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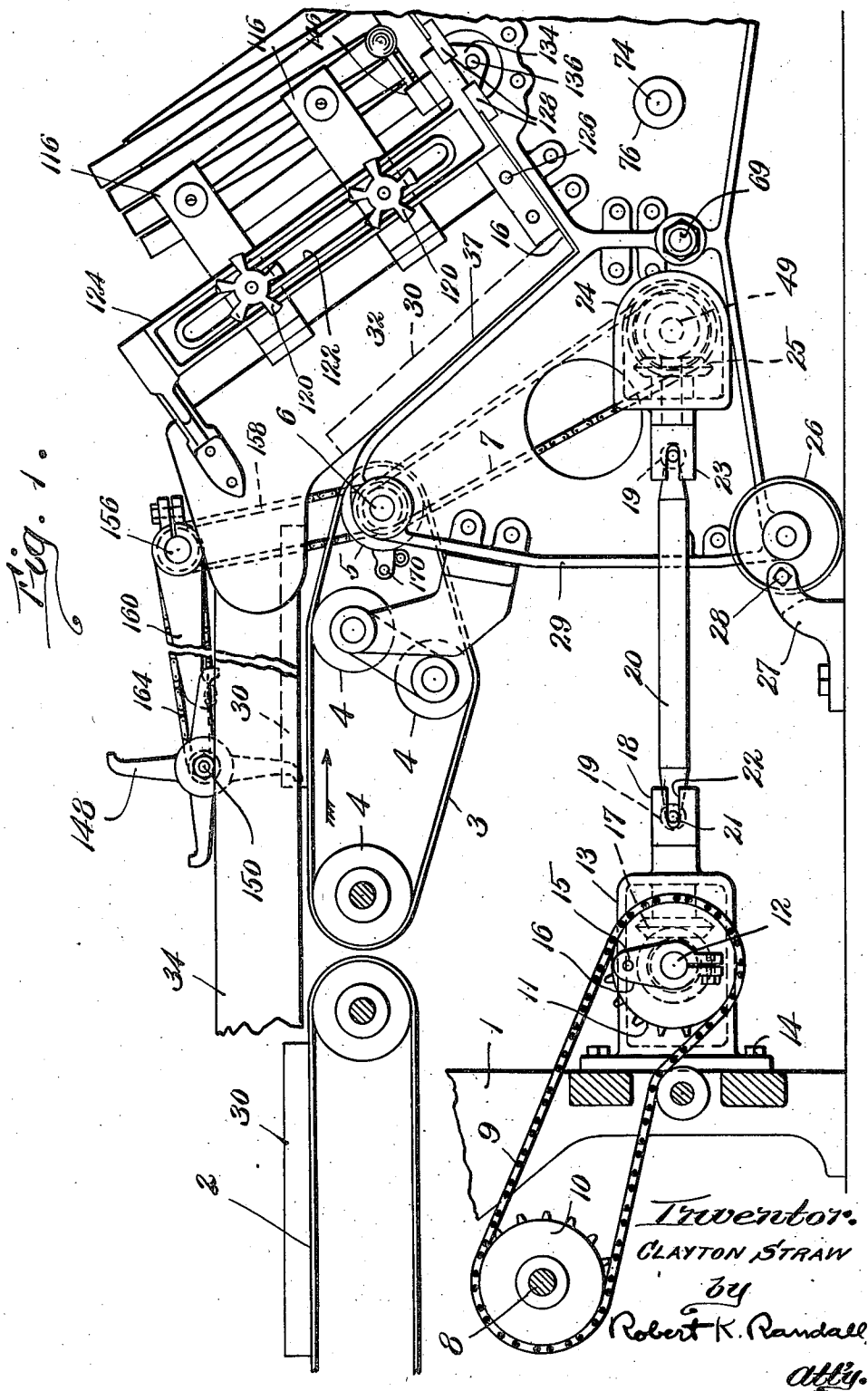
C. STRAW

2,452,020

BOX STACKER

Filed Feb. 10, 1943

6 Sheets-Sheet 1



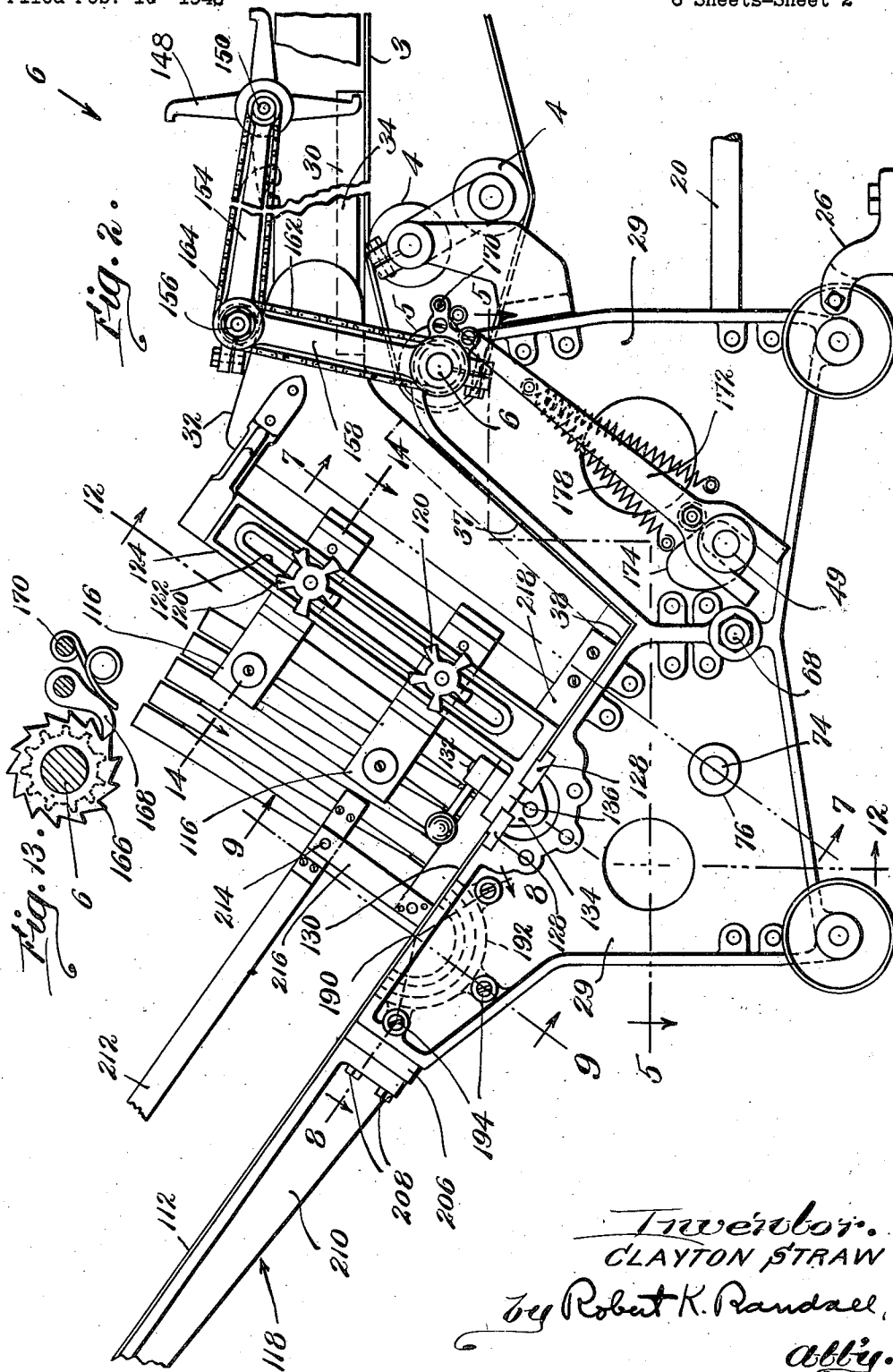
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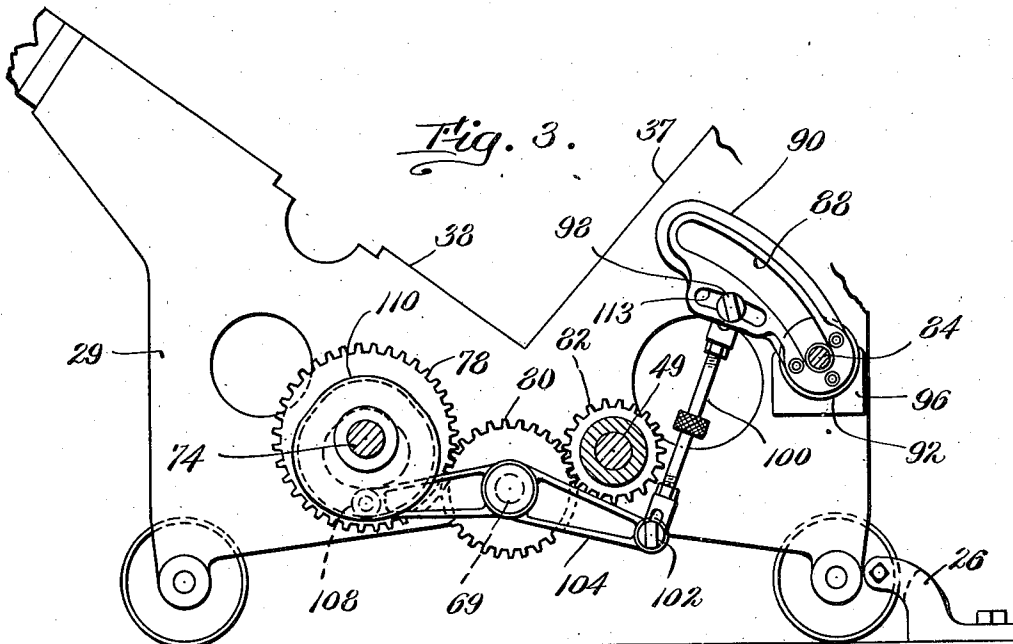
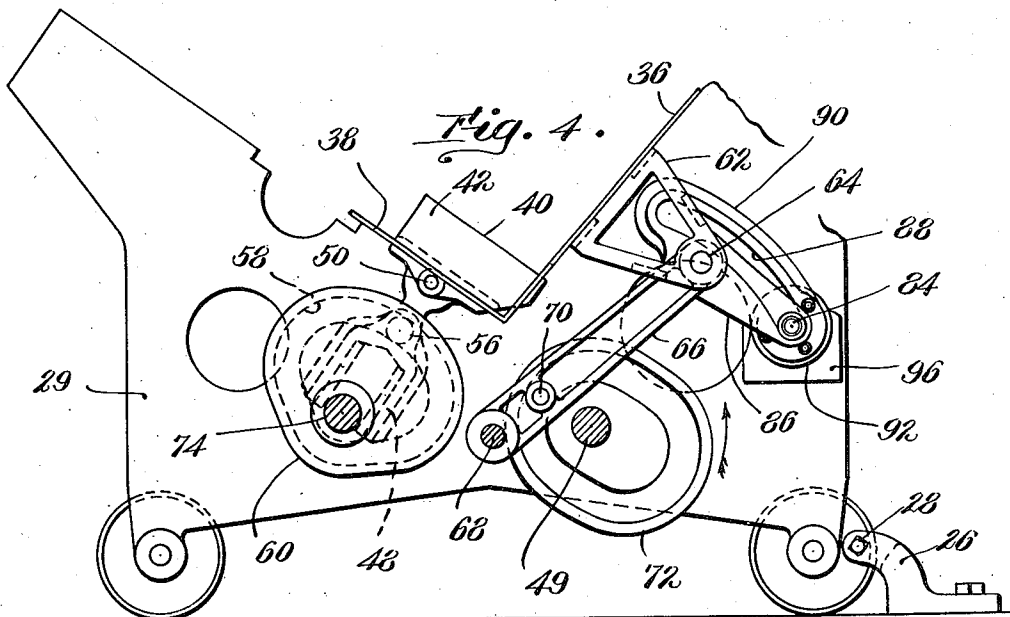
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BOX STACKER

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Fig. 5.

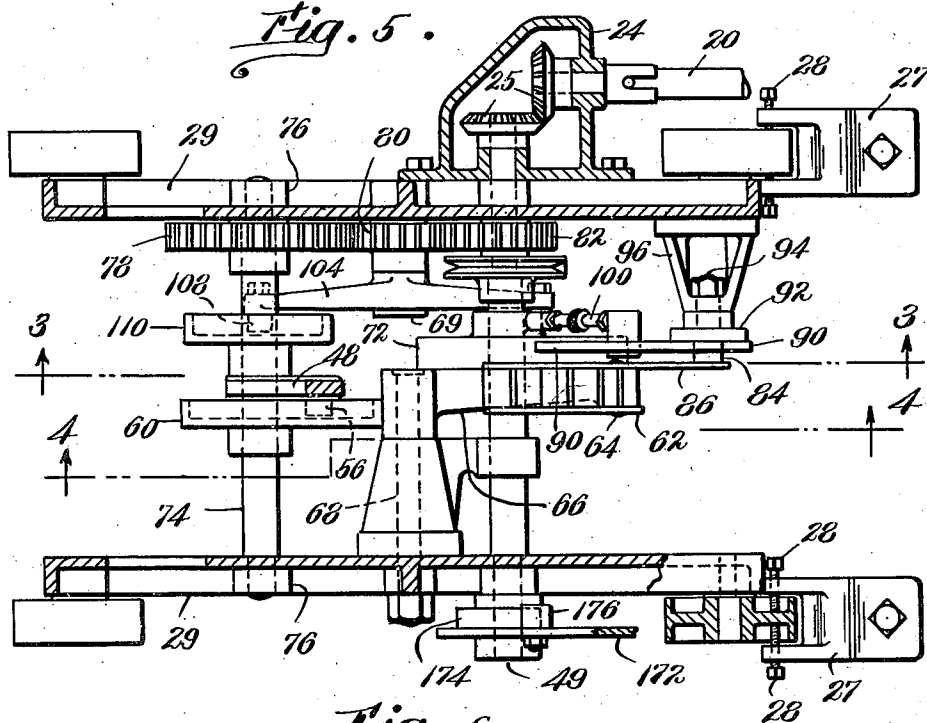


Fig. 6.

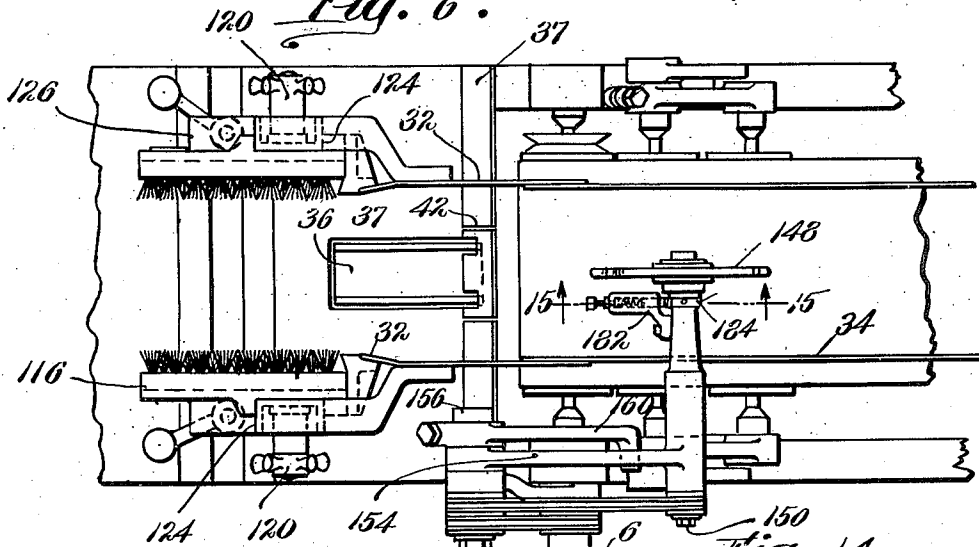


Fig. 14.

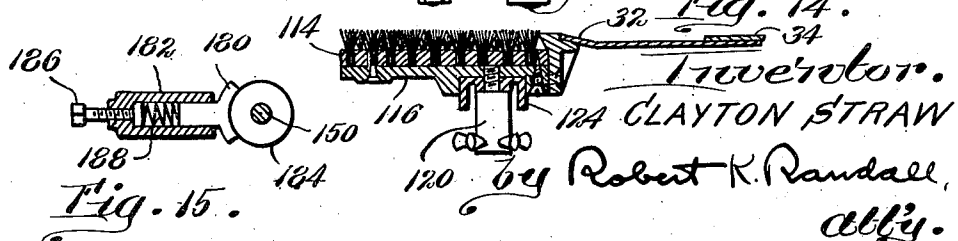


Fig. 15.

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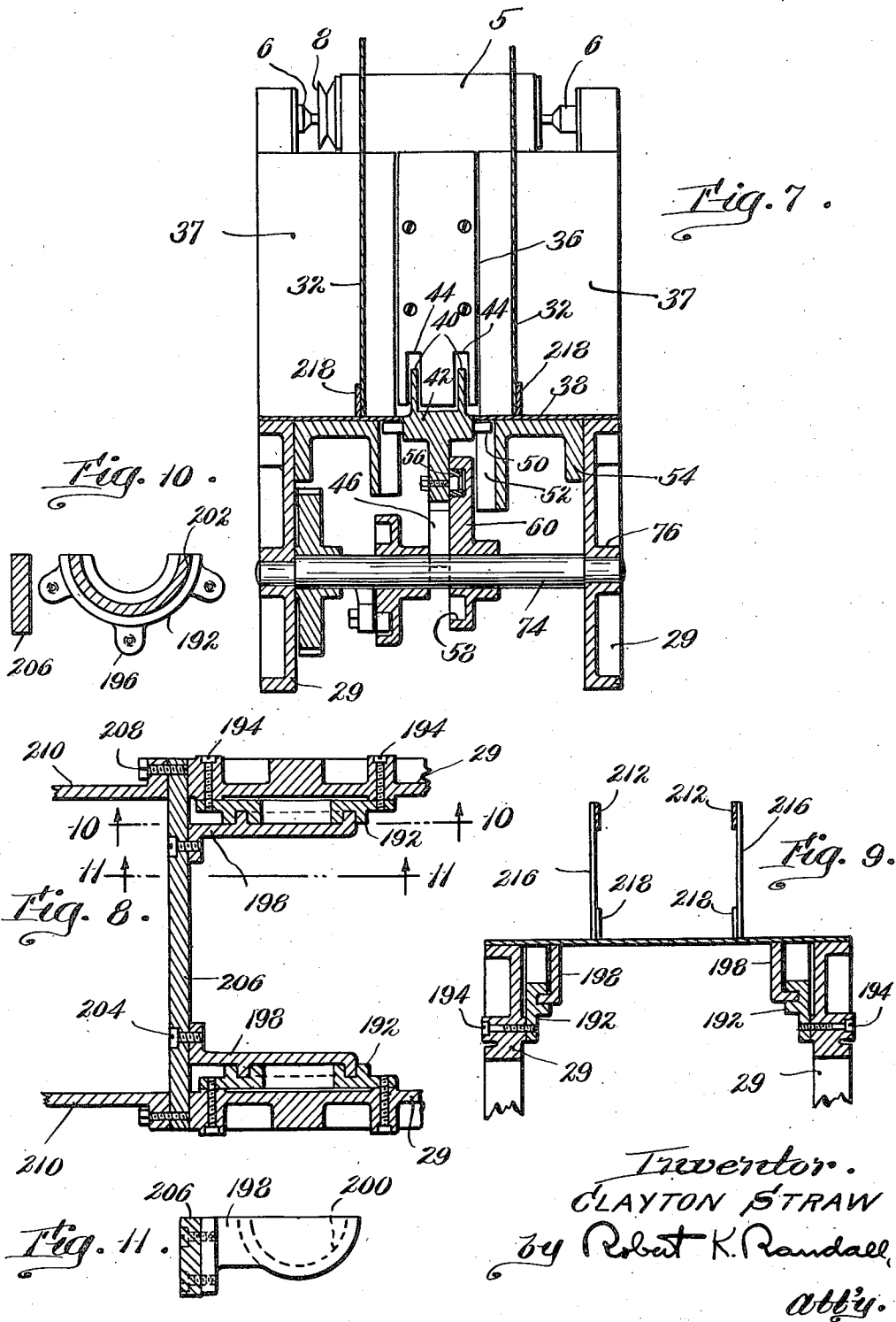
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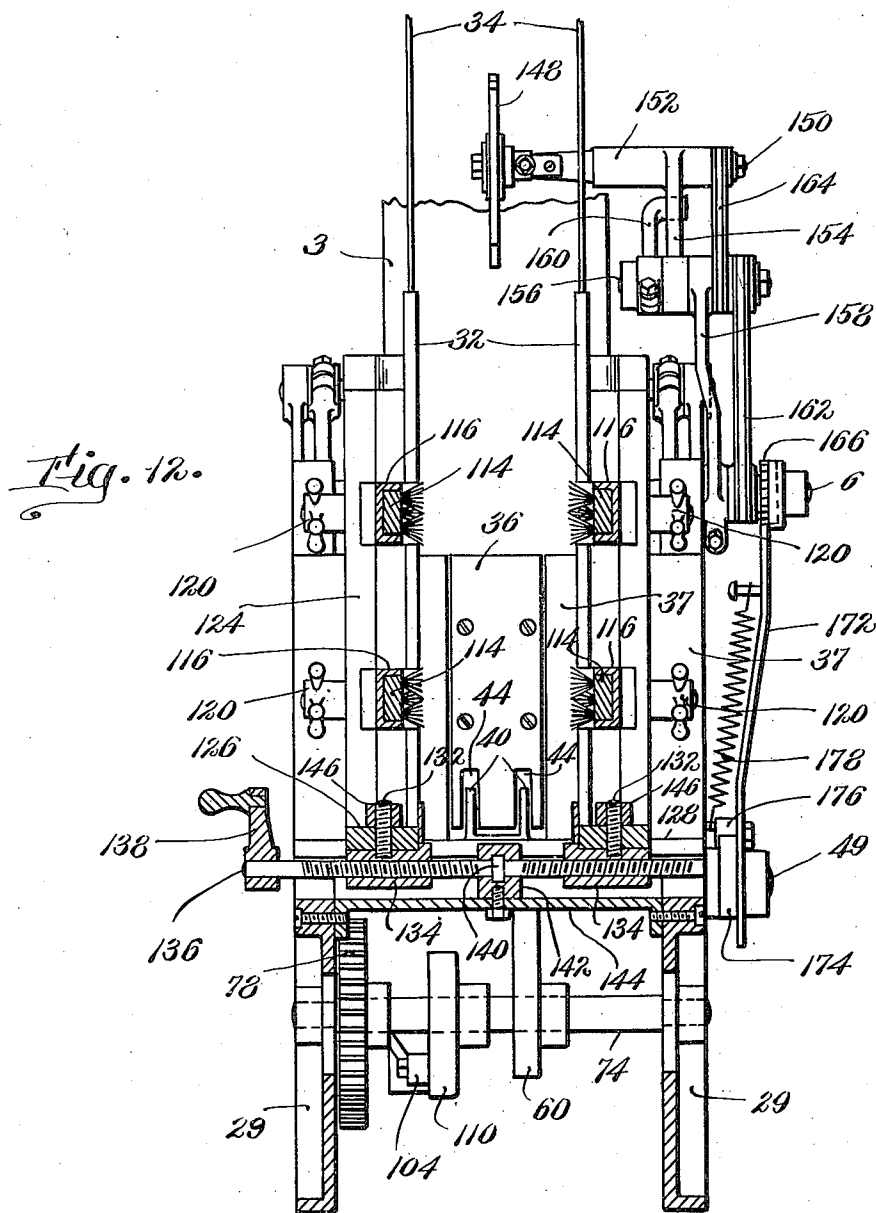
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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,452,020

BOX STACKER

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Application February 10, 1943, Serial No. 475,453

4 Claims. (Cl. 214—7)

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This invention relates to the manufacture of paper boxes, and to stacking devices primarily for use as adjuncts to paper-box-making machines for the purpose of assembling the boxes successively discharged from the box-making machine into coherent nested relation so as to form compact stacks facilitating handling, shipment, and storage, and to dispose the boxes in safe and orderly manner as discharged from the box-making machine.

The main object of the present invention is to provide stacking devices which will receive open-top parallel-sided boxes, including under this term the similarly shaped covers therefor, singly as discharged from a box-making machine, and interengage two corners and a substantial portion of the bottom and side walls of each box adjacent thereto within the corresponding portions of the next preceding or succeeding box, so as to wedge the two together in coherent relation. As is well known, since the interior dimensions of the boxes involved are the same at both top and bottom of the boxes, it is not possible to telescope the boxes into a nested relation in which the bottoms are parallel, because the bottom of one box will not pass wholly within the open top of a similar box of identical size. Hence it is customary to assemble them in the manner just indicated, with two corners of one box inside and two corners thereof outside the adjacent box and in overlapping or offset relation, with their bottoms in alternately oppositely-tilted and thus in zigzag relation.

The present invention attains this stacking or nesting of the boxes in novel and improved manner through feeding the successive boxes in alternately oppositely-tilted relation to each other, either open-side or bottom-side first, and each in offset, overlapping, vertically-displaced relation to its predecessor, so that before making contact with each other the successive boxes are both alternately tilted to bring their bottoms into the zigzag relation they must assume to each other and also are in the staggered relation which admits two corners of one box within the corresponding corners of the adjacent box. At the same time, yielding resistance is opposed to the travel of the boxes as thus fed, so as to cause each box as fed to be wedged into coherent relation with its predecessor and to push the stack onward sufficiently to make room for the next box to be added thereto.

This is accomplished in the present embodiment by receiving the box discharged from the box-making machine upon a table or against a

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stop which supports or stops it through engagement with the side or end of the box, which table or stop changes its position to arrest alternate boxes after a lesser degree of travel, and intermediate boxes after a greater degree of travel, from the box-making machine, while a plunger which engages the bottom of the boxes shoves the boxes successively off from the table or away from the stop in a direction substantially at right angles to their previous direction of movement. The working face of the plunger changes its slant after successive working strokes so that one side or end of a given box is slightly in advance of the rest of such box as it is pushed forward by the plunger while the opposite side or end of the next succeeding box is in advance when thus fed forward by the plunger, so that the successive boxes before they reach the stack are thus given the overlapping and zigzag relationship which comprises their ultimate position when nested together in the stack.

Additional features of the present invention comprise novel means in the form of brushes yieldingly engaging the sides of the stack of boxes to hold it back sufficiently to insure proper nesting of the successive boxes as each is added thereto while permitting onward travel of the stack under push of the added box without opposing sufficient resistance to cause crushing of the boxes. A further feature comprises the use of a detent or escapement in the form of a star wheel to hold back the successive boxes and release them in proper timed relation to be handled correctly by the stacking members, regardless of their rate of feed from the box-making machine to the stacker. Another feature is the provision for driving the box stacker from the box-making machine by means of driving connections admitting of easy attachment and disconnection of the two machines. A further feature is the provision for folding the rack holding the stacked boxes back over the machine when not in use.

Other aims of the invention, and the manner of their attainment, are as made plain herein-after.

An illustrative embodiment of the invention is shown in the accompanying drawings, in which:

Fig. 1 is a side elevation of the main parts of the box stacker, showing its driving and feeding connections with the box-making machine.

Fig. 2 is an elevation similar to Fig. 1, showing the other side of the machine.

Fig. 3 is a view in vertical section on line 3—3 of Fig. 5.

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Fig. 4 is a view in vertical section on line 4—4 of Fig. 5.

Fig. 5 is a view in horizontal section on line 5—5 of Fig. 2.

Fig. 6 is a view from above, looking down on the machine obliquely in the direction of the arrow shown at 6 in Fig. 2.

Fig. 7 is a view in section on the line 7—7 of Fig. 2.

Fig. 8 is a section on line 8—8 of Fig. 2.

Fig. 9 is a sectional elevation on line 9—9 of Fig. 2.

Figs. 10 and 11 are sectional views on the lines 10—10 and 11—11, of Fig. 8, respectively.

Fig. 12 is a view in section on line 12—12 of Fig. 2.

Fig. 13 is a detail of the ratchet actuating the star-wheel detent which times the feed of the boxes.

Fig. 14 is a section on line 14—14 of Fig. 2.

Fig. 15 is a section on line 15—15 of Fig. 6.

The box stacker of the present invention is intended to be used to receive and stack entirely automatically the output of boxes from box-making machines of conventional type such as the well-known Kingsbury & Davis quadruple box-staying machine, shown in U. S. Letters Patent No. 728,086, granted May 12, 1903.

The box stacker is preferably but not necessarily driven by power taken from the box-making machine. For this purpose, a novel power take-off is provided, as shown in Fig. 1, which facilitates connecting up and disconnecting the box stacker from the box machine, and at the same time transmits the necessary driving power to the box stacker without exerting any material pull or push such as is involved in a belt drive, thereby enabling the box stacker to be mounted on wheels for easy portability and avoiding the necessity for bolting the machine permanently to the floor to hold the box stacker in operative relation. Hence a single box stacker can serve a number of box making machines in succession. Thus, main driveshaft 49 of the box stacker is driven from the cam shaft 8 of the box machine by a chain 9 and sprockets 10, 11, the latter sprocket being loose on a shaft 12 mounted in a housing 13 bolted at 14 to the frame 1 of the box-making machine, a shear pin 15 transmitting the drive from sprocket 11 to an arm 16 keyed and clamped to shaft 12. Bevel gears 17 drive a socket 18 outside the housing, in which socket is received the ball-shaped extremity 19 of a short propeller shaft 20, a transverse pin 21 extending out from each side of the ball and being received in a slot 22 in socket 18 to form a universal joint connection. A similar connection between the other end of shaft 20 and a corresponding socket 23 on a housing 24 on the outside of frame 29 of the box stacker transmits the drive to a pair of bevel gears 25, one of which is fixed on the end of main shaft 49 of the box stacker. To set up the drive, it is merely necessary to roll the box stacker on its wheels 26 into a position where its apron 3 is in rough alignment with delivery apron 2 of the box-making machine, and guide the two ends of driveshaft 20 into the two sockets 18, 23, as the machines are brought together. A pair of clamps 27 bolted to the floor have raised slotted extremities into which the rims of the leading pair of wheels 26 are introduced, screws 28 thereupon being tightened against the webs of wheels 26 within their rims to hold this machine in driving connection with the other.

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The box-making machine, indicated fragmentarily at 1, has the endless apron conveyor 2 which receives the boxes as completed and discharges them out of the machine. A similar apron conveyor 3 is provided in the stacking machine, and arranged with its outer end at the same level and in close proximity to the delivery end of the conveyor on the box-making machine, so that the successive boxes carried by the first conveyor will ride off of the end thereof and onto the conveyor of the stacker without pause. This conveyor 3 is borne by rolls 4, freely rotating in brackets extending out from frame 29, one of such rolls being an idler adjustable in its position to tighten the belt, and by a roll 5 rotatable on pivots 6 fixed in frame 29 and driven by a belt 7 and V-pulleys 8 from main-drive shaft 49 of the stacker.

The boxes 30 fed from the box-making machine 1 by conveyor 2 onto conveyor 3 of the stacker are discharged one after another into an inclined hopper defined by downwardly-extending sheet metal wings 32, guards 34 being provided in hinged connection with these wings to overlie each margin of conveyor 3 to confine the boxes against lateral escape. Each box in turn descends over the inclined surface of a flat-faced pusher 36, Figs. 4, 7, and 12, working in an inclined wall 37 of the hopper and which performs the operation of pushing the boxes together into nested or stacked relation. As they slide down over the face of pusher 36, alternate boxes come to rest with their lower ends against the bottom 38 of the hopper, while the intermediate boxes are arrested at a higher level by engagement with the two raised ribs 40 of a stop 42 rising and falling in an aperture formed for it in the bottom 38 of the hopper. The bottom end of pusher 36 is slotted at 44, the raised ribs 40 entering these slots when the stop is elevated, so that each member can perform its desired motion even when the working faces of the two members are in overlapping and intersecting relation as shown in Fig. 4.

To cause stop 42 to assume alternately an elevated and depressed position, so as to arrest the alternate boxes sliding down over the pusher 36 at a higher level than the intermediate boxes of the series, stop 42 has an integral shank 46, Fig. 7, which is formed as indicated at 48 in Fig. 4 to straddle a shaft 74 mounted in bearings 76 in the machine frame and driven at half the speed of main shaft 49 by gearing 78, 80, 82. Stop 42 is equipped at each side with a projecting pin 50 sliding in guideways 52, Fig. 7, in a frame-member 54 supporting the hopper bottom 38. A cam follower 56 on the shank 46 works in a path 58 in a closed cam 60 fixed on shaft 74, thus alternately lifting stop 42 and depressing it until its ribs 40 are flush with the bottom 38 of the hopper. This change in the elevation of the ribs 40 imparts the essential vertically offset relation to the successive boxes to present one end-portion of the preceding box intermediate the length of the slightly flaring sides of the oncoming box, thus enabling them to nest easily.

The pusher 36 makes its stroke across the bottom 38 of the hopper to push a box dropped in front of it onto the end of the stack, by reason of its being carried by a bracket 62, Figs. 4 and 5, which is pivotally connected at 64 with a lever 66 mounted on a stud 68 in the machine frame, such lever being actuated by a cam follower on a pin 70 in the lever and working in a path cam 72 fixed on main shaft 49.

While lever 66 imparts a forward and backward movement to pusher 36, the working face of the pusher is alternately tilted during its working stroke so that its upward end travels faster than its downward end during one working stroke, and then during its next working stroke its downward end travels faster than its upward end, and so on in alternation, by a pin 84 fixed in an extension 86 on bracket 62 and carrying a roll working in a slot 88 in a path cam 90 attached to the face of a plate 92 having a shank 94, Fig. 5, swiveling in a bracket 96 on the inside of the machine frame 29. Path cam 90 is pivotally connected at 98 with a link 100 pivoted at 102 to one end of a lever 104 mounted on a stud 69 on the frame and having a roll 108 pivoted on its opposite end engaging a cam 110 fixed on shaft 74. Thus, with the parts in the relation shown in Figs. 3 and 4, upon rotation of shaft 49 for one-half turn pin 84 follows a path higher than that of pin 64 which supports the pusher and its bracket on lever 66, with the result that the top of pusher 36 travels forward faster than the rest of the pusher's surface, thus pushing the box which has been dropped in front of it forward toward the stack with its upper end in the lead while the whole box is held in elevated relation above the bottom 38 of the hopper by the rails 40 on account of the elevated position of stop 42. Continued rotation of shaft 49 for another half turn causes cam 72 to retract pusher 36 back to its position illustrated in Fig. 4, its starting point, while the accompanying quarter-turn rotation of shaft 74 and cam 60 lowers stop 42 until its rails 40 are level with the bottom 38 of the hopper. At the same time, this latter rotation of shaft 49 causes cam 110 to move lever 104 so as to depress the free end of cam 90, so that after the next box is dropped by conveyor 3 in front of pusher 36 the latter will travel forward with its bottom end in the lead, upon continued rotation of cam 72 in counterclockwise direction, and will thrust the box across bottom 38 of the hopper with the box's lower end in advance of the rest of the box and depressed below the bottom of the immediately preceding box. In this way both the staggering of the boxes which enables two corners of one to enter within the interior of its adjacent box, and the oppositely-tilted oblique or zigzag relation of the planes of the bottoms of successive boxes which enables them to nest compactly, are attained.

To increase the relative obliquity given to the successive boxes as pushed forward by pusher 36, for proper nesting of deeper boxes than those shown, the position of the pin 98 is shifted along the small slot 113 in cam 90 in which it is shown mounted, in a direction toward the cam's pivot 94, to increase the throw of the cam, the pin being thereafter operatively fixed.

To keep the alternate boxes, when advanced with their bottom edges in the lead by the backwardly tilted pusher 36, from lifting the stack up off of the floor of the stack-supporting surface 112 on which it rests, the amount of the changed inclination of pusher 36 during successive working strokes is not divided equally each side of the line of thrust of the pusher 36 toward the stack, but is mostly added to the slant of the pusher when the latter advances with its top edge in the lead and hence pushing the intermediate boxes on to the stack with their top edges in advance of their bottom edges. This is accomplished by threading link 100 into its clevises at each of its

ends with screw threads of opposite hands, so that its effective length can be adjusted to tip cam 90 up or down as needed to vary the relative elevation of the free end thereof, without affecting the scope of movement imparted to this cam by link 100 as set by the position of pivot 98.

Pusher 36 returns after each stroke into the same position in the plane of the inclined wall 37 of the hopper because pin 84 passes along groove 88 in cam 90 until coaxial with the pivot 94 of such cam as shown in Figs. 3 and 4. Thus the momentary position or continuing movement of cam 90 has no effect on the slant of pusher 36 at this time, and the latter is retracted flush with wall 37 to permit each box to descend thereover without catching on the top edge of the pusher.

Obviously, the boxes can be fed onto the stack either with their open sides or with their bottom sides forward. The present device is arranged to shove the boxes onward into nested relation with their open sides forward, as this avoids the problem of getting the pusher 36 to enter within the box interior without catching on the upstanding side walls.

The intermeshing of the ribs 40 on the stop 42 within the slots formed in the foot of the pusher provides for the necessary rise and fall of stop 42 to position the successive boxes alternately in elevated and depressed relation, while enabling the pusher to be made as long as the longest box to be handled, so that the area of its bearing surface engaging the box bottom will be extensive enough to make sure that the bottom of the box will take the same slant as that of the working face of the pusher. For the purpose of causing the bottom of the box thus to conform to the slant of the pusher, the whole hopper is tilted backwardly toward the box-making machine, so that gravity will cause the box bottom to rest accurately and conformably against the working face of the pusher. However, if preferred, the hopper wall 37 and pusher 45 can be disposed either vertically, with the stack-support 112 which receives the accumulated stack of nested boxes arranged horizontally, or the hopper wall 37 and pusher can be horizontal with a vertical stack-support on two or more sides of the stack.

Each box as thrust forward by pusher 36 is forced between two pairs of bristle-clad members or brushes 114, Figs. 6, 12 and 14, in holders 116 which are set at the proper spacing widthwise of the machine to engage the vertical sides of each box as it is pushed forward by pusher 36 and to oppose a moderate amount of resistance to the forward movement of the boxes under pressure of the pusher. This pressure combined with the movement of the boxes bends the bristles in the direction of the feed causing them to resist reverse movement of the boxes. When stop 42 is in its depressed position the top surfaces of its ribs 40 are substantially in line with the bottom 38 of the hopper which latter is in the plane of the stack-supporting surface 112 which forms the floor of an extending rack 118 made long enough to hold an accumulation of a relatively large number of boxes in staggered relation, and from which the stacked boxes are removed by hand periodically for use or for storage in nested form. Thus every other box, being pushed uphill along bottom 38 to the limit of the stroke of pusher 36, passes between and is held by brushes 114, its side-walls passing over the protruding end-por-

tion of its predecessor, and under pressure of the succeeding boxes is slid upward along stack-support 112. The intermediate boxes are elevated from bottom 38 through the alternating elevation of stop 42 which assists in attaining the nested relation, and each is likewise thrust between the brushes and over the end-portion of the lower-most box in the stack. The brushes 114, aided by the resistance to uphill movement opposed by the stack as it accumulates, affords the necessary resistance to insure each successive box being fully nested over its predecessor. Clamp screws 120 put through slots 122 in uprights 124 enable the brushes to be adjusted to the proper heights for different lengths of boxes. The angular foot portions 126 on uprights 124 are mounted for adjustment widthwise of the machine, each foot having a shouldered portion slidably fitting between two parallel guide-edges 128 extending transversely across the machine between the terminus of bottom 38 of the hopper and a plate 130 forming an extension of the floor 112 of the stack-support. Manually operable clamp screws 132 are fixed in screw threaded sleeves 134, Figs. 2 and 12, which have shoulders engaging the under sides of guide-edges 128 along the parallel edges of the latter. These sleeves are oppositely threaded and receive a threaded shaft 136 revolved by hand-crank 138 and itself held from endwise movement by a central shoulder 140 held rotatably in a block 142 screwed to frame member 144 at midwidth of the machine. When hand-nuts 146 are loosened, rotation of adjusting screw 136 by its crank moves the uprights and the brushes inward or outward to suit boxes of different widths. Tightening the hand-nuts 146 clamps the feet 126 and the sleeves 134 against the guide-edges to maintain the adjustment. The wings 32 of the hopper are likewise supported on brackets extending from the uprights 124, so that this adjustment also sets the width of the hopper and the spacing of side guards 34 carried thereby, correctly for the width of box being turned out. The wings 32 steer the oncoming box accurately over the last preceding one held by the brushes.

To feed the boxes into the hopper in properly timed relation to the movements of pusher 36, a revolving detent or escapement device in the form of a star-wheel 148 is employed, having hooked radial arms which extend downward into proximity to the surface of conveyor 3 to enter within the open top of each box as it is carried past by the conveyor and to hold back the box, releasing it at the proper moment to cause the conveyor to discharge it into the hopper over pusher 36 while the latter is in the fully retracted position shown in Fig. 4.

To do this, detent 148 is fixed on a shaft 150 so as to stand at midwidth of conveyor 3, the shaft being rotatably mounted in a bearing 152 at the free end of a supporting arm 154 pivotally mounted on a stud 156 fixed in the upper end of an arm 158 whose lower end is clamped in fixed angular position about the protruding end of one pivot 6 on which roll 5 supporting the conveyor rotates (Figs. 2, 6 and 12). An arm 160, clamped in fixed angular position to stud 156, has an angularly bent extremity which supports arm 154 and thus the star-wheel at the desired elevation above conveyor 3, in a manner allowing the star-wheel to rise freely without disarranging the setting or damage to the parts in the event that two boxes arrive beneath the star-wheel one on top of the other, as sometimes occurs. The end of pivot 6

rotatably supports a sprocket which when rotated transmits rotation to star-wheel 148 by means of chains 162, 164, a pair of connected sprockets on stud 156, and a sprocket fixed on shaft 150 carrying star-wheel 148. Fast with the sprocket on pivot 6 is a ratchet 166, Fig. 13, actuated by a pawl 168 on an oscillating pawl-carrier 170 which is actuated by a link 172 having a forked lower end which straddles the end of shaft 49 which projects outwardly through side frame 29. A cam 174 fixed on the end of shaft 49 engages a roll 176 on link 172 to move the link and hence the pawl-carrier 177 with its pawl in one direction to give the pawl its idle stroke, while contracting springs 178 move the link in the opposite direction to give the pawl its working stroke rotating star-wheel 148 to lift its acting arm out of the box being detained thereby, and immediately thereafter to put its succeeding arm down inside the following box to hold that one back until the pusher 36 has disposed of the preceding box and is ready to receive the next one. Since there is a dwell of the star-wheel after it arrests each box and while the pusher is stacking the preceding box, friction means is provided to prevent vibration of the machine coupled with the drag of continuously moving conveyor 3 against the bottom of the detained box from shifting the star-wheel sufficiently to release the box prematurely. This comprises a brake shoe 180, Fig. 15, having its reduced shank portion held in a guide-sleeve 182 fixed on the side of the bearing 152, the block being pressed yieldingly against a collar 184 fixed on shaft 150 by a screw 186 and interposed spring 188 so as to create friction enough to hold the star-wheel against accidental rotation.

This arrangement of the star-wheel detent permits it to be moved forward or back along conveyor 3 to suit boxes of varying length, or lowered or raised for boxes of different depth, without losing the proper timing of its release of the successive boxes; thus there is no occasion to change the setting of cam 174.

The extended rack 118 which holds the stack of nested boxes accumulating in the machine is arranged so that it can be folded back over the body of the machine to get it out of the way when the stacker is not in use. For this purpose, the rack swings around a transverse axis at 190, Fig. 2, a short distance beyond the guide-edges 128 and at the terminal edge of extension-plate 130. To create this axis in the plane of stack-supporting surface 112 and of plate 130, segmental guides 192, Figs. 2, 8, 9, and 10, are bolted to the inner surfaces of side frames 29 of the machine, by means of screws 194 passing through suitable bosses in the webs of the frames and threaded into lugs 196 on the guides. Corresponding guide-members 198, Figs. 8, 9, and 11, having semi-circular tongues 200 fitting within the semi-circular grooves 202 of guides 192, are bolted at 204 to a cross-member 206 to the ends of which are fixed by screws 208 the flanged ends of angle-section members 210 supporting the stack-supporting surface 112 forming the floor of extended rack 118.

To hold the stack of nested boxes on the surface 112 of the extended rack, side guards 212, Fig. 2, are provided, each pivotally supported at 214 well above the surface 112 by a member 216 rigidly secured at its lower end to an elongated strip 218 affixed to the inward surface of each upright 124 carrying the brushes 114, and having its lower end outside of and fixed to the foot of

each wing 32 defining the hopper. Thus mounted, the same adjustment which sets the uprights, brushes, and wings to suit the width of the boxes being stacked, also adjusts the side guards 212 toward and from each other to suit the width of the boxes, while the pivotal connection at 214 lets the guards fold back over the machine along with the extended rack 118. A suitable support (not shown) rigidly attached to the upper end of each side guard 212 and extending at right angles to rest upon the surface 112 of the rack, maintains the upper ends of guards 212 in elevated position roughly parallel to the surface 112, when the machine is in use.

While I have illustrated and described a certain form in which the invention may be embodied, I am aware that many modifications may be made therein by any person skilled in the art, without departing from the scope of the invention as expressed in the claims. Therefore, I do not wish to be limited to the particular forms shown, or to the details of construction thereof, but what I do claim is:

1. Stacking devices for boxes having in combination means feeding the boxes one by one, a surface supporting the boxes, a pusher engaging the boxes one by one and pushing them in the same direction over such supporting surface, and means varying the angular inclination of the pushing surface of the pusher by causing one end of the pusher to be in the lead during alternate working strokes and the other end to be in the lead during the intermediate working strokes.

2. Stacking devices for boxes having in combination means feeding the boxes one by one, a surface supporting the boxes, a pusher engaging the boxes one by one and pushing them all in the same direction over such supporting surface, and means causing the pushing surface of the pusher to assume alternately oppositely-tilted relation when it completes the pushing of successive boxes.

3. Stacking devices for boxes, having in combination means feeding the boxes one by one, a surface supporting the boxes, a pusher engaging

the boxes one by one and pushing them all in the same direction along such supporting surface, means varying the angular inclination of the pushing surface of the pusher during its successive working strokes so as to advance the boxes to the stack of accumulated boxes in alternately oppositely-tilted relation, and means varying the path of travel of each successive box while engaged by the pusher.

4. Stacking devices for boxes having in combination means feeding the boxes one by one, a surface supporting the boxes, a pusher engaging the boxes one by one and pushing them all in the same direction over such supporting surface, means reversing the angular inclination of the pushing surface of the pusher on successive working strokes, after pushing each successive box, and means varying the amount of angular inclination to suit boxes of different depths.

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