roger C. Dent
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 5

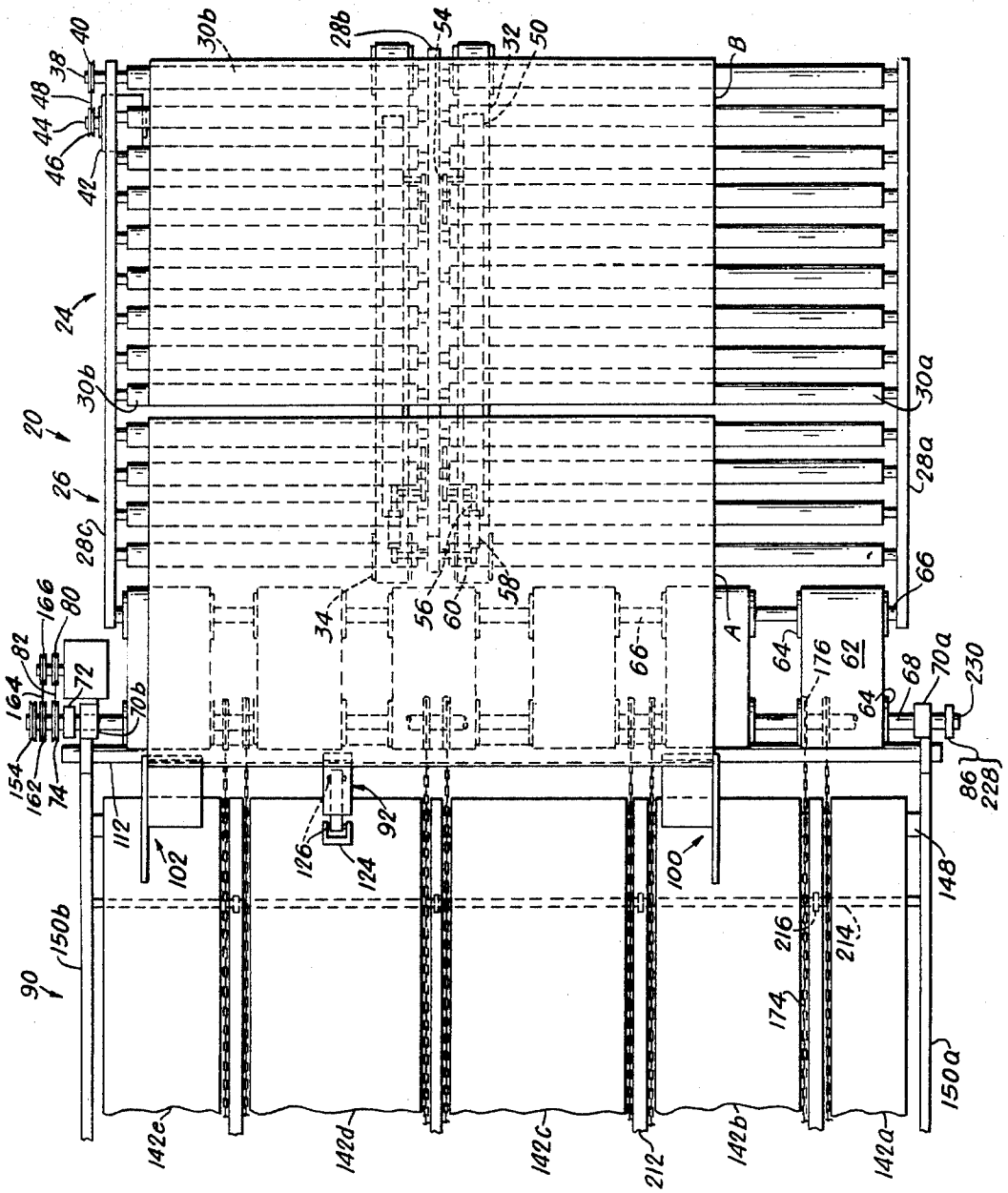


FIG. 5

INVENTOR.
MIRCEA CALISTRAT
BY Boyce C. West
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 6

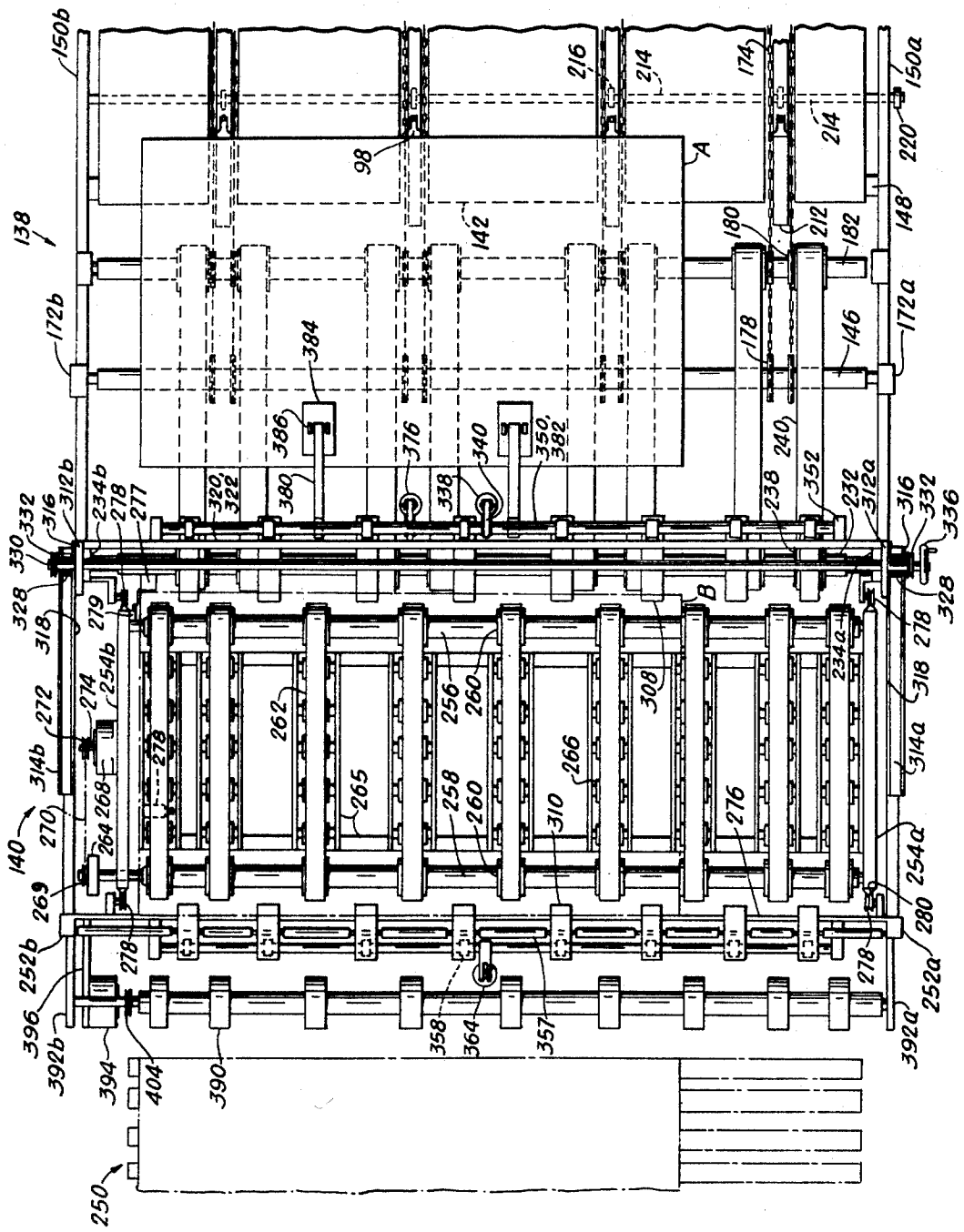


FIG. 6

INVENTOR.
MIRCEA CALISTRAT
BY Boyce C. Dent
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 7

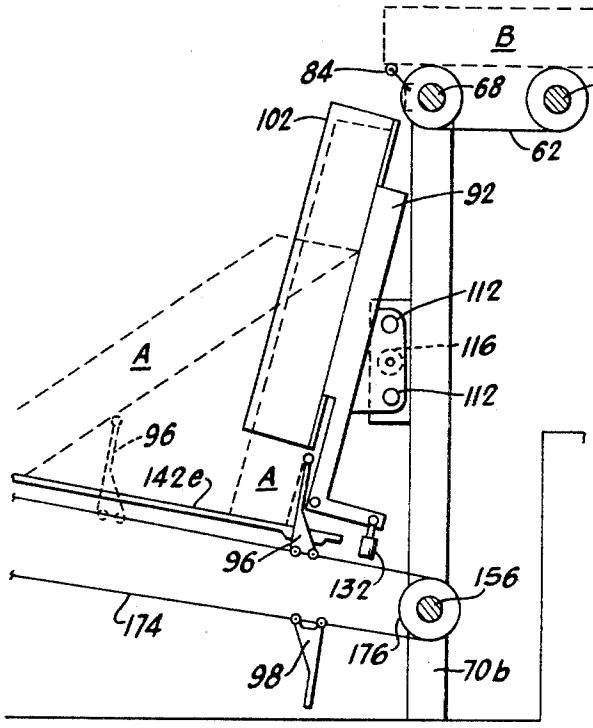


FIG. 7

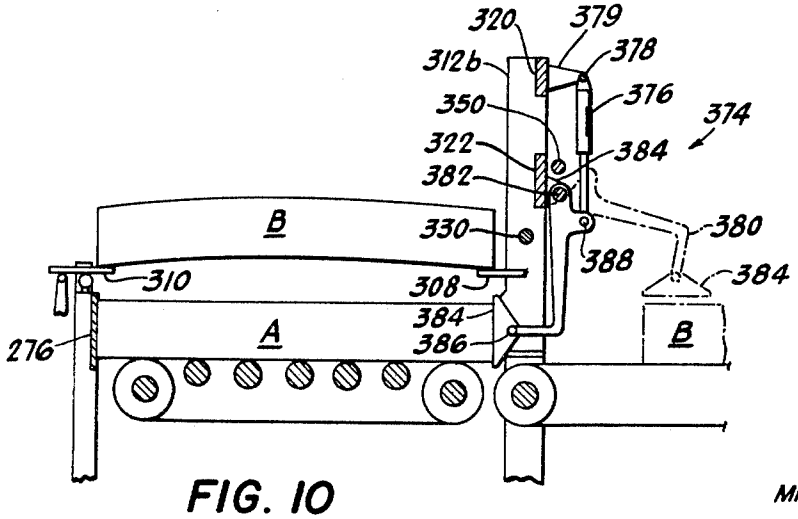


FIG. 10

INVENTOR.
MIRCEA CALISTRAT

BY Roger C. Dent

his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 8

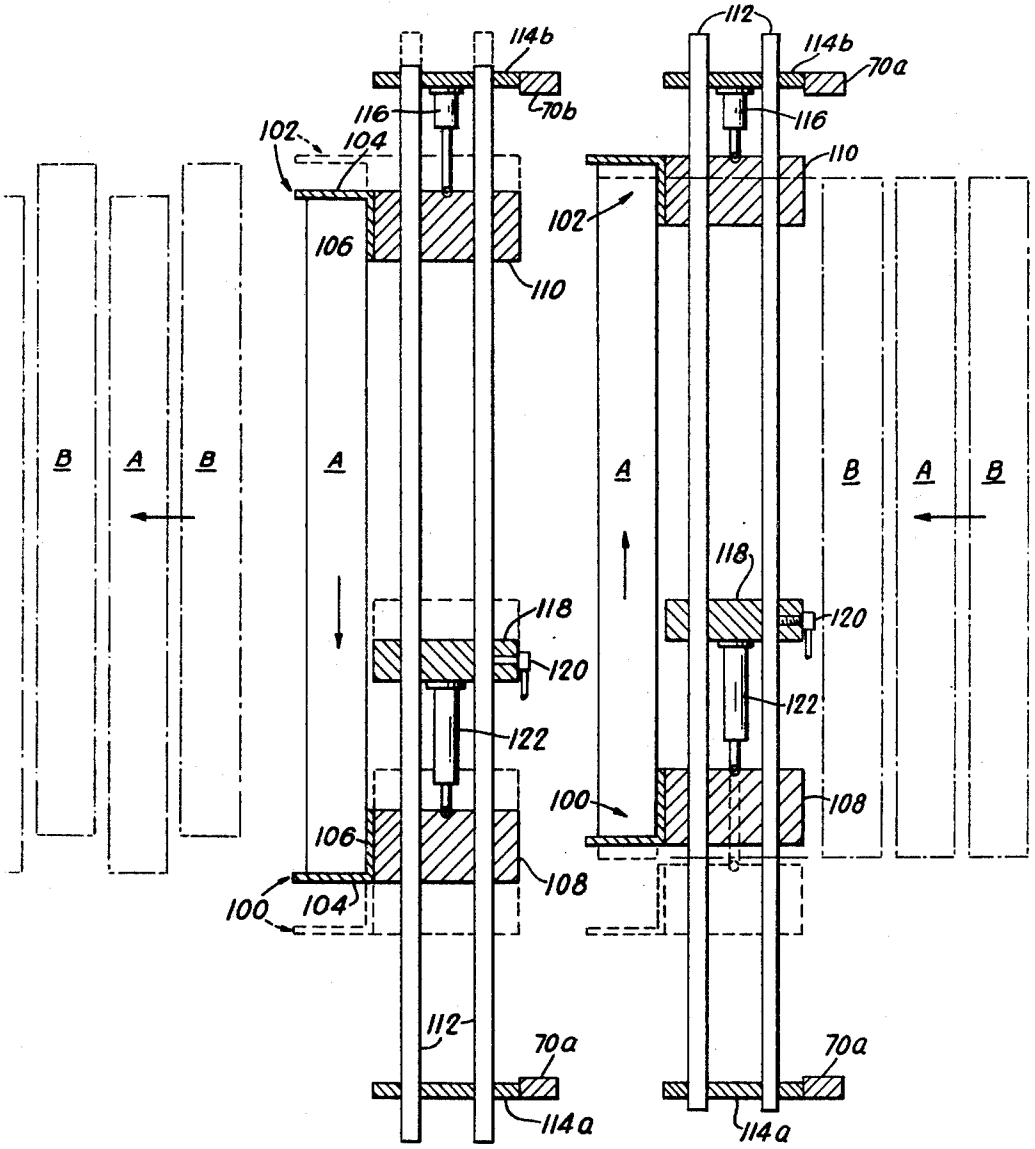


FIG. 8

INVENTOR.
MIRCEA CALISTRAT

BY Bayer C. Dent

his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 9

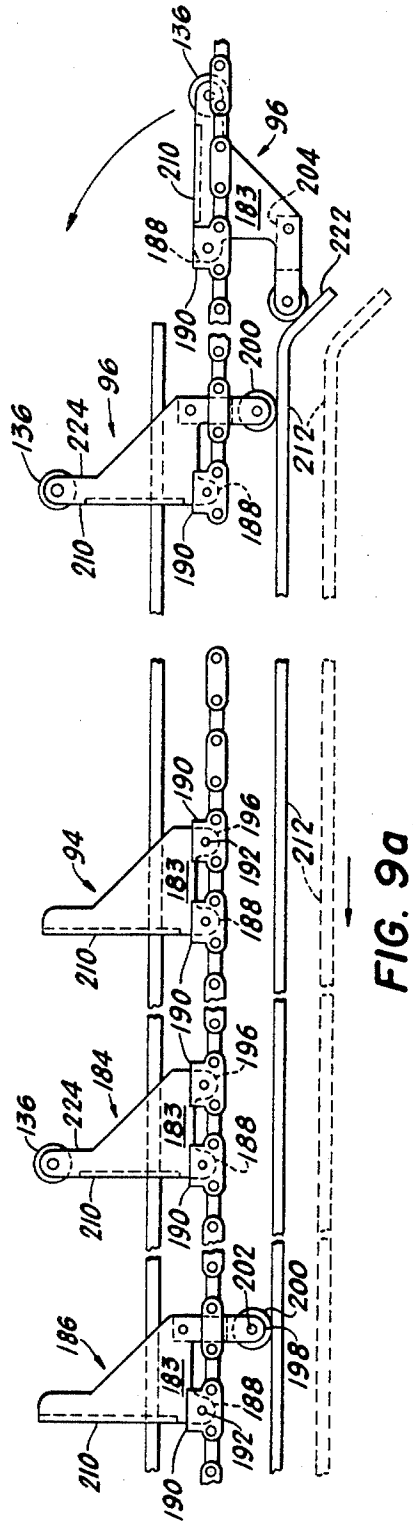


FIG. 9a

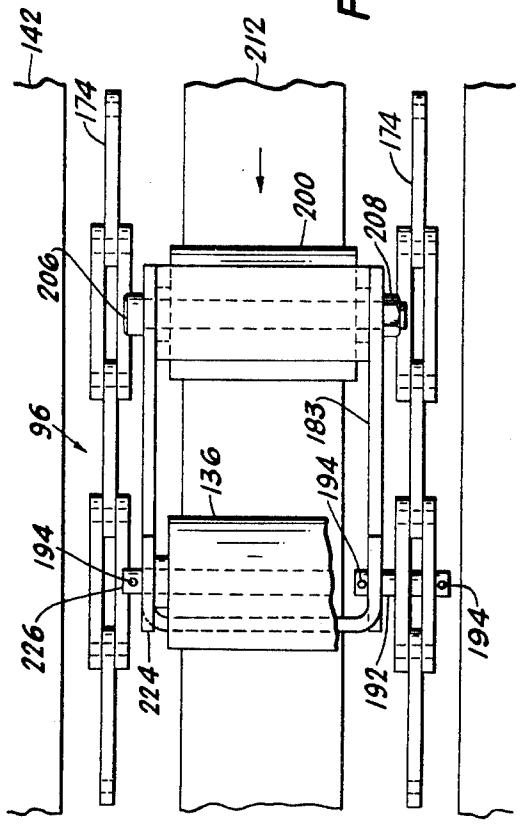


FIG. 9b

INVENTOR.
MIRCEA CALISTRAT
BY Boyce C. Dent
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 10

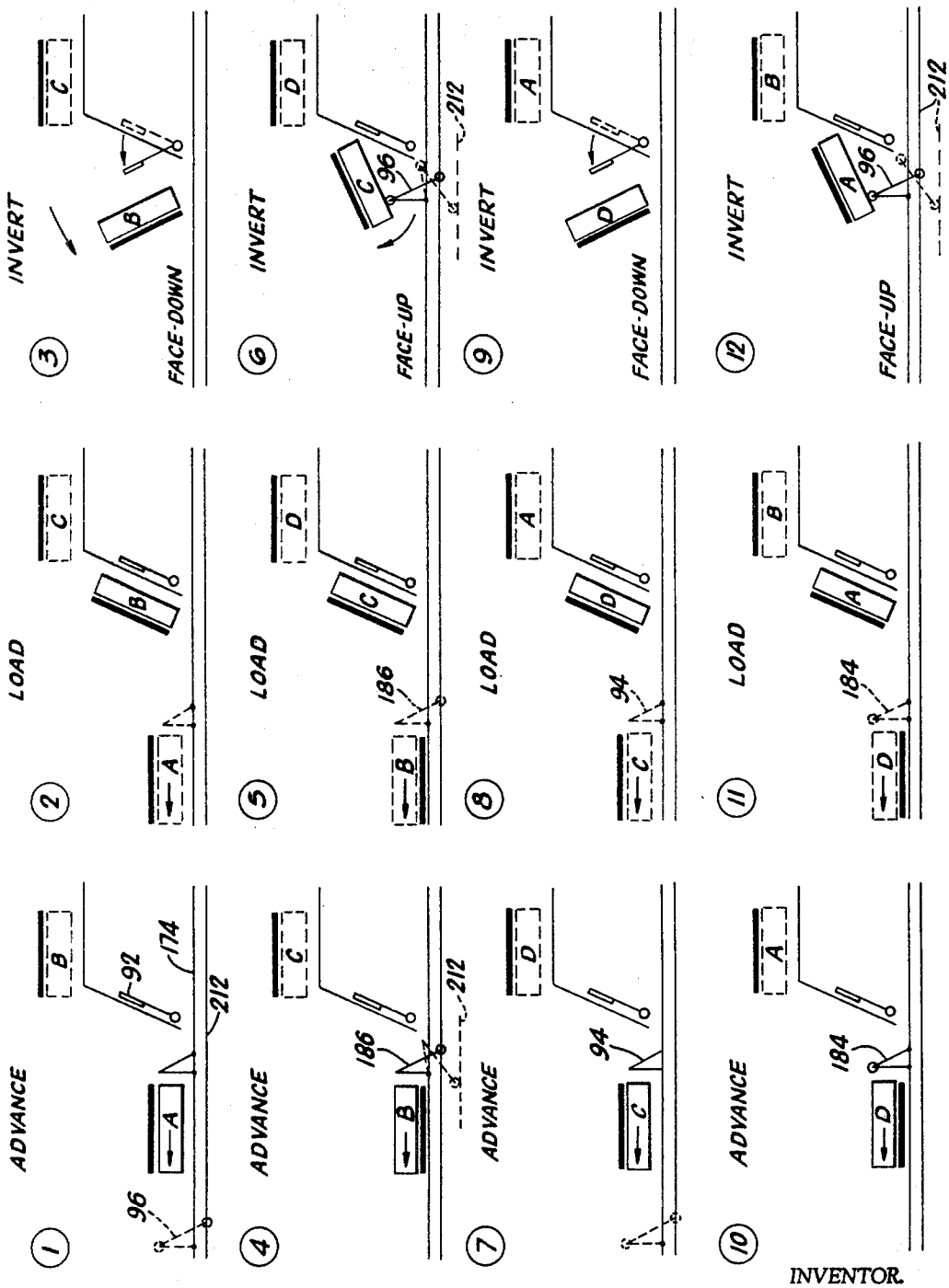


FIG. 11

INVENTOR.
MIRCEA CALISTRAT
BY Boyer C. Hunt
his Attorney

March 17, 1970 M. CALISTRAT 3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Original Filed Sept. 11, 1967 11 Sheets-Sheet 11

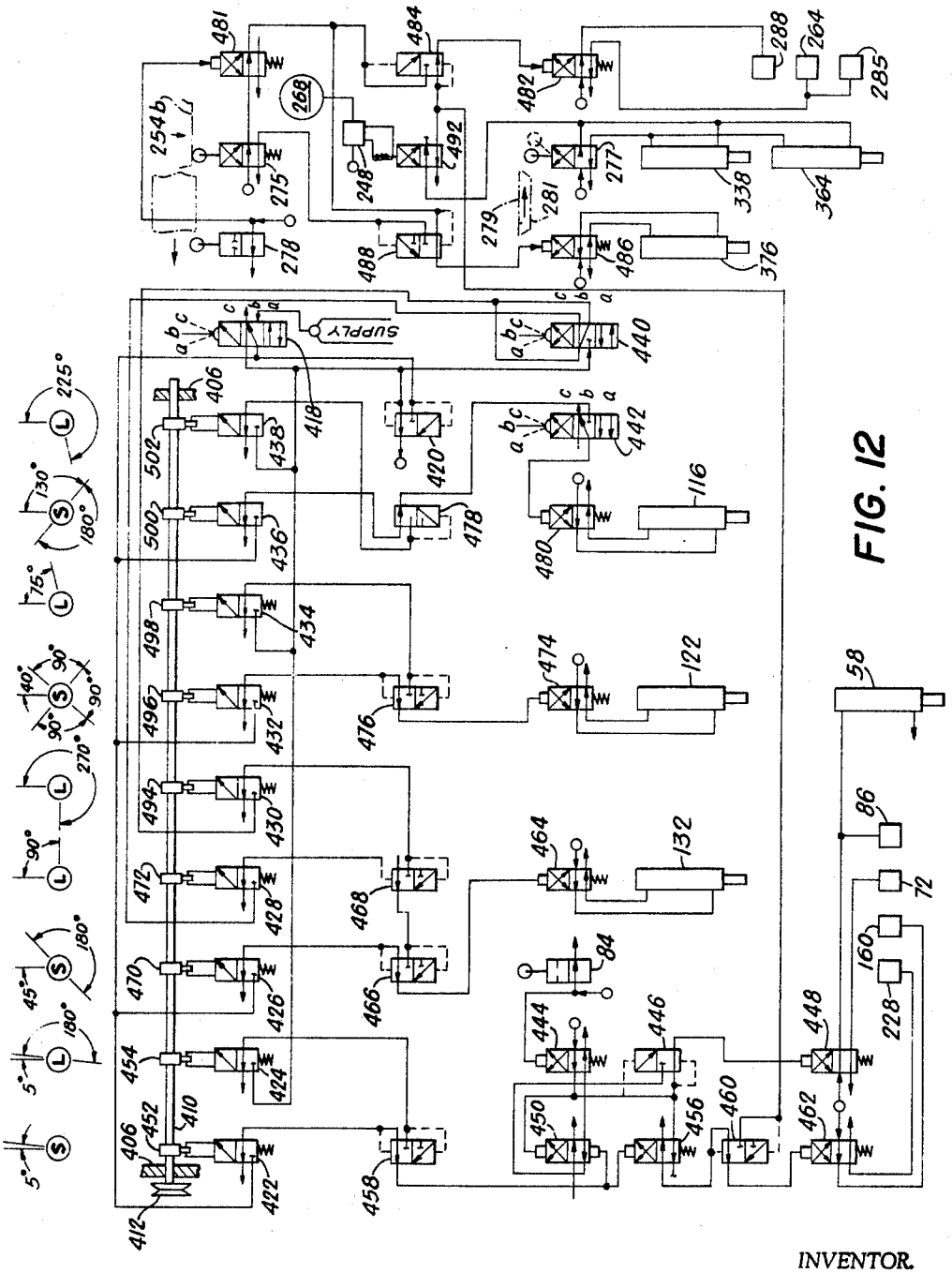


FIG. 12

INVENTOR.
MIRCEA CALISTRAT

Bayer C. Dent
his Attorney

United States Patent Office 3,500,980
Patented Mar. 17, 1970

3,500,980

STACKING SYSTEM FOR PAPERBOARD BLANKS

Mircea Calistrat, Baltimore, Md., assignor to Koppers Company, Inc., a corporation of Delaware

Original application Sept. 11, 1967, Ser. No. 666,605, now Patent No. 3,447,696, dated June 3, 1969. Divided and this application Nov. 27, 1968, Ser. No. 810,866
Int. Cl. B65g 47/22
U.S. Cl. 198—29 2 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for stacking alternate stacks of corrugated paperboard blanks discharged from a blank-forming machine face up and face down to reduce warping comprising an intermittently rotating transverse storage conveyor means for receiving and temporarily storing stacks of blanks in face-up position from an in-line conveyor adjacent the blank-forming machine; an inverter for sequentially receiving stacks from the storage conveyor and inverting alternate stacks to a face-down position on a rising conveyor comprising a guide for directing the stacks into a substantially vertical position with the stack resting on its leading edge on the rising conveyor where a pivoting finger carried by the rising conveyor engages the bottom edge of a first stack on the conveyor to advance it along the conveyor thereby positioning the first stack face up, an inverting lever adjacent the underside of a subsequent stack intermittently operable to engage the underside surface of this second stack to pivot it about its bottom edge so that it descends onto the rising conveyor with its underside up, said guide including movable opposed side members which can laterally offset the stacks relative to each other, first and second advancing fingers for sequential engagement with the trailing edges of the first and second stacks to advance them along the rising conveyor; a stacker for receiving stacks of blanks from the rising conveyor and stacking them one under the other to form a pile of blanks comprising a lifting conveyor including a stop for positioning each of the stacks, means for raising the lifting conveyor, with the stack thereon, a distance slightly greater than the height of the stack, a support for engaging the bottom face of the lifted stack to maintain the stack in its lifted position, means for lowering the lifting conveyor to receive another stack for repeating the foregoing lifting operation, and means rotating the lifting conveyor in its uppermost position when the pile of blanks reaches a selected height to discharge the pile on a skid or other conveyor for further handling.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates generally to material or article handling and more particularly to article piling or arranging apparatus. This is a division of application Ser. No. 666,605, filed Sept. 11, 1967, now Patent No. 3,447,696, June 3, 1969.

Description of the prior art

Corrugated paperboard blank-forming apparatus, commonly known as a corrugator, forms a continuous web of corrugated paperboard. Usually this web is longitudinally split into a plurality of parallel widths and each width is then cut laterally to form blanks of the material for making corrugated cartons such as boxes. The longitudinally advancing blanks are collected in stacks on a delivery conveyor which then discharges them transversely to the path of blank travel for manual stacking into piles on a skid or other conveyor.

Despite constant efforts to improve the quality of box blanks thus produced, the blanks still have a tendency to curl or warp, usually in a direction lateral to the web path. Warped blanks are difficult to process by further processing machinery. To reduce the amount of warp in the blanks, it is customary to stack them in large piles of smaller stacks of which smaller stacks are alternately placed face up and face down. In this manner, the warped portions of one stack oppose the warped portions of an alternate stack so that the weight of the pile tends to flatten the blanks.

Another inconvenience exists in that the advancing parallel adjacent blanks tend to become misaligned on the discharge conveyor so that the individual blanks of adjacent stacks become interlaced. Thus, the attendants are required to manually separate these piles into discrete stacks before alternate ones can be inverted.

Letchworth Patent No. 3,297,174 discloses apparatus for inverting alternate small stacks of blanks. The Letchworth apparatus receives the stacks of blanks from the corrugator on a plurality of conveyor delivery belts which are parallel but are at different levels so that one series of blanks can be placed on another to form a larger stack which is therafter inverted.

The parallel delivery belts of Letchworth require individual height adjustment for supporting the parallel advancing blanks whose width may vary from order to order. A disadvantage of this arrangement is that the parallel streams of blanks exiting from the cutoff portion of the corrugator are frequently interlaced. Therefore, it is difficult for the blanks to drop to different levels as described by Letchworth. It is also observed that it would be difficult to maintain the height of the final pile since it is formed by adding stacks to the top of the pile. Finally, turning alternate stacks of very large blanks 180 degrees in one continuous motion requires considerable energy because of the large air resistance encountered by the blanks during such movement.

SUMMARY

The present invention provides apparatus for automatically forming a pile of alternately inverted stacks of blanks which pile may be of unlimited height. The apparatus is adaptable for use in conjunction with existing delivery conveyors without the need for complex adjustments. The apparatus includes a transverse storage conveyor adapted to receive stacks of blanks from a corrugator delivery conveyor; an inverting apparatus for receiving consecutive individual stacks of blanks from the storage conveyor in a manner to stand the stacks on their leading edge, including an offsetting device for offsetting alternate ones of the stacks relative to the other ones of the stacks across their length, and a first pivoting means for pivoting a first stack about its upstanding trailing edge to position the stack on a rising conveyor with its top face up and a second pivoting means for pivoting a second stack about its leading edge to position the stack on the rising conveyor with its top face down; and a stacking means for receiving alternately inverted stacks from the rising conveyor and forming them in a pile one under the other by a lifting means for lifting each stack consecutively into engagement with a pile support means, the lifting means operable to discharge a pile of blanks of selected height onto subsequent processing apparatus.

The above and further objects and novel features of the invention will appear more fully from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are not intended as a definition of the invention but are for the purpose of illustration only.

DESCRIPTION OF THE DRAWINGS

In the drawings wherein like parts are marked alike:

FIGURE 1 is a diagrammatic front elevation of a conentional delivery conveyor illustrating the usual discharge of interlaced blanks;

FIGURE 2 is a diagrammatic side elevation of an emodiment of the storage and loading conveyors and nverting mechanism illustrating stacks stored on the conveyor and a second stack being pivoted toward a top faceown position on the rising conveyor;

FIGURE 3 is a diagrammatic side elevation of an emodiment of the rising conveyor and stacking mechanism lustrating a pile of alternately inverted stacks of blanks eing formed;

FIGURE 4 is a plan view of FIG. 1;

FIGURE 5 is a plan view of FIG. 2;

FIGURE 6 is a plan view of FIG. 3;

FIGURE 7 is a partial view of the inverting mechanism f FIG. 2 illustrating a first stack being pivoted toward a)p face-up position on the rising conveyor;

FIGURE 8 is a section view taken along the line VIII—'III of FIG. 2 illustrating an off-set mechanism for latrally off-setting alternate stacks of blanks;

FIGURE 9*a* is an elevational view of a portion of the ising conveyor illustrating the types of pivoting fingers nd advancing fingers used to pivot a first stack of blanks nd advance both first and second stacks of blanks;

FIGURE 9*b* is a plan view in partial cross-section of ne of the pivoting fingers of FIG. 9*a* illustrating its conection to the chains used on the rising conveyor;

FIGURE 10 is a partial view of the stacking mechaism of FIG. 3 illustrating a squaring mechanism for ligning the stacks prior to lifting them to form the pile;

FIGURE 11 is a schematic illustration of the sequence f pivoting the stacks in the inverting mechanism into alernate face-up and face-down positions; and

FIGURE 12 is a schematic diagram of the controls used or controlling the functions of the invention.

THE PREFERRED EMBODIMENT

In the manufacture of corrugated blanks, a web of corugated paperboard is formed and then slit into a number f parallel streams of desired width. These streams are ubsequently cut transversely to form parallel streams of)lanks. The cutting operation, by its nature, inherently has tendency to skew the blanks so that they are not exactly)arallel to the flow of blanks. Accordingly, overlapping of he blanks between the parallel stream occurs. This overapping is commonly known as interlacing. Stacks of inerlaced blanks are illustrated in FIGS. 1 and 4.

Referring now to FIGS. 1 and 4, piles of interlaced lanks A and B and shingled blanks C and D (a portion f one blank resting upon the next adjacent lower blank) re shown preparatory to lateral discharge from a conventional delivery conveyor, generally designated **10**, of a corugator (not shown). Delivery **10** may be of the type hown in Lopez Patent No. 3,079,150 which includes belts **2** for advancing the blanks downstream in shingled fashon where they are temporarily halted by a gate **14**. Beond gate **14**, delivery **10** includes a plurality of longiudinally mounted rollers at a lower elevation than belts **2**. When gate **14** is removed from the leading edges of he shingled blanks C and D, they are advanced by belts **2** causing them to fall one on top of the other upon ollers **16** to form piles A and B. A backstop **18** is proided to halt the forward progress of the blanks and s adjustable upstream and down to accommodate the ength of blanks being handled. Hereinafter, the "length" f the blanks on stacks refers to their longitudinal dimenion along the delivery **10** as viewed in FIG. 4.

When piles A and B reach a selected height, gate **14** s moved to intercept the flow of blanks C and D. Therefter, rollers **16** are driven to discharge the piles A and B pon a storage conveyor assembly generally designated **20**. When pile B is completely clear of delivery **10**, the foregoing process is repeated.

Although only two paralle streams of blanks are shown, it is not uncommon to have the initially formed web slit into four and sometimes as many as seven streams. The slit web is usually divided into an equal number of narrower webs of which one-half are guided into an upper cutoff knife and the other half into a lower cutoff knife. The shingled blanks C and D are discharged from one of the knives. Another delivery **10** is provided to handle the discharge from the other knife. Either or both deliveries **10** may be provided with the present invention which is illustrated herein to handle four streams from each delivery at maximum corrugator speed and more at lesser corrugator speeds.

STORAGE CONVEYOR

In accordance with the invention, the blanks coming from the delivery conveyor **10** are received by a storage conveyor **20**. The length of storage conveyor assembly **20** exceeds the width of delivery conveyor **10** so that regardless of the number of piles on delivery **10**, conveyor **20** is capable of receiving all of them.

The function of conveyor assembly **20** is to store the stacks received from delivery **10** and load them one at a time into the inverting mechanism **22** where stack A will be pivoted into face-up position and stack B will be pivoted into face-down position. Hereinafter, the "face" of the stack refers to its top surface as it is discharged from conveyor **10**. The "underside" of the stack refers to its bottom surface as it is discharged from conveyor **10**.

Conveyor assembly **20** includes a storage conveyor **24** and a loading conveyor **26**. Both conveyors **24** and **26** are intermittently driven simultaneously. However, when conveyor **24** is not driven, it is capable of free-wheeling whereas conveyor **26** will remain stationary. Thus, it can be seen that stack A will be loaded into inverter **22** upon rotation of conveyor **26** and, since conveyor **24** also rotates, stack B will move forward into the position previously occupied by stack A thereby leaving conveyor **24** clear to receive subsequent stacks from delivery **10** when it is rotated for discharging. These subsequent stacks will advance upon the free-wheeling conveyor **24** by momentum induced by rollers **16** of the delivery **10** until they rest against the stack B being held in stationary position by conveyor **26**. In this manner, the timing of conveyor assembly **20** is independent of the timing of the discharge from delivery **10**, the only requirement being that conveyor **20** discharges the stacks faster than it receives them as otherwise the stacks coming in from delivery **10** would shove the stack A off.

As mentioned above, conveyors **24** and **26** are driven simultaneously. Thus, stack A, for example, advances beyond conveyor **26** and falls into inverter **22**. As stack A falls into inverter **22**, the interlacing of blanks between stacks A and B is broken leaving stack B as a discrete stack on conveyor **26**. The interlacing of the stacks is broken when the center of stack A passes over the end of conveyor **26**, which causes the trailing edge of stack A to rise, and falls into inverter **22**. Thus, it can be seen that the bending occurring between the stacks as stack A falls into the inverter breaks the interlacing. This is advantageous since merely attempting to break the interlacing by pulling the stacks apart in a straight line is often ineffective because blanks near the top of the stacks tend to follow one another.

Storage conveyor **24** adjacent the discharge side of delivery **10** receives piles of blanks A and B therefrom. Conveyor **24** comprises spaced frame portions **28***a*, **28***b* and **28***c* between which a plurality of rollers **30***a* and **30***b* are bearing mounted in the conventional manner at an elevation substantially equal to the elevation of rollers **16** of delivery **10**. Frame portion **28***b* is located near the center between frame portions **28***a* and **28***c* to support the inboard ends of rollers **30***a* and **30***b*. The only difference

between rollers **30***a*, **30***b* is their length as illustrated. By supporting them near the center, there is less tendency for them to sag. If desired, rollers **30***a*, **30***b* may have identical lengths.

Rollers **30***a*, **30***b* are driven at the desired interval of time by a pair of driven endless belts **32** positioned under the rollers, one of which is adjacent either side of frame portion **28***b*. Belts **32** encircle pulley wheels **34** mounted for rotation with pulley shafts **36***a* and **36***b* which are bearing mounted between frame portions **28***a*, **28***b* and **28***c* in a fashion similar to rollers **30***a*, **30***b*. One of rollers **30***b*, FIG. 5, has an extension **38** extending through frame portion **28***c* upon which is mounted a chain sprocket **40**. A motor **42** is mounted in a known manner to frame portion **28***c* and has an output shaft **44** upon which is mounted a chain sprocket **46**. A roller chain **48** encircles sprockets **40** and **46** for driving the pulley shafts **36***a*, **36***b*. The pulley shafts **36***a* and **36***b* are connected where they are supported by frame portion **28***b* so that both belts **32** are driven thereby.

Rollers **30***a*, **30***b* are driven by raising the upper run of belts **32** into frictional engagement with their lower surfaces. To raise belts **32**, a belt lifting bar **50** is provided beneath the upper runs of the belts which lifts the upper run against the rollers. Lifting bars **50** are pivotably mounted to frame portions **52** by levers **54** having conventional pin connections **55** for attaching the levers to the bars and to the frame portions. One of levers **54** for each lifting bar **50** has an extension **56** for connection with an air operated ram **58** pivotably connected to frame portion **28***b*. Conventional clevis connections **60** may be used to connect the extensions **56** to the rams and the rams to the frame portions.

As best illustrated in FIG. 2, as rams **58** are activated, they will extend and pivot extensions **56** about their pin connections thereby raising lifting bars **50** to the position shown by the dotted lines. In this latter position, belts **32** are pressed into driving engagement with rollers **30***a*, **30***b*. Motor **42** runs continuously. Rams **58** are simultaneously energized by a signal from inverting mechanism **22**, as will be later explained, to advance the stacks A and B with stack A being loaded into the inverting mechanism.

LOADING CONVEYOR

Loading conveyor assembly **26** is adapted to discharge stack A, as illustrated in FIG. 2, into inverter **22** and simultaneously place stack B into the position previously occupied by A. Conveyor **26** comprises a plurality of endless belts **62** spaced side by side across the width of the assembly and surrounding pulley wheels **64** secured for rotation on shafts **66** and **68**. Shaft **66** is bearing mounted between frame portions **28***a*, **28***c* and drive shaft **68** is bearing mounted between frame portions **70***a*, **70***b*. Shaft **68** extends beyond frame portion **70***b* and has a conventional pneumatically energized clutch **72** mounted thereon. Clutch **72** may be, for example, a Model LW, made by Horton Manufacturing Co., Minneapolis, Minn., which includes an integrally mounted V-belt sheave **74**. Drive shaft **68** is driven through clutch **72** by a motor **76** having an output shaft **78** upon which a V-belt sheave **80** is mounted for rotation, the sheaves **74** and **80** being connected by V-belt **82**. Motor **76** is conveniently mounted to frame portion **70***b*. Preferably, a speed reducer (not shown) is placed between clutch **72** and shaft **68** in the known manner so that clutch **72** can be run at high speed by a conventional high speed motor.

Motor **76** runs continuously. Clutch **72** is selectively energized by a signal from inverter **22**, as will be later explained. When clutch **72** is energized, belts **62** are rotated and stack A advances generally horizontally until its center of gravity passes beyond the return of belts **62** around pulleys **64**. At this time, stack A pivots about pulleys **64** and drops, leading edge downward, into inverter **22**. Simultaneously, rams **58** have been activated and accordingly stack B advances onto conveyor **26** until it trips a pneumatic valve **84** which deactivates rams **58** and clutch **72**.

Shaft **68** also extends beyond frame portion **70***a* and has a conventional pneumatically energized shaft-mounted brake **86** mounted thereon and held against rotation in the known manner. Brake **86** may be, for example, a Model K diaphragm type, made by Horton Manufacturing Co., Minneapolis, Minn. Brake **86** is energized when valve **84** is tripped by an advancing stack so that belts **62** cease rotating immediately, as clutch **72** is de-energized, to prevent the stack from advancing too far beyond the pulleys **64** on shaft **68**.

INVERTER AND OFFSETTING ASSEMBLIES

Inverter assembly **22** receives individual stacks of blanks and inverts alternate ones of the stacks to a face-down position upon a rising conveyor assembly **90**. The remaining stacks are placed on conveyor **90** in a face-up position.

Inverter **22** also offsets alternate stacks in a lateral direction as illustrated in FIG. 8. This offset condition contributes to ease of handling of the stacks in subsequent processing operations, providing a gripping surface which the attendants may use in moving the stacks.

As best illustrated in FIG. 2, a stack B is inverted to a face-down position by pivoting the stack B about its leading edge, as shown by the dotted lines. Pivoting is accomplished by an inverting lever **92** adjacent the bottom face of stack B. After stack B has been laterally offset, lever **92** is actuated to pivot the stack about its leading edge so that it falls face down upon conveyor **90**. Thereafter, stack B is advanced along the conveyor by an advancing finger **94** and stack A (now on the conveyor **26**) is discharged into inverter **22** by loading conveyor **26**.

Stack A, FIG. 7, is pivoted about its trailing edge by a roller finger **96**, as shown by the dotted lines so that it falls face-up on rising conveyor **90**. Thereafter, stack A is advanced by a subsequent advancing finger **98**.

FIG. 11 illustrates, in panels ① through ⑫, the inverting sequence of four stacks A, B, C and D. The stacks are lettered and the heavy line adjacent the face of the stacks indicates the relative face positions of the stacks during operation of inverter **22** and rising conveyor **90**. Certain of the roller and advancing fingers are disengaged when extra-width stacks are being handled. This feature will be subsequently described. Coincidentally, reading panels ①, ④, ⑦ and ⑩ vertically shows the stacks A, B, C and D to be alternately inverted to face-up and face-down positions.

Inverter assembly **22**, FIGS. 2 and 8, comprises side guides in the form of upright angles **100** and **102** for receiving the stacks as they fall from loading conveyor **26**. Each of the guides has a side leg **104** for engaging the ends of the stacks and a bottom leg **106** engaging the underside of the stacks to support them in an upright position. Slide block **108** secured to leg **106** of guide **100** and mounting block **110** secured to leg **106** of guide **102** support the guides on a pair of support rods **112**.

OFFSETTING ASSEMBLY

Support rods **112**, FIG. 8, are slidably mounted in brackets **114***a* and **114***b* provided on frame portions **70***a*, **70***b*. Mounting block **110** is secured in a convenient manner to rods **112**. A pneumatic ram **116** is connected in a conventional manner to both mounting block **110** and to bracket **114***b* so that, when ram **116** is actuated, block **110**, and consequently guide **102**, moves laterally with respect to bracket **114***b*.

Guide **100** is secured to slide block **108** which is free to slide along rods **112**. A base block **118**, similar to mounting block **110**, is movably mounted on rods **112** inboard of slide block **108**. Base block **118** is locked against one of rods **112** by a clamp screw **120**. A pneumatic ram **122** is connected in a conventional manner to both base block **118** and slide block **108** so that, when ram **122** is actuated, block **108**, being slidable on rods **112**, moves

aterally with respect to base block **118**, carrying guide **00** with it. Base block **118** can be poistioned and clamped long rods **112** to place guide **100**, through ram **122**, in he correct position for acting on the stacks. In this manner, adjustment is provided to compensate for stacks of arious lengths.

FIG. 8 is a section taken along lines VIII—VIII of IG. 2 except that the stacks are pictured as all standing n end to better illustrate the manner in which they are ffset. Thus, the stacks are shown entering the inverter 2 with their lateral edges or ends in substantial alignment, t being understood that some of the individual blanks nay be slightly askew.

The right-hand portion of FIG. 8 illustrates the posiion of guides **100**, **102** prior to and after acting upon tack A. The left-hand portion illustrates the position of he guides prior to and after operating on stack B. The xtreme left-hand portion illustrates the relative lateral ffset positions of stacks A and B after the offsetting oper-tion.

Referring to the right-hand portion of FIG. 8, guide **02** is in the position shown prior to receiving stack A rom conveyor **26**. Leg **104** of guide **102** is spaced a short listance from the edge of stack A as it enters inverter 2. Leg **104** of guide **100** is in the position indicated by he dotted lines, being placed in this position by the exension of ram **122** and being spaced a short distance from he edge of stack A. After stack A has entered inverter **22**, am **122** is actuated thereby pulling guide **100** against tack A and moving it against guide **102**. Ram **122** is imnediately actuated in the reverse direction returning the uide **100** to its original position. Accordingly, stack A s unrestrained so that it may be pivoted about its trailing dge by roller finger **96** and thus fall face up on rising onveyor **90**.

After stack B has entered inverter **22**, as shown in the eft-hand portion of FIG. 8, guide **100** is again actuated n the same manner as for stack A thereby moving stack 3 against guide **102**, guide **102** being in the position indiated by the dotted lines. Simultaneously, ram **116** is acuated which moves rods **112** to the left as shown by the lotted lines. Base block **118**, being clamped to rods **112**, noves to the left pushing slide block **108**, via ram **122**, to he position shown. In this manner, stack B is squared gainst guide **102** and also offset to the left with respect to tack A. When stack B reaches its offset position, ram **116** s retracted and ram **122** is extended to return guides **100** nd **102** to their previous positions ready to receive subsequent stack A.

INVERTER ASSEMBLY

After each stack A or B has been offset, stack A is inverted to a face-up position and stack B is inverted to a face-down position. As previously mentioned, stack A is pivoted about its trailing edge by a roller finger **96** and hen advanced along rising conveyor **90** by advancing inger **98**. Stack B is pivoted about its leading edge by nverting lever **92** and then advanced along rising conveyor **90** by advancing finger **94**.

The inverting lever **92** is pivotably supported between a clevis bracket **124** by a pin **126** passing through lever 2 and bracket **124**. Bracket **124** is secured to rising conveyor **90**. Lever **92** includes an upstanding leg portion **128** which, in its retracted position, is on the same plane with he leg portions **104** of guides **100** and **102**. That is, leg 128 lies immediately behind the bottom face of a stack A or B in the inverter **22**. Lever **92** includes a short leg **130** formed at a right angle with leg **128** and connected to a pneumatic ram **132** by a conventional pin connection 134. Ram **132** is pivotably secured to rising conveyor **90** by a similar pin connection **136**. After a stack B in the inverter **22** has been offset, as previously described, ram **132** is actuated thereby pivoting lever **92** about pin **126** as shown by the dotted lines in FIG. 2. Upstanding leg **128** pushes against stack B thereby pivoting it about its leading edge so that it falls face down on conveyor **90**. Thereafter, advancing finger **94** is moved forward to engage the trailing edge (previously the leading edge) of stack B and advance it along conveyor **90**. Simultaneously, ram **132** is retracted to return lever **92** to its original position.

To invert a stack A in inverter **22** to a face-up position on conveyor **90**, a roller finger **96** is advanced against the lower portion of the back of stack A after the stack has been offset. A small roller **136** carried by finger **96** pushes against the stack thereby moving its leading edge forward and letting its trailing edge slide down the leg portions **106** of guides **100** and **102**. The end result is that stack A is generally pivoted about its trailing edge until it rests on conveyor **90**. As the stack slides down onto conveyor **90**, finger **96** continues to advance along the conveyor, with the small roller **136** rolling along the bottom of the stack, until finger **96** is forward of stack A. Thereafter, advancing finger **94** is moved forward to engage the trailing edge of the stack and advance it along conveyor **90**.

RISING CONVEYOR

Rising an advancing conveyor **90** advances the offset and inverted stacks to an entry conveyor **138** from which the stacks are discharged into a stacker portion **140**. Conveyor **90** comprises a plurality of stack supports **142***a*, *b*, *c*, *d* and *e* extending substantially between a lower sprocket shaft **144** and an upper sprocket shaft **146**. As best illustrated in FIGS. 2 and 3, supports **142** are mounted upon a pair of cross-members **148** which have their ends supported by longitudinally extending frame members **150***a*, **150***b* secured to upstanding frame portions **70***a*, **70***b* and **152***a*, **152***b*.

Sprocket shaft **144** is rotatably mounted between frame portions **70***a*, **70***b* and has an extended portion **154** extending beyond frame portion **70***b* upon which is mounted a pulley wheel **156**. A speed reducer **158** is mounted on frame portion **70***b* and carries a clutch **160** thereon, the clutch being substantially identical to clutch **72** previously described. Clutch **160** is driven by the rotation of speed reducer **158** which is in turn rotated by a pulley wheel **162** mounted thereon connected by a V-belt **164** to a pulley wheel **166** mounted on output shaft **78** of motor **76**. An output pulley wheel **168** on clutch **160** drives pulley wheel **156** through a V-belt **170** and thereby rotates sprocket shaft **144**.

Upper sprocket shaft **146** is rotatably mounted between frame portions **172***a*, **172***b* of entry conveyor **138**. Pairs of roller chains **174** located in spaces provided between stack supports **142** encircle sprockets **176** and **178** mounted respectively on the lower sprocket shaft **144** and upper sprocket shaft **146**. The path traveled by the upper runs of chains **174** carries them over sprockets **180** secured to pulley shaft **182** of entry conveyor **138** for driving shaft **182**.

As best illustrated in FIGS. 9*a* and 9*b*, each pair of chains **174** carries roller fingers **96** and advancing fingers **94** therebetween so that the fingers travel with the chains. Four kinds of fingers, **94**, **96**, **184**, and **186** are used. Each of the fingers includes a U-shaped body portion **183** as viewed in FIG. 9*a*, having a lug portion **188** on each leg thereof extending beside the adjacent chain **174**. Chain **174** includes a link **190** extending upward so as to overlap lug portions **188**. Pins **192** extend through holes provided in both the lugs **188** and links **190** to pivotably support the fingers to the chains. Pins **192** are retained by cotter pins **194**.

Fingers **94** and **184** also include lug portions **196** similar to and spaced from lugs **188** to overlap a subsequent link **190** in chain **174**. Pins **192** likewise connect lugs **196** to links **190** so that fingers **94** and **184** will not pivot about pins **192** in lugs **188**.

Fingers **96** and **186** include lug portions **198** extending beneath chains **174** between which a roller **200** is carried by a pin **202** passing through the roller **200** and lugs **198**. Pin **202** is retained by cotter pins **194**. Thus, it can be

seen that fingers **96** and **186** are free to pivot about pins **192** in lugs **188** as indicated in the right-hand portion of FIG. *9a*. A counterweight **204** is secured between the legs of the U-shaped body portion of fingers **96** and **186** by a bolt **206** and a nut **208** clamping the legs against the counterweight. The counterweight causes the stack engaging faces **210** of the fingers to lie substantially flat with respect to the chain **174** as viewed to the extreme right of FIG. *9a*.

Referring now to FIGS. 2 and 3, conveyor **90** also includes a roller support **212** beneath the upper run of each pair of chains **174** for engaging rollers **200** of fingers **96** and **186** to maintain the fingers in an upright position as viewed in FIG. *9a*. However, roller supports **212** may be lowered to the position shown by dotted lines in FIGS. 2, 3, *9a*, and 11. When in the lowered position, fingers **96** and **186** will lie flat as previously explained.

Lowering of roller supports **212** is accomplished by pivotably supporting them on frame members **150***a*, **150***b*. Pivot rods **214** are provided between frame members **150***a*, **150***b*. Pivot rods **214** are provided between frame members **150***a*, **150***b*. Pivot rods **214** are provided between frame members **150***a*, **150***b* with pivot arms **216** secured thereto in a position beneath roller supports **212**. Pivot arms **216** are connected to the supports **212** by a conventional pin connection **218** which allows the supports to swivel with respect to the pivot arms. Thus, when the pivot arms **216** are rotated clockwise, as viewed in FIGS. 2 and 3, the roller supports **212** will be lowered to the position indicated by the dotted lines. An operating lever **220** is provided on one end of one of pivot rods **214** for rotating the rod. A suitable clamp (not shown) is provided to lock the pivot rod in the desired position when the supports **212** are in either the raised or lowered position.

Thus, it can be seen that when the supports **212** are in the lower position, fingers **96** and **186** will traverse the upper run of chains **174** in a flat position, as viewed in FIG. *9a*, since rollers **200** do not contact the supports **212**. However, when supports **212** are in the raised position, rollers **200** will flip the fingers **96** and **186** into an upright position as they approach the supports **212**. A lead-in portion **222** on supports **212** aid in pivoting the fingers to an upright position. Fingers **96** and **186** merely hang free from pins **192** during the traverse of chains **174** along the lower run between the sprockets **176** and **178**.

The length of rising conveyor **90** is made to accommodate the widest stack to be handled. As viewed in FIGS. 2 and 3, which may conveniently be joined to give a complete picture of conveyor **90**, stack A is being discharged onto entry conveyor **138** as stack B is being inverted to fall face down on conveyor **90**. Thus, sufficient space must be allowed between finger **98** and the finger **94** approaching inverter **22**. For example, if the maximum width stack to be handled is five feet, a space of about six feet is required between the fingers. However, if the stack width is less than half the maximum width, that is, two and one-half feet or less, obviously two stacks can be accommodated between fingers **98** and **94**. This explains the reason for providing some of the fingers with rollers **200** supported by roller supports **212**.

FIG. 11 illustrates stacks of two and one-half feet or less being processed. For stacks A and C two fingers are required; roller finger **96** to invert the stack to a face-up position and advancing finger **94** to advance the stack along the conveyor. On the other hand, stacks B and D require only an advancing finger **186** to advance it along the conveyor. Thus, three fingers are required for each "set" of stacks A–B and C–D. Since a set of narrow stacks can be accommodated simultaneously on conveyor **90**, obviously another set of three fingers can be carried on the lower run of chains **174**. Accordingly, a total of six fingers are provided at the proper sequential spacing on chains **174**. However, appropriate ones of the fingers may be lowered to an inoperative position by lowering roller supports **212** so that only three fingers remain upright for handling stacks wider than two and one-half feet.

Obviously, lowering three adjacent fingers will leave three fingers upright at a short spacing. Therefore, selected ones of the fingers are lowered to leave three fingers upright at the required spacing for wide stacks. FIG. 11 illustrates in dotted lines those fingers to be lowered when wide stacks are handled.

As previously mentioned, finger **96** is provided with a roller **136** to permit the finger to pass beneath stack A after the stack has been inverted thereby. Finger **184** is likewise provided with a roller **136**. Roller **136** is carried between upstanding lug portions **224** of fingers **96** and **184** by a pin **226** passing through both the roller **136** and lugs **224**. Cotter pins **194** retain pin **226**, as illustrated in FIG. *9b*.

Although the foregoing arrangement of conveyor **90** has been described for wide stacks of from two and one-half to five feet and narrow stacks of two and one-half feet and less, obviously the proportions may be designed to handle other size stacks which may be manufactured.

Conveyor **90** normally runs continuously, however, in the event that a stack is not present in loading conveyor **26**, a signal is provided to disengage clutch **160** so that conveyor **90** is not driven. The signal also energizes a brake **228** (similar to brake **86**) carried by an extension **230** on sprocket shaft **144** extending beyond frame portion **70***a*. The signal will be discussed further in the control portion of the specification. Brake **228** is used to stop the chains **174** immediately after the signal is received so that the fingers will remain in timed relation to loading conveyor **26**. Otherwise, a stack could be loaded in inverter **22** with the fingers in the wrong position to maintain the inverting sequence.

ENTRY CONVEYOR

Entry conveyor **138** removes stacks of blanks from conveyor **90** at a slightly faster speed than they are traveling so that they move away from the advancing finger to allow the finger to clear the stack as it passes over sprocket **180** and thereafter around sprocket **178**. The stacks are also made level for entry into stacker **140**.

Conveyor **138** comprises a pulley shaft **182** mounted for rotation between frame portions **152***a*, **152***b* and a pulley shaft **232** mounted for rotation between frame portions **234***a* and **234***b*, the latter frame portions being common to stacker **140**. Pulley wheels **236** are mounted on shaft **182** adjacent each of the sprockets **180** as shown in FIG. 6. Corresponding pulley wheels **238** are mounted on shaft **232**. Endless belts **240** encircle corresponding pairs of pulley wheels **236** and **238**. Pulley wheels **236** are driven by the rotation of shaft **182** which is in turn driven by sprockets **180** being rotated by chains **174**. Sprockets **180** are somewhat smaller than the pulleys **236** so that the surface speed of belts **240** is greater than the velocity of the advancing fingers. An increase in speed of about 5% is usually sufficient to allow the fingers to clear the stacks being advanced by the entry conveyor **138**.

STACKER ASSEMBLY

Stacker **140**, FIG. 3, forms a pile of stacks received sequentially from entry conveyor **138** and discharges a pile of selected height to a conveyor, skid, or the like for subsequent processing. This function is accomplished by receiving each stack on a lifting conveyor **242**, raising the conveyor to lift the stack a predetermined distance, retaining the stack in its raised position by a holding device **244** under the leading edge of the stack and a holding device **246** under the trailing edge of the stack, lowering conveyor **242** to its original position to receive a subsequent stack, releasing the holding devices **244**, **246** to drop the raised stack onto the stack now rising on conveyor **242**, raising both stacks a predetermined distance and repeating the foregoing procedure until the pile

reaches a height sufficient to trip a limit switch **248** which stops the whole machine preceding the stacker **140**. At this time, lifting conveyor **242** remains in its raised position and is slowly rotated to discharge the pile onto a conveyor **250**. Thereafter, conveyor **242** is lowered and the whole procedure is repeated.

The lifting conveyor portion **242** of stacker **140** is positioned between frame portions **234***a*, **234***b* and frame portions **252***a*, **252***b*. Conveyor **242** comprises a pair of laterally spaced sub-frames **254***a*, **254***b* between which a pair of pulley shafts **256**, **258** are journaled for driven rotation. Pulleys **260** are spaced across and secured to the pulley shafts **256**, **258** as best illustrated in FIG. 6. Endless belts **262** encircle pulleys **260** and have an upper run at the same level as belts **240** of entry conveyor **138**. A substructure **265** secures subframes **254***a*, **254***b* and also supports idler rollers **266** under the upper run of belts **262**.

A motor **268**, secured to subframe **254***b*, is provided for driving belts **262**. A clutch **264**, similar to clutches **72** and **160**, is mounted on an extension **266** of pulley shaft **258** and includes a pulley wheel **269** connected by a V-belt **270** to a pulley wheel **272** on output shaft **274** of motor **268**. Motor **268** runs continuously but the belts **262** are rotated only when clutch **264** is energized. The belts **262** are rotated when lifting conveyor **242** is in the lowered position to receive stacks from entry conveyor **138**. The belts continue to rotate until the stack reaches a backstop **276** fixed between frame portions **252***a*, **252***b* at which time the stack trips a valve **278** which de-energizes clutch **264**. Simultaneously, with stoppage of belts **262**, conveyor **242** is lifted.

A valve **275** is mounted on frame portion **296** in a position to be tripped by subframe **254***b*. Valve **275** energizes clutch **264** to start belts **262** rotating when conveyor **242** returns to its lowermost position.

A valve **277** is mounted to frame portion **234***b* in a position to be tripped by a cam **279** mounted on subframe **254***b*. The function of valve **277** is to retract the holding plates **308** and **310** from beneath the pile just prior to the stack being raised reaching them so that the pile descends only a short distance. Valve **277** maintains the plates retracted until the stack being lifted is above them at which time the plates are extended beneath the pile. Valve **277** is a conventional maintained contact type, being operable only so long as it remains tripped by cam **279**. Thus, cam **279** has a long contact surface **281**. Valve **277** is a single-direction type so that cam **279** does not actuate it during downward travel of lifting conveyor **242**.

The subframes **254***a*, **254***b* are guided for vertical movement by V-notched rollers **278** secured to frame portions **234***a*, **234***b* and **252***a*, **252***b*. The V-notches in rollers **278** mate with corresponding V-portions **280** formed in the edges of subframes **254***a*, **254***b*.

Lifting of conveyor **242** is accomplished by a crank mechanism **282** comprising a gear-box **284** driven by a continuously running motor **286** connected thereto through a conventional shaft-mounted air clutch **288**. The gear-box **284** has an output shaft **290** extending from opposite sides thereof upon which are mounted driving arms **292**. The driving arm **292** on one side of the gear-box is connected to a bell crank **294** toward the upstream side of the stacker and the other driving arm is connected to a bell crank **294** toward the downstream side. The bell cranks **294** are pivotably supported on a cross-member **296** between frame portions **234** and **252**. Connecting links **298** connect bell cranks **294** to driving arms **292** through conventional pin connections **300**. Lifting arms **302** connect the bell cranks **294** to the subframes **254***a*, **254***b* through pin connections **304**. Thus, it can be seen, as best illustrated in FIG. 3, that rotation of output shaft **290** pivots bell cranks **294** about their fulcrums **306** thereby lifting the subframes **254***a*, **254***b* through the connecting links. The proportions of crank mechanism **282** are easily calculated in the known manner to give the amount of vertical travel desired.

Clutch **288**, previously referred to, is actuated by valve **278** (which also stops belts **262**) to elevate lifting conveyor **242** when the advancing stack has reached backstop **276**. The clutch remains engaged until arms **292** have made a complete revolution and, consequently, the conveyor **242** is in its lowermost position. As the conveyor reaches the lower position, valve **275** is tripped which disengages the clutch **288**. Switch **278** is ready for triggering by another advancing stack to again stop belts **262**.

The input shaft **283** of gear-box **284** extends beyond the side opposite to where it is connected to coupling **288** and has a shaft mounted air brake **285** mounted thereon (similar to brake **228**) for stopping rotation of the output shaft **290** of the gear-box.

It should be noted here that switch **248** not only stops the portion of the machine preceding the stacker, but also disengages clutch **288** and actuates brake **285** to stop lifting conveyor **242** in its uppermost position. Simultaneously, switch **248** activates clutch **264** to start belts **262** and signals motor **268** to run at half-speed to slowly discharge the pile onto conveyor **250**.

After a stack has been received on conveyor **242** and belts **262** have stopped, the conveyor is lifted to an upper position. At this time, holding devices **244** and **246** are actuated. Holding device **244** includes a number of support plates **308** extendable horizontally beneath the raised stack to provide a support upon which the stacks may rest after the lifting conveyor is lowered. Holding device **246** includes similar support plates **310**.

Holding device **244** is supported on an upstream-downstream adjustable support provided for longitudinally positioning plates **308** for the different width stacks to be handled. The adjustable support comprises upright stanchions **312***a* and **312***b* guided on spur toothed racks **314***a* and **314***b* secured between frame portions **234***a*, **234***b* and **252***a*, **252***b*. Guiding is accomplished by providing a tongue portion **316** along the bottom edge of the stanchions which mates with corresponding grooves **318** formed in the sides of racks **314***a*, **314***b*. This arrangement also prevents the stanchions **312***a*, **312***b* from tilting.

Stanchions **312***a*, **312***b* are laterally connected by cross-members **320** and **322**. To adjust holding device **244** towards backstop **276**, spur gears **324** are secured to stub shafts **326** rotatably mounted in stanchions **312***a*, **312***b* so that the gears are in mesh with racks **314***a*, **314***b*. Stub shafts **326** extend through stanchions **312***a*, **313***b* and have sprockets **328** secured to their outermost ends. A cross-shaft **330** is rotatably mounted in stanchions **312***a*, **312***b* at a height sufficient to permit a stack to pass thereunder onto lifting conveyor **242**. A sprocket **332** is secured to the outermost ends of cross-shaft **330** beyond the stanchions. A roller chain **334** encircles the sprockets **332**, **334** on the stub-shafts and cross-shaft respectively. A handwheel **336** is provided on one end of cross-shaft gears **324** along racks **314***a*, **314***b* to position holding device **244**. A conventional shaft-lock (not shown) is provided on cross-shaft **330** adjacent handwheel **336** to lock the stanchions in the position selected.

Support plates **308** of holding device **244** are moved into engagement with the bottom of a lifted stack by a pneumatic ram **338** pivotably secured to a bracket **340** by a pin connection **342**; the bracket **340** being secured to cross-member **322**. Each plate **308** rests on a support shaft **344** journaled between stanchions **312***a*, **312***b*. Each plate **308** is connected via pin connection **346** to an associated lever **348** pivotably supported on a cross-shaft **350** rotatably mounted in brackets **352** secured to cross-member **322**. Ram **338** is connected to one of levers **348** by pin connection **354**. All of levers **348** are keyed to cross-shaft **350** so that pivoting of the lever connected to the ram causes all the levers to pivot causing plates **308** to **330** for turning the cross-shaft which in turn will rotate move substantially horizontally into and out of engagement with the stack.

Holding device **246** is constructed in a similar fashion to holding device **244**. Support plates **310** rest on a roller **357** journaled between frame portions **252***a*, **252***b*. Each plate is connected via pin connection **356** to an associated lever **358** pivotably supported on a cross-shaft **360** rotatably mounted in brackets **362** secured to frame portions **252***a*, **252***b*. Ram **364** is pivotably supported by a pin connection **366** to a bracket **368** which is secured to frame portion **370**. Ram **364** is connected to one of the levers **358** by pin connection **372**. Actuation of ram **364** moves all the plates **310** either into or out of engagement with the stack, depending upon whether the ram is extended or retracted.

Stacker **140** also includes a squaring device **374** for urging a stack on lifting conveyor **242** into full engagement with backstop **276**. Squaring device **374** operates in a similar fashion to holding device **244**, as best illustrated in FIG. 10. A pneumatic ram **376** is pivotably supported by a pin connection **378** on a bracket **379** secured to cross-member **320**. Levers **380** are pivotably supported laterally adjacent to levers **348** on a cross-shaft **382** rotatably supported in brackets **384** secured to cross-member **322**. Each lever **380** has a squaring shoe **384** connected thereto by a pin connection **386** which permits the shoe to swivel. Ram **376** is connected to one of the levers **380** by a pin connection **388**. When ram **376** is retracted, the levers **380** assume the position shown by the dotted lines, leaving clearance for a stack to enter stacker **140**. When ram **376** is extended, shoes **384** are urged against the trailing edge of the stack to urge it into full engagement with backstop **276**. After the stack is squared, ram **376** is immediately retracted so that the stack may be lifted without interference.

Stacker **140** preferably includes a discharge roller **390** rotatably journaled between brackets **392***a*, **392***b* secured to frame portions **252***a*, **252***b*. A continuously running motor **394**, mounted to bracket **396** secured to frame portion **252***b*, is provided for driving roller **390**. A sprocket **398** on output shaft **400** of motor **394** is connected by a chain **402** to a sprocket **404** provided on roller **390**. Thus, as the pile is discharged from stacker **140** by rotation of lifting conveyor **242**, roller **390** supports the pile and transports it to conveyor **250** for further handling.

CONTROLS

The controls for the complete machine are illustrated schematically in FIG. 12. For the most part, the controls are pneumatic although a completely electrical system will work equally well and may be used if desired.

As illustrated herein, most of the valves used are contained in a console **406** supported by frame portion **408** as shown in FIG. 2. A camshaft **410** is journaled in console **406** for actuating various ones of the valves used. Camshaft **410** is driven by a sprocket **412** mounted thereon connected by a chain **414** to a sprocket **416** mounted on speed reducer **158**.

Referring now to FIG. 12, air pressure is supplied to manually controlled valve **418** which has three operative positions *a*, *b* and *c*. Position *a* is used for narrow stacks, i.e., in the example previously given, stacks up to two and one-half feet wide. Position *b* in the "off" position whereby the air supply is cut off and all air lines are vented to atmosphere. Position *c* is used for wide stacks, i.e., for stacks between two and one-half and five feet in width.

Shuttle valve **420** is supplied with pressure from either of positions *a* or *c* of valve **418**. Valve **420** supplies pressure to all nine main cam-actuated valves **422**, **424**, **426**, **428**, **430**, **432**, **434**, **436**, and **438**. Each of these main valves is operated by a cam secured on camshaft **410** which rotates once for each revolution of chains **174**.

A manually controlled valve **440** controls the inverting sequence. In position *a*, all the wide stacks are inverted face up on rising conveyor **90**; in position *b*, all the stacks are inverted face down on rising conveyor **90**; and, in position *c*, the stacks are inverted alternately face up and face down on conveyor **90**.

Microvalve **84**, located on loading conveyor **26**, is triggered by, that is, senses, a stack advanced to the loading position above inverter **22**.

A manually controlled valve **442** is used to interrupt the offsetting function shown in FIG. 8.

The foregoing valves are conventional. For example, valves **418**, **440** and **442** may be three-position selector valves, Model 8771 such as made by Republic Manufacturing Company, Cleveland, Ohio. Valves **84** and **278** may be hair-trigger microvalves, Model HTW–40D, such as made by Mead Fluid Dynamics, Chicago, Ill. Even numbered valves **422** through **438** may be three-way roller cam-actuated spring-return, Model CW 13–25, made by Parker-Hannifin, Des Plaines, Ill. Valve **275** may be a four-way Model CC13–25 made by the same company. Valve **420** may be a shuttle-valve, Model OR–25, also made by Parker-Hannifin.

For a better understanding of the operation of the controls, assume that conveyor **20** is empty, chains **174** are moving, and valves **422** and **424** are not actuated. Pressure from valve **444** flows through valve **446** to actuator valve **448**. Pressure from valve **448** actuates clutch **72** and releases brake **86** and ram **58** so that belts **62** begin to move. Pressure from valve **444** also switches valve **450** from the position shown with no immediate effect.

When cams **452** and **454** trigger either of valves **422** or **424** respectively, and still no stack is on belts **62**, pressure from valves **422** or **424** actuates valve **56** through valve **458**. Pressure from valve **444** flows through valve **456** and valve **460** and actuates valve **462** so that the clutch **160** for chains **174** is vented to atmosphere and brake **228** is actuated. Accordingly, chains **174** are stopped but belts **62** continue to move. It should be noted that, for wide stacks, manual valve **418** supplies pressure to valve **424** and, for narrow stacks, it supplies pressure to valve **422**.

Now, assuming that chains **174** are stopped and a stack triggers sensing valve **84**, then valve **84** actuates valve **444**. Port A–**1**, previously under pressure, is vented so that valve **450** is switched back to the position shown. Pressure from port A–**2** flows through valves **450** and **446** to maintain valve **448** actuated so that belts **62** continue to move.

Because port A–**1** of valve **444** is vented, port O–**2** of valve **456** is also vented. Because valve **456** is actuated, valve **462** is also vented, through valve **460**, so that it is deactivated. Thus, clutch **160** is actuated and chains **174** begin to move. When chains **174** move, camshaft **410** is rotated, as previously described, and cam **452** releases valve **422** (or cam **454** releases valve **424**) so that valve **456** is deactivated and valve **462** remains vented. Note that whenever valve **462** is under pressure, chains **174** are stopped and when valve **462** is vented, chains **174** will move.

Movement of belts **62** loads the stack into inverter **22** and simultaneously releases sensing valve **84**. Valve **444** is thereby deactivated and pressure flows through its port A–**1**, and on through valve **446** to activate valve **448** to keep belts **62** running. Valve **444** simultaneously activates pilot P–**1** of valve **450**.

When a subsequent stack triggers sensing valve **84**, valve **444** is actuated and both ports of valve **446** are vented; one through valve **444** and the other through valve **50**. Accordingly, valve **448** is deactivated and belts **62** stop with the stack waiting to be loaded into inverter **22** as illustrated in FIG. 2.

While belts **62** are stopped and a stack is waiting to be loaded, chains **174** continue to move. Valve **444** is activated, with its port A–**1** vented. As camshaft **410** rotates, cam **452** triggers valve **422** (or cam **454** triggers valve **424**) and pressure flows through valve **458** to activate pilot P–**2** of valve **450**. Pressure from port A–**2** of valve

444 flows through valve 450 and valve 446 to actuate valve 448 to energize clutch 72 and belts 62 start to move. Although valve 456 is also activated, chains 174 continue to move because port O–2 of valve 456 is vented through valve 444. As the stack falls into inverter 22, the sequence, previously described, is repeated wherein a subsequent stack triggers sensing valve 84 that stops the belts 62, as previously described, which are again started at the proper time by either of cams 452 or 454.

The inverting ram 132 is actuated (extended) by valve 464. Valve 464 is actuated by either of valves 466 or 468 which can be actuated by any one of valves 426, 428 or 430. Valve 426 is supplied with pressure only from position *a* of manual valve 418 which position is used for narrow stacks. Cam 470 for valve 426 has two lobes for actuating valve 426 twice for each revolution of camshaft 410 thereby causing every other stack to be inverted face down. This results only when narrow stacks are being handled since, as illustrated in FIG. 11, four stacks are handled for every complete revolution of chains 174.

Valve 428 is supplied with pressure only from position *c* of manual valve 418 which position is used for wide stacks. Cam 472 for valve 428 has only one lobe for actuating valve 428 once for each revolution of camshaft 410 thereby causing every other stack to be inverted face down. This results when wide stacks are handled since only two stacks are handled for every complete revolution of chains 174.

Provision is made for inverting every other stack of wide stacks or inverting them all face up or all face down. Selector valve 440 controls this function. Accordingly, when selector valve 418 is in position *c* for wide stacks, valve 440 must also be positioned in position *a*, *b* or *c* for the inverting sequence desired. Therefore, valve 428 is supplied with pressure from positions *a* or *c* of valve 440 when valve 418 is in position *c*. Valve 430 is supplied with pressure from position *a* of valve 440 when valve 418 is at position *c* so that all of the wide stacks are inverted face up.

The off-setting function is accomplished by actuating both rams 116 and 122. If no offset is desired, only ram 122 is actuated. For each revolution of chains 174, four offsets are required for narrow stacks and two offsets for wide stacks. Valves 432, 434, 436, and 438 are used to control rams 116 and 122. Valves 432, 436 are actuated for narrow stacks; valves 434, 438 are actuated for wide stacks. Valve 474 actuates ram 122 with pressure supplied from valve 476. Valve 472 is actuated by either valve 432 or 434. Either of valves 436 and 438 actuate valve 480 through valve 478. Valve 478 actuates ram 116.

The stacker 140 is controlled by microvalve 278 which is triggered by a stack entering upon lifting conveyor 242 and a conventional electric limit switch 248, mounted on frame portion 478, which is triggered by the pile when it reaches the desired height. Switch 248 may be positioned vertically along frame portion 478 at any desired interval to provide piles of various heights.

When valve 278 is triggered, it actuates pilot valve 481 which stops the flow of pressure to valve 482 from valve 484 and the flow of pressure to valve 486 from valve 488. Thus, clutch 264 is disengaged and lifting conveyor belts 262 stop; brake 285 is released and clutch 288 is engaged so that lifting conveyor 242 begins to rise. Simultaneously, ram 376 is actuated to activate the squaring device 374.

After rising conveyor 242 begins to rise, valve 275 is triggered by subframe 254*b* moving upward away from it. This stops the flow of pressure to valve 481 and instead supplies pressure to valve 486 which reverses ram 376 to retract squaring device 374. Valve 275 remains activated until lifting conveyor 242 returns to its lower position.

Cam 279, carried on subframe 254*b*, triggers valve 277 as lifting conveyor 242 rises. Valve 277 actuates rams 338 and 364 which retract holding plates 308 and 310 thereby letting the pile fall upon the ascending stack. The holding plates remain retracted until conveyor 242 is in its uppermost position.

Provided the pile has not yet reached its preselected height for discharge, the crank mechanism 282 continues to run so that conveyor 242 returns to its lower position. In the uppermost position of conveyor 242, the lower portion of surface 281 of cam 279 has passed valve 277, releasing it. When valve 277 is released, it actuates (extends) rams 338 and 364 to place holding plates 308 and 310 under the lifted pile. As conveyor 242 moves downward, the movement of cam 279 does not affect valve 277 because the valve works only when triggered in a single direction. As the conveyor 242 moves downward, the pressure of the stacks against valve 278 is released. However, the conveyor 242 continues to move downward because valve 275 will remain actuated until it is deactivated by contact with subframe 254*b*. Thereafter, the cycle is repeated until the pile reaches the height at which it is to be discharged onto conveyor 250.

Upon reaching the predetermined height, electric limit 248 is triggered which in turn actuates solenoid valve 492. However, valve 277 is still actuated by surface 281 of cam 279, and will remain so until cam surface 281 clears valve 277, so that no change occurs. However, when valve 277 is released by surface 281, pressure flows through it to valve 482 through valves 492 and 484. This deactivates clutch 288 and actuates brake 285 to stop conveyor 242 in its uppermost position. Simultaneously, electric switch 248 signals motor 268 to run at half-speed, clutch 264 being energized, to run belts 262 thereby discharging the pile onto driven roller 390 and thereafter onto conveyor 250. Valve 492 remains actuated until the stack is discharged at which time valve 482 is deactivated and the conveyor moves downward through the same cycle that occurred during normal stacking without discharge.

While conveyor 242 is stopped in its uppermost position for discharging, pressure flows through valves 277 and 492 to valve 462 through valve 460 thereby stopping movement of chains 174. The chains remain motionless throughout the time the pile is being discharged.

The various valves used in the above control system are conventional and commercially available. For example, valves 444, 464, 474, 480, 456, 462, 448, 481, 486 and 482 may be pilot operated four-way spring return pressure valves, Model CC10–25 made by Parker-Hannifin, Des Plaines, Ill. Valve 450 may be a pilot operated four-way pressure return pressure valve Model CC12–25 made by the same company. Valve 492 is a solenoid operated four-way pressure valve Model CCJ1–25, also made by Parker-Hannifin.

The various cams on camshaft 410 are preferably made angularly adjustable about the camshaft so that the timing of the machine can be easily altered if needed. Setscrews (not shown) can be used to clamp the cams to the shaft for this purpose.

From the foregoing description of the control system, it will be understood that the lobes of the cams are positioned at various angles to each other in order that the valves may be actuated in the proper sequence. Since some of the valves are actuated more than once during each operating cycle of chains 174, some of the cams have more than one lobe. For the preferred embodiment of the machine described herein, the angular position of the lobes on the cams is illustrated schematically in the top portion of FIG. 12. Although the cams continue to actuate their respective valves regardless of the length of stacks being handled, some of the valves themselves are inoperative depending on the width of the stacks. Accordingly, S indicates that the cam and its associated valve are operative for narrow stacks; L indicates that the cam and its associated valve are operative for wide stacks.

OPERATION

In operation gate 18 of delivery conveyor 10 is positioned in a known manner upstream or downstream to ac-

commodate the length of the blanks forming the stacks. Thereafter, the guide **100** in the offsetting portion of inverter **22** is positioned by clamping slide-block **118** on rods **112** as previously described. Leg **104** of guide **100** is preferably positioned about four inches from the lateral end of the stack as it enters the inverter **22**.

If wide stacks are to be handled, roller supports **212** are lowered by turning handle **220** on rising conveyor **90** and clamping it in position. This causes the appropriate ones of the inverting and advancing fingers to become inoperative as previously described. For narrow stacks, roller supports **212** remain in the raised position.

The next step is to adjust the longitudinal position of holding plates **308** for the length of the stack being handled. This is done by rotating handwheel **336** on stacker **140** to move plates **308** toward or away from backstop **276**. The holding device **244**, carrying plates **308**, is then locked in position by clamping handwheel **336**.

The height of the pile to be formed is selected and switch **248** is raised or lowered accordingly and clamped on its support **478**.

Thereafter, manual valve **418** is turned from "off" position *b* to either *a* position for narrow stacks or *c* position for wide stacks. Manual valve **440** is turned to position *a* if the stacks are to be all inverted face up; to position *b* if all the stacks are to be inverted face down; or to position *c* if alternate stacks are to be inverted face down. Manual valve **440** is operative only when wide stacks are processed, that is, at position *c* of valve **418**. Narrow stacks are always alternately inverted. Manual valve **478** is turned from the "off" position *b* to position *c* if offsetting of the stacks is desired; to position *a* if no offsetting is desired.

A master switch (not shown) is turned on to energize motors **42**, **76**, **268**, **286**, and **394**. At this time, the machine is operative and in condition to receive stacks from delivery conveyor **10**.

As the blanks are supplied in stacks from the corrugating delivery conveyor **10**, the stacks are received on storage conveyor **24**. Conveyors **24** and **26** are operated simultaneously to advance the stack to conveyor **26** to convey the stacks to the position shown in FIG. 2. The conveyor **26** is actuated again when chains **174** are at the correct position at which point stack A and stack B are advanced simultaneously, but stack A is advanced beyond the support provided by conveyor **26**. The leading edge of stack A is thus unsupported and tends to fall and its trailing edge tends to rise thereby separating any interlacing between the stacks. Stack A is received by inverter **22** and guided into an upright position. The guides **100** and **102** are operated to laterally offset the stack. Stack A is pivoted about its trailing edge by a pivoting finger carried on the rising conveyor **90** so that it falls face up on the conveyor. Thereafter, an advancing finger carried by the conveyor engages the trailing edge and advances stack A along the conveyor. Meanwhile stack B on the storage conveyor **24** has been advanced upon conveyor **26** to the position previously occupied by stack A. At the proper interval of rotation of chains **174** on conveyor **90**, conveyor **26** will be rotated to load stack B into inverter **22**. Stack B is offset and then pivoted about its leading edge by the inverting lever **92**, so that it falls face down upon conveyor **90**. Thereafter an advancing finger on chains **174** engages its trailing edge and advances it along conveyor **90**. Meanwhile stack A, which has preceded stack B, is received upon entry conveyor **138** which rotates faster than chains **174** so that the trailing edge of stack A advances faster than the advancing finger so that the finger will clear the stack as it begins its return along the lower run of chains **174**. Entry conveyor **138** loads stack A into stacker **140**. The lifting conveyor **242** of stacker **140** is in its lower receiving position as stack A is loaded into the stacker. Upon entering the stacker, stack A will trip a valve **278** which simultaneously stops rotation of belts **262** of conveyor **242** and raises the lifting conveyor to an upper position. Upon reaching the upper position, supporting plates **308** and **310** are operated to engage the underside of stack A to support it in the upper position. Conveyor **242** is then returned to its lower position for receiving subsequent stack B from entry conveyor **138**. Stack B is then lifted toward the upper position by conveyor **242**. As the stack approaches stack A, the supporting plates **308** and **310** are retracted from beneath stack A so that stack A falls upon stack B. Conveyor **242** continues to rise thereby lifting both stack A and stack B to the upper position whereupon support plates **308** and **310** are again operated to engage the underside of stack B to support both stacks A and B in the upper position. Conveyor **242** again returns to its lower position for receiving a subsequent stack A. The foregoing steps are repeated until the pile of stacks in stack **140** reaches a height sufficient to trip limit switch **248**. Limit switch **248** is operative to stop the conveyor **242** in its uppermost position and simultaneously rotate belts **262** of conveyor **242**. This causes the pile of blanks resting on the belts to be discharged to the left, as shown in FIG. 3, upon driven roller **390** which aids in advancing the pile to conveyor **250** for further handling.

The pile in stacker **140** is comprised of individual small stacks, the alternate ones of such stacks being offset with respect to the next adjacent stack and alternate ones of the individual stacks facing upwardly and downwardly. As previously explained, the inverting mechanism is operative to place all stacks in either a face-up or face-down position so that the pile in conveyor **140** may have all of the stacks face up or face down. In addition, as previously explained, the off-setting mechanism is made operative to place all of the stacks in lateral endwise alignment so that the pile formed in stacker **140** has no off-set stacks.

Having thus described the invention in its best embodiment and mode of operation, that which is desired to be claimed by Letters Patent is.

I claim:

1. Offsetting apparatus for use with stack handling apparatus, comprising:

receiving means for receiving stacks of blanks sequentially from a supply of said stacks;

first offsetting means for engaging one side of a first stack of blanks;

second offsetting means for engaging a second side, opposite said one side of a second stack of blanks; and

discharging means for discharging said stacks from said offsetting apparatus,

said first offsetting means operative to urge said first stack in a first direction against said second offsetting means,

said discharging means operative to discharge said first stack prior to said second stack being received in said offsetting apparatus,

said first offsetting means operative to urge said second stack in said first direction against said second offsetting means,

said second offsetting means operative against said second stack simultaneously with said first offsetting means, said second offsetting means operative to urge both said first offsetting means and said second stack in a second direction opposite to said first direction for a predetermined distance,

said discharging means operative to discharge said second stack prior to a subsequent first stack being received in said offsetting apparatus,

whereby said first and second stacks are discharged in alternate offset relation.

2. The apparatus of claim **1**, and in addition, control means for rendering said second offsetting means inoperative against said second stack whereby both said first and

second stacks are urged against said second offsetting means so that said stacks are discharged in side-wise alignment.

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GERALD M. FORLENZA, Primary Examiner
R. J. SPAR, Assistant Examiner

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