March 10, 1964 R. A. LABOMBARDE 3,124,059

MACHINE FOR HANDLING PAPER SHEETS OR COLLAPSED BOXES

Filed Feb. 14, 1962

5 Sheets-Sheet 1

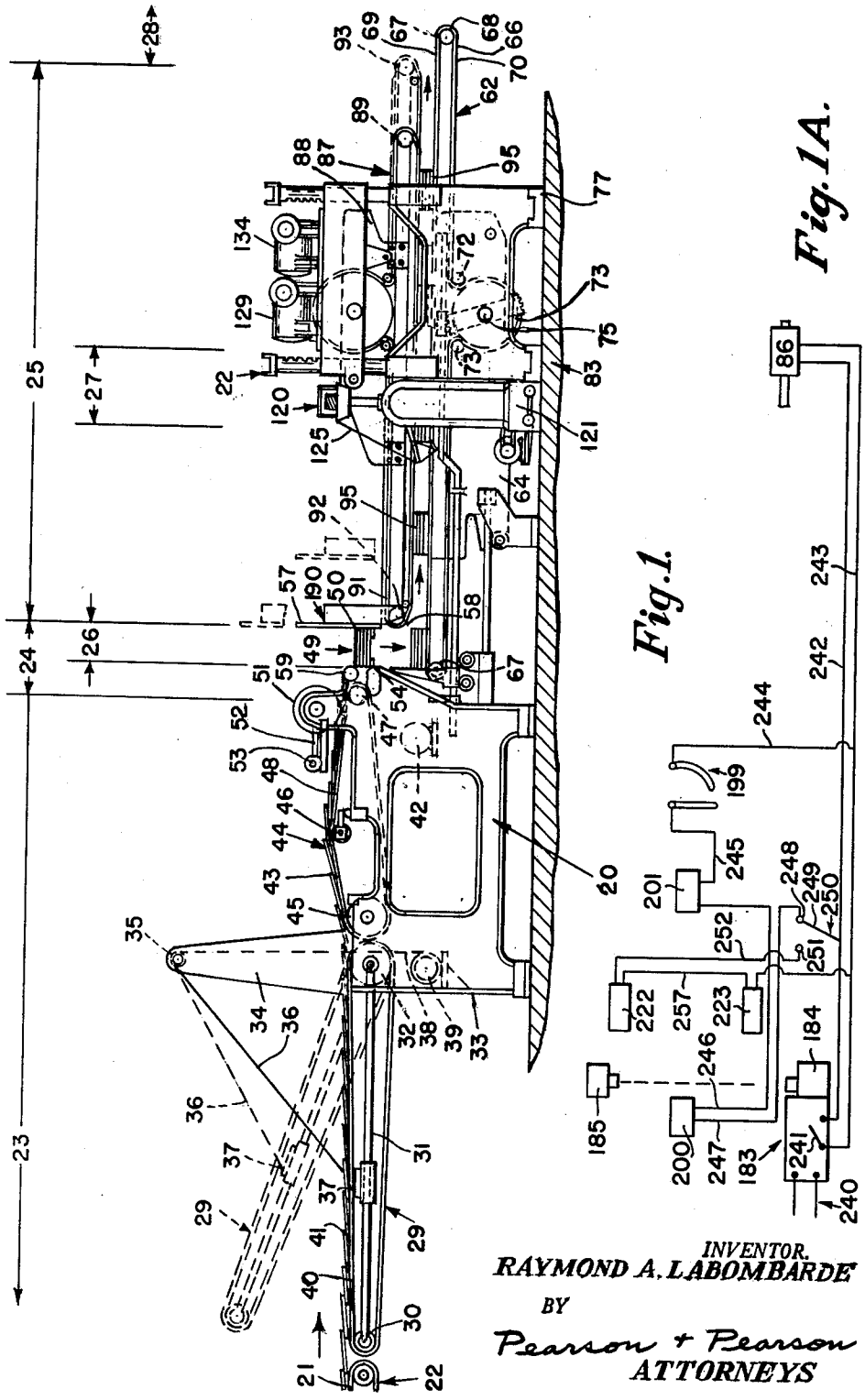


Fig. 1.

Fig. 1A.

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Filed Feb. 14, 1962 5 Sheets-Sheet 2

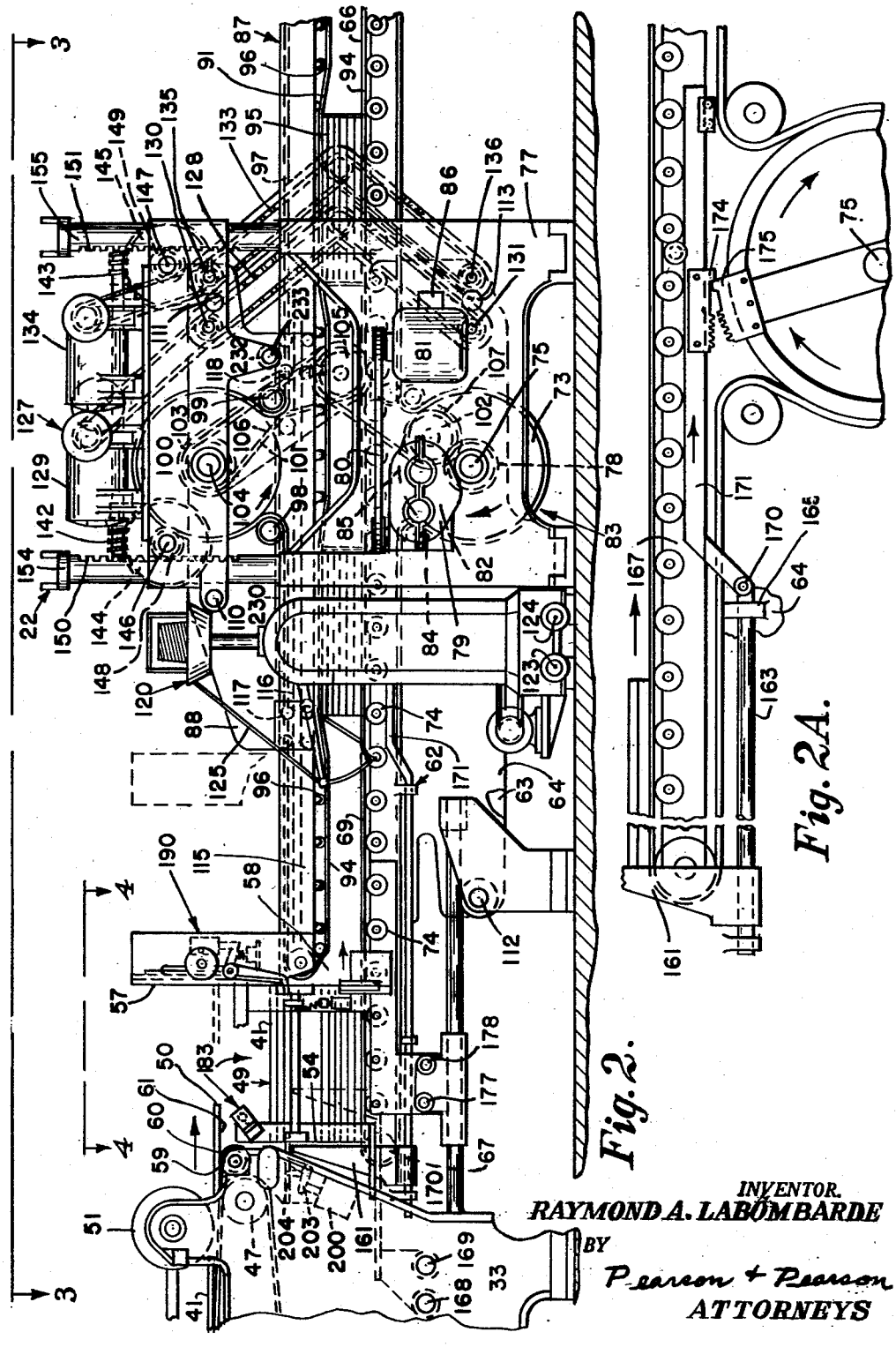


Fig. 2.

Fig. 2A.

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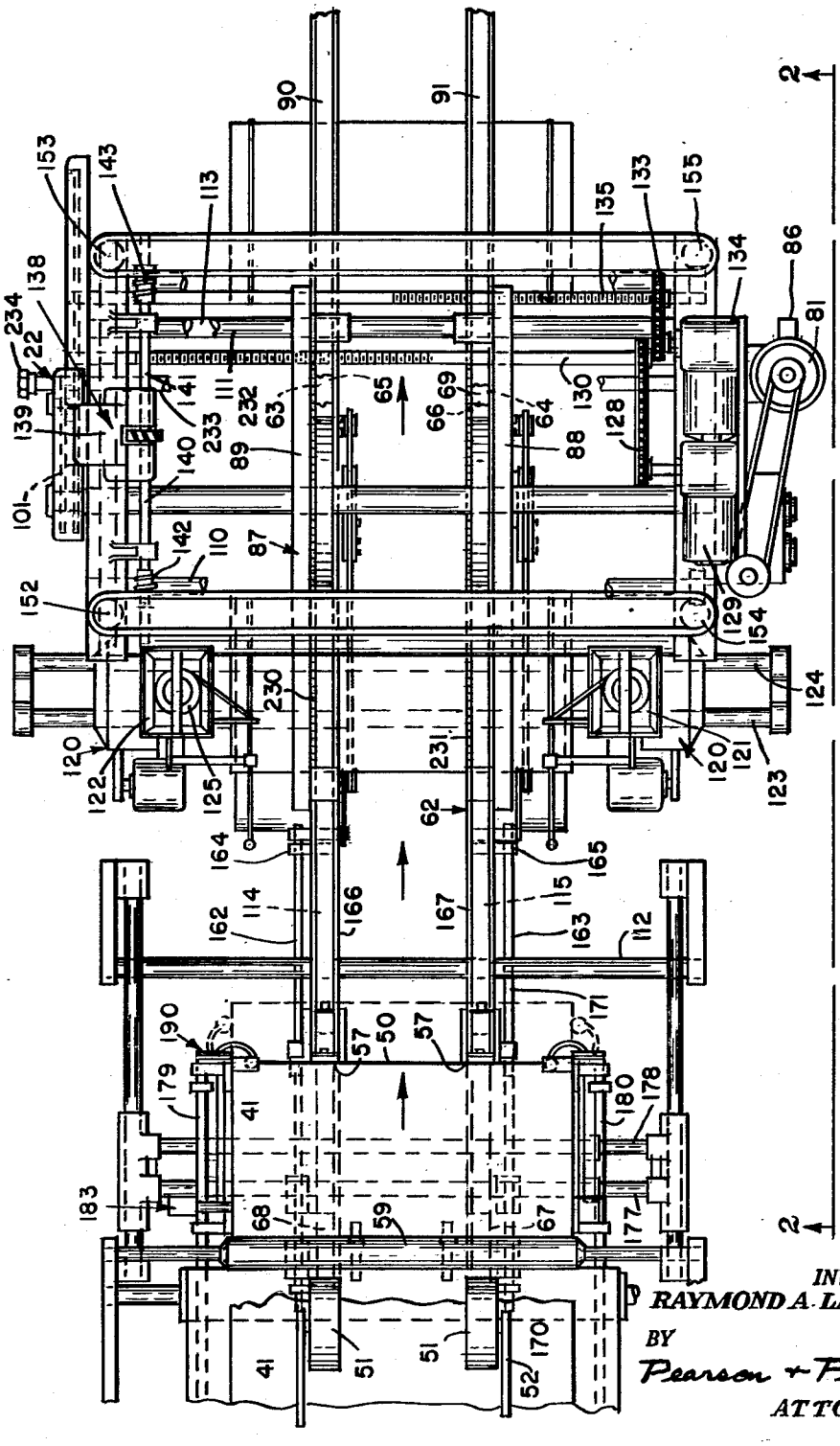


Fig. 3.

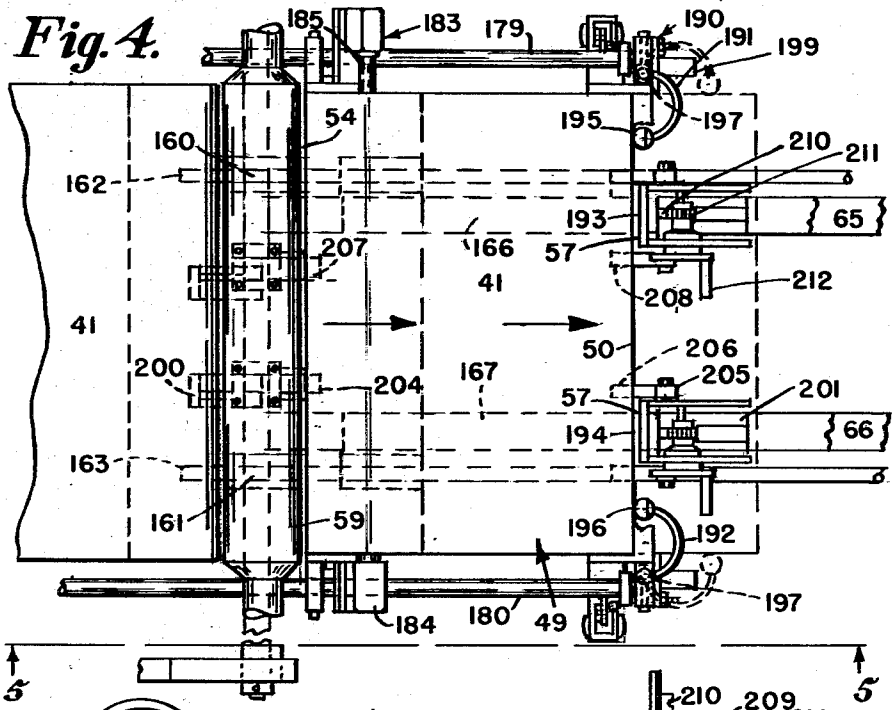
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Fig. 4.



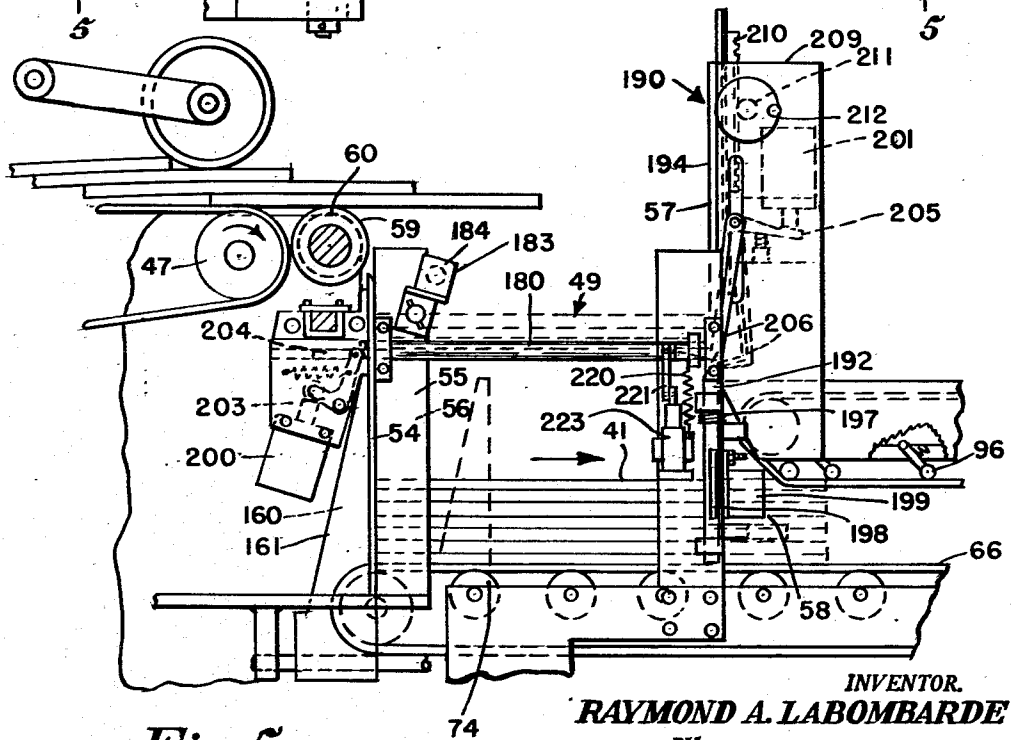


Fig. 5.

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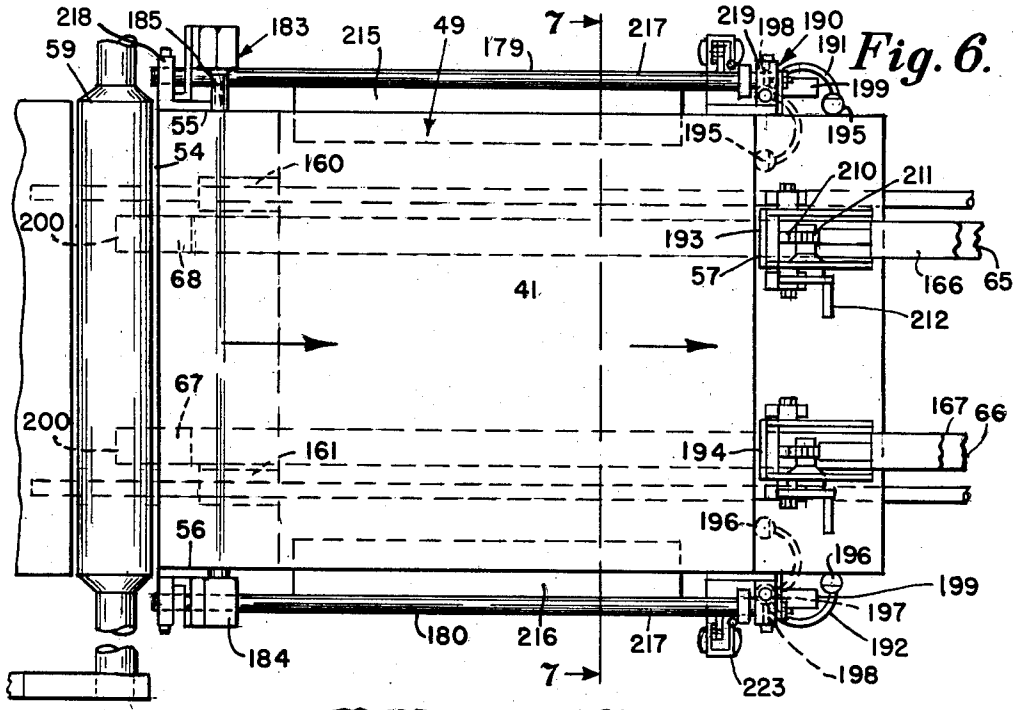


Fig. 6.

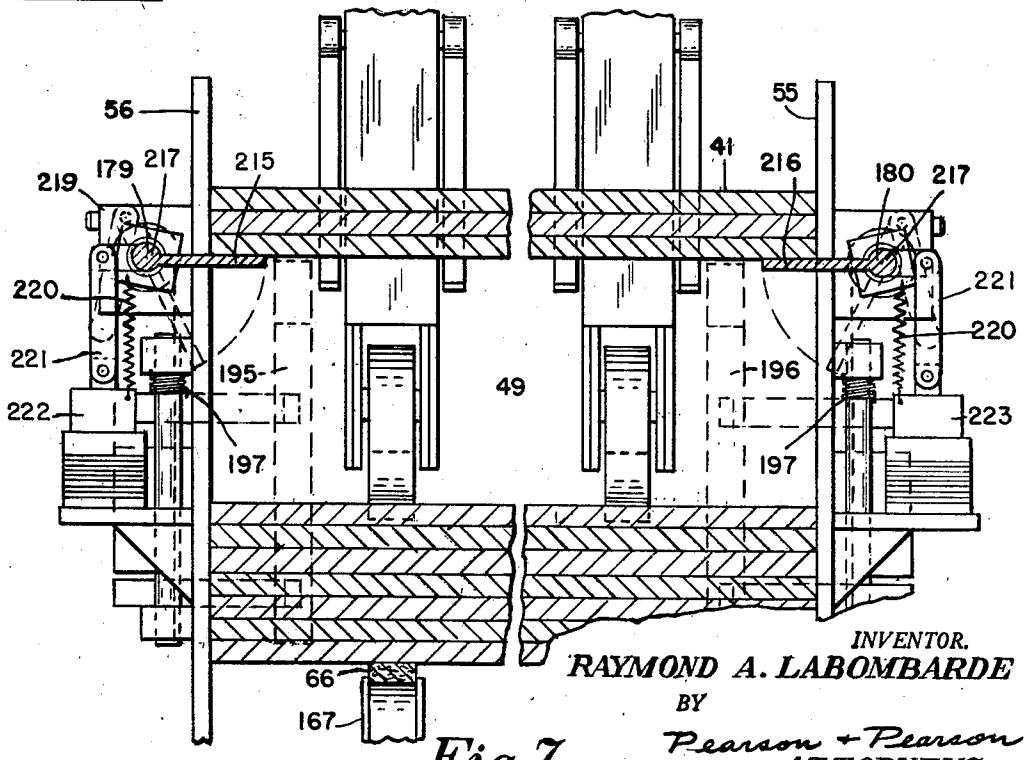


Fig. 7.

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United States Patent Office 3,124,059
Patented Mar. 10, 1964

3,124,059
MACHINE FOR HANDLING PAPER SHEETS OR COLLAPSED BOXES

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Filed Feb. 14, 1962, Ser. No. 173,617
25 Claims. (Cl. 100—4)

This invention relates to a machine for forming a vertical stack of horizontal sheets, compressing the stack and tying the compressed stack into a compact bundle all automatically and at high speed.

More particularly, the invention relates to the art of bundling collapsed tubular cartons of heavy paperboard delivered at high speed, usually in shingled formation, from the shingle stacking apron of a carton folding and glueing machine.

It has heretofore been proposed to provide carton handling machines in which the individual cartons descend successively in a hopper to accumulate into a counted vertical stack, the stack then being translated horizontally from the hopper to another station. Such a machine is described in U.S. Patent 2,585,076 to Bandura of February 12, 1952. Collapsed tubular, or knocked down flat, cartons when so stacked are usually shipped to the ultimate user, and each carton is then erected, filled and closed. It has been proposed in U.S. Patent 2,947,125 to Wilson of August 7, 1960, to assemble a plurality of such stacks, or piles, of flat cartons, affix palletizing means thereto and then compress and strap the assembly into a bale ready for shipment.

It is the principal object of this invention to provide a machine which forms individual stacks of knock down cartons and compresses and ties the stacks into compact bundles discharged from the machine ready for shipment in cartons, on pallets, or otherwise.

Another object of the invention is to provide apparatus for forming counted, vertical stacks from a succession of advancing, shingled, individual, collapsed boxes and advancing the vertical stacks to a stack discharge zone.

Another object of the invention is to provide a machine for accumulating, compressing and tying a plurality of flat sheets into a compact bundle, wherein the sheets following each counted stack are held out of contact with a counted stack, midway of the hopper, or accumulator, while the counted stack is moved out of the hopper, thereby avoiding damage to the sheets.

A further object of the invention is to provide a bundling machine capable of automatically handling the production of a modern carton making machine, which may reach one hundred thousand cartons in an eight hour day, whereby compacted, bundles of cartons, each wrapped with twine around each end, are delivered by the machine, whereby the limitations of manual operations are overcome and whereby it is no longer necessary to slow the production to permit the bundling operators to catch up with the production rate.

Still another object of the device is to provide a machine for automatically stacking, compressing and tying a plurality of knock down paperboard cartons into individual bundles with the cartons therein uniformly squared, the bundles being delivered intermittently to provide time for packing or palletizing thereof.

A still further object of the invention is to provide a machine for accumulating advancing sheets into vertical stacks wherein the number of sheets in a completed stack is controlled by a count of the sheets in the stack rather than by the number of revolutions of some part of the machine whereby miscounts in the bundled stacks are eliminated.

A still further object of the invention is to provide an automatic means for stacking, counting and tying sheets or the like wherein the feed apron to the machine is an

inspection table but can be lifted out of the way when not in use to provide working space behind the preceding machine in the production line.

A still further object of the invention is to provide a machine for forming tied bundles of corrugated cartons wherein a stack of cartons is advanced horizontally out of a hopper by a pusher operable on the rear edges of the stack to maintain alignment, the aligned stack is gripped and advanced by upper and lower carrier belts advancing at the same speed for maintaining alignment and the stack is tightly tied into a bundle while compressed between the upper and lower carriers.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawings and from the drawings in which:

FIG. 1 is a side elevation of a bundling and tying machine constructed in accordance with the invention,

FIG. 1A is a circuit diagram of the invention,

FIG. 2 is an enlarged, fragmentary, side elevation of the machine, on line 2—2 of FIG. 3, showing the stacking station and the tying station,

FIG. 2A is an enlarged, side elevation of mechanism for actuating the pusher rods of the machine,

FIG. 3 is a plan view, on line 3—3, of FIG. 2,

FIG. 4 is a further enlarged, fragmentary plan view, on line 4—4 of FIG. 2, of the stacking station,

FIG. 5 is a side elevation on line 5—5 of FIG. 4,

FIG. 6 is a plan view, similar to FIG. 4, but showing the hopper expanded to accommodate long cartons or sheets, and

FIG. 7 is an enlarged end elevation, in section on line 7—7, of FIG. 6.

Referring to FIGURE 1, a machine **20** constructed in accordance with the invention is preferably positioned in straight line extension of the delivery apron **21** of a straight line machine **22** for forming knock down cardboard cartons, such machines being well known and, therefore, not described in detail. The paper line along which the cartons advance, in shingled formation, on apron **21**, is substantially horizontal and about waist height and, heretofore, several operators have been required in the area designated as zone **23**, to manually assemble, stack and tie the flat cartons into bundles. The production rate of the machine **22**, which often reaches eighteen thousand cartons per hour, is considerably in excess of the production rate of operatives manually forming bundles, thereby limiting the production rate of the machine **22**. The production rate of the machine **20** in automatically forming uniformly squared compacted bundles is such that it can handle the maximum production of machine **22** while producing bundles easier to handle, stack and store.

For convenience of description, the machine **20** has been divided into an inspection zone **23**, which includes the manual bundling and tying area mentioned above, a segregation zone **24**, a stack compression zone **25**, a stacking station **26**, a tying station **27** and a discharge station **28**.

In the inspection zone **23** of machine **20**, an endless belt conveyor **29** is trained around a roll **30**, journalled at the end of a frame piece **31**, and around a drive roll **32** journalled in the forward side frames **33**, the frame piece **31** being pivotable vertically on the horizontal axis of the roll **32**. Upstanding posts, such as **34**, are fixed to the forward side frames **33**, for rotatably supporting a pulley **35**, there being a flexible element **36** connected at one end **37** midway of frame piece **31**, trained over pulley **35** and having its other end **38** wound around a suitable power operated hoist **39** on machine **20**. The upper stretch **40** of the conveyor **29** inclines upwardly to raise the level of the shingled flat cartons received from apron **21**, while an operative inspects the cartons for any mis-

prints or defects. As shown in dotted lines, the entire conveyor 29 resembles a drawbridge in that it may be raised through an angle of 90° by the power hoist 39 to separate the bundling machine 20 from the folding and glueing machine 22 to thereby permit manual bundling and tying.

The upwardly inclined upper stretch 40 of the pivotable, inspection conveyor 29, receives shingled cartons such as 41 from apron 21 and delivers the cartons, still in shingled formation, to the upwardly inclined stretch 43 of an endless belt conveyor 44. Conveyor 44 is trained around rolls 45, 46 and 47 journalled in the side frame pieces 33 of machine 20 and includes the downwardly inclined upper stretch 48 which terminates at the level of the top of the hopper, well or accumulator 49. A pair of laterally spaced holddown rolls, such as 51, are provided, each rotatable on an arm 52 pivotable on a rod 53 supported at each opposite end in frame pieces 33, the arms being laterally movable on the rod to yieldably hold down cartons of various widths. Roll 32 is driven by roll 45 through suitable gears, not shown, and roll 47 is driven through a suitable gear train, not shown, by an electric motor 42.

It will be apparent that if the shingled cartons 41 were merely discharged into hopper 49, at the relatively high speed of the conveyor 44, the leading edges would sag downwardly, the cartons would tend to fall on edge to the bottom of the hopper, a disorganized pile rather than an oriented stack would result and accurate counting would be most difficult. In the machine of this invention the hopper 49 forms the laterally and longitudinally expansible stacking station 26, and includes a forward wall 54, a pair of laterally movable side walls 55 and 56 and a longitudinally movable rearward wall 57. The rearward wall 57 serves the double purpose of a vertically movable gate, forming a gateway 58 therebelow for stacks for various heights, and a barrier for intercepting the leading edges 50 of cartons advanced at high speed, horizontally, across the top of the hopper. As each successive individual carton 41, forming the lowermost, leading element of the shingled carton formation, is advanced beyond the portion of conveyor 44 over roll 47, its leading edge 50 advances about half way across the top of the hopper 49 (FIG. 5) while still in shingle formation and while maintained horizontal by the counterweight effect of the holddown rolls 51 resting on the next succeeding cartons and increasing the frictional resistance to relative advance of the cartons. When the lowermost carton 41 is substantially one half of its own length across the hopper, with the minimum amount of "dip" or "front edge drop" incompatable with proper singling out and stacking, its rearward portion becomes less controlled by the rolls 51 and the carton comes under the control of, and is picked up by, what is termed herein, a "kick" roll 59, the roll 59 having a friction face 60 of rubber or the like and having a surface speed considerably greater than the speed of advance of the conveyor 44. Roll 59 is driven by a suitable gear train, not shown, powered by the motor 42 and the friction face 60 engages the exposed underface 61 of each leading shingled carton to frictionally advance the carton out from under the advancing shingled formation, throw the carton across the top of the hopper 49 with the carton in a horizontal plane and cause the leading edge 50 to strike the rearward wall 57. Each successive carton after striking wall 57 descends, or floats, horizontally downward in hopper 49, with sufficient space between descending cartons to permit the light beam type counting means 183 of the machine to secure an accurate count (FIG. 2).

The hopper 49 is mounted over the forward end of lower carrier means 62, the lower carrier means 62 extending along the compression zone 25, which includes the tying station 27, and terminating at the end of the discharge station 28. Lower carrier means 62 preferably includes a pair of laterally movable, lower sub frames 63 and 64 each carrying a lower carrier belt 65 or 66. Each carrier belt such as 65 is trained around a roll 67 or 68 rotatable at an opposite end of its sub frame 63, the upper belt stretch 69 froming a horizontal stack support line which is at a slightly lower level than the paper line of the glueing machine 22, but which, by reason of the upward incline of conveyors 29 and 44, is at a convenient height for an operative to receive the bundled cartons at station 28. Each lower stretch 70 of the belts 65 and 66 is trained over idler rolls 71 and 72 and around an enlarged drive roll 73 and suitable longitudinally spaced rollers such as 74 support the full length of upper stretch 69 including the portion in the compression zone 25. The enlarged drive roll 73 is mounted on a shaft 75, journalled in the rearward side frames 77 of machine 20, the shaft 75 carrying a gear 78, driven by the gear box 79 and the gear box 79 being driven through a power train 80 by the electric motor 81.

The indexing means 83 of the invention includes a conventional, single revolution clutch 82 mounted in gear box 79. The clutch 82 is actuated by a solenoid switch 86 controlled in a manner to be described, whereby the upper stretch 69 indexes along a horizontal path a predetermined distance with gradual acceleration from zero to maximum speed and gradual deceleration from maximum speed back to zero.

Since the machines 20 and 22 are capable of handling sheets, or cartons, up to fifty inches in longitudinal dimension, the indexing advance of the upper stretch 69 is about sixty-six inches to cause a stack of such blanks to clear the hopper and the needles of the tyers 121 and 122 with each actuation.

The upper carrier means 87 of the machine 20 is also a pressure applying means for gripping and compressing a stack, under uniform pressure, as the stack is advanced from the rearward wall 57 of the hopper, through the tying station 27 to the end of the compression zone 25 at discharge station 28. Upper carrier means 87 preferably also includes a pair of laterally movable upper sub frames 88 and 89 each carrying an upper carrier belt 90 or 91.

The lower stretch 94 of each belt 90 and 91 forms the upper extremity of the horizontal path of the stacks 95 through the compression zone. Each lower stretch 94 of the upper carrier belts 90 and 91 is backed up by a plurality of longitudinally spaced pressure rolls such as 96 advancing therebelow. The upper stretch 97 of each upper carrier belt is trained under idler rolls 98 and 99 and over the enlarged drive roll 100, all of the rolls being mounted on the sub frame 88 whereby the entire belt assembly is laterally movable. The flexible knee joint, enclosed, power train 101, includes the sprocket 102, powered from the shaft 75 of the lower carrier means, the sprocket 103 on the shaft 104 of roll 100, the intermediate double sprockets 105 and the chains 106 and 107.

The upper belts 90 and 91 are thus caused to index forwardly exactly in unison with the lower belts 65 and 66 while permitting the upper carrier means 87 to be moved vertically to accommodate stacks of various thickness. The upper sub frames 88 and 89 and the lower sub frames 63 and 64 are laterally movable to expand and contract relative to the longitudinal centre line of the machine by means of suitable cross rods such as 110, 111, 112 and 113 upon which the parts of each belt assembly are laterally slidable.

The upper sub frames 88 and 89 are also characterized by the feature that the elongated supporting bars 114 and 115, which carry the end rolls 92 and 93 and the yieldable pressure rolls 96, include elongated tracks such as 116 longitudinally slidable in opposed, track rollers 117 and 118 on the upper portion of the sub frames. Thus the upper carrier belt units can be moved longitudinally of the machine 20 to expand or contract the corresponding dimension of the hopper 49. The forward

wall 57 of the hopper 49 is formed by two upstanding barriers each fixed to the rearward end of one of the supporting bars 114 and 115 of the upper carrier means to permit such adjustment of the length of the hopper.

Tying means 120 is mounted alongside the carrier means 62 at the tying station 27 for tying each individual and successive stack halted at the station into a compact bundle. Tying means 120 preferably comprises a pair of commercially available devices 121 and 122 for wrapping twine around a package, knotting the twine and cutting the twine.

The particular knot tyers 121 and 122 selected for illustration herein are the Model SR1A Saxmayer package tyer of National Bundle Tyer Co., Blissfield, Michigan. As shown, each knot tyer 121 and 122 is mounted on cross rods 123 and 124 for lateral movement with the sub frames 63 and 64 and each is arranged to wrap a flexible element, such as the twine 125, around one of the opposite ends of a stack 95 while the stack is compressed by the upper carrier means 87 and halted at tying station 27.

Power means 127 is provided for moving the upper and lower carrier belt assemblies and the knot tyers laterally in either direction to speed "make ready" time when the dimensions of the sheets, or cartons, 41 are changed for a new "run." Power means 127 includes a knee point type power train 128, similar to train 101, and connecting the motor 129 with the rotatable, threaded cross rods 130 and 131 which move the assemblies on one side of the machine laterally. A knee joint type power train 133, similar to train 101, connects the motor 134 with the rotatable, threaded cross rods 135 and 136 which move the assemblies on the other side of the machine laterally.

Power means 138 is provided for raising and lowering the upper carrier means 87 and includes the motorized drive unit 139 (FIGS. 2 and 3) having the shafts 140 and 141 which carry worm gears 142 and 143 meshed with gears 144 and 145. Each gear 144 and 145 is mounted on a cross shaft 146 or 147 and each cross shaft 146 carries a gear 148 or 149 at each opposite end. Each gear 148 or 149 is meshed with a gear rack 150 or 151 carried by a vertically slidable post 152 or 153 which carry the upper carrier means. Thus actuation of the reversible motorized unit 139 causes the gear racks of each of the four corner posts 152, 153, 154 and 155 to move upwardly or downwardly as desired to adjust the upper carrier means 87 to the height of the stacks.

Preferably the forward wall 54 of hopper 49 includes a pair of upstanding, laterally spaced, pusher arms 160 and 161, mounted at the forward ends of longitudinally extending rods 162 and 163. The rods 162 and 163 are longitudinally slidable in brackets 164 and 165 while the brackets 164 and 165 are laterally movable with the forwards ends 166 and 167 of the lower sub frames 63 and 64. The forward ends 166 and 167 are laterally slidable on cross rods 168 and 169 extending between the forward side frames 33 of the machine 20. Each push rod, such as 163, is connected at 170 to one end of a slideable bar 171, the bar 171 carrying a gear rack 174 actuated by a gear segment 175. A segment such as 175 is provided for each pusher arm, the gear segments being laterally slidable on, but keyed to, the shaft 75 whereby the pusher arms move laterally with their respective sub frames 63 or 64. While the indexing distance is sixty-six inches, the gear segments 175 move the pusher arms only about eight inches, this distance being sufficient to assure the alignment of the trailing edges of the stack until the upper and lower faces of the stack have entered the space between the upper and lower carrier belts to be firmly gripped, compressed and advanced thereby.

The side walls 55 and 56 of hopper 49 are laterally slidable on cross rods 177 and 178 and longitudinally slidable on longitudinal rods 179 and 180, suitable set screw mechanism being provided to retain the side walls in the desired position on the rods.

Counting means 183 is provided, at the stacking station 26, for counting each carton 41 descending, or floating, horizontally downward in hopper 49. Counting means 183 includes a photo cell 184 and a light beam source 185, the light beam extending laterally across the hopper 49 just below the level of the kick roll 59 and being intercepted by each successive carton. The counting means 183 may be of any commercially available type arranged to count to the desired number of cartons for forming a vertical stack to be bundled and to then close a circuit to the solenoid switch 86 of the indexing means.

Because of the high production rate of the machine 22, however, the machine 20 preferably includes interception means 190, intermediate of the height of hopper 49 to intercept descending cartons. For relatively short cartons the interception means 190 includes a pair of horizontally movable gates 191 and 192, each pivoted on a vertical axis proximate one of the laterally movable, upstanding barriers 193 and 194 forming the rearward wall 57 (FIG. 4). Each gate such as 191 is of curved cross section, and coextensive in height with the hopper, the free terminal ends 195 and 196 thereof extending laterally into the path of a stack moving out of the hopper through gateway, or passage 58. As shown in dotted lines in FIG. 4, when counting means 183 actuates switch 86 to advance a stack out of hopper 49, the leading edges of the stack engage the ends 195 and 196 to open the gates 191 and 192. Each gate such as 191 is held normally closed by the hinge spring 197 and includes a lever arm 198 for actuating a switch 199.

Control of the count in the stack and ejection, or discharge, only of accurtaely counted stacks is accomplished by counting means 183 which senses each carton descending in the hopper. When the pre-set number of cartons has been sensed, for example twenty, the twentieth counted carton causes the means 183 to energize solenoids 200, 201 while at the same time energizing the solenoid switch 86 of the single revolution clutch 82. Solenoid 200, through bell crank lever 203, advances a longitudinally slidable rod 204 into the path of the trailing edge of the carton next following the stack being advanced out of the hopper by the indexing means 83. Solenoid 201 pivots bell crank lever 205 to advance the hooked end 206 thereof into the path of the leading edge of the said next following carton. A rod 207 and a hooked end 208, on the opposite side of the longitudinal centre line of the hopper are actuated simultaneously in a similar manner. Thus a counted carton causes the counted stack to move out of the hopper, opening the gates 191 and 192, and causes the first blank of the next stack to be temporarily halted midway of the height of the hopper. When the trailing edge of the counted stack passes beyond gates 191 and 192, the gates spring to closed position thereby moving the arms 198 to actuate switch 199 and de-energize the solenoids 200 and 201.

The hooked ends 206 and 208 and the rods 204 and 207 are thereby retracted out of the vertical path of the cartons descending in the hopper to permit the accumulated pile of cartons to descend to the bottom of the hopper. It is thus not possible for a stack to move out of the hopper until the counted carton has been deposited on top of the stack, so that miscounted stacks cannot occur. Each lever 205 is pivotally mounted in a member 209 vertically slidable, in one of the upstanding barriers 193 forming the rearward wall 57, by means of a gear rack 210, gear 211 and a manually rotatable handle 212. Thus when the height of the gateway is changed, the hooked ends 206 and 207 can be vertically re-adjusted to positions exactly opposite to and at the same level as the rods 204 and 207 or to positions slightly below, if desirable.

It has been found that unusually long cartons are some-

times so flexible and non self supporting from front to rear, as to flex, or flip by the rods 204 and 207 and the hooked ends 206 and 208 to drop to the bottom of the hopper. The interception means 190 of the invention therefore also includes a pair of trapdoors, or gates, 215 and 216, each vertically pivotable on a horizontal axis intermediate of the height of one of the side walls 55 or 56 at the level of the rods 204 and 207. Each trapdoor such as 215, is releasably clamped to a longitudinally extending rod 217, rotatable in bearing blocks 218 and 219 and normally spring pressed into a horizontal plane by the spring 220, and maintained horizontal by a latch 221, releasable by a solenoid 222.

Thus when long cartons are to be run, the solenoids 200 and 201 which operate the rods 204 and 207 and the hooked ends 206 and 208 are disconnected from the counting circuit, and the solenoid 222, plus a similar solenoid 223 for the other trapdoor 216, are connected into the counting circuit. The trapdoors 215 and 216, which can hang down out of the path of descendindg cartons when not needed, are clamped onto their respective rods 217 to assume their horizontal position.

A stack of fifteen, twenty-five, or other desired number of cartons thus accumulates on the trapdoors, rather than on the bottom of the hopper formed by the lower carrier belts. When the stack count is complete, counting means 183 energizes the solenoids 222 and 223 to unlatch the trapdoors, drop the accumulated stack to the bottom of the hopper and actuate the switch 86 for advancing the stack out of the hopper. The spring loaded trapdoors bear against the sides of the stack as the stack drops therethrough and snap back into latched horizontal position in time to catch the next following carton and commence the accumulation of the next following stack. The gates 191 and 192, continue to open and close with each advancing stack, but are not used to trigger any action when trapdoors 215 and 216 are operative.

Each upper supporting bar 114 and 115, includes a gear rack 230 or 231, each meshed with one gear 232 of a pair of gears laterally slidable on, and rotatable with, a transverse rod 233 turnable by the knob 234, whereby the upper sub frames are longitudinally movable to desired positions.

The side located trapdoors 215 and 216 and the forward and rear located rods 204 and 207 and hooked ends 206 and 208 can be used separately or jointly as desired. It will be understood that some cartons are so long as to sag downwardly between the trapdoors making the use of the rods 204 and 207 desirable while other cartons are so short and light weight as to be unable to lower the trapdoors. By providing interception means on both pairs of opposite sides of the hopper 49, the descending cartons can be accumulated without damage during the translation of a stack out of the hopper, using the combination of interception members required by the characteristics of the sheets or cartons.

It will be apparent that the apparatus of the invention may be used for stacking only, for stacking and tying without compression or for stacking, compressing and tying.

When it is desired to form vertical counted stacks from the advanceing, shingled boxes on the upper stretch 48 of the conveyor, or apron, 44, without tying or compressing the stack, the upper carrier means 87, tying means 120, power means 127 and 138, pusher arms 160 and 161, gates 191 and 192 may all be disconnected leaving in operation only the lower carrier means 62, hopper 49, the trapdoors 215 and 216 of interception means 190, the counting means 183 and the friction faced, cylindrical "kick" roll 59. The lower carrier means may continue to index forwardly as described above, or may advance continuously since the stacks are accumulated on the trapdoors until a predetermined count is reached, and then are dropped onto the bottom of the hopper formed by the lower carrier means to be moved away from the hopper. Preferably roll 59 has a surface speed about five times greater than that of the conveyor 44 and the lower carrier means 62 has a surface speed about one fifth that of the conveyor 44.

When bundling and tying are desired without compression of the stack the tying means 120, may be made operative along the path of the counted stacks, in rear of the trapdoors 215 and 216 to tie each advancing stack.

In such case, it is preferred to move the tying means 120 to the stacking station for wrapping each end of each stack as the counted stack drops onto the bottom of the hopper formed by the lower carrier means, the wrapped stack then being moved away from the hopper to the stack discharge zone. To permit straight line production, the tyers 121 and 122 may be placed on their sides, rather than upright, to wrap a strand around each counted stack before it is moved out of the hopper, and while the next succeeding stack is accumulating midway of the height of the hopper.

Alternatively the stack translation means for moving a counted stack away from the hopper may be a pusher arm such as 160, actuated by the mechanism shown in FIG. 2A, with or without the lower carrier means 62, the stroke of the pusher arm being sufficient to move the stack onto any well known type of conveyor, or out of the hopper a sufficent distance for manual removal by an operator.

As shown diagrammatically in FIG. 1A, the counting means 183, is connected to a source of current 240 and includes a switch arm 241 for closing a circuit to solenoid switch 86 through conductors 242 and 243 to actuate the clutch 82 at the desired count. Solenoids 200 and 201 and gate switch 199 are connected into this circuit by conductors 244, 245, 246, 247, switch terminal 248 and switch arm 249 of a selector switch 250. If solenoids 222 and 223 are desired to be used, switch arm 249 is moved to terminal 251 to complete a circuit including the arm 251, conductor 252, solenoid 222, conductor 253, solenoid 223 and conductor 254.

I claim:

1. A machine for building a plurality of sheets or like articles, said apparatus comprising lower carrier means for advancing a vertical stack of said sheets along a horizontal path from a stacking station, through a tying station to a discharge station; a hopper mounted over said carrier means at said stacking station for accumulating a vertical stack of horizontal, flatwise sheets; tying means, along said carrier means, at said tying station for tying each successive stack into a bundle; upper carrier and pressure means extending horizontally, at a spaced distance above said lower carrier means, from said stacking station through said tying station for compressing a stack before the tying thereof; power actuated indexing means for advancing said upper and lower carrier means a predetermined distance along said path and counting means, at said stacking station, for actuating said indexing means when a predetermined number of sheets have been accumulated in said hopper.

2. A machine as specified in claim 1 wherein said lower carrier means includes a pair of endless belts, each having an upper stretch extending along said path and a plurality of longitudinally spaced rolls supporting each said stretch and said upper carrier means includes a second pair of endless belts each having a lower stretch extending above said path and a plurality of longitudinally spaced pressure rolls yieldably engaging each said stretch.

3. A machine as specified in claim 1 wherein said hopper includes a stationary forward wall, oppositely disposed, laterally adjustable, side walls and a longitudinally adjustable, rearward wall, said rearward wall forming a target for barring the advance of the leading edge of sheets fed into said hopper and being vertically movable to form an adjustable gateway therebelow for the passage of a stack.

4. A machine as specified in claim 1 wherein said upper

carrier means is vertically movable relative to said lower carrier means; said upper carrier means includes a carrier belt support bar movable longitudinally relative to said lower carrier means and said hopper includes a rearward wall mounted on said belt support bar whereby sheets of various lengths and thickness can be received in said hopper by longitudinally adjusting said carrier belt support bar.

5. A machine as specified in claim 1 wherein said tying means comprises a pair of tying members each on an opposite side of said path for affixing a wrapping element around each opposite end of each successive stack halted at said tying station.

6. A machine as specified in claim 1 wherein said indexing means includes a single revolution clutch operatively connected to said carrier means for smoothly accelerating and decelerating said carrier means and maintaining the integrity of a stack being advanced from said stacking station to said tying station.

7. A machine as specified in claim 1 wherein said counting means includes means responsive to the descent of a predetermined counted sheet in said hopper, to form the top sheet of a counted stack, for actuating said indexing means to move said counted stack out of said hopper.

8. A machine as specified in claim 1 plus opposed interception members movably mounted intermediate of the height of opposite walls of said hopper, out of the vertical path of sheets descending therein and mechanism for moving said members in and out of said vertical path for temporarily intercepting a plurality of said sheets intermediate of the height of said hopper.

9. A machine as specified in claim 8 wherein said interception members comprise a pair of hooked elements mounted in the rear wall of said hopper and a pair of slidable elements mounted in the forward wall of said hopper, and said mechanism includes a pair of horizontally pivotable gates extending into the path of a stack moving out of said hopper on said lower carrier means, the sensing of the deposit of a counted sheet to complete the count of a stack in said hopper, by said counting means causing said elements to move into the vertical path of sheets descending in said hopper to intercept the same and the closing of said gates, after the passage of said stack, causing said elements to retract out of said vertical path for depositing the sheets accumulated thereon on said lower carrier means.

10. A machine as specified in claim 8 wherein said interception members comprise a pair of vertically pivotable spring return trapdoors, each mounted in one of the side walls of said hopper and said mechanism includes latches normally retaining said doors in the path of descending sheets but releasable in response to the sensing by said counting means of the sheet completing a stack of predetermined count to deposit said counted stack on said lower carrier means.

11. A machine as specified in claim 1 plus a conveyor on said machine, in advance of said hopper, for feeding sheets in shingled formation thereto, said conveyor having an upwardly inclined upper stretch section for raising sheets up to the level of the top of said hopper and having a drawbridge type pivoted section in advance of said upwardly inclined section for disconnecting said machine from a production line.

12. A machine as specified in claim 1 plus a conveyor feeding sheets in shingled formation to the top of said hopper, a friction faced, rotatable roll mounted at the top of said hopper to engage the exposed underface of said successive endmost shingled sheet and means for rotating said roll at a substantially greater surface speed than the speed of said shingled sheets for frictionally advancing each successive individual sheet out from under said shingled formation and across said hopper.

13. A machine as specified in claim 12 plus a holddown roll mounted above said conveyor to engage the upper faces of the sheets advancing therealong, in advance of said friction faced roll, said holddown roll counter weighting the trailing portion of each successive endmost sheet engaged by said roll and increasing friction between the endomst sheets on said conveyor.

14. A machine as specified in claim 1 plus power means arranged to vertically move said upper carrier means relative to said lower carrier means for accommodating stacks of various thickness; means arranged to longitudinally move said upper carrier means relative to said lower carrier means for accommodating stacks of various lengths and power means arranged to laterally move said upper and lower carrier means said tying means for accommodating stacks of various widths.

15. A machine as specified in claim 1 plus a pair of laterally spaced, upstanding pusher arms forming a portion of the forward wall of said hopper, and arm actuating means, cooperable with said indexing means, advancing said arms along said path and pushing on the trailing edges of the sheets in a stack in said hopper to advance the leading portion of said stack into the space between said upper and lower carrier means.

16. A machine as specified in claim 15 wherein said arm actuating means includes mechanism for accelerating said pusher arms more rapidly than the acceleration of said lower carrier means whereby said pusher arms advance a stack slightly relative to said lower carrier means while advancing therewith.

17. A machine for bundling a plurality of collapsed, tubular paper boxes, said machine comprising a pair of laterally spaced, lower carrier belts having upper stretches extending horizontally along a path through said machine including a stacking station, a tying station and a discharge station, a hopper mounted over said upper stretches of said lower carrier belts at said stacking station, said hopper including interception members intermediate of the height thereof movable into, and out of, the vertical path of sheets descending therein; a pair of laterally spaced, upper, carrier and pressure belts having lower stretches extending horizontally, at a spaced distance above the upper stretches of said lower carrier belts, along said path from said stacking station, through said tying station to said discharge station for compressing each successive stack at said tying station; a pair of knot tying devices, each on an opposite side of said path at said tying station for tying twine around each opposite end of a stack at said tying station; power actuated indexing means for advancing said upper and lower carrier belts intermittently a predetermined distance along said path with gradual acceleration and deceleration; counting means, at said stacking station, including means projecting a light beam across said hopper, for actuating said indexing means, at a predetermined count, to advance a counted stack of said sheets along said path and for moving said interception members into the path of sheets descending in said hopper; a pair of pivoted gates, each in the path of a stack moving out of said hopper, and mechanism, actuated by the closing of said gates, to retract said members out of the path of said descending sheets.

18. A machine as specified in claim 17 wherein said interception members are spring return trapdoors having latches for maintaining the same in the path of descending sheets and said counting means includes mechanism for releasing said latches at a predetermined count to permit a counted stack to drop onto said lower carrier means.

19. Apparatus for handling a plurality of collapsed, tubular, paper boxes advancing individually and successively in shingled formation on a conveyor apron, said apparatus comprising a hopper at the terminal end of said conveyor apron for receiving said shingled boxes and accumulating the same in a vertical stack, said hopper having an open top and vertical walls including one wall in the path of a box advanced across the open top of said hopper; stack translation means, forming the bottom

of said hopper, for advancing a vertical stack of said boxes along a horizontal path away from said hopper; interception members intermediate of the height of the walls of said hopper and movable into and out of the vertical path of boxes descending therein for accumulating a stack of boxes thereon; counting means, responsive to the descent of each successive box in a vertical path in said hopper to move said interception members at a predetermined count for dropping a counted stack in a vertical path onto the bottom of said hopper; a friction faced, cylindrical, roll mounted at the top of said hopper to engage the exposed underface of each successive endmost shingled box and means for rotating said roll, at a substantially greater surface speed than the speed of said shingled boxes, for frictionally advancing each successive endmost box out from under said shingled formation, across the open top of said hopper into engagement with the said one vertical wall thereof.

20. Apparatus as specified in claim 19 plus at least one holddown roll mounted to rotate above said conveyor apron in engagement with the upper faces of said shingled boxes for holding down said boxes, and restraining the advance thereof relative to said apron, while the endmost box is advanced across said hopper at high speed by said friction faced, cylindrical roll.

21. Apparatus as specified in claim 19 plus stack tying means mounted along the path of said vertical stacks, in rear of the interception members on said hopper, for tying each said stack into a bundle.

22. Apparatus as specified in claim 19 wherein said interception members comprise a pair of vertically pivotable spring return trapdoors, each mounted in one of the opposite side walls of said hopper, latches, normally retaining said doors in the path of descending boxes and means for releasing said latches at a predetermined count of said counting means to deposit a counted stack on said hopper bottom.

23. Apparatus as specified in claim 19 wherein said roll rotating means includes means for rotating the same at a surface speed about five times the surface speed of said conveyor apron and said stack translation means includes means for advancing said lower carrier means at a surface speed about one-fifth the surface speed of said conveyor apron.

24. Apparatus as specified in claim 19 wherein said stack translation means is lower carrier means comprising a pair of endless belts each having an upper stretch forming the bottom of said hopper and means for advancing said upper stretches in a direction away from said hopper.

25. Apparatus as specified in claim 19 wherein said stack translation means is a pusher arm adapted to engage one side of a counted stack in said hopper and means for advancing said pusher arm across said hopper bottom to move a counted stack in a direction away from said hopper.

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