Jan. 7, 1969 T. M. BAUM 3,420,387

BLANK HANDLING APPARATUS

Filed Jan. 5, 1967 Sheet 1 of 4

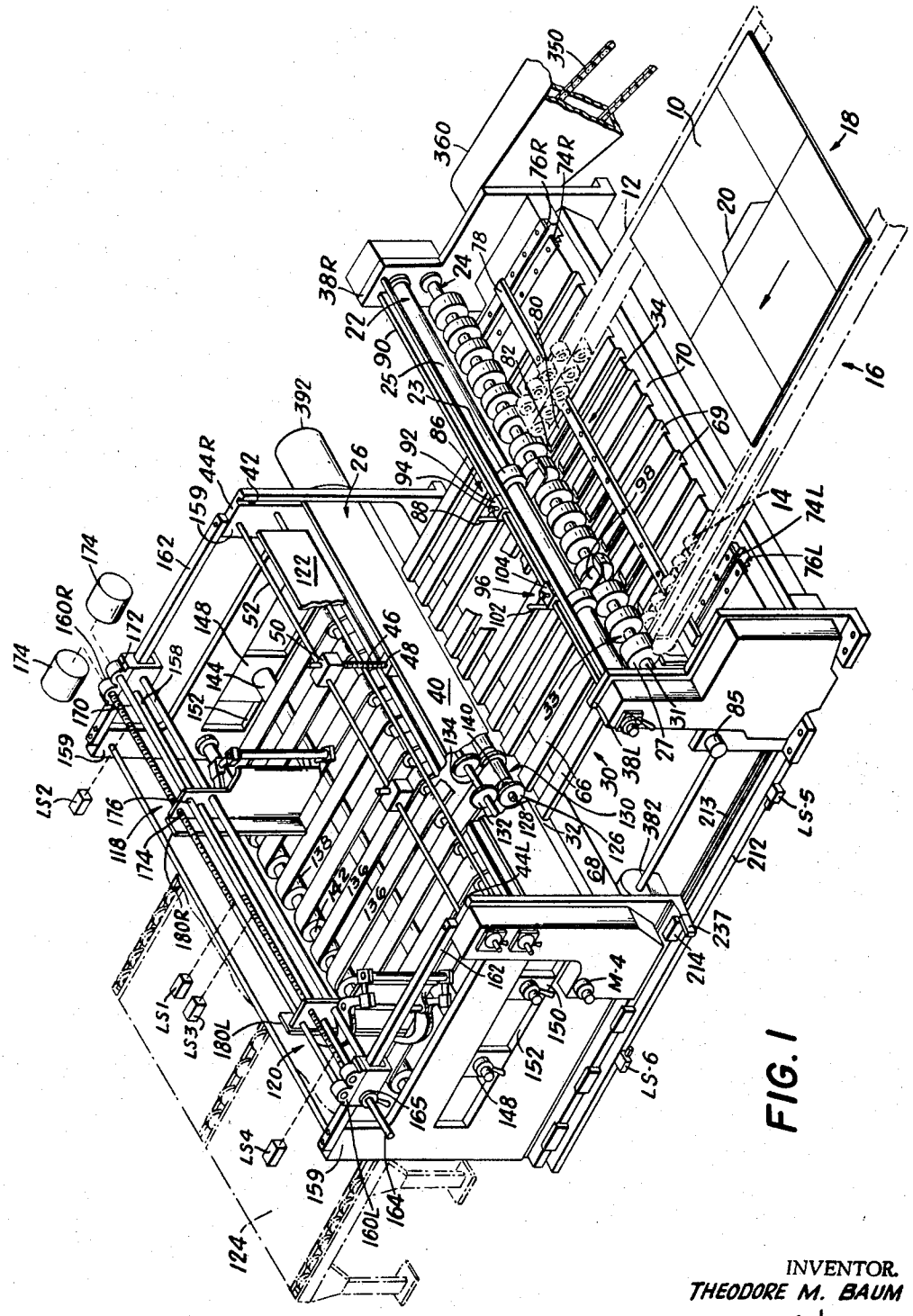


FIG. 1

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BLANK HANDLING APPARATUS

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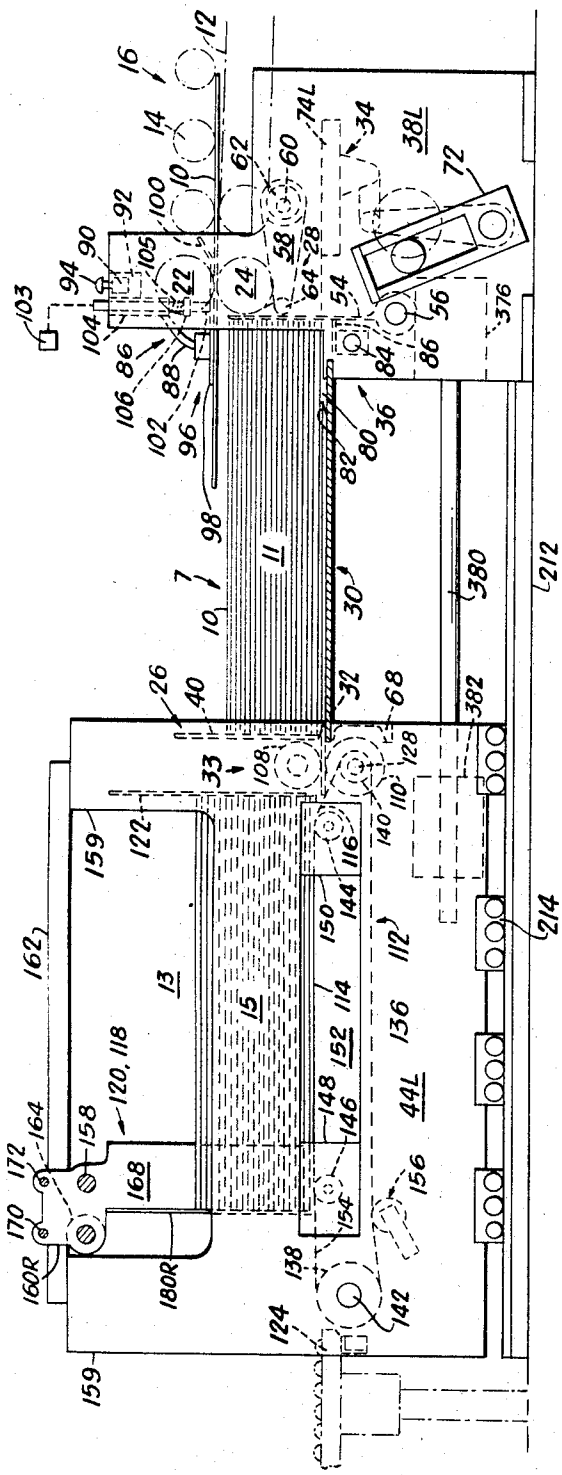


FIG. 2

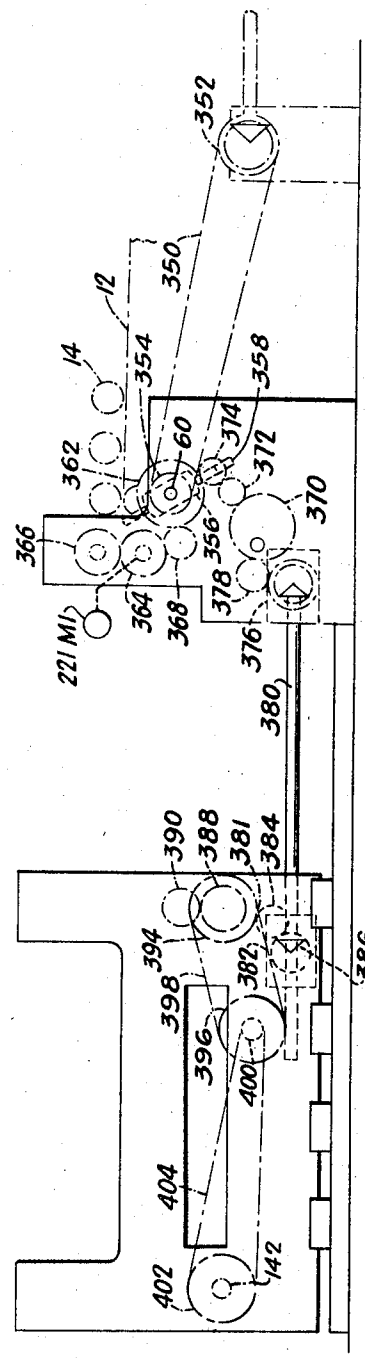


FIG. 4

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BLANK HANDLING APPARATUS

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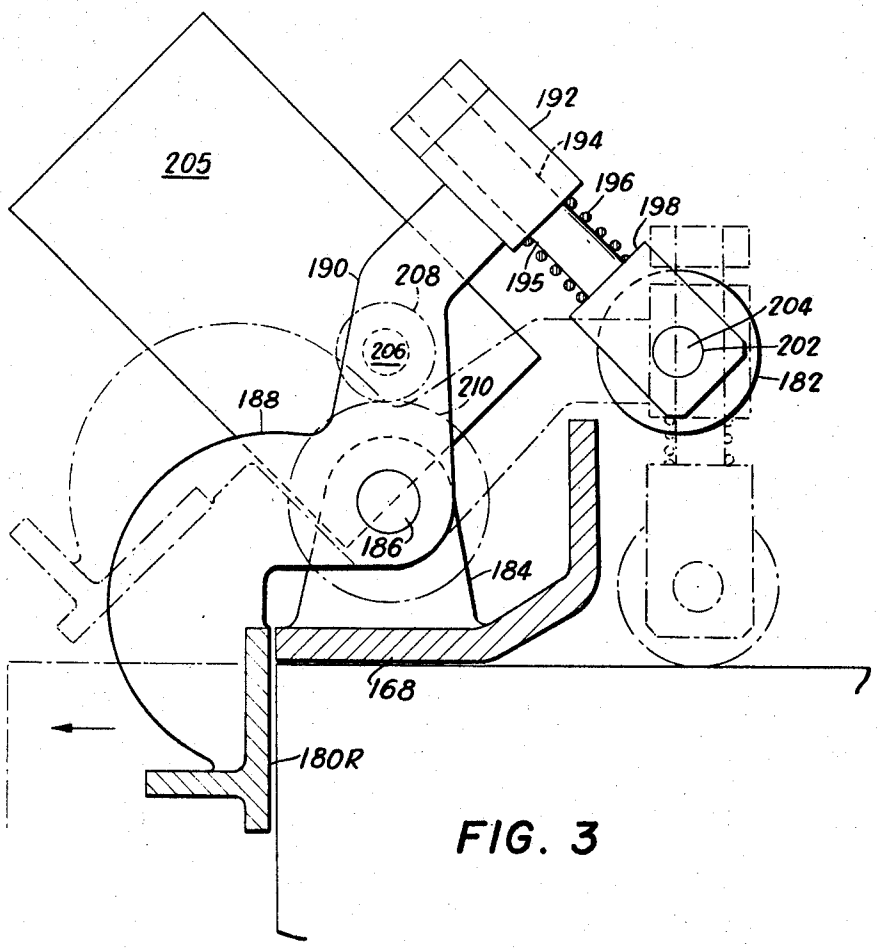


FIG. 3

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BLANK HANDLING APPARATUS

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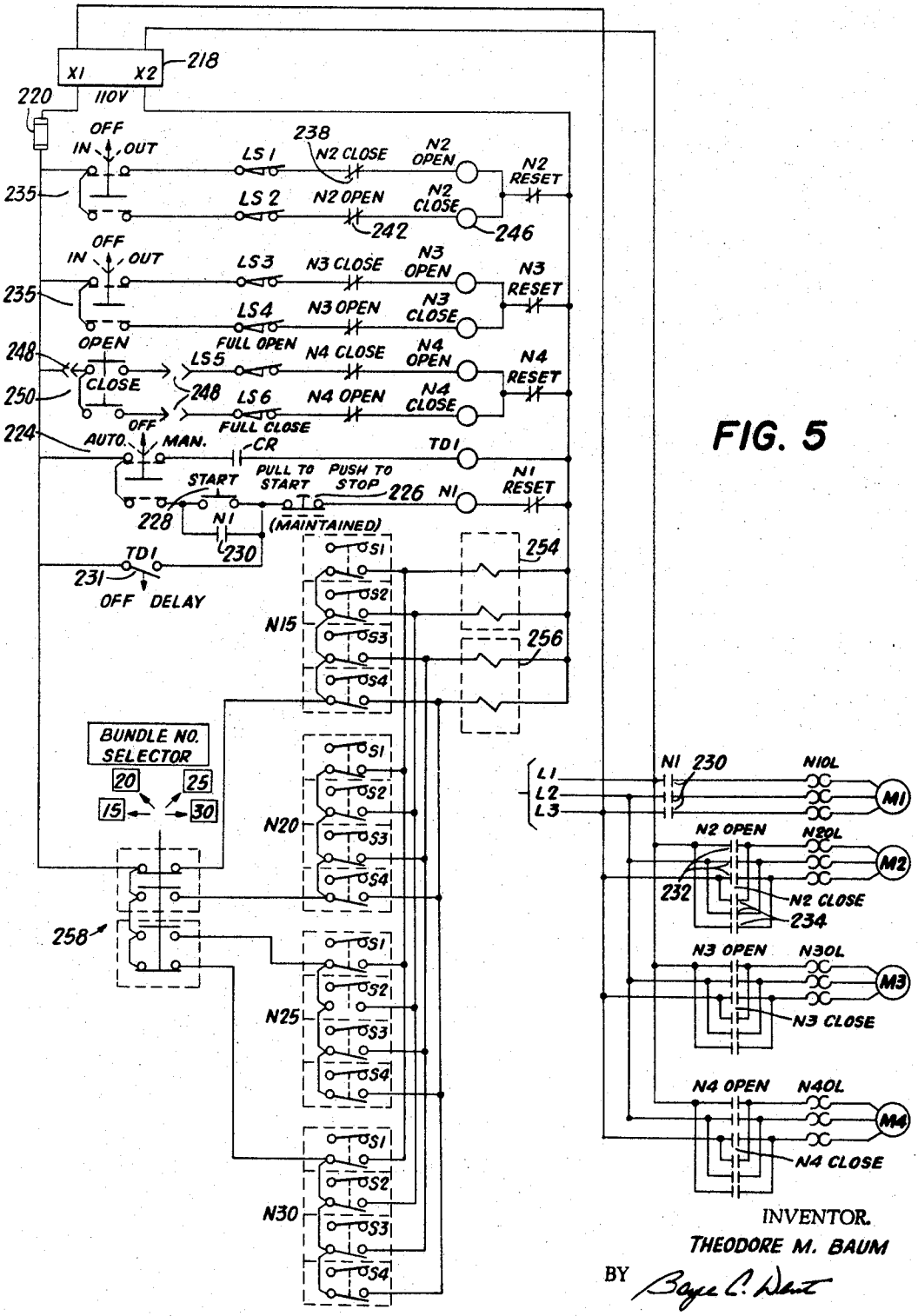


FIG. 5

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United States Patent Office 3,420,387
Patented Jan. 7, 1969

3,420,387

BLANK HANDLING APPARATUS

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Filed Jan. 5, 1967, Ser. No. 607,527
U.S. Cl. 214—6 4 Claims
Int. Cl. B65h 29/00

ABSTRACT OF THE DISCLOSURE

Apparatus for stacking a preselected number of corrugated blanks for tying into a bundle for shipping purposes comprises a first stacker for forming the individual blanks that are fed from a folder-gluer into a stack by action of an oscillating plate acting against the trailing edges of the blanks to square the blanks and force the leading edges against a feed gate; a reciprocating feeding mechanism for feeding the bottommost blank from the first stack to a final stacker where a second stack of blanks of predetermined number is formed on a continuously running conveyor by blanks fed to the underside of the second stack. The conveyor urges the leading edges of the blanks against a pair of stop-gates while a front guide for the trailing edges of the blanks prevent the stack from tipping over. The feeding of blanks from the first stack is interrupted upon completion of the final stack and simultaneously the stop-gates are pivoted out of engagement with the second stack to permit the removal of the stack by the conveyor.

This invention relates to stacking apparatus for receiving the individual blanks from a folder-gluer and for stacking the blanks into a stack of a predetermined number of blanks for tying and shipping as a bundle. Blanks folded and glued in conventional folder-gluer machines often leave the folder-gluer machine in an out of square condition. This condition, of course, must be corrected before the glue dries. It is desirable to have these individual blanks piled in a stack for subsequent bundling. In view of floor space and material handling considerations, it is also desirable to accomplish squaring and stacking in a straight line operation immediately following the folder-gluer. It is additionally helpful to have the squaring and stacking accomplished at substantially the same level that the blanks leave the folder-gluer. Since the folder-gluer is capable of processing blanks of various sizes, blanks squaring and stacking machines must possess a capability for handling blanks whose dimensions may vary widely. Besides this, it preferably is adjustable to provide stacks of blanks of preselected varying numbers for subsequent bundling preparatory to shipping.

The present invention provides apparatus for automatically stacking, squaring and delivering stacks of blanks of predetermined number at a position which is in lateral and substantial horizontal alignment with a folder-gluer machine. The invention contemplates a first stacker for receiving individual blanks from the folder-gluer, a final stacker for receiving individual blanks from the first stacker, a feed for feeding individual blanks from the first stacker to the final stacker at a rate greater than the individual blanks are received by the first stacker and a conveyor for discharging from the final stacker a stack of a predetermined number of individual blanks, and controls for stopping the feed during the discharge of the stack from the final stacker.

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.

In the drawings wherein like parts are marked alike:

FIGURE 1 is perspective view of the novel apparatus as it would appear when used in connection with a folder-gluer and delivery conveyor, both of the latter being shown in phantom lines;

FIGURE 2 is a side elevation of the apparatus shown schematically to best illustrate its operation;

FIGURE 3 is a top view of the stopgates in partial cross-section showing the two positions of the gates;

FIGURE 4 is a schematic diagram for the power train of the machine; and

FIGURE 5 is a wiring diagram of the electrical controls for the machine.

Referring to FIG. 2, there is provided a first stacker **7** for accumulating blanks **10** in a stack **11** as they are received in sequence from belt **12** of a folder-gluer machine **16**; a second stacker **13** for accumulating a final stack **15** of a preselected number of blanks; and a feeder comprised of feed rolls **33** and a reciprocating mechanism **34** for operatively connecting the stackers by feeding successive bottommost blanks from the first stack **11** onto the bottom of the second stack **15** until the desired number of blanks are in the second stack **15**, and a control system, FIG. 5, for interrupting the feeding of the bottommost blanks to the second stack **15** after a desired number of blanks have been fed to the second stack, and for discharging the final stack **15** of blanks from the machine and onto a conveyor **124** during the time that the feeding is interrupted and thereafter for continuing the feeding and stacking sequence.

The blank **10**, FIGS. 1 and 2, is shown as it is being discharged from between a conveyor **12** and pressure rollers **14** of a conventional folder-gluer **16**. Blank **10** enters into the first stacker **7** and undergoes the first phase of the stacking, squaring, and delivering operation in this portion of the machine that is hereafter referred to as the squaring-compression section. This first phase consists of accumulating the individual blanks **10** as a stack **11** of blanks and concurrently squaring the stack. The blanks have been folded into a tubular knocked-down carton shape in the folder-gluer as indicated generally at **18** in FIG. 1. Blank **10** has a corner tab **20** which has been glued to a corner of the blank. Since the blank may not be folded perfectly square in the folder-gluer **16**, a squaring plate assembly **28** is provided at stacker **7** to square the blank before the glued tab **20** has a chance to set.

The first stacker or squaring-compression section **7** comprises a pair of pull rolls **22**, **24** for maintaining control of the blanks as they leave the folder-gluer **16**; a feed gate **26** for arresting the forward travel of the blanks and (as will be later described) for metering the flow of blanks to the second stacker or bundle-ejector section **13**; an oscillating squaring plate assembly **28** at a position opposite the feed-gate **26** for periodically spanking the trailing edges of the blanks, thereby urging their leading edges against the feed gate **26** with enough force to square the blanks; a feed bed **30** for supporting the blanks as they settle to form a stack cooperative with the feed gate **26** so that the leading edge of the bed forms a gap **32** between the bed and the bottom of the feed gate **26** for metering only the bottommost blank into the bundle-ejector section **13**; a reciprocating feed mechanism **34** for engaging the trailing edge of the bottommost blank and urging the blank forward into gap **32** where feed rolls **33** feed it into the bundle-ejector section **13** as the lowermost blank and a feed interruptor **36** which is actuated after a preselected number of blanks have been fed to the second stacker **13** to raise the trailing edge of the stack to prevent engage-

ment by the feeder **34** for an interval of time after which time the stack is lowered and the feed cycle is repeated.

The blank **10** enters stacker **7** by way of a pair of pull rolls **22**, **24** which are journaled for driven rotation between a pair of spaced apart side frames **38L**, **38R**. These rolls are positioned at a level to receive the blanks **10** from the folder-gluer in the nip formed by the rolls. Upper roll **22** is journaled in conventional eccentrics (not shown) which can be simultaneously rotated in the known manner to move roll **22** closer to roll **24** to suit the caliper of the blanks.

Upper roll **22** is made by securing a pair of laterally spaced collars **23** for rotation with a shaft **25**. The collars **23** preferably have an outer elastomeric covering such as synthetic rubber to aid in gripping the blanks. The collars **23** are adjustable axially of shaft **25** so that they may be positioned to grip the blanks at any desired location, usually near the lateral edges. They may be secured in the selected location by means of set-screws (not shown).

Lower roll **24** is made by securing several laterally spaced collars **27** for rotation with a shaft **31** defining spaces **33** between them having a width about equal to that of collars **27**. Collars **27** are similar to collars **23** except that they ordinarily remain in a fixed location rather than being adjustable axially.

The forward movement of the blanks is arrested by a feed-gate **26** which comprises a lateral plate **40** having each end slidably nested in vertical slots **42** formed in the bundle-ejector side frames **44L**, **44R**. The plate **40** is raised or lowered to permit only one blank to pass through the gap **32** into the bundle-ejector section. Vertical adjustment is accomplished by rotating a pair of rods **46** threaded into plate **40** at location **48**. Rotation of rods **46** is effected by a pair of conventional miter gear assemblies **50** connected to the rods **46** and to a common cross shaft **52** which is rotatably secured between the side frames **44L**, **44R**.

The stack of blanks is maintained in alignment or squared by way of an oscillating squaring plate assembly **28**, particularly by a plate **54** that is pivotably supported by a cross shaft **56** which, in turn, is supported between side frames **38L**, **38R**. When plate **54** is in the vertical position, one face of plate **54** is coplanar with the trailing edges of the blanks in the stack. When the plate is oscillated about shaft **56**, plate **54** moves away from the stack at an angle and then returns to coplanar contact. If any of the blanks are out of square, some of the edges of the blanks will protrude beyond the desired planar surface (both leading and trailing edges), and the plate **54** will force them into alignment by spanking the blank against the feed gate **40**. It can be observed that each blank may be subjected to the spanking action several times as the blank moves downward in the stack.

Oscillation of plate **54** is accomplished by connecting the plate by a connecting rod **58** to a drive shaft **60** which has an eccentric **62** connected for rotation therewith. Connecting rod **58** encircles the eccentric **62** so that as the drive shaft **60** rotates, the rod **58** is caused to reciprocate and, being connected to plate **54** by a conventional pin connection **64**, causes plate **54** to oscillate about cross shaft **56** to which it is pivoted. In the event the folder-gluer is subsequently improved to the extent that the folded blanks are squared prior to leaving the machine, the squaring plate assembly **28** would not be required. The squaring-compression section would operate substantially in the same manner except that plate **54** could be stationary.

The stack **11** of blanks accumulates or piles up on a feed bed **30**. A number of spaced apart slats **66** constituting bed **30** extend longitudinally of blank travel with their downstream ends secured to a cross member **68** mounted between side frames **44L**, **44R**. The upstream ends of slats **66** rest in corresponding grooves **69** provided in a cross member **70** mounted between side frames **38L**, **38R**.

The lowermost blank of stack **11** is fed onwardly toward the second stacker **13** by reciprocating feed mechanism **34** and feed rolls **33**. Mechanism **34** is conventional. As illustrated herein, a feed mechanism such as described in Greenwood Patent No. 2,705,143 issued Mar. 29, 1955, is used except that the skip-feed feature described in the Greenwood patent is not required in the present machine. Briefly, the feed mechanism **34** comprises a Whitworth crank mechanism **72** which imparts reciprocating motion through suitable gearing and levers to a pair of kicker bars **74L**, **74R** which are slidably situated in a pair of corresponding spaced apart slots **76L**, **76R** provided in cross member **70**. A feeder bar **78** spans the kicker bars and is secured to the bars at each end. Feeder tongues **80** are secured to the feeder bar **78** so that the tongues extend forwardly towards the bottommost blank of the stack resting on feed bed **30**. The feeder tongues **80** are spaced intermediate the grooves **69** carrying slats **66** and thus rest on the cross member **70**. The forward or leading edge of tongues **80** are inclined upwardly toward the rear to a point short of intersection with the top plane of the tongue at which point the incline becomes vertical thus forming a ledge **82** which engages the trailing edge of the bottommost blank to urge it forward upon each forward stroke of the feeder bar **78**. In this manner, each succeeding bottommost blank is fed into the downstream bundle-ejector section until the feeding action is stopped by a feed interruptor **36**.

Feed interruptor **36** comprises a cross shaft **84** rotatably mounted in side frames **38L**, **38R** in a position beneath the trailing edge of the stack of blanks **11** resting on feed bed **30**. A number of fingers **86** are spaced along the shaft and secured to the shaft so as to fit alternately between the slats **66** and feeder tongues **80**. Upon the pivoting of cross shaft **84**, fingers **86** engage the bottom of the stack **11** and lifts it upward. Now, the ledge **82** of feeding tongues **80** cannot engage the trailing edge of the bottommost blank.

Shaft **84** is pivoted about 30–60° (the amount is not critical) by a conventional rotary air cylinder **85** attached to one end of the shaft and anchored to one of the side frames **38L** or **38R**. Air cylinder **85** rotates shaft **84** in response to a signal from one of four conventional rotary limit switches N–**15**, N–**20**, N–**25**, N–**30**, FIG. 5, geared to drive shaft **60**. An air cylinder such as a ROTA–CYL Model 2.5 made by Graham Engineering Company, Palo Alto, California, can be used for this purpose. Shaft **60** completes one revolution for each blank leaving the folder-gluer. One rotary limit switch N–**15** is geared to transmit a signal to the air cylinder **85**, for example, after fifteen blanks have entered the hopper, and the remaining three switches N–**20**, N–**25** and N–**30** are geared to transmit signals corresponding to 20, 25 and 30 blanks entering the hopper. A selector switch **258** connects the air cylinder to the proper rotary switch corresponding to the number of blanks desired in the final stack **15**.

Also included in the squaring-compression section is an air holddown assembly **86**. As a blank exits from between the pull rolls **22**, **24**, assembly **86** directs a jet of air against the top trailing edge of each blank. This forces the trailing edge of the blank down against the top of the stack so that the leading edge of the following blank does not jam against the trailing edge of the foremost blank.

Air holddown assembly **86** comprises an air nozzle **88** in communication with a suitable air supply (not shown) and supported on a cross bar **90** mounted between side frames **38L**, **38R**. The support may be in the form of a collar **92** around cross bar **90** which can be secured in a selected lateral position by a clamp screw **94**. Nozzle **88** is secured to support **92** by means of a U-shaped clamp or the like.

Also included in the squaring-compression section is a jam switch **96** which, when triggered, will signal the main drive for the folder-gluer to stop its operation. Thus, if a

jam-up occurs, the machine will stop until the obstruction is removed.

Jam switch **96** as illustrated in FIG. 2 comprises a flat plate **98** that is placed between pull rolls **22, 24**. The upturned end **100** of plate **98** is spaced in front of the pull rolls to aid in guiding the blanks **10** between the rolls. Plate **98** extends in the space between the collars **23** of upper pull roll **22** so as not to interfere with the pulling action of the rolls **22** and **24** against the blanks. Secured to the top of plate **98** is a rod **102** which extends through a collar **104** resembling collar **92** and secured in similar fashion to cross bar **90**. A spring **105** between a shoulder **106** on rod **102** and the collar **104** maintains the plate **98** in operating position. A stop mounted on the opposite end of rod **102** (not shown) prevents the spring **104** from over-extending the plate **98** into the path of the blanks. If for some reason the stack of blanks **11** builds up to the point of interference with blanks leaving the folder-gluer, the plate **98** will be elevated and, through rod **102**, trigger a conventional limit switch **103** located adjacent the upper end of rod **102**. When triggered by the rod, switch **103** transmits a signal to stop the main drive motor of the folder-gluer. The main drive motor will remain stopped until the plate **98** is returned to its operating position. If preferred, the air holddown assembly can be combined with the jam switch to form an integral assembly.

The lowermost blank that is fed through the gap **32** between gate **26** and support **30** is fed into the second stacker **13** as the lowermost blank of stack **15** by way of feed rolls **33** which are comprised of a pair of driven pull rolls **108, 110**. These rolls pull the blanks into the bundle-ejector **13** as they are fed through the gap **32** formed by the feedgate **26** and the feed bed **30**. The movement of the blank is also aided by a driven conveyor assembly **112** that has an upper run **114** slightly higher than the top of feed bed **30**. The upper run is supported on the lower pull roll **110** so that the upper run has an upstream inclined portion **116** for guiding each blank under the stack being formed.

Stacker **13** also includes a pair of back-stop assemblies **118, 120** against which the blanks are urged by the upper run **114** of conveyor **112** and a front guide **122** to prevent the stack of blanks from tipping over. An actuator **205**, FIGURE 3, pivots the back-stop assemblies **118, 120** about **186** out of the path of travel of the blank, following actuation of the feed interruptor **36**. Conveyor assembly **112** now ejects the accumulated stack **15** of blanks onto an idling roller conveyor **124**. At this time, no blanks are being fed from stack **11** into the bundle-ejector section because fingers **86** have lifted the trailing edge of stack **11** out of engagement with the feed tongues **80**. A manual adjustment **164** adjusts the lineal position of the back-stop assemblies **118, 120** for accommodating preselected lengths of blanks. A motor opening assembly (motor M–4, rack **213**) adjusts the lineal position of the bundle-ejector section **13** in relation to the squaring-compression section **7** to adjust the latter section to accommodate the same preselected length of blanks.

Pull rods **108, 110** of feed roll unit **33** are journaled for driven rotation between spaced apart side frames **44L, 44R** at a level to receive in the nip between them the blank that is being fed through the gap **32** between feed gate **26** and bed **30** by the reciprocating feed mechanism **34**. Advantageously, upper roll **108** is journaled in conventional eccentrics (not shown) which can be rotated in the known manner to move roll **108** closer to roll **110** and change the nip openings to suit the caliper of the blanks. Lower roll **110** is made by securing several laterally spaced collars **126** for rotation with a shaft **128** defining spaces **130** therebetween. Upper roll **108** is made by securing a corresponding number of laterally spaced collars **132** for rotation with a shaft **134** in radial alignment with lower collars **126**. Upper collars **132** are preferably steel and lower collars **126** are preferably covered with synthetic rubber around their outer periphery. Thus, the blanks **10** are gripped between the opposing collars **136** and **126** and forced under stack **15** as the lowermost blank.

Conveyor assembly **112** for cooperating with feed roll unit **33** comprises a plurality of conveyor belts **136** encircling aligned pairs of pulleys **138, 140**. Pulleys **138** are secured for rotation with a driven pulley shaft **142** spaced downstream from lower pull roll **110**. Pulleys **140** are mounted around bushings (not shown) situated on lower pull roll shaft **128** in the spaces **130** between the lower pull roll collars **126**. This arrangement permits pulleys **140** to free-wheel around shaft **128**. Pulleys **140** have an outer diameter smaller than the outer diameter of pull roll collars **126** so that the conveyor belts **136** encircling the pulley do not protrude vertically above the periphery of the lower pull roll collars into the nip between them and the upper pull roll. As best illustrated in FIG. 2, a pair of idler rolls **144, 146** are provided to support the upper run **114** of belts **136** at a level slightly higher than the top surface of feed bed **30**. Preferably, idler rolls **144, 146** are journaled for rotation in slide blocks **148, 150** placed in a slot **152** in side frames **44L, 44R**.

The upstream and downstream pairs of slide blocks **148, 150** are adjustable towards and away from each other and can be clamped in position by any convenient clamping means. Thus, it can be seen that this adjustment provides means for adjusting the inclined portion **116** of belts **136** between lower pull roll **128** and idler roll **144** and an inclined portion **154** between idler roll **146** and pulley shaft **142**. It may be desirable to adjust the amount of incline depending on the length of blank being handled to prevent tipping of the stack. Pulley shaft **142** is driven at about one-eighth pull roll speed for minimum length blanks and up to one-half pull roll speed for maximum length blanks. This provides an additional measure of control over the blanks to prevent tipping of the stack being formed.

A conventional belt tightener **156** is provided for maintaining the desired tension on conveyor belts **136**.

Since the dimensions of the blanks being stacked may vary, stacker **13** is made adjustable. Accordingly, back-stop assemblies **118, 120** for the stack **15** of blanks are mounted for lateral adjustment on a pair of cross-rods **158**. Cross-rods **158** are supported in slide carriages **160L, 160R** through which racks **162** pass in meshing engagement with toothed pinions **164** secured to the ends of one of the cross-rods **158** which is rotatable. Racks **162** are supported between upstanding portions **159** of the side frames **44L, 44R**. An end **164** on the rotatable cross-rod extends through carriage **160L** and is adapted to receive a ratchet wrench (not shown) for rotating the cross-rod for moving the carriages **160L, 160R** upstream or downstream. A conventional pinch type clamp **165** is provided on cross-rod end **164** to lock the cross-rod against rotation once it has been rotated to the desired position. In this manner, back-stop assemblies **118, 120** are moved toward or away from front guide **122** to correspond to the length of blanks being handled. It should be understood that a suitable gear motor can be provided for rotatable connection with cross-rod end **164** to replace the manual adjustment just described.

Front guide **122** for the stack **15** comprises an upstanding plate suitably secured between side frames **44L, 44R** immediately behind upper pull roll **108**. The top of front guide **122** extends a little beyond the maximum height of the stack to be formed. The bottom of the guide terminates above the lower surface of the upper pull roll **108** so as not to interfere with the blanks being fed onto the bottom of the stack.

To provide for lateral adjustment of back-stop assemblies **118, 120** to accommodate the width of the blanks being handled, the back-stop assemblies have corresponding side plates **166, 168**. A pair of threaded screws **170, 172** are provided adjacent to and parallel with cross-rods **158**. Each threaded screw has threads formed thereon

beginning near the lateral center of the machine with the threads on one screw extending to the left and on the other to the right-hand side of the machine. A pair of holes **174**, **176** are provided in side plates **166**, **168** of which alternate ones are threaded for engagement with one of the pair of screws **170**, **172** passing through the holes. The unthreaded hole slides along the unthreaded portion of the adjacent screw. The ends of screws **170**, **172** are supported for rotation in slide carriages **160L**, **160R**. Thus, it can be seen that simultaneous rotation of both screws causes the back-stop assemblies to either move toward or away from the center of the machine depending upon the direction of rotation of the screws. One end of each threaded screw **170**, **172** is secured for driven rotation with one of two gearmotors **174** mounted to slide carriage **160R**. Suitable pushbutton controls are provided to run the gearmotors in the appropriate direction to position the backstop assemblies relative to the center of the machine.

Besides being adjustable to accommodate various size blanks, back-stop assemblies **118**, **120** are designed to arrest forward travel of the blanks as a stack is being formed and then to be disengaged from the stack at the proper interval to permit the stack to be ejected from the bundle-ejector section and onto, for example, a roller table **124** where the stack may be tied with string for handling and shipping. This is accomplished by providing gate-stops **180L**, **180R**, against the leading edges of the blanks and pivotable about a vertical axis to a position out of engagement with the stack immediately following engagement of feed interruptor **36**. With the gate-stops **180L**, **180R** out of engagement, conveyor assembly **112**, which runs continuously, moves the stack of blanks downstream for further handling.

Preferably an upstanding side roller **182** is provided to engage each side of the stack when the gate-stops are retracted to provide a reduced friction side guiding surface for the stack as it is ejected. This roller engages the side of the stack so that all the blanks move forward simultaneously.

The construction of the right-hand back-stop assembly **118** may be more readily understood by reference to FIG. 3 wherein there is illustrated sideplate **168** for loosely engaging the side of the stack. The lower portion of sideplate **168** terminates just short of touching the tops of conveyor belts **136** and the upper portion extends above the top of the stack wherein the aforementioned holes for cross-rods **158** and threaded screws **170**, **172** are provided.

A pair of spaced apart upper and lower lugs **184** are formed on the outside of sideplate **168** between which a pivot rod **186** is supported. Gate-stop **180R** includes a pair of arms **188** through which pivot rod **186** passes for pivotal support. Another pair of arms **190** are formed substantially diametrically opposite arms **188** for mounting side roller **182**.

Arms **190** include an enlarged portion **192** with a hole **194** through which a pin **195** is kept in an extended position by means of a coil spring **196** between a shoulder portion **198** and enlarged portion **192**. Pins **194** have vertically aligned holes **202** for receiving reduced diameter end portions **204** of rotatable rubber covered side roller **182**.

The geometry of arms **188** and **190** is such that when gate-stop **180R** is engaging the leading edges of the blanks, side roller **182** is out of engagement with the sides of the blanks. When gate-stop **180R** is pivoted out of engagement about pivot rod **186**, side roller **182** moves into engagement with the sides of the blanks. The proportions are such that spring **196** is compressed by engagement of side roller **182** with the blanks so that the roller compensates for any unevenness of the blanks.

The alternate position of the gate-stop and side roller is indicated by phantom lines in FIG. 3. To pivot the gate-stop **180R** from the engaged to the disengaged position there is provided a conventional rotary air cylinder **205** (such as described for use with the feed interruptor) whose output shaft **206** is connected to pivot rod **186** by means of meshing spur gears **208** and **210** of which gear **208** is secured for rotation to output shaft **206** and gear **210** is secured for rotation with pivot rod **186**. Since gate-stop **180R** preferably rotates about 45° from one position to the other and output shaft **206** rotates about 90°, the ratio of gear **210** is about 2:1 with gear **208**. This ratio is not critical and other arrangements can be used if desired.

Rotary air cylinder **205** can be mounted by means of suitable brackets (not shown) to side plate **168**. A conventional double acting solenoid air value is provided in the air supply to cylinder **205** to rotate output shaft **206** in one desired direction. The valve is triggered by a signal from one of the rotary limit switches N–15, N–20, N–25 or N–30 being used to signal the feed interruptor **36**. Thus, when the feed interruptor **36** stops the feeding of blanks into the bundle-ejector section **13**, the gate-stops **180L**, **180R** swing out of contact with the blanks, the side rollers **182** engage the side of the stack, and conveyor **112** moves the stack out of the machine onto idling conveyor **124** for subsequent handling.

To adjust the lineal position of the bundle-ejector section in relation to the squaring-compression section to accommodate the selected blank length, there is provided a pair of rails **212** anchored to the floor. These rails are adapted to guide a number of roller cages **214** secured to the bottom of side frames **44L**, **44R**. A toothed rack **213** is secured to the inside wall of each rail **212**. Meshing with each rack is a pinion gear on the output shaft of a pair of miter gear boxes (not shown) each of which is respectively secured adjacent the rack on the inside of side frames **44L**, **44R**. The gear boxes are linked for simultaneous rotation by a shaft which is connected to a gearmotor M–4 mounted to side frame **44L**. Thus, upon rotation of gearmotor M–4, the pinion gears meshing with the racks **213** pull the bundle-ejector section towards or away from the squaring-compression section. This, of course, moves feed gate **40** in relation to the oscillating squaring plate **54** for setting the proper distance between them for the blank selected. The mechanism just described for moving one section relative to another is conventionally used on box machines such as printer-slotters.

The power train, FIGURE 4, for running the machine is comprised of conventional elements such as chains and sprockets, spur gears, and clutches. The manner in which they are mounted and connected is well known in the art so that only a brief description is deemed necessary. Referring now to FIG. 4, the machine is powered by a chain drive **350** from a take-off sprocket **352** on the folder-gluer to a sprocket **354** on the end of drive shaft **60**. Sprocket **354** rotates drive shaft **60** through a conventional manual clutch **356** having an engaging/disengaging handle **358**. A friction clutch such as bronze bushing type 8B made by Link-Belt Company, 301 W. Pershing Road, Chicago, Ill., is satisfactory for this purpose. Its operating handle may be used to disengage the clutch from the chain drive. In this manner, the squaring-compression section or the bundle-ejector section can be easily maneuvered. For example, the oscillating squaring plate **54** can be manually pivoted to its extreme upright position for gauging the hopper opening when setting up for a different size blank. The chain drive **350** and clutch **356** are enclosed in a suitable guard **360** as shown in FIG. 1.

On the opposite end of drive shaft **60**, a spur gear **362** is mounted for meshing engagement with spur gears **364**, **366** on the ends of pull rolls **24** and **22** through an idler gear **368** mounted to the side frame to provide the correct direction of rotation. Gear **364** rotates lower pull roll **24** through an overrunning clutch **221** as previously mentioned, so that when the lower roll is rotated by the auxiliary motor M–1, gear **368** does not try to back-drive the remainder of the machine. A satisfactory clutch to per-

form this function is a Formsprag FSO–500 type made by Formsprag, 23601 Hoover Road, Warren, Mich.

A crank gear **370** mounted to the side frame is driven by gear **362** through a pair of idler gears **372, 374** which are also mounted to the side frame. The idlers provide the proper direction of rotation for crank gear **370**. As previously mentioned, crank gear **370** is used to provide reciprocation of the feed mechanism **34**. It has also been pointed out that a connecting rod **58** between the drive shaft **60** and the squaring plate **54** operates to oscillate the squaring plate.

A bevel gear box **376** is mounted to the side frame and connected to crank gear **370** by an idler **378** also mounted to the side frame. Gear box **376** contains conventional bevel gears for changing the output direction of the power train at right angles to the input. This arrangement permits connection of a line shaft **380** between gear box **376** and a corresponding bevel gear box **382** mounted to the side frame of the bundle-ejector section. Power is transmitted to the latter section through the line shaft **380** where it again changes direction to rotate gear **381** on the end of lower pull roll **110** through an idler gear **384** mounted to the side frame. The line shaft **380** has a sliding, splined connection with bevel gear **386** in gear box **382** so that the bundle-ejector section can be moved toward and away from the squaring-compression section without affecting the power transmitted by line shaft **380**.

A pair of gears **388, 390** on the ends of pull rolls **110** and **108** mesh to provide driven rotation for upper roll **108**.

A variable ratio pulley unit **392** has its input driven from the opposite end of lower pull roll **110**. Input pulley **394** is connected to output pulley **396** by a belt **398**. A hand-rotated control (not shown) is provided for changing the relative diameters of pulleys **394, 396** to provide a variable output speed on a shaft to which a spocket **400** is mounted. An example of a pulley unit satisfactory for this purpose is a variable pulley No. 412 made by Leuellen Manufacturing Company, Columbus, Ind. Conveyor shaft **142** is driven by a sprocket **402** mounted on its end connected with sprocket **400** by a chain **404**. In this manner, the speed of conveyor **112** can be varied between one-eighth and one-half blank speed as previously pointed out.

The gear and sprocket diameters are chosen to give the ratios required to operate the various parts of the machine at different speeds, as desired. Since the selection of such ratios is commonplace, no further description is considered necessary in this regard.

FIG. 5 is a wiring diagram illustrating the various electrical controls for the machine. The portion of the circuit for each control function is labeled to correspond to that portion of the machine being controlled. The motors M_1, M_2, M_3 and M_4 are conventional and may, for example, as illustrated be energized by 220/440 volt three phase-60 cycle current supplied through leads L_1, L_2, and L_3. The various relays, limit switches, etc. are energized by 110 v. single phase 60 cycle current supplied through leads X_1 and X_2 from a control tranformer **218**. A fuse **220** is provided in X_1 to prevent damage to transformer **218** in the event of a malfunction.

The first control function is for the pull rolls **22** and **24** for which provision is made to keep the rolls rotating for a predetermined length of time after the main drive is stopped so that the last blank leaving the folder-gluer will be fed into the squaring-compression section, and to permit manual control of the rolls during set-up of the machine or to clear a jam-up.

Unidirectional motor M_1 is provided to rotate pull rolls **22** and **24** through a conventional overrunnig clutch **221** mounted to one end of the lower roll **24**. The upper roll **22** is driven by a gear **366** mounted on one end in mesh with a gear **364** mounted on the corresponding end of the lower roll **24**.

To control motor M_1 the control circuit is divided into a manual and automatic portion. The automatic portion comprises an auto-manual switch **224** (common to both portions of the circuit) in series with CR contacts (control relay) located in the main drive cabinet for the folder-gluer. CR contacts automatically close when the main drive is energized and with the auto-manual switch on automatic, the circuit is completed to energize motor M_1. When this portion of the circuit is completed, a coil TD1 is energized to close relay contacts N1 (**230**) in the supply line to motor M_1. Coil TD1 also closes time delay relay contacts TD1 (**231**) which remain closed X seconds after coil TD1 is deenergized (X can be adjusted). Thus, when the main drive is stopped, CR contacts open, breaking the circuit. But, time delay relay contacts TD1 complete the circuit through push-pull switch **226** (in the start position), thus, coil N1 is energized to keep contacts N1 closed to energize motor M_1. After X seconds have elapsed, time delay contacts TD1 open, breaking the circuit to the motor. In this manner, the pull rolls are rotated by motor M_1 for X seconds after the main drive is stopped.

To operate motor M_1 manually, switch **224** is pushed to the "manual" position. Push-pull switch **226** is pulled to the "start" position. Start button **228** is pushed which completes the circuit through coil N_1 which closes relay contacts N_1 (**230**) after which start button **228** may be released. Contacts **230** complete the circuit to motor M_1.

It will be observed that there are thermal overload switches N1OL in the line between relay contacts N_1 and motor M_1. These contacts open in the event of overload and automatically open the normally closed reset relay contacts N_1 in the manual circuit. When the overload ceases, reset contacts N_1 are used to reset overload switches N1OL. In the event of an overload occurrence when operating in the automatic mode, similar reset contacts are opened in the main drive (not shown).

Each of the other circuits shown contain similar overload and reset relay switches and no further description of these is necessary.

Each of the backstop assemblies **118** and **120** are laterally positioned by motors M_2 and M_3 as previously described. Since the control circuits are identical for each motor, only the circuit for motor M_2 will be described. The circuit is divided into two portions, one of which closes relay contacts N_2 (**232**) to run motor M_2 in one direction and the other which closes contacts N_2 (**234**) to run motor M_2 in the opposite direction. A three-position selector switch **235** is common to both portions and when in the "in" position completes the circuit through a normally closed limit switch LS1, a normally closed relay N_2 (**238**), a coil N_2 and a normally closed reset relay N_2. With the circuit completed, coil N_2 closes contacts N_2 (**232**) to motor M_2. Coil N_2 also opens normally closed relay N_2 (**242**), as a safety precaution, to prevent accidental closing of both contacts N_2 (**232** and **234**) simultaneously. The other portion of the circuit operates in similar fashion when the selector switch **235** is in the "out" position. In this position, coil N_2 (**246**) opens normally closed relay N_2 (**238**).

The limit switches LS1 and LS2 are mounted on some stationary portion of the machine with LS1 being near the center of the machine and LS2 being near the side frame in alignment with the backstop assembly **118**. They are positioned to limit the amount of lateral travel of the backstop assembly so that it does not move too far in either direction. When the backstop assembly hits either of the switches, the circuit is broken and the selector switch **235** must be turned to the opposite position to operate the motor M_2 in the opposite direction. This will restore the activated limit switch to its normal position.

The motor opening circuit is used to control motor M_4 to adjust the bundle-ejector section **13** in relation to the squaring-compression section **7**. Motor M_4 is reversible and controlled by a divided circuit similar to the circuit used for the backstop assemblies. There are two differ-

ences, of which the first is the limit switches LS5 and LS6. These switches are mounted to the side rail **212** in a position to be actuated respectively by a cam **237** secured to the frame **44**L. The purpose of the switches is to prevent the bundle-ejector section from being positioned beyond designed for maximum and minimum distances from the squaring-compression section.

Also shown in the motor opening circuit are opening circuit jacks **248** which are provided as a matter of convenience to permit the selector switch **250** to be plugged into the circuit.

The remainder of the control circuit is for controlling the feed interruptor **36** and the pivoting backstop assemblies **118** and **120**. The rotary air cylinder **85** previously mentioned rotates clockwise or counterclockwise in response to pressurized air directed in the appropriate directions by a solenoid operated air valve. Rotation of the air cylinder raises or lowers the stack of blanks by the rotation of fingers **86**.

The rotary air cylinder **205** previously mentioned pivots the stop-gates **180**L, **180**R in the appropriate direction in the same manner.

The air solenoid for operating the feed interruptor **36** is illustrated at **254** and the air solenoid for operating the stop-gates **180**L, **180**R is illustrated at **256**. These solenoids are energized by one of four separate circuits designated as N–**15**, N–**20**, N–**25** and N–**30**. Each of these circuits are energized by a selector switch **258** which is manually turned to place the desired pair of contacts in series with one of circuits N–**15**, N–**20**, N–**25** or N–**30**. Each of the latter circuits comprise conventional rotary limit switches geared to drive shaft **60** so that N–**15** will operate after the drive shaft has rotated 15 revolutions; N–**20** will operate after the drive shaft has rotated 20 revolutions and so on. Since one blank enters the squaring-compression section hopper for each revolution of the drive shaft and the remainder of the machine is in timed sequence, it is obvious that a stack in the bundle-ejector section will be dicharged with the desired number of blanks as selected by selector switch **258**.

Each rotary limit switch has cooperating pairs of contacts S**1**, S**2**, S**3**, and S**4**. The switch is arranged so that upon operation after the correct number of revolutions of the drive shaft **60** occurs, S**1** contacts close to energize solenoid **254** to actuate the feed interruptor. Thereafter, S**3** contacts close to energize solenoid **256** to pivot gate-stops **180**L, **180**R out of engagement with the stack in the bundle-ejector section. The switch is adjustable to vary the time interval between closing of contacts S**1** and S**3**. The adjustment is made to allow sufficient time for the last blank being fed, after actuation of the feed interruptor, to contact the gate-stops before they are opened to discharge the final stack. Thereafter, contacts S**2** and S**4** close simultaneously to energize both solenoids **254** and **256** to return the feed interruptor **36** and the gate-stops **180**L, **180**R to their original positions for the next cycle. An example of a rotary limit switch suitable for this purpose is a standard 4 cam type 2000–92 made by Gemco Electric Company, Clawson, Mich.

It should be understood that other type switches can be used to count the blanks and at other locations on the machine. For example, ratchet-type limit switches could be provided for triggering by the leading edge of the blanks as they enter gap **32** between feed bed **30** and feed gate **40**. Four switches could be used of which one would furnish a signal after being triggered 15 times, another would furnish a signal after 20 times and so on. A selector switch as described above would be used to determine which limit switch was to be activated.

Operation

To operate the machine, one of the blanks to be handled is placed on the feed bed **30** with its trailing edge resting against the oscillating squaring plate **54** which is in the upright position. (This position can be obtained by jogging the machine by actuating the main drive control until the plate is vertical.) The selector switch **250** is used to move the bundle-ejector section towards (or away from) the squaring-compression section until the feed gate **40** rests loosely against the leading edge of the blank.

The same blank may then be used to set up the bundle-ejector section by placing the blank on the conveyor **112** with its trailing edge resting against front guide **122**. Shaft end **164** is rotated manually to move the gate stop assemblies **118**, **120** loosely against the leading edge of the blank. Shaft **158** may be locked in position by clamp **165**. Switches **235** may then be used to operate motors M_2 and M_3 to move the backstop assemblies **118** and **120** into edgewise contact with the blank. If desired, the inclined portion **116** of conveyor **112** may be adjusted to suit the length of blank being handled.

If the thickness of the blanks is different from the preceding order, both upper pull rolls **22** and **108** may be adjusted to give the proper gap between them and the lower pull rolls **24** and **110**.

A stack of blanks is then placed in the squaring-compression section hopper to the height of the oscillating plate **54**. The pull roll drive selector switch **224** is placed on "automatic." The bundle selector switch **258** is positioned to the selected number of blanks desired in the final stack. The machine is now ready to run.

The ratios of the gears in the power train is such that the pull rolls **22** and **24** in the squaring-compression section rotate at blank speed. The drive shaft **60** also rotates at blank speed, that is, it makes one revolution for each blank entering the hopper. Thus, the rotary limit switches N–**15**, N–**20**, N–**25** and N–**30** geared to the drive shaft determine the desired number of blanks in the final stack by counting the appropriate number of revolutions of the drive shaft.

A factor in the successful operation of the machine lies in running the feed mechanism **34** to remove blanks from the first stack **11**, during the feed cycle, at a faster rate than they are deposited on top of this stack. Otherwise, during a dwell period of the cycle, i.e., the time that feed interruptor **36** is operative to permit discharging the final stack **15** from the bundle-ejector section **13**, the blanks from the folder-gluer would pile up on top of the stack and jam the machine. Thus, by removing more blanks than are added in an interval of time, a reservoir on top of the stack is created to store the blanks added during the discharge cycle. As an example of the operation, the folder-gluer supplies blanks to rolls **22**, **24** at the rate of 5 per second, feeder **34** operates for 2 seconds and the interruptor **36** maintains the feeder in a dwell period for 1 second. Then 10 blanks are added to the stack **11** in 2 seconds. The discharge cycle for stack **15** which is to contain 15 blanks requires one second, i.e., it is operative to discharge during the dwell period. The 15 blanks are removed from the stack **11** in two seconds. This depletes the reservoir of stack **11** by 5 additional blanks during the two second interval in which blanks are being fed from stack **11** but this number is replenished during the one second discharge interval during which a dwell period exists in the feed to stack **15**.

Suitable ratios for the gears in the power train to establish this rate are provided in accordance with well-known formulae for such gears.

The pull rolls **108** and **110** in the bundle-ejector section run faster than the blanks are fed by the feed mechanism **34**. This will result in a space between succeeding blanks passing between the pull rolls to insure that the trailing edge of the preceding blank has cleared the pull rolls before the next blank is fed. Otherwise, the blanks would not be fed one under the other.

Having thus described my invention in its best embodiment and mode of operation, what I desire to claim by Letters Patent is:

1. Apparatus for forming a final stack of blanks of predetermined number from a sequential supply of said blanks, comprising:

first stacking means receiving blanks from said sequential supply for forming a first stack of blanks;

final stacking means for forming said final stack of blanks; feeding means forming a part of said first stacking means and engaging said first stack for feeding blanks consecutively from said first stack to the underside of said final stack at a rate faster than the rate at which blanks are received by said first stack; said final stacking means including a continuously driven conveyor having an upper run forming the bottom of said final stacking means and supporting said final stack and having an inclined portion for receiving blanks from said first stack; interrupting means for disengaging said first stack from said feeding means to interrupt the flow of blanks to said final stack when the final stack contains said predetermined number of blanks;

discharging means for discharging said final stack of blanks from said final stacking means during said interruption of flow of blanks from said first stacking means, said discharging means including

a pair of back-stops each having a first portion for engaging the leading edge of said blank to arrest the forward travel and a second portion for engaging the lateral edges of said blanks; and

actuator means operative during the interruption of the flow of blanks for moving said first portion of said back-stops out of engagement with said leading edges and said second portion into engagement with the lateral edges of said blanks so that said conveyor moves the stack forward to discharge it from said final stacking means.

2. The apparatus of claim 1, and in addition:

adjusting means for varying the size of said first and final stacking means to correspond to the blank size being handled, comprising:

mounting means for fixing said feed gate to said final stacking means;

first adjusting means for moving said final stacking means lineally relative to said first stacking means whereby the space between said feed gate and said squaring means is varied to correspond to the length of the blanks;

second adjusting means connecting said back-stops for lineal adjustment relative to the inclined portion of said conveyor whereby the space defined by said back-stops and said inclined portion is varied to correspond to the length of blanks; and

third adjusting means connecting said back-stops for lateral adjustment relative to one another whereby the space between the back-stops is varied to correspond to the width of the blanks.

3. The apparatus of claim 2, and in addition:

pneumatic pressure means comprising a nozzle secured to said first stacking means adjacent said trailing edge of the blanks in said first stack and in communication with a supply of air under pressure for directing a jet of air against the trailing edge of the blank entering said first stacking means to prevent the leading edge of the successive blank from jamming against the trailing edge of the preceding blank.

4. The apparatus of claim 2, and in addition:

a jam switch for shutting down a main drive motor in response to jammed conditions within said first stacking means comprising a plate and a signal means, said plate being located in a normal position immediately above the level of travel of blanks entering said first stacking means and in resilient engagement with said signal means for actuating the latter to signal said drive motor in response to a displacement of said plate from said normal position.

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