Sept. 3, 1940. R. J. GRUENBERG ET AL 2,213,494

BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 1

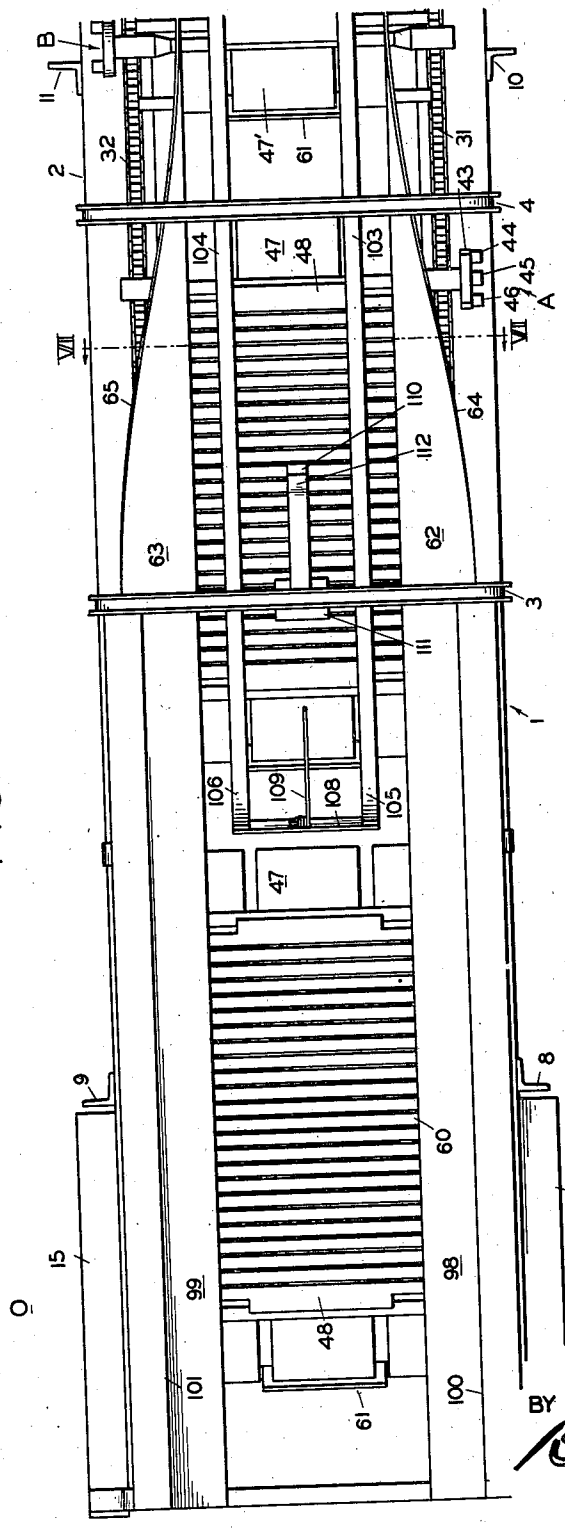


FIG. 1.

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Sept. 3, 1940. R. J. GRUENBERG ET AL 2,213,494

BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 2

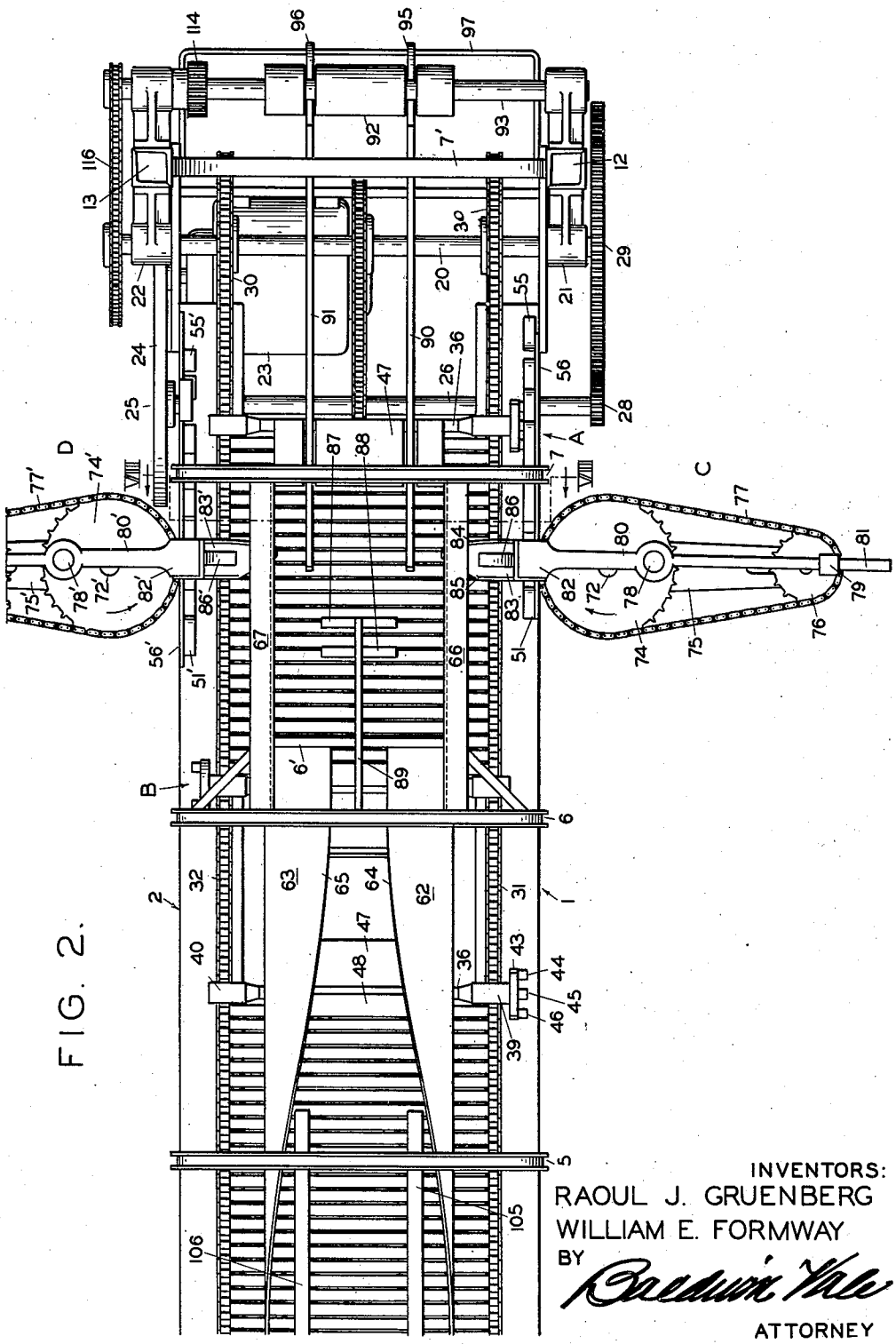


FIG. 2.

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BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 3

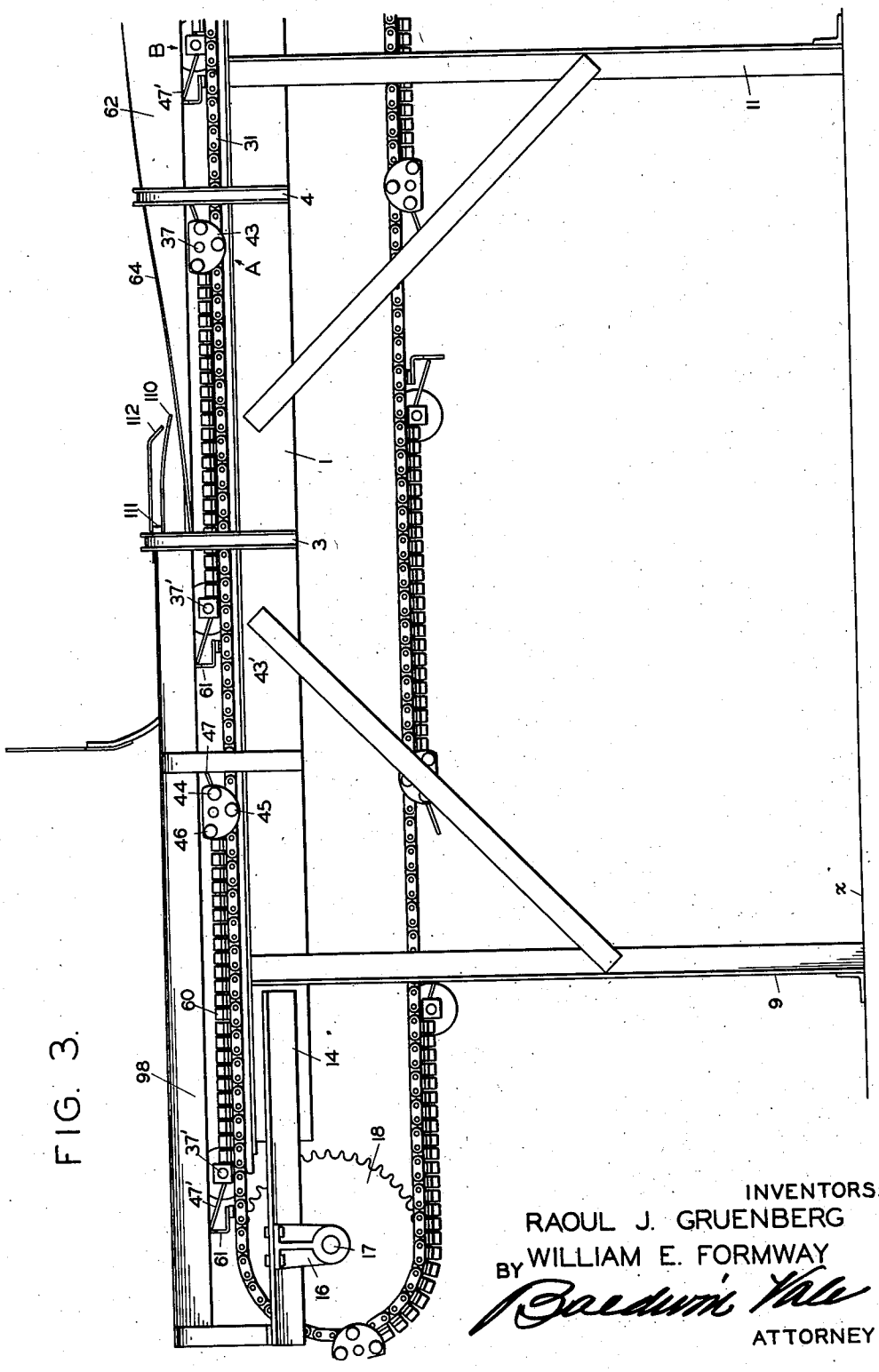


FIG. 3.

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Sept. 3, 1940. R. J. GRUENBERG ET AL 2,213,494

BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 4

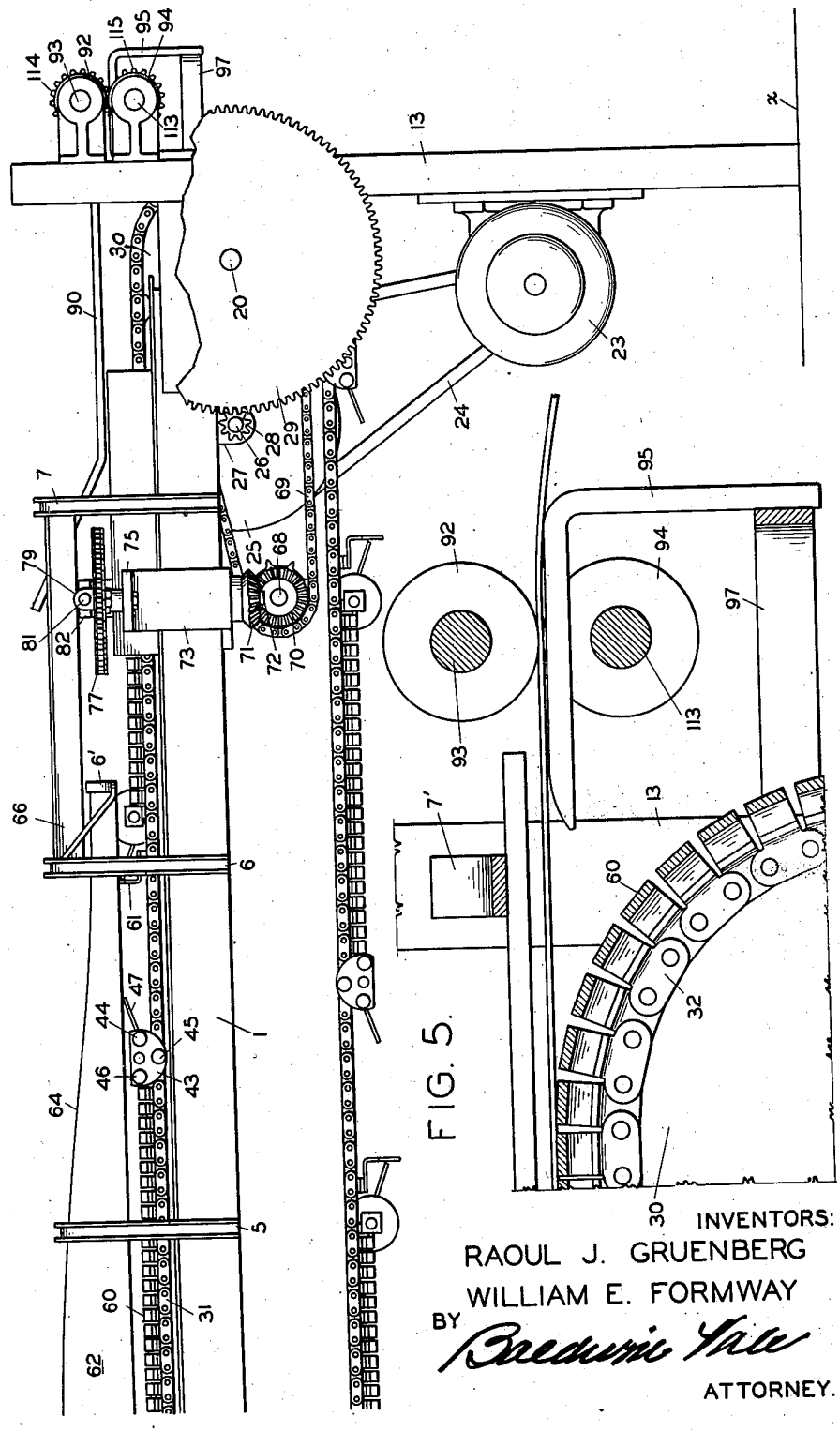


FIG. 4.

FIG. 5.

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Sept. 3, 1940. R. J. GRUENBERG ET AL 2,213,494

BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 5

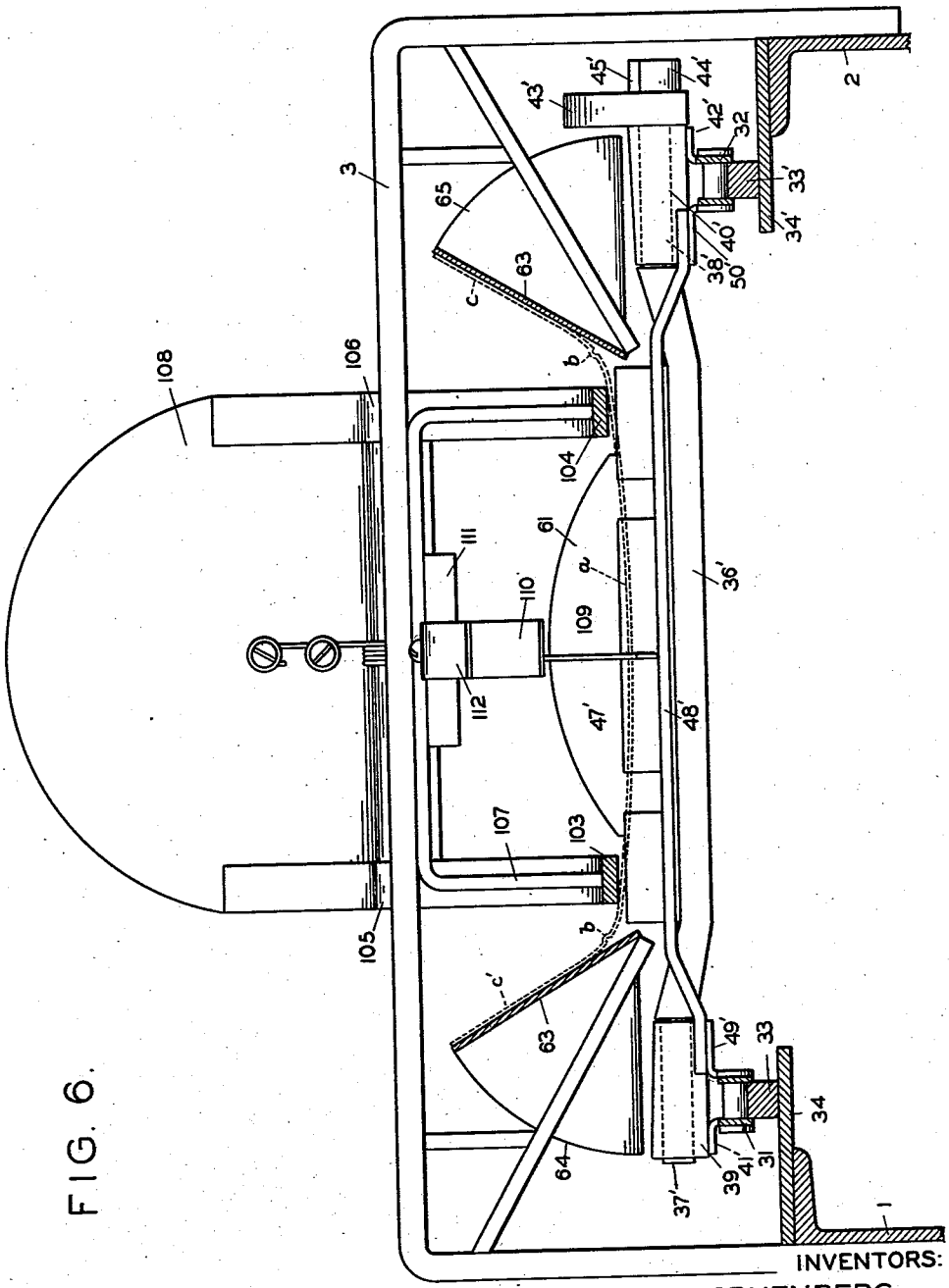


FIG. 6.

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BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 6

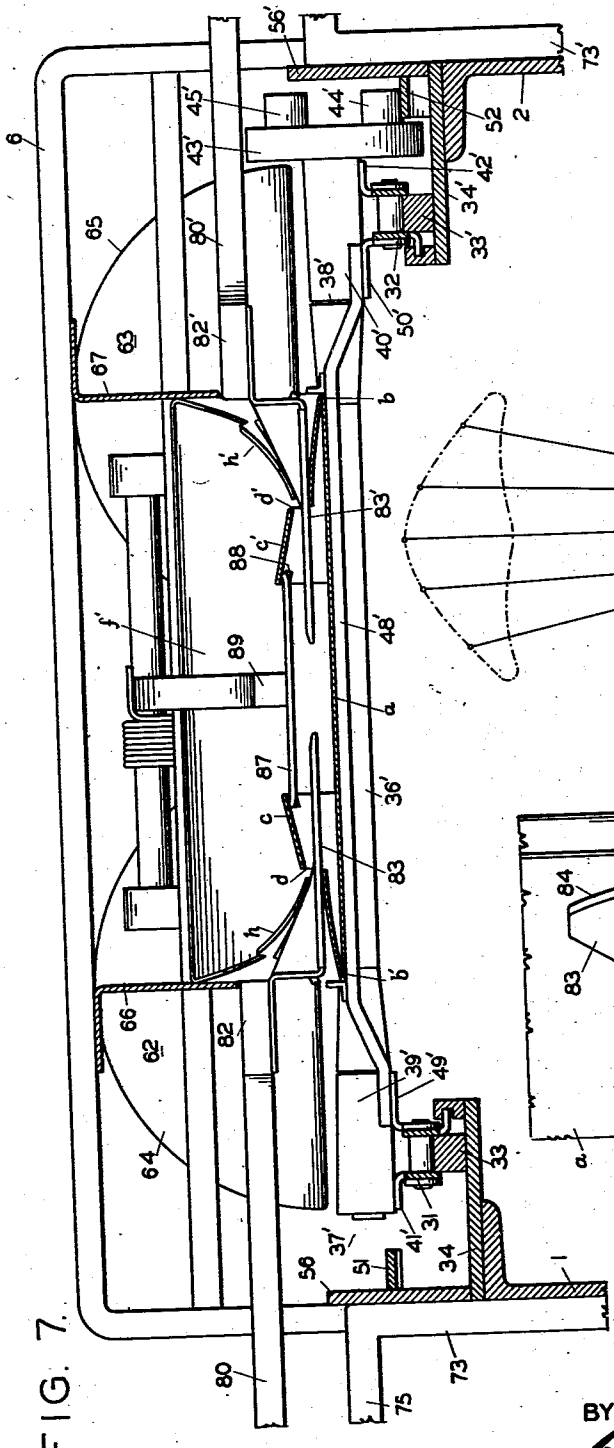


FIG. 7.

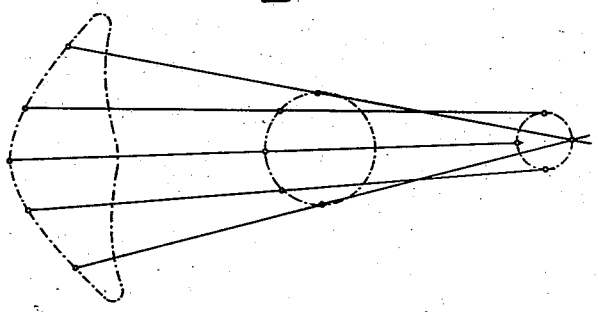


FIG. 11.

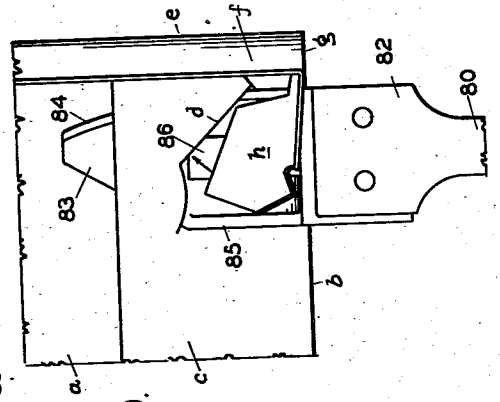


FIG. 10.

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Sept. 3, 1940. R. J. GRUENBERG ET AL 2,213,494

BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 7

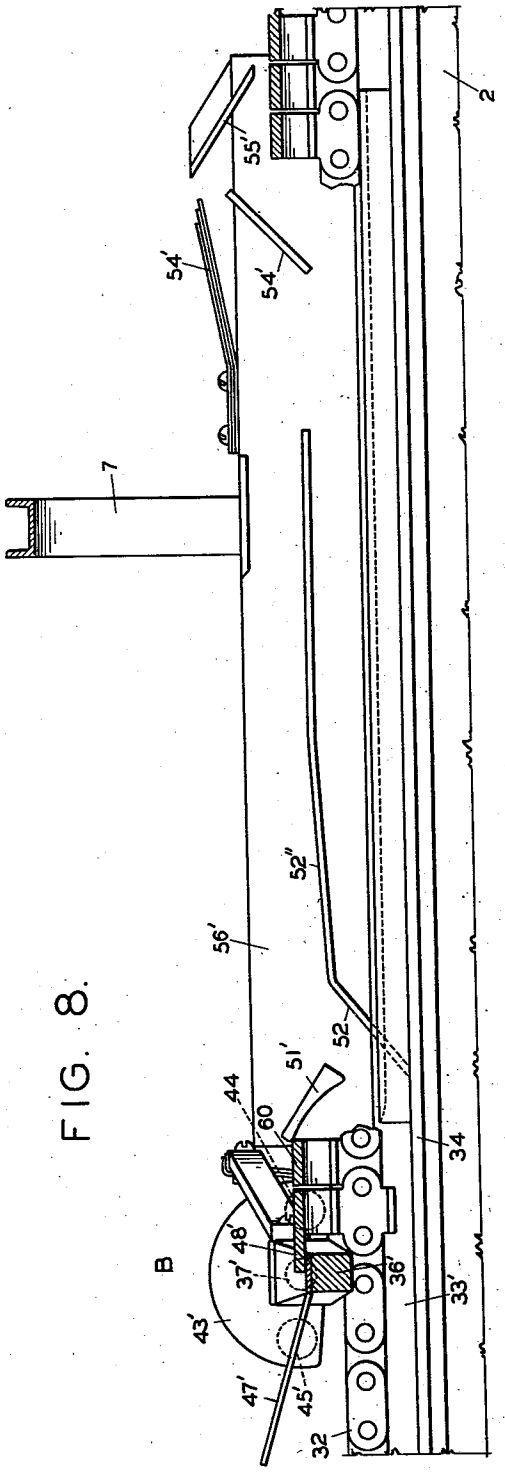


FIG. 8.

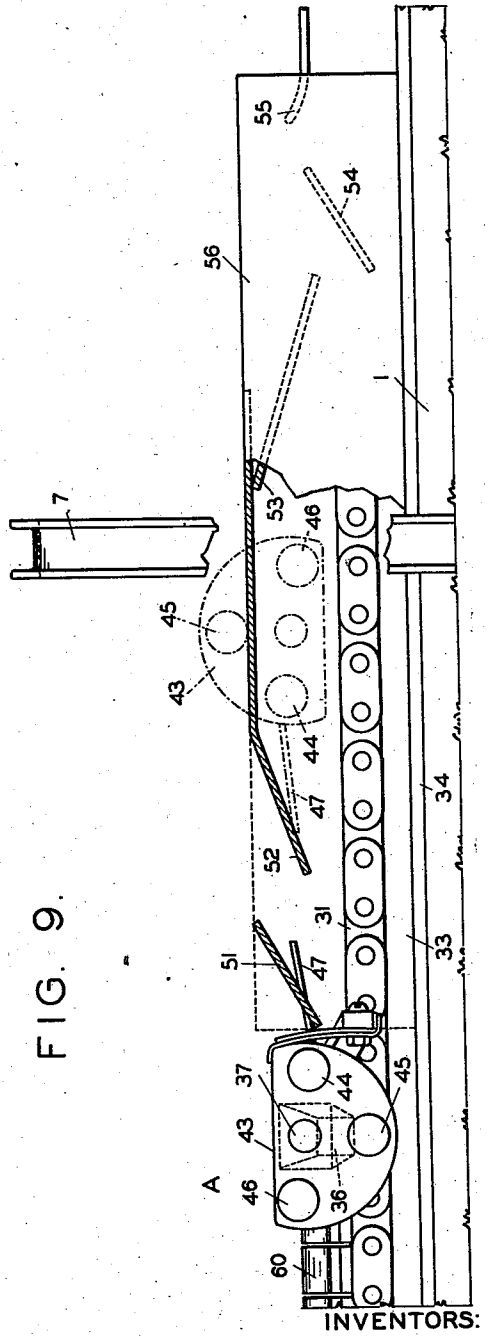


FIG. 9.

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Sept. 3, 1940. R. J. GRUENBERG ET AL 2,213,494

BOX FOLDING MACHINE

Filed June 15, 1938 8 Sheets-Sheet 8

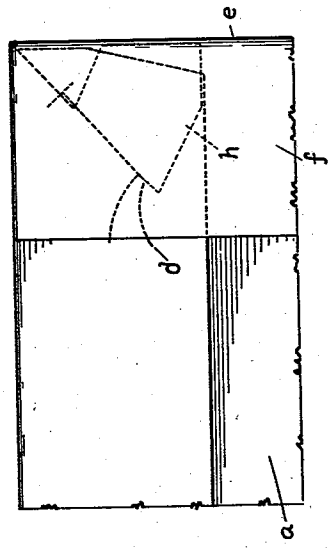


FIG. 13.

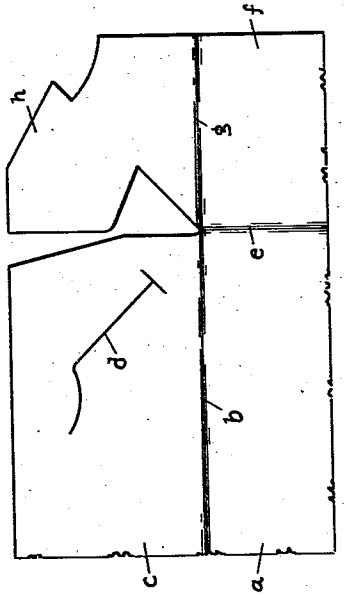


FIG. 12.

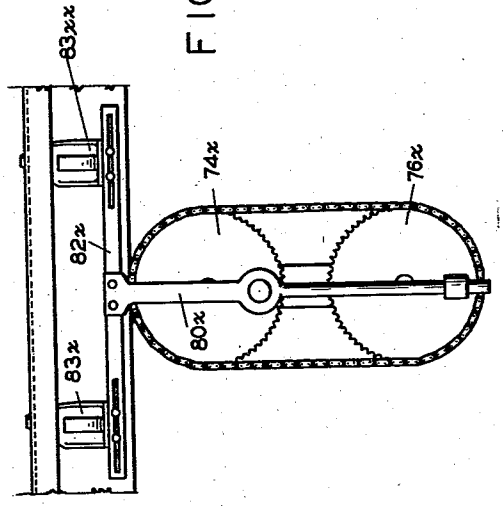


FIG. 14.

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Patented Sept. 3, 1940 2,213,494

UNITED STATES PATENT OFFICE

2,213,494

BOX FOLDING MACHINE

Raoul J. Gruenberg, San Francisco, and William E. Formway, Los Altos, Calif., assignors to Cumlokt Company, San Francisco, Calif., a corporation

Application June 15, 1938, Serial No. 213,804

15 Claims. (Cl. 93—49)

This invention relates to improvements in box folding machines and, more particularly, to a machine for folding boxes of the class shown in the patents to Edgar L. Stern, Number 1,463,448, dated July 31, 1923, entitled Folding box, and Stern and Gruenberg, No. 2,008,935, dated July 23, 1935, entitled Folding box, and the machine for folding this type of box disclosed in the patent to John William Low, Number 1,937,027, dated Nov. 28, 1933, entitled Box folding machine.

Among the objects of the invention is to provide a machine that will automatically feed and fold box blanks seriatim and interlock the tabs and slots to form fully assembled collapsed boxes ready for immediate use when opened.

Another object is to reduce the cost of production and increase the demand for folded boxes.

Another object is to fold and interlock the boxes as a continuous function of the machine.

Other objects and advantages will appear as the description progresses.

In this specification and the accompanying drawings, the invention is disclosed in its preferred form. But it is to be understood that it is not limited to this form, because it may be modified within the purview of the claims following the description.

In the eight sheets of drawings:

Fig. 1 is a plan view from above of the receiving end of a box folding machine constructed in accordance with this invention.

Fig. 2 is to read as a continuation of Fig. 1 and shows the tab interlocking and delivery end of the machine.

Fig. 3 is a side elevation of the receiving end of the machine as shown in Fig. 1.

Fig. 4 is a side elevation of the tab interlocking and delivery end of the machine, as shown in Fig. 2.

Fig. 5 is an enlarged detail longitudinal vertical section of the folded box flattening mechanism at the delivery end of the machine.

Fig. 6 is an enlarged detail in transverse vertical section on the line VI—VI in Fig. 1 of the blank curling mechanism.

Fig. 7 is a similar view taken on the line VII—VII in Fig. 2 of the slot opening, tongue inserting and end folding mechanism.

Fig. 8 is an enlarged detail in longitudinal vertical section showing the cam actuated and folding mechanism, approaching the folding of the rear end of a box.

Fig. 9 is a similar view of the opposed end folder showing it in the operative position following the folding and interlocking of the front end of the box.

Fig. 10 is a fragmentary detail showing the slot opener in operative position, diagrammatically indicating the entry of the locking tongue into the slot.

Fig. 11 is a kinematic diagram plotting the curvilinear action of the slot opener.

Fig. 12 is a fragmentary plan view of one die cut corner of the box blank.

Fig. 13 is a similar view of the same in the folded, interlocked and collapsed condition.

Fig. 14 is a detail in plan view of a modified mechanism for opening the slots in the box blank preparatory to the entry of the locking tongues.

In detail, the construction illustrated in the drawings, referring first to Fig. 12, comprises a box blank of conventional boxboard *a*. This is longitudinally scored as at *b* to form side panels *c* on opposite sides of its length. The opposite ends of all these side panels *c* have oppositely disposed oblique slots such as *d*, shaped as shown for reasons set forth in detail in the above patents. The end margins of the blank are transversely scored as at *e*, to form the opposite end panels *f*. These panels are traversed by the longitudinal score lines *b* to form bendable hinge lines *g* for the tongues *h* to engage the slots *d* at the four corners of the box respectively, the four corners being similar in structure and operation.

Departing from the usual practice the present boxes are shaped by folding the side panels *c* inwardly and downwardly. During the infolding of the sides, the slots are forced open to receive the tongues *h* brought into position above the side panels *c* when the end panels *f* are folded inwardly. Completion of the infolding of the ends *f* forces the tongues *h* backwardly and completely through their respective slots *d* and to a position beneath the end panels where they lie contiguous to the plane of the blank *a*.

Fig. 10 shows the tongue *h* about to enter the slot *d*. The interlocking of the tongues and slots at the four corners of the box in the manner described holds the sides *c* and the ends *f* collapsed against the plane *a* of the blank which then forms the bottom of the box, as shown in Fig. 13.

In the present machine one end of the box at a time is infolded and interlocked by the machine. This enables one slot opening and interlocking mechanism on each side of the machine to act simultaneously on the respective ends of the box blanks as they pass continuously through the machine.

Referring next to Figs. 1, 2, 3, and 4, the structure of the machine comprises a rigid main frame having the parallel channel bars 1 and 2 properly trussed and cross braced to form the bed of the machine, with the transverse overhead trusses 3, 4, 5, 6, 7 fixed thereto. This bed is supported on the pairs of supporting legs, such as 8, 9, 10, 11, 12, 13 properly fixed and braced to the bars 1, 2 and anchored to sills or the floor *x*.

At the front end, see Fig. 3, the side extension bars 14, 15 are added to the length of the side bars 1, 2 respectively, to which the bearing brackets such as 16 are bolted to support the idle shaft 17 upon which the laterally spaced sprockets 18, 18 are fixed parallel with their respective side bars 1, 2.

The driven shaft 20 at the delivery end of the machine is similarly mounted in the brackets 21, 22 fixed to the supporting legs 12 and 13 respectively, Fig. 2. This shaft is driven by the motor 23, through the V-belt 24 and the pulley 25 on the counter-shaft 26 mounted in bearings 27 on the main frame. This counter-shaft has the pinion 28 enmeshed with the spur gear 30 fixed on the shaft 20. The pair of sprockets 29, 30 are fixed on the shaft 20 in alinement with the sprockets 18, 18 on the front shaft 17.

The conveyor feed for the blanks *a* consists of the pair of endless sprocket chains 31, 32, preferably of the roller type, encircling their respective sprockets 18, 29 and 18, 30. The top reaches of these chains run on their respective tracks 33, 33' supported on the brackets 34, 34' extending inwardly from the side bars 1, 2. The rollers of the sprocket links reduce the friction between the chains and the tracks. The lower reaches of the conveyor hang suspended below its said sprockets to maintain the required tension on the chains 31, 32.

At proper intervals, determined by the length of the box blanks *a*, the end bending units A, B are mounted on the chains 31, 32 across the top of the conveyor, see Figs. 1, 2. These end benders are alike in construction and operation, except that alternate units act upon the opposite ends of the box blanks and are actuated by similar cam sets located on opposite sides of the main frame. It is deemed sufficient to describe one end bender in detail, similar parts in the others being identified by the same reference numerals with the omission of the prime signs ('). These benders are duplicated at intervals on the conveyor.

Figs. 6, 7 are different operative views of the bender B that has the square offset shaft 36' with its reduced opposite ends 37' and 38' oscillatable in their bearings 39', 40' fixed on the brackets 41', 42' fixed to links of their respective chains 31, 32 of the conveyor.

The end bender A has the crank head 43 fixed on the end 37 of the offset shaft 36. This head has the studs 44, 45, 46 extending therefrom and having the antifriction rollers thereon. The shaft 36 has the bending vane 47 fixed thereon, see also Fig. 9.

In advance of and parallel with the end benders are the pressure bars such as 48', best illustrated in connection with the end bender B, mounted upon the brackets 49', 50' fixed to links of their respective chains, as 32. In Fig. 9 the bender A is approaching its operating cam 51 fixed on the face of the plate 56 mounted on the main frame lateral to the conveyor. The roller 44 engages the cam 51 thus swinging the vane 47 backward while the stud 45 passes under this cam 51, until it engages the inclined cam 52 up which it rides to further lift the vane 47 while the studs 44, 46 pass under the incline 52 to hold the vane in operative position, as shown in dot-dash lines. At the end of the functional travel of the bender A, the stud 46 engages the decline cam 53 to reverse the swing of the vane 47. When the stud 46 strikes the incline 54, it throws the stud 45 downward beneath the decline cam 55, which completely restores the end bender unit to inoperative position with the vane 47 retracted as in full lines Fig. 9.

The end bender unit B, Fig. 8, is similar in construction to the bender A above described, except that it operates contrawise to the travel of the box blank. The bending vane 47' is fixed to the offset shaft 36', oscillated by the crank head 43' fixed on the end 38' of this shaft. The head has the studs 44', 45'. The stud 44' is depressed by the cam 51' fixed on the plate 56'. When the first stud 44' strikes under the inclined cam 51', the offset shaft 36' is rotated 90 degrees. The stud 44' then strikes the incline 52' which carries the vane 47' through an additional 90 degrees, bringing the roller 45' into engagement with the substantially horizontal continuation 52'' of the incline 52'. At the end of the horizontal travel, the stud 45' passes off the plane 52'' and rides up the inclined cam 53' until it engages the declined cam 55', which restores the offset shaft 36' and vane 47' to the inoperative position shown in Fig. 8. The spring guard 54' engages the roller 45' to safeguard against its overcarrying above the plane of the declined cam 55'.

Intermediate the various end bending units A—B, the conveyor is provided with the cross cleats such as 60, coplanar with the pressure bars 48, to receive the plane *a* of the box blanks, see Fig. 3. The opposite ends of these cleats are bent downward and fixed to individual links of their respective chains 31, 32 to form successive flexible gridlike tables between the end benders A—B, duplicated throughout the length of the conveyor.

To the rear of each bender A is an upstanding gage 61 to center the box blank between the end benders and to cause the blanks to advance with the conveyor against the resistance of the side-folding shrouds 62, 63. The front ends of these shrouds overhang and are substantially parallel with the plane of the conveyor, beginning at the overhead truss 3, Fig. 1. Their outer edges 64, 65 respectively are helically curled upwardly about ninety degrees at the second truss 4, then inwardly to substantially one hundred eighty degrees, just beyond the truss 6 to the cross bracket 6', the opposed shrouds having substantially one half turn in their lengths to fold the side panels *c, c* inward and downward against the plane of the blank *a*.

The vertical side plates 66, 67 extend between the trusses 6, 7 above the plane of the cleats 60 of the conveyor. When the side panels *c, c* emerge from the curling shrouds, the advance tongues *h, h* snap upwardly to vertical positions against the plates 66, 67 respectively, as the blank advances toward the slot opening units C, D, see Fig. 2.

The slot openers C, D, located on opposite sides of the conveyor, are alike in structure and operation, except that they operate in opposed relation to each other and the box blank. The slot opener C will be described in detail. Similar parts in D will be given the common reference numerals

with the addition of the prime signs (′). The jack shaft 68 is mounted in suitable bearings on the main frame, see Fig. 4, and is driven by the sprocket chain 69 encircling a driven sprocket on the counter-shaft 20 and a sprocket on the shaft 68. The bevel gear 70 is fixed on the jack shaft 68 and meshed with the similar gear 71 on the vertical shaft 72, mounted in the bearing bracket 73 on the main frame. The sprocket 74 is fixed on the upper end of this vertical shaft 72, see Fig. 2. The lateral extension 75 of the vertical bracket 73 provides suitable mounting for the smaller driven sprocket 76 driven by the sprocket 74 and chain 77. The speed ratio of these sprockets is two to one.

The crank pin 78 is eccentrically fixed in the sprocket 74 and the sliding guide pivot 79 is rotatably mounted in the sprocket 76 eccentric to its center. These sprockets function in effect as cranks. The reciprocating arm 80 is pivoted on the crank pin 78 and has a tail extension 81 slidable through and deflected by the planetary pivot 79 on the sprocket 76. This arrangement of parts gives a novel mechanical curvilinear movement to the head 82 on the arm 80. Fig. 11 is a kinematic plot of this movement, showing the reciprocations and the advance and retractive movements of the head 82 with respect to the travel of the conveyor. The head 80 has a flat spear shaped slot plate 83 with tapering upturned edges 84, 85 on opposite sides of the fin 86 inclined from the plane of the slot plate 83. These plates 83, 83′ advance across the traveling folded edges *b*, *b*′ on top of the side panels *c*, *c*′ and through the slots *d*, *d*′ respectively, see Fig. 10, being driven in unison with the advance of the conveyor by the common prime-mover 23.

To insure the entry of the slot opening plates 83, 83′ into the slots *d*, *d*′, the side panels *c*, *c*′, emerging from the shrouds, ride up over the cross bars 87, 88 on the arm 89, pivoted under the truss 6, see Figs. 2 and 7. These cross bars are adapted to uphold the edges of and present the side panels *c*, *c*′ at an angle to the approach of the slot opening plates 83, 83′ to assure the proper entry of the plates and the wedge shape edges 84, 85 into the slots. This condition maintains until the end folder B comes into position, at which time the approaching gage 61 kicks up the arm 89 to lift the bars 87, 88 clear of the side panels *c*, *c*′ that are still held depressed by the plates 83, 83′.

After passing the slot opening and interlocking mechanisms at C—D, the box, transformed from the blank *a*, passes beneath the overhead depressing bars 90, 91 extending longitudinally through the truss 7, and supported on the cross-bar 7′ located near the end of the bars 90, 91. The roller 92 is fixed on the shaft 93, see Figs. 2, 3. This pressure roller 92 registers vertically with a similar lower roller 94 on the shaft 113, Figs. 4, 5, between which the folded edges *b*, *b*′ and *e*, *e*′ are compressed to maintain the boxes in interlocked and collapsed condition. The shafts 93 and 113 are rotated in unison by the meshed pinions 114 and 115 fixed thereon. The shaft 93 is driven from the main shaft 20 by the chain 116 encircling sprockets on the two shafts. The completed boxes are delivered across the top of the bars 95, 96 on the cross bar 97 fixed to the end of the main frame and extending through annular slots in the lower roller 94 above the axis thereof, see also Fig. 5.

The front end of the machine, to the left in Fig. 1, has the angular Z shape receiving plates 98, 99 overhanging the edges of the conveyor at the level of the cleats 60. These plates have upstanding vertical planes 100, 101, see Fig. 1, to aline the edges of the blanks *a*, with the edge curling shrouds 62, 63. The machine may be automatically fed by a conventional pneumatic press feeder arranged at the end of the machine, or by hand.

The machine operates substantially as follows: If hand fed, the operator preferably stands at O and reaches across the machine to the stacked blanks on the opposite side at P, see Fig. 1. A single blank from the top of the stack is laid lengthwise on the plates 98, 99 between the vertical planes 100, 101, where it lies until the conveyor rising on the sprocket 19, brings a gage 61 up behind the blank, sliding it forward on to the forward ends of the side curling shrouds 62, 63. The advancing side panels *c*, *c*′ ride up the helical planes of the shrouds which bend the blank on the longitudinal score lines *b*, *b*′, see Fig. 6. The pressure bars 103, 104, having the upturned ends 105, 106 respectively, are mounted beneath the trusses 3, 4, 5 on brackets such as 107. The upturned ends 105, 106 are joined by the guard plate 108 which guides the box blanks beneath the pressure bars. These bars 103, 104 bear against the upper plane of the blank *a* adjacent the score lines *b*, *b*′ while the side panels *c*, *c*′ are being curled upward and inward by the shrouds 62, 63. The center portion of the blank *a* is prevented from buckling upward by the down pressure of the spring 109, fixed beneath the guard 108, during the passage of the box blank.

Should a blank buckle and jam in passing beneath the shrouds, it will rise and bear under the contact finger 110. This finger is separated by the dielectric block 111 fixed under the truss 3 from a similar contact 112. These contacts are adapted to ground a suitable relay circuit controlling the motor 23 and stop the machine, permitting the removal of the damaged blank.

Emerging from the shrouds 62, 63 at 6′, the forward tongues *h*, *h*′ snap up vertically against the vertical plates 66, 67, permitting the lifter bars 87, 88 to pass beneath the ends of the side panels *c*, *c*′. In synchronism with the entrance of the lifter bars, the points of the plates 83, 83′ enter and spread the first pair of slots *d*, *d*′ before the end bender A has entered its sequence of cams 55—59 to bend up the end *f* of the box, which throws the vertical tongues *h*, *h*′ forward and downward against the fins 86, 86′ respectively, which deflects the tongues into the slots *d*, *d*′, see Figs. 7 and 10. The continued swing of the vane 47 flattens the end *f* down on top of the side panels *c*, *c*′, completing the interlocking of the tongues curled into the slots, just as the slot openers 83, 83′ withdraw from the slots, and the end of the box passes beneath the pressure bars 90, 91 to maintain the interlocked condition.

In the meantime, the gage 61 kicks up the arm 89, freeing the bars 87, 88 as the rear end bender B approaches the slot openers C, D, which thrust the plates 83, 83′ into the second pair of slots *d*, *d*′, see Fig. 7. This opens the slots, permitting the pair of tongues *h*, *h*′, brought into position by the vane 47′, to enter the slots *d*, *d*′ respectively, as the end bender B enters its sequence of cams 51′—55′.

Coincidentally with the interlocking of the tongues and slots on the rear end of the box, the plates 83, 83′ withdraw from the slots and the end *f*′ passes under the pressure bars 90, 91 and between the pressure rollers 92, 94, as previously

described. The folded, interlocked, and collapsed boxes emerging from the machine are stacked in a manner to prevent them snapping open, as fully described in the patents referred to in the preamble. Such boxes snap open ready for use when the sides *c*, *c'* are lifted.

The slot opening and closing mechanisms C, D, shown and described, operate on the pairs of slots *d* at the opposite ends of the blank seriatim as the blank passes through the machine. A modification is shown in Fig. 14 in which the cross head 82*x* on the arm 80*x* has a pair of plates 83*x*, 83*xx* fixed thereon. These plates are thus adapted to simultaneously enter the slots *d*, *d* at both ends of the blank to condition them to receive the tongues *h* simultaneously. The sprockets 74*x*, 76*x* are of the same diameter for obvious reasons. With appropriate timing of the end benders A, B, both ends of the box can be interlocked simultaneously to speed up production.

By arranging gumming means on the arms 82, 82', instead of the slot opening heads 83, 83', this machine is equally adapted to the folding and adhering of end tabs on the end panels to the ends of the side panels on similar boxes where the interlocked tongues and slots are less desirable.

As used throughout the specification and claims "continuously" means without interruption.

Having thus described this invention, what we claim and desire to secure by Letters Patent is:

1. A box folding machine including a conveyor adapted to continuously move a box blank; means for folding and interlocking the sides and ends of the box in a plane substantially parallel with the box bottom during the continuous travel of the box on said conveyor.

2. A box folding machine including a conveyor adapted to carry a box blank having side and end panels with tongues and slots respectively; means for simultaneously folding the slotted sides inwardly toward the bottom of the box; lateral means adapted to enter and withdraw from said slots during the passage of said blank; and end folding means adapted to curl said tongues though said slots and lay said ends over the ends of said sides.

3. A box folding machine including a stationary frame; a conveyor on said frame adapted to carry a box blank having side and end panels with tongues and slots respectively; side panel folding means and slot opening means on said frame; and end folding means on said conveyor adapted to interlock said tongues and slots in synchronism with the operation of said slot opening means.

4. A box folding machine including a stationary frame; a conveyor on said frame adapted to carry a box blank having side and end panels with tongues and slots respectively; side panel folding means on said frame; lateral means on said frame adapted to enter and withdraw from said slots during the passage of said blank; and end folding means adapted to curl said tongues through said slots in synchronism with said lateral means.

5. A box folding machine including a stationary frame; a conveyor on said frame adapted to carry a box blank having side and end panels with tongues and slots respectively; slot opening means on opposite sides of said conveyor each comprising a crank pin and a pivot driven in unison with said conveyor; an arm pivoted on said crank pin and slidable in said pivot and having a head adapted to enter and withdraw from the slots in the opposite side panels respectively; and end folding means synchronized with said slot opening means and adapted to interlock said tongues and slots.

6. A box folding machine including a frame; a conveyor on said frame adapted to carry a box blank having side and end panels with tongues and slots respectively; slot openers on said frame movable into and out of said slots during the passage of said blank; and end folding means adapted to interlock said tongues and slots.

7. A box folding machine including a frame; a conveyor on said frame; brackets on opposite sides of said frame, each bracket having a pair of cranks driven in unison with said conveyor and having a crank pin and a pivot thereon respectively; an arm pivoted on said pin and slidable in the said pivot and having a slot opening head on one end; and end folding means operated in synchronism with said arms.

8. A box folding machine including a frame; a conveyor adapted to carry a box blank; side and end folding means in operative relation to said blank respectively; a pair of cranks on said frame alined transversely to the travel of said conveyor and driven in unison therewith and at different speeds relative to each other; an arm pivoted on one of said cranks and slidable in a pivot on the other crank; and a slot opening head on said arm in operative relation to said blank.

9. A box folding machine including a frame; a conveyor on said frame and adapted to carry a box blank having side and end panels with tongues and slots respectively; slot openers on said frame movable into and out of said slots during the passage of said blank; end folding means transversely pivoted on said conveyor and engaging actuating means on said frame and adapted to interlock said tongues and slots in synchronism with the operation of said slot openers.

10. A box folding machine including a frame and a conveyor adapted to carry a box blank having side and end panels with tongues and slots respectively; side panel folding shrouds on the opposite sides of said frame in operative relation to said blank; means for holding the side edges above the bottom of said box; slot opening means on the opposite side of said frame and having tongue guiding fins thereon; end folding means transversely pivoted on said conveyor at the opposite ends of said blank respectively and adapted to curl said tongues against said fins and into said slots; trips on said frame in operative relation to said end folding means; and means for compressing the folded box.

11. A machine for opening the slots in folding boxes including a frame; a conveyor on said frame adapted to carry a box blank having slots therein; a pair of cranks on said frame alined transversely to the travel of said conveyor and driven in unison therewith at different speeds relative to each other; an arm pivoted on one of said cranks and slidable in a pivot on the other crank; and a slot opening head on one end of said arm.

12. The method of interlocking a folding box having side and end panels with tongues and slots respectively, consisting in simultaneously folding the slotted sides inwardly toward the bottom of the box; then opening the slots; then folding the end panels inwardly and simul-

taneously curling the tongues through said slots in a backwardly direction.

13. The method of interlocking a folding box having side and end panels with tongues and slots respectively, consisting in simultaneously folding the slotted sides inwardly substantially parallel with the plane of the bottom of the box; then folding the end panels inwardly over the side panels and interlocking the tongues in said slots while the box blank moves continuously forward.

14. The method of interlocking a folding box having side and end panels with tongues and slots respectively consisting in folding said panels inwardly, then passing said tongues inwardly and backwardly through said slots while the box blank is in collapsed condition and in continuous motion through a box folding machine.

15. The method of interlocking a folding box having side and end panels with tongues and slots respectively consisting in folding said panels inwardly, then passing said tongues through said slots toward said end panels while the box blank is in collapsed condition and in continuous motion through a box folding machine.

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