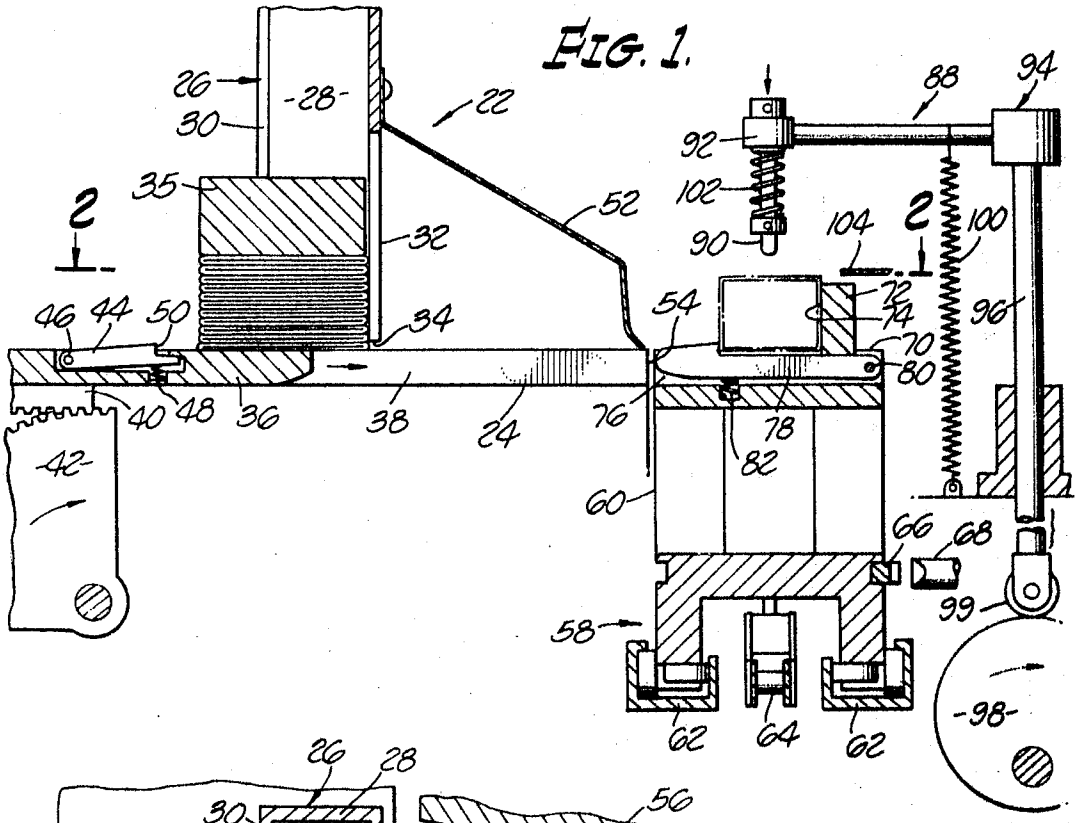
July 29, 1969 R. R. BOWER 3,457,843

BOX ERECTING APPARATUS

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FIG. 1.



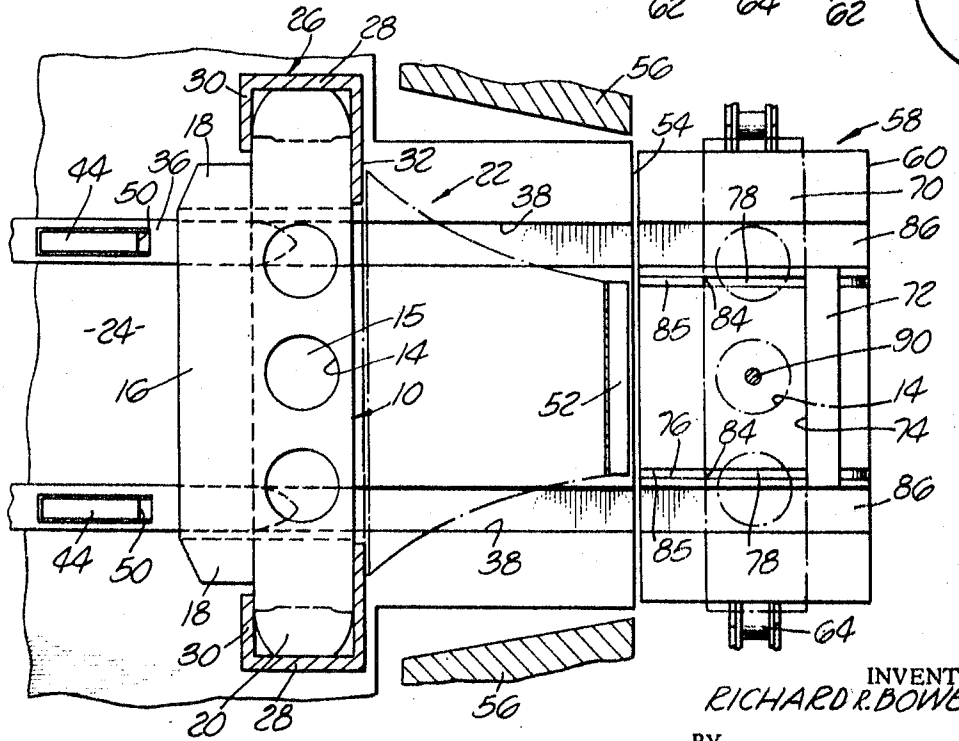


FIG. 2.

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FIG. 3.

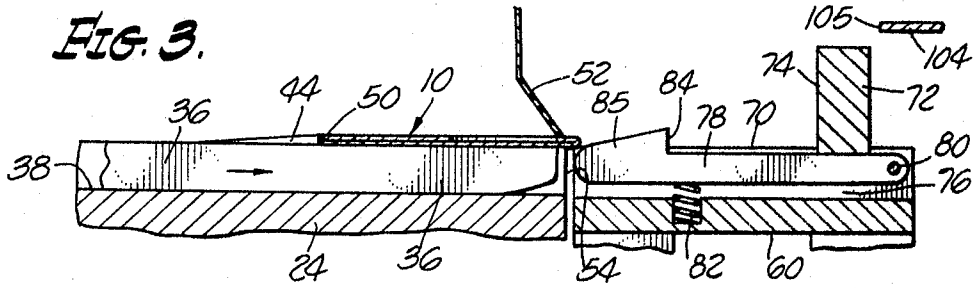


FIG. 4.

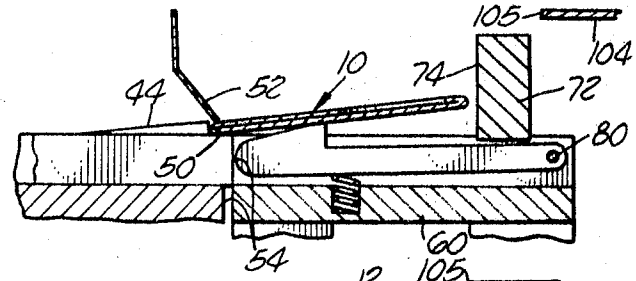


FIG. 5.

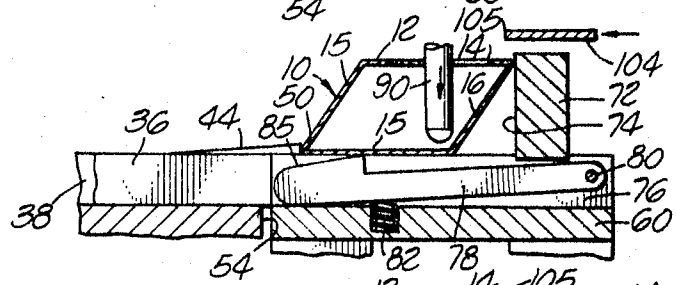


FIG. 6.

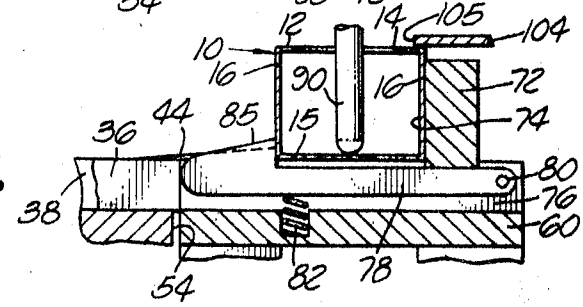
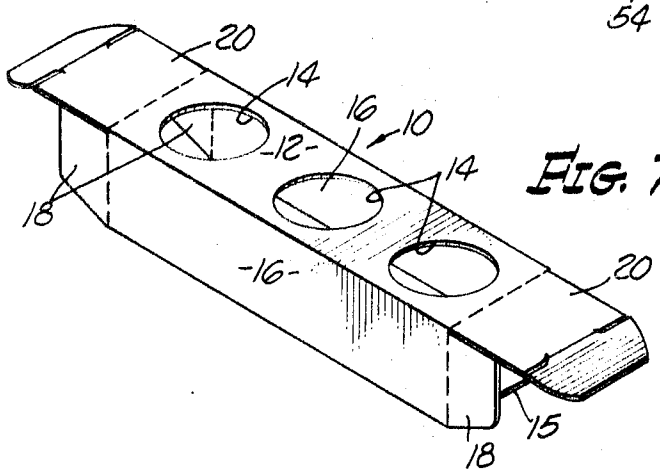


FIG. 7.



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United States Patent Office 3,457,843 Patented July 29, 1969

3,457,843

BOX ERECTING APPARATUS

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Filed Jan. 8, 1968, Ser. No. 696,308
Int. Cl. B31b 1/78
U.S. Cl. 93—53 8 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for automatically sequentially selecting and erecting boxes from a stack thereof which are folded flat on a pair of diagonal corners. Reciprocating pusher means engages one of said folded diagonal corners of the bottom box in the stack, sliding this box off from under the stack onto an erection platform and forcing the other said folded corner against an abutment surface extending upwardly normally from the platform so as to unfold and erect the box against said abutment surface and platform. Spring biased gripping fingers in the platform engage said pushed corner to latch the box in its erected position.

BACKGROUND OF THE INVENTION

Cardboard boxes or cartons are normally provided by the box manufacturers in a folded and stacked condition, with the boxes folded over on diagonal corners, and with the side and end flaps extending outwardly at the ends of the folded boxes. In automated assembly and packaging systems it is desirable to include automatic apparatus for sequentially separating such folded boxes from a stack thereof and erecting the boxes and holding them in such erected positions for receiving assembled articles therein.

The use of such automatic box erecting apparatus, as compared with manual opening of the boxes, is particularly important where assembly and packaging is being carried out on a rapidly operating assembly conveyor system, where the boxes must be quickly erected and positively located in accurately timed relationship to movements of the conveyor units upon which the packaging is to occur.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the present invention to provide apparatus for automatically removing a folded box from a stack of such boxes and both opening or erecting the box and locating the box so that the box is adapted to receive one or more assembled articles therein.

Another object of the invention is to provide apparatus for erecting, in sequence, a plurality of stacked boxes that are folded flat on diagonal corners, wherein reciprocating pusher means periodically removes a folded box from the stack, locates the box on an erection platform and erects the box by pushing against one of the folded corners of the box, while the opposite folded corner is engaged against an abutment surface extending upwardly from the platform.

Another object of the invention is to provide box erecting apparatus of the character described wherein each of the erected boxes is latched in its erected position by spring biased gripping fingers which engage the corner of the box which was pushed by the pusher means to cause erection of the box.

A further object of the invention is to provide box opening or erecting apparatus of the character described wherein means for erecting the boxes and securing the boxes in their erected positions are periodically driven so as to periodically erect a sequence of the boxes, whereby

the apparatus is particularly adapted for synchronized operation in connection with a conveyor apparatus on which articles may be assembled and disposed in the erected boxes.

Other objects and advantages of the present invention will appear during the course of the following part of the specification, wherein the details of construction and mode of operation of a presently preferred embodiment are described with reference to the accompanying drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a vertical section, partly in elevation, illustrating the box erecting apparatus of the present invention in connection with an assembly conveyor system, the section being longitudinal relative to the principal movements involved in the box erection, and being transverse relative to the principal movements of the assembly conveyor system.

FIGURE 2 is a fragmentary horizontal section, partly in elevation, taken on the line 2—2 in FIGURE 1.

FIGURES 3, 4, 5 and 6 are enlarged, fragmentary vertical sections taken on the same section line as FIGURE 1, illustrating four successive stages in the movement and erection of a box in accordance with the present invention.

FIGURE 7 is a perspective view of a box which has been erected by the apparatus of the present invention.

DETAILED DESCRIPTION

A typical cardboard box or carton **10** that is to be opened or erected by the apparatus of the present invention is illustrated in its erected position in FIGURE 7, and includes a top wall **12** having a series of openings **14** therein to receive assembled objects, a bottom wall **15** parallel to the top wall **12**, and parallel side walls **16** which, in the erected position of the box, are at right angles to the top and bottom walls. The box **10** is adapted to be closed at its opposite ends by a pair of side flaps **18** extending from the ends of each of the sides **16**, and an end flap or tongue **20** extending from each end of the top wall **12**.

Boxes of this type are provided by the box manufacturers in stacks of the boxes which are folded over on diagonal corners so as to be flat, with the top wall **12** and one of the side walls **16** forming an upper layer, and the bottom wall **15** and the other side wall **16** forming a lower layer. This flattened condition of the boxes is illustrated in FIGURES 1 through 4, and is clarified by the partially erected parallelogram cross section thereof illustrated in FIGURE 5.

The apparatus of the present invention includes a magazine generally designated **22** adapted to receive therein a stack of these flattened boxes or cartons **10**. The magazine **22** includes a horizontal table **24** upon which the stack of boxes **10** rests, and a bin **26** extending vertically upwardly from the table **24** arranged to hold the boxes **10** in their vertically stacked relationship. The bin **26** is in the form of a vertically oriented slideway for the stacked, flat boxes, including parallel sides **28**, rear flnages **30** extending inwardly from the rear edges of the sides **28**, and forward wall **32** the lower edge of which is spaced above the table **24** adjacent the sides thereof a distance slightly greater than the thickness of one of the flattened boxes **10** so as to define a horizontal feed slot **34** through which the lowermost box **10** of the stack of boxes is adapted to be fed by pusher means described hereinafter. A weight **35** or other suitable biasing means is disposed immediately above the stack of boxes **10** to shift the remaining boxes downwardly each time the bottom box is thus fed out of the bin through the slot **34**.

The pusher means includes a pair of elongated, spaced, parallel slide members **36** slidably mounted for simultaneous reciprocating movement in a pair of spaced, parallel slots **38** in the table **24**. The slide members **36** are driven by means of a rack **40** attached to both slide members, and a gear sector **42** operatively engaged with the rack **40** and reciprocally driven from a main power unit which also provides the motive power for the synchronized movement of the other movable parts to be described hereinafter.

Each of the slide members **36** is provided with an elongated, upwardly facing recess within which a longitudinally arranged pusher finger **44** is pivotally mounted on a rearwardly disposed pivot pin **46**. Each pusher finger **44** has its forward end portion biased upwardly by means of a coil spring **48** seated in a recess in the respective slide member **36** underneath the forward portion of the finger, so that a forwardly facing shoulder **50** on each finger normally projects upwardly from the upper surface of the table **24** a distance about the same as the thickness of one of the folded boxes **10**. With this construction, each time the pair of slide members **36** moves forwardly in the table **24**, or to the right in FIGURES 1 through 6, the exposed finger shoudlers **50** will engage the rearward folded diagonal corner of the lowermost box **10** in the magazine so as to push the lowermost box out from under the stack through feed slot **34** and thence to the right along the table top and off of the forward end **54** of the table top onto the conveyor system. A leaf spring **52** is attached to the forward wall **32** of the magazine bin and extends forwardly and downwardly to a free, straight guide edge immediately above the table top adjacent the forward edge **54** of the table, so that as each of the flat boxes **10** is thus pushed off of the forward end **54** of the table, the leaf spring **52** biases the flat box down flat against the table and onto the conveyor.

A pair of stationary cam members **56** are disposed on opposite sides of the table **24** between the magazine bin **26** and forward edge **54** of the table. These cam members **56** engage the end flaps or tongues **20** of the box as the box is pushed along the forward portion of the table so as to bend the end flaps downwardly and thereby apply an initial crease to the end flaps.

The conveyor is generally designated **58**, and includes a plurality of longitudinally spaced carriages **60** which ride along on and are accurately positioned relative to the table **24** by track means **62**, the carriages being drivingly connected to a drive chain **64** which is intermittently driven, preferably from the same power source as the one which reciprocally drives the gear sector **42**. The track means **62** and drive chain **64** are arranged so that movement of the carriages **60** is normal to the direction of movement of the slide members in the table, and the drive chain **64** is stopped when a carriage **60** comes into registry with the forward end **54** of the table as best shown in FIGURE 2. Accurate indexing of the carriage **60** relative to the table may be accomplished by provision of a notched indexing member **66** on the carriage which is engaged by an indexing rod **68** having a beveled forward end, as best shown in FIGURE 1, when the carriage **60** is halted adjacent the forward end of the table. Movement of the indexing rod **68** into engagement with the notched indexing member **66** on the carriage may be accomplished by cam means driven by the same power source as drives the gear sector **42** and the drive chain **64**.

The carriage **60** has an upwardly facing horizontal support surface **70** thereon which is coplanar with the upper surface of table **24** so that a flat, folded box **10** will slide onto this support surface **70** when it is pushed off of the top of table **24**. An abutment flange **72** projects upwardly from the support surface **70** of the carriage adjacent the side of the carriage remote from table **24**, and has a vertical abutment surface **74** which faces rearwardly or toward the table **24**.

Pivotally mounted in a pair of parallel slots **76** is a pair of retainer fingers or latches **78** which have free ends adjacent the forward edge **54** of the table, and are pivoted on pivot pins **80** adjacent the side of carriage **60** that is remote from the table. The retainer fingers **78** are biased upwardly by means of springs **82** in respective recesses in the carriage under the respective retainer fingers **78**, and in the uppermost positions of retainer fingers **78** as illustrated in FIGURES 1, 3 and 6, forwardly facing retainer shoulders **84** on the fingers **78** are exposed above the plane of table **54** and horizontal support surface **70**. The fingers 78 have ramp surfaces **85** which slope downwardly and rearwardly from the retainer shoulders **84** to the rearward or free ends of the fingers, so that as a flattened box **10** is pushed under the leaf spring **52** and onto the carriage support surface **70** it will meet such ramp surfaces **85** on the fingers and will thereby be allowed to smoothly slide into position on the carriage.

A pair of slots **86** extend across the carriage **60**, being recessed downwardly in the carriage from the support surface **70**. These slots **86** are arranged for accurate alignment with the respective table slots **38** when the carriage **60** is properly indexed relative to the table. The forward stroke of movement of slide members **36** carries the forward ends of the slide members **36** into the carriage slots **86**. The forward ends of slide members **36** are tapered as shown in FIGURE 2 so that the slide members **36** will readily fit into the carriage slots **86**, and by this means any slight misalignment of the carriage member will be corrected when the slide members **36** enter into the carriage slots **86** beyond the tapered front tips of the slide members **36**.

Seating means, generally designated **88**, includes a seating rod **90** which is reciprocally moved on a vertical axis so as to move downwardly when a box is partially erected, as in FIGURE 5, through the center opening **14** in the top wall of the box and push downwardly against the bottom wall **15** of the box so as to assist in the final erection and seating of the box on the carriage **60**. The seating rod **90** is mounted in a head portion **92** of the seating means which generally overlies the center of the carriage **60** when the carriage is in its indexed position, and this head portion **92** is mounted on support structure **94** including a generally vertically arranged cam follower shaft **96** which is vertically reciprocated by means of a cam **98** that is driven by the same power source as the reciprocating gear sector **42** and drive chain **64**. The cam **98** is synchronized relative to the movements of gear sector **42** and drive chain **64** so that the seating rod **90** will remain spaced above the carriage generally as illustrated in FIGURE 1 while a folded box is pushed out of the magazine and onto the carriage, and the rod **90** will then be moved downwardly as the box becomes partially erected as shown in FIGURE 5 so as to engage against the bottom wall **15** of the box as in FIGURE 6, and then the rod **98** will be moved upwardly so as to completely clear the erected box, as shown in FIGURE 1, before further movement of the drive chain **64** is initiated to move the carriage **60** and erected box away from the table **24** to be replaced by a succeeding carriage **60**.

The cam follower shaft **96** is provided at its lower end with a roller **99** which rides on the cam **98**, the cam follower roller **99** being biased against the cam **98** by a suitable biasing spring **100**.

The seating rod **90** is slidably mounted in the head portion **92** of the seating means **88**, and is downwardly biased by a suitable compression spring **102**. This provides a lost motion type of mounting of the seating rod **90** which permits the rod **90** to engage against the bottom **15** of the box with a biasing force determined by the strength of spring **102** for a predetermined interval of time suitable to allow full erection and seating of the box from the position of FIGURE 5 to the position of FIGURE 6.

A generally flat, horizontally oriented holding finger **104** is positioned and movable in a horizontal plane spaced upwardly from the horizontal support surface **70**

of carriage **60** a distance corresponding substantially to the height of the erected box. This holding finger **104** is normally in a forward position as illustrated in FIGURES 1, 3 and 4, wherein its rearward edge is spaced forwardly from the abutment surface **74** of the upstanding flange **72** on the carriage. However, as the box is shifted from a partially erected position such as that shown in FIGURE 5 to a fully erected position as shown in FIGURE 6, this holding finger **104** shifts rearwardly so that its rearward edge **105** projects rearwardly past the vertical plane of the abutment surface **74**, whereby the rearward edge of the holding finger **104** overlaps and engages the top wall **12** of the box adjacent the forward folded corner of the box which has been straightened out during erection of the box. The combination of this holding finger **104** and the seating rod **90** assures that the erected box will be securely latched in place on the carriage. The holding finger **104** is shifted forwardly out of engagement with the box prior to movement of the carriage away from the table with the erected box in place on the carriage. The holding finger **104** is preferably moved by cam means, such as means driven by the cam **98**, which is driven from the same power source as the gear sector **42**, chain **64** and cam **98**, for synchronized movement with the other movable parts of the apparatus.

Although most phases of the operation of the box-erecting apparatus have already been described in connection with the detailed description of the structure, a brief overall description of the operation of the apparatus will now be given.

A stack of the flat, folded box blanks **10** is inserted into the magazine bin **26** and the weight **35** is placed on top of this stack to bias the boxes downwardly in the bin. When power is supplied to the apparatus, the gear sector **42** moves the slide members **36** from their rearwardmost positions as shown in FIGURE 1 forwardly so that the shoulders **50** on pusher fingers **44** pick up the lowermost box blank and slide it forwardly or to the right in FIGURES 1 and 2, sliding the flat box out of the magazine bin through feed slot **34** and over the forward portion of table **24**. Before the flat box **10** starts to leave the forward edge **54** of the table the carriage **60** will be moved by the drive chain **64** into indexed alignment with the table **24**. At this time the seating rod **90** is spaced upwardly out of the way of the carriage, and also the holding finger **104** is out of the way forward or to the right of the vertical abutment surface **74** on the carriage.

The slide members **36** continue their forward movement so that the pusher fingers **44** push the flat box **10** off of the table **24** and onto the carriage **60** as successively illustrated in FIGURES 3 and 4. As a major portion of the box leaves the table **24** and overlies the carriage support surface **70**, the leaf spring **52** tends to hold down the rearward corner of the box, and the retainer fingers **78** on the carriage tend to push the forward part of the box upwardly so that the forward corner of the box will engage the abutment surface **74** at a line spaced somewhat above the horizontal support surface **70**. The box will ride up on the ramp surfaces **85** of the fingers **78** between the position of FIGURE 3 and the position of FIGURE 4. As the pusher fingers **44** thus push the box onto the carriage, the forward end portions of the slide members **36** will move forward into engagement in the carriage slots **86**.

The pusher fingers **44** continue to push against the rearward folded corner of the box from the position of FIGURE 4 until the forward folded corner of the box engages the vertical abutment surface **74**, at which point continued forward pushing of the fingers **44** buckles the flattened box open to a parallelogram shape, and further forward movement of the pusher fingers **44** opens this parallelogram out generally as shown in FIGURE 5, at which time the bottom wall **15** of the box tips the retainer fingers **78** downwardly to allow the bottom wall **15** of the box to slide thereover along the horizontal support surface **70** of the carriage.

During the opening of the parallelogram as illustrated in FIGURE 5, the seating rod **90** is moved downwardly through the central opening **14** in the top wall of the box so as to engage against the bottom wall of the box and push the bottom wall flat against the support surface **70**. At the same time, the holding finger **104** shifts rearwardly so as to overlap the forward upper corner of the box and assist in holding the box downward in the final phase of erection. This final phase occurs when the forwardly facing shoulders **50** on the pusher fingers **44** move forward to a position substantailly registering with the forwardly facing shoulders **84** on the retainer fingers **78**, at which time the retainer fingers **78** are popped upwardly by their respective springs **82** into latching engagement with the rearward, lower corner of the box which has been pushed forwardly by the pusher fingers **44**.

After erection of the box has thus been completed, the seating rod **90** is removed upwardly out of engagement in the box, the holding finger **104** is shifted forwardly out of engagement with the upper, forward corner of the box, and the slide members **36** are shifted rearwardly so as to disengage from the carriage slots **86** and move back toward their initial, rearwardmost positions as illustrated in FIGURES 1 and 2. The erected box **10** remains securely held in its erected position on the carriage **60** by the retainer or latching fingers **78**, with the forward side wall **16** held flush against the vertical abutment surface **74** and the bottom wall **15** seated flush against the horizontal support surface **70**. The carriage **60** is now free to be moved away from the table **24** by movement of the drive chain **64**, with the erected box securely held in position on the carriage **60** for receiving assembled articles therein. A succeeding carriage will then move into position in front of the table **24**, and the procedure will be repeated to erect the next box in the stack on this succeeding carriage.

It will be apparent that the apparatus of the present invention provides rapid erecting and accurate positioning of boxes in a manner particularly suitable for high-speed assembly and packaging.

While the instant invention has been shown and described herein in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is therefore not to be limited to the details disclosed herein, but is to be accorded the full scope of the claims.

What is claimed is:

1. Apparatus for successively erecting a plurality of boxes that are folded flat on a pair of diagonal corners, which comprises a magazine for holding said folded boxes in stacked relationship, an abutment surface spaced from said magazine, and pusher means engageable against one of said diagonal corners of a box in said magazine to remove such box from the magazine and push the other said diagonal corner thereof against said abutment surface so as to erect said box against said abutment surface, said pusher means being reciprocally movable between retracted and extended positions, said pusher means being disposed rearwardly of said stacked boxes in its said retracted position and as it moves from its said retracted position to its said extended position removing a box from the magazine and pushing it into erected condition against said autment surface, said pusher means being located proximate its said extended position upon completion of erection of the box, and means adjacent said abutment surface releasably holding the erected box in its erected condition against said abutment surface upon retraction of said pusher means from its said extended position.

2. Apparatus as defined in claim **1**, wherein said platform includes a stationary section associated with said magazine and a movable section upon which said abutment surface and said holding means are mounted and upon which the erected box is held by said holding means,

said movable platform section forming a part of a conveyor intermittently movably generally normal to the direction of reciprocating movement of said pusher means, the intermittent movement of said conveyor being synchronized with the reciprocal movement of said pusher means.

3. Apparatus for succsisvely erecting a plurality of boxes that are folded flat on a pair of diagonal corners, which comprises a magazine for holding said folded boxes in stacked relationship, an abutment surface spaced from said magazine, pusher means engageable against one of said diagonal corners of a box in said magazine to remove such box from the magazine and push the other said diagonal corner thereof against said abutment surface so as to erect said box against said abutment surface, said pusher means being reciprocally movable between retracted and extended positions, said pusher means being disposed rearwardly of said stacked boxes in its said retracted position and as it moves from its said retracted poition to its said extended position removing a box from the magazine and pushing it into erected condition against said abutment surface, said pusher means being located proximate its said extended position upon completion of erection of the box, platform means having a generally horizontal, planar upper working surface, said abutment surface extending generally vertically upwardly from said working surface, said magazine being disposed generally above said working surface in spaced relation to said abutment surface and being arranged to hold said folded boxes in a generally vertical stack with the bottom box against said working surface, said magazine and working surface defining generally horizontal slot means, said pusher means being slidable along said working surface and having forwardly facing shoulder means thereon engageable with said bottom box to slide the latter out from under said stack, through said slot and against said abutment surface.

4. Apparatus as defined in claim 3, wherein said platform means has longitudinally arranged groove means therein communicating with said working surface, and said pusher means includes slide means reciprocally slidably movable in said groove means and carrying pivoted finger means thereon, said finger means having said shoulder means formed forwardly thereon and being tiltable about a rearward, generally horizontal pivot axis between a raised position wherein said shoulder means is exposed above said working surface to engage and push a folded box and a lowered position substantially completely recessed in said groove means below said working surface to allow retraction of said pusher means under said stack of folded boxes, and means biasing said finger means toward its said raised position.

5. Apparatus as defined in claim 3, which includes seating means overlying said working surface adjacent said abutment surface, said seating means being generally vertically downwardly movable toward said working surface into engagement against said box during the erection thereof so as to seat one wall of the erected box against said working surface adjacent said abutment surface, the erected configuration of the box being defined at least in part by the seating of said one wall of the box against said working surface and engagement of an adjacent wall of the box against said abutment surface, said seating means being upwardly movable out of engagement with said box after the completion of said seating of the box.

6. Apparatus as defined in claim 5, wherein said seating means is reciprocally driven by cam means synchronized with said reciprocally movable pusher means.

7. Apparatus as defined in claim 5, which includes latch means adjacent said abutment surface releasably holding the erected box in its said erected and seated position after said seating means has become disengaged from said box.

8. Apparatus as defined in claim 7, wherein said platform includes a stationary section over which said magazine is positioned and a movable section upon which said abutment surface and said latch means are mounted and upon which the erected box is held by said latch means, said movable platform section forming a part of a conveyor intermittently movable generally normal to the direction of reciprocating movement of said pusher means, the intermittent movement of said conveyor being synchronized with the reciprocal movement of said pusher means.

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BERNARD STICKNEY, Primary Examiner