

Jan. 29, 1952

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2,583,641

BOXMAKING MACHINE

Filed Dec. 3, 1946

8 Sheets-Sheet 1

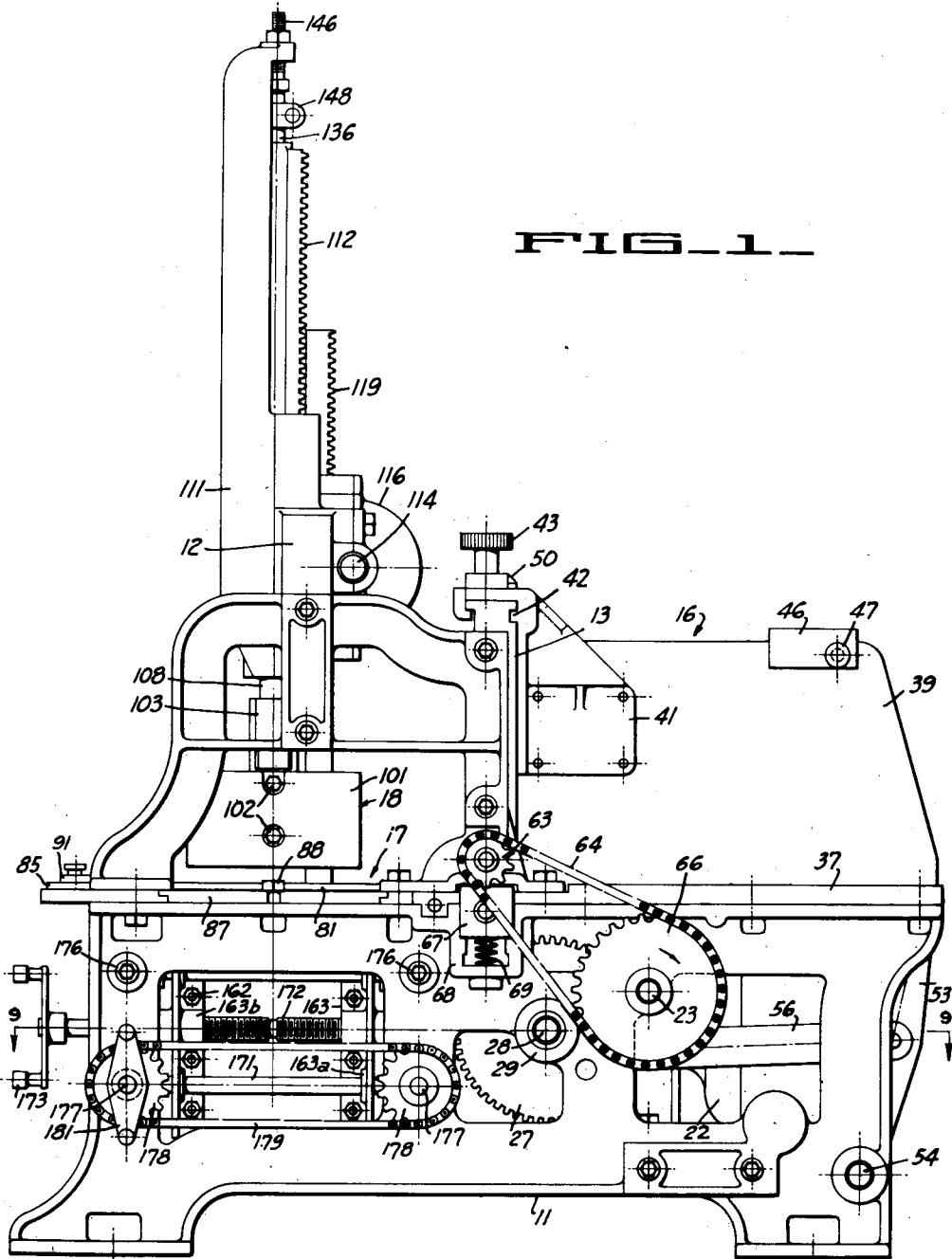


FIG. 1

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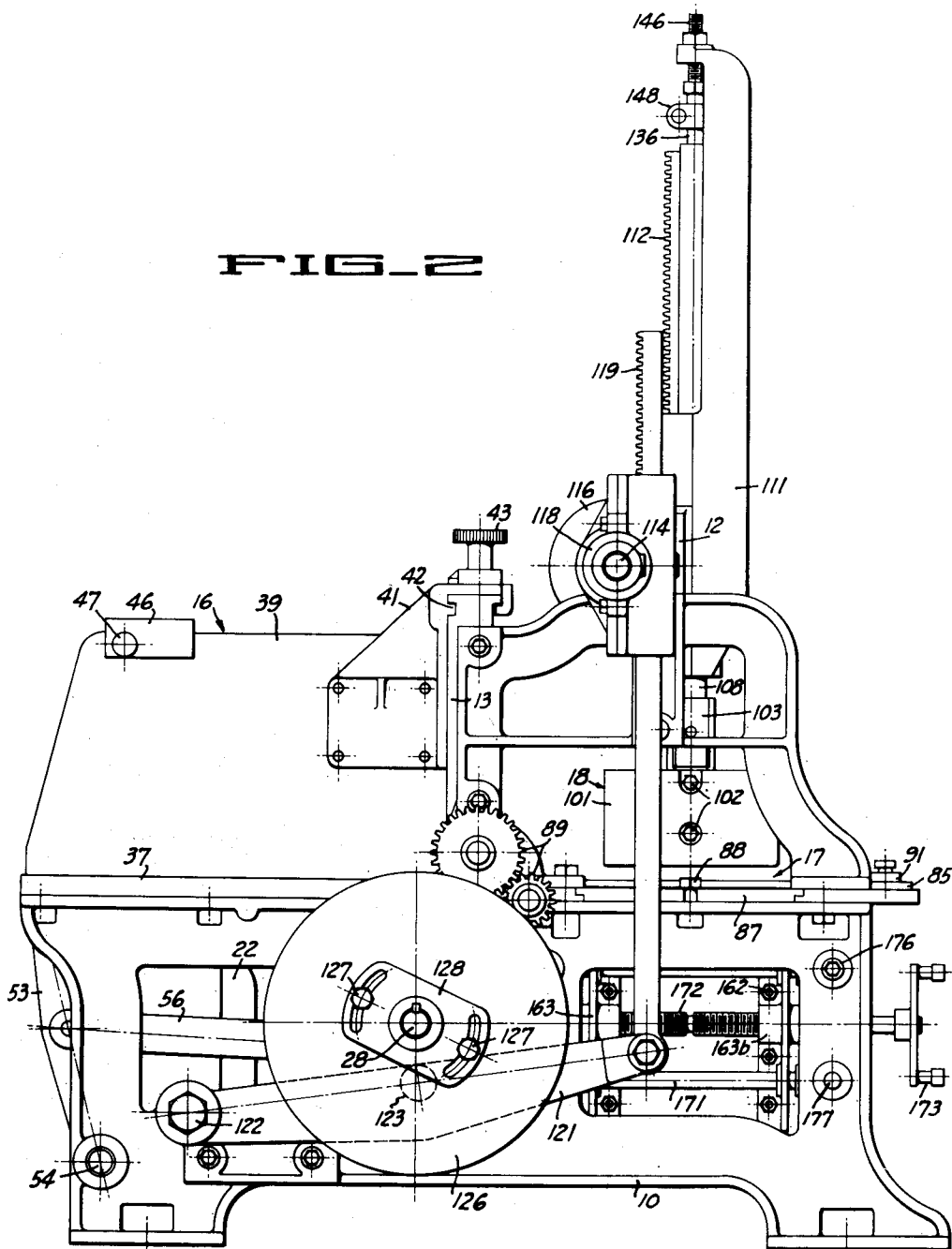
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FIG. 2



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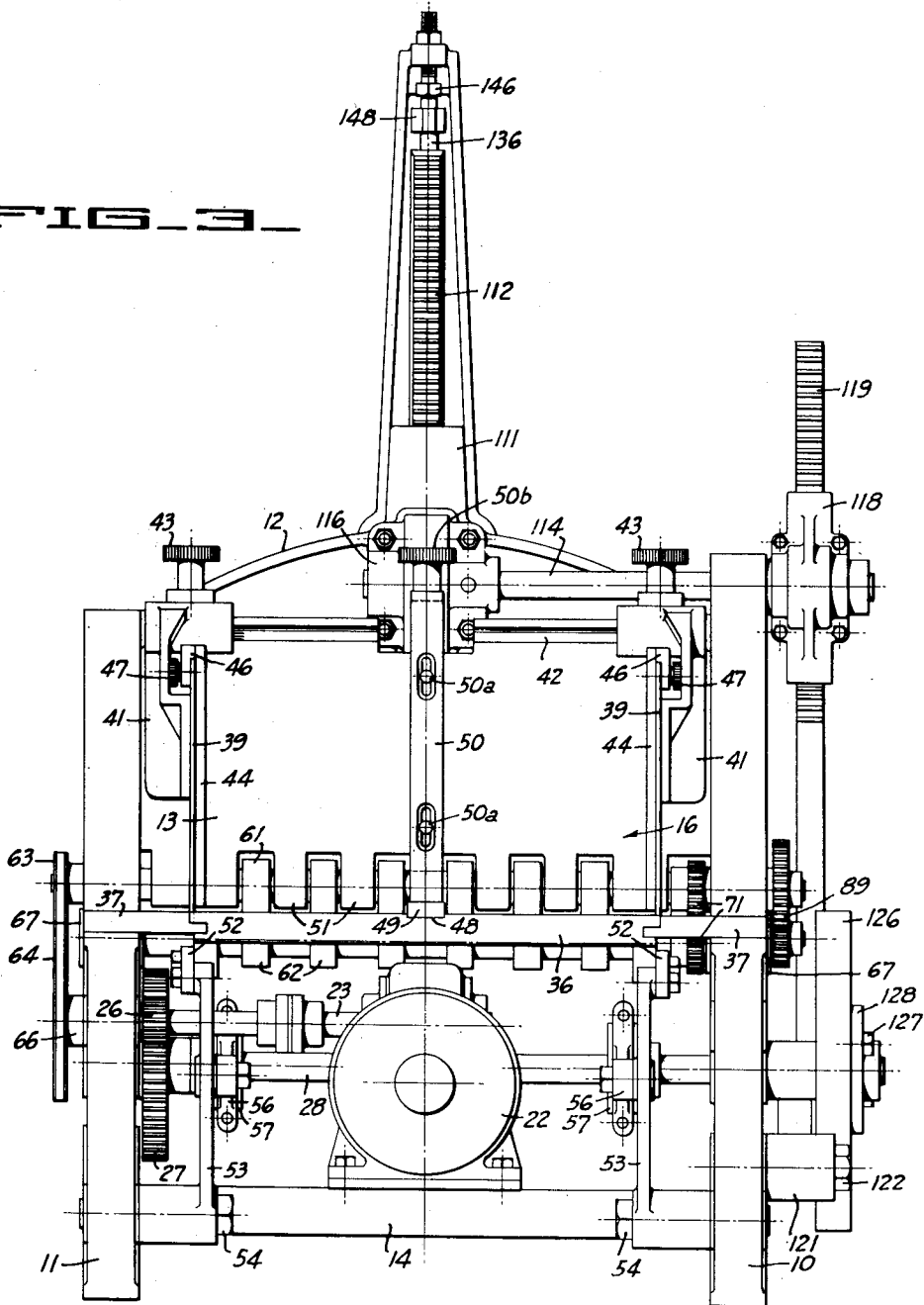
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FIG. 3



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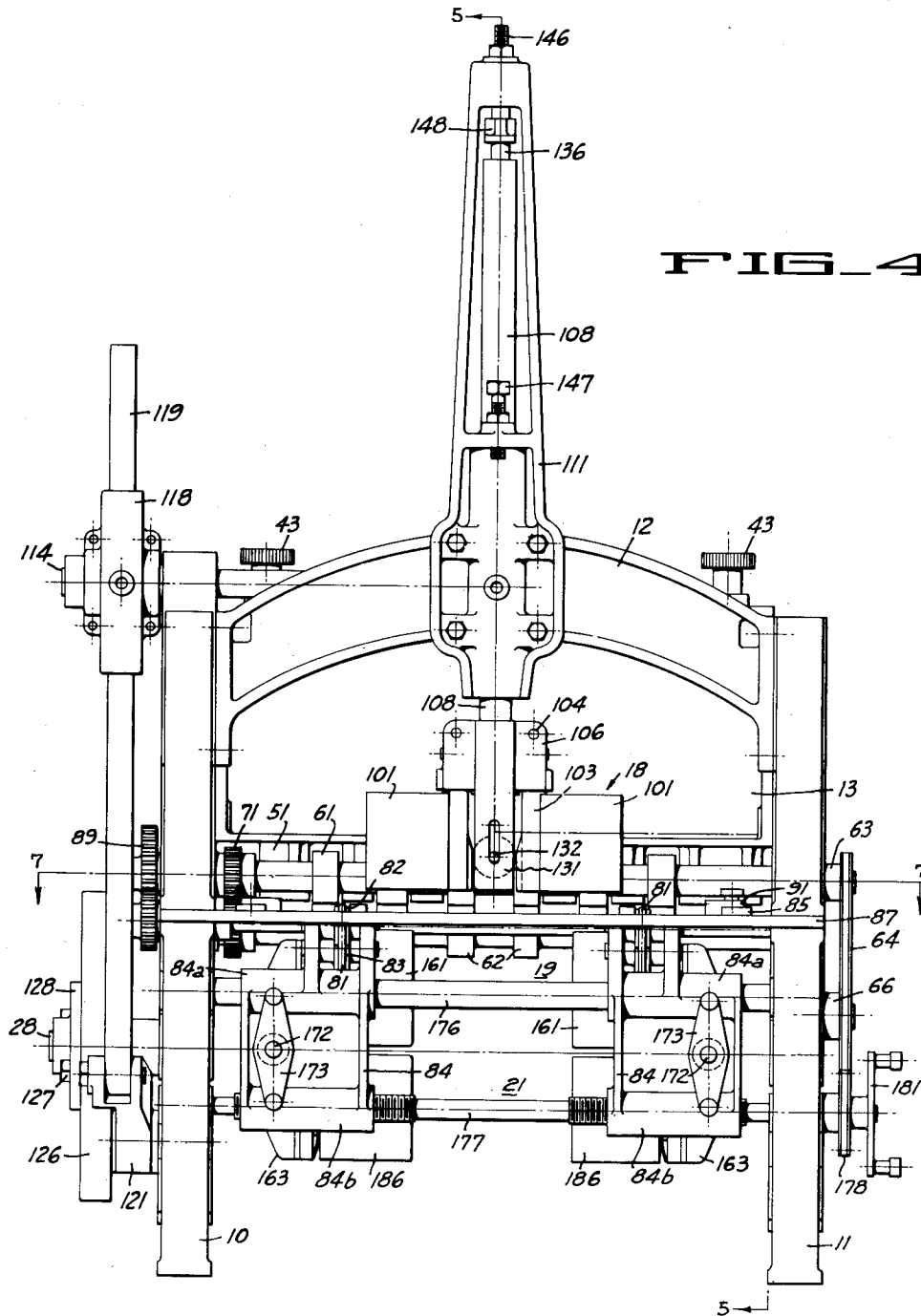
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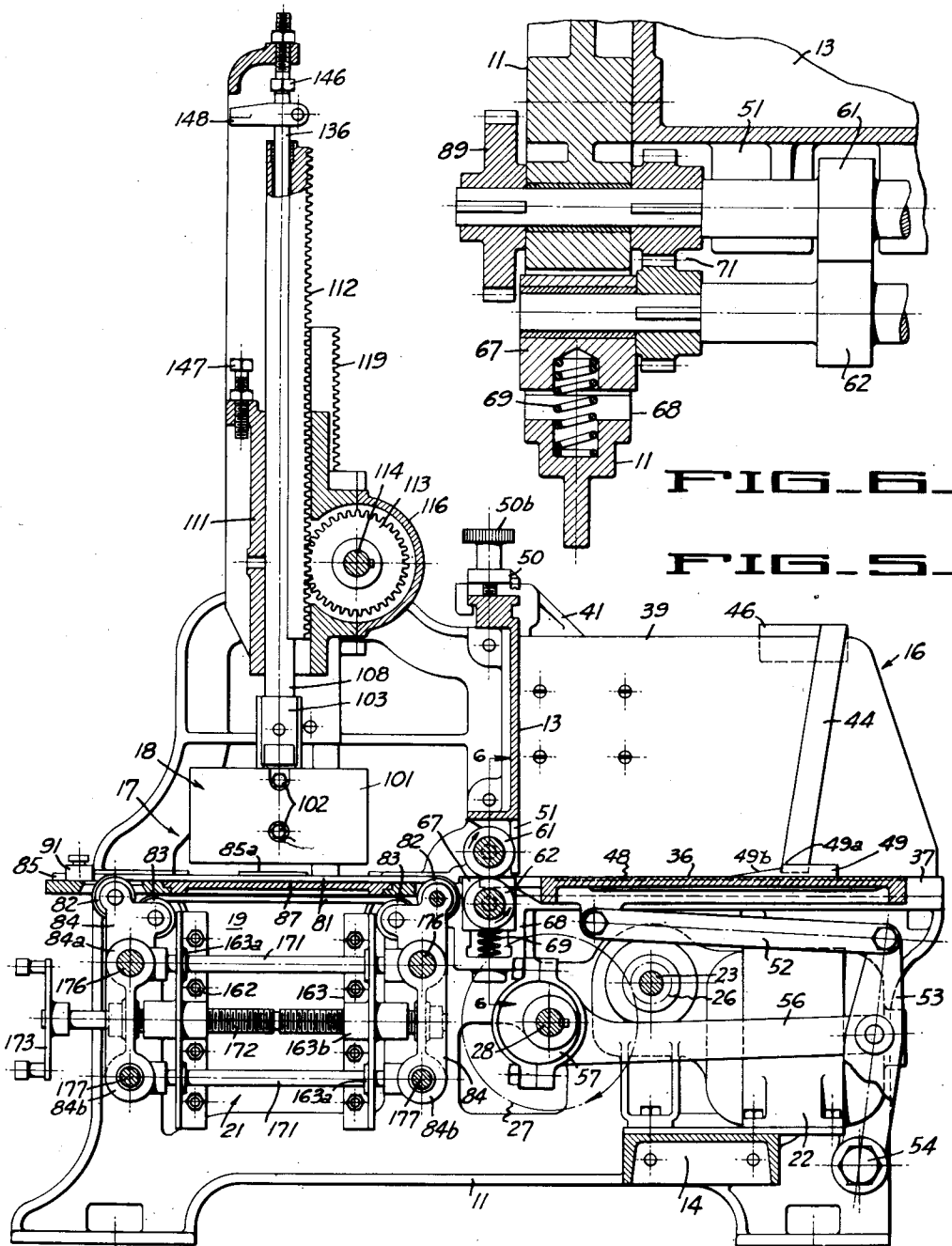


FIG. 6.

FIG. 5.

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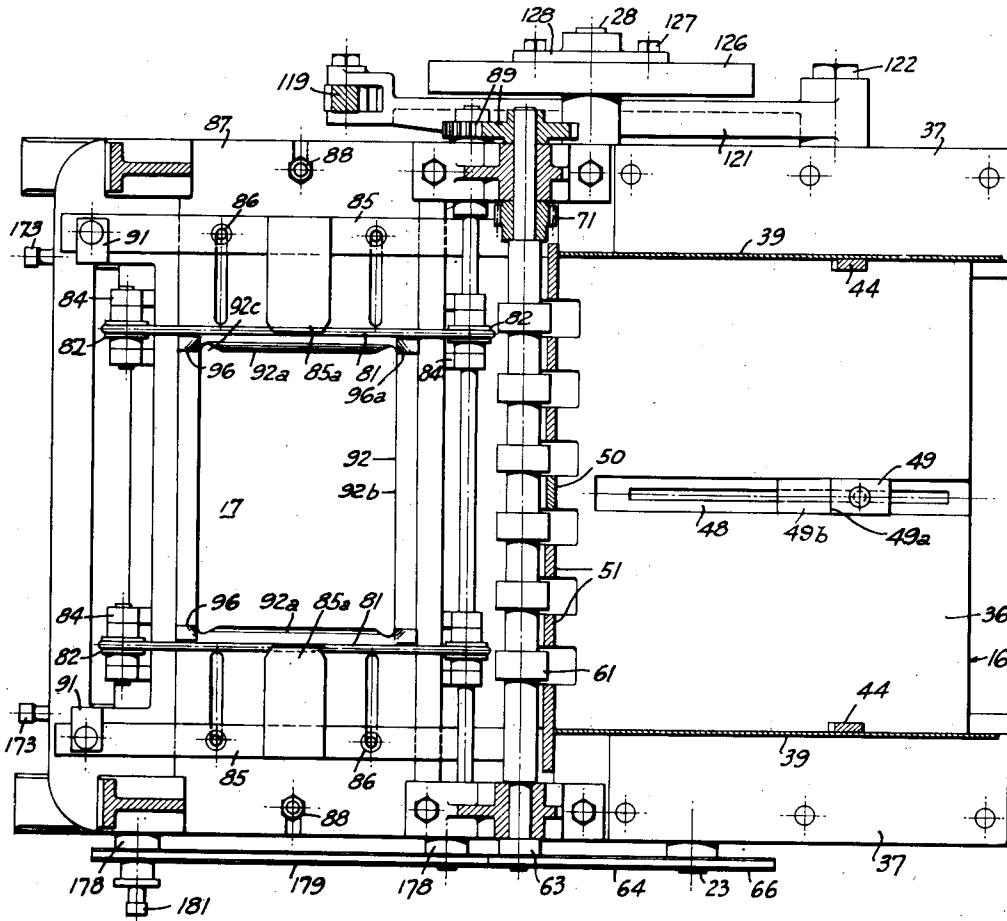


FIG. 7

FIG. 8

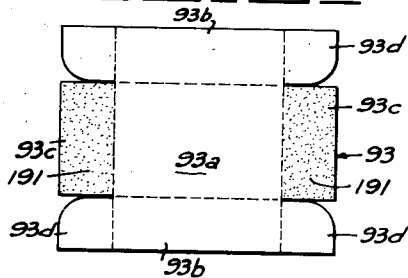
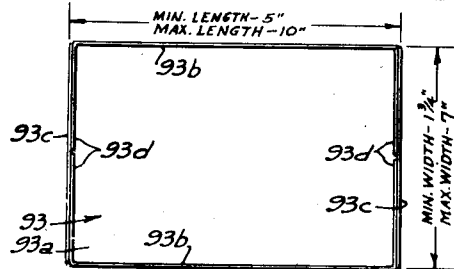


FIG. 10



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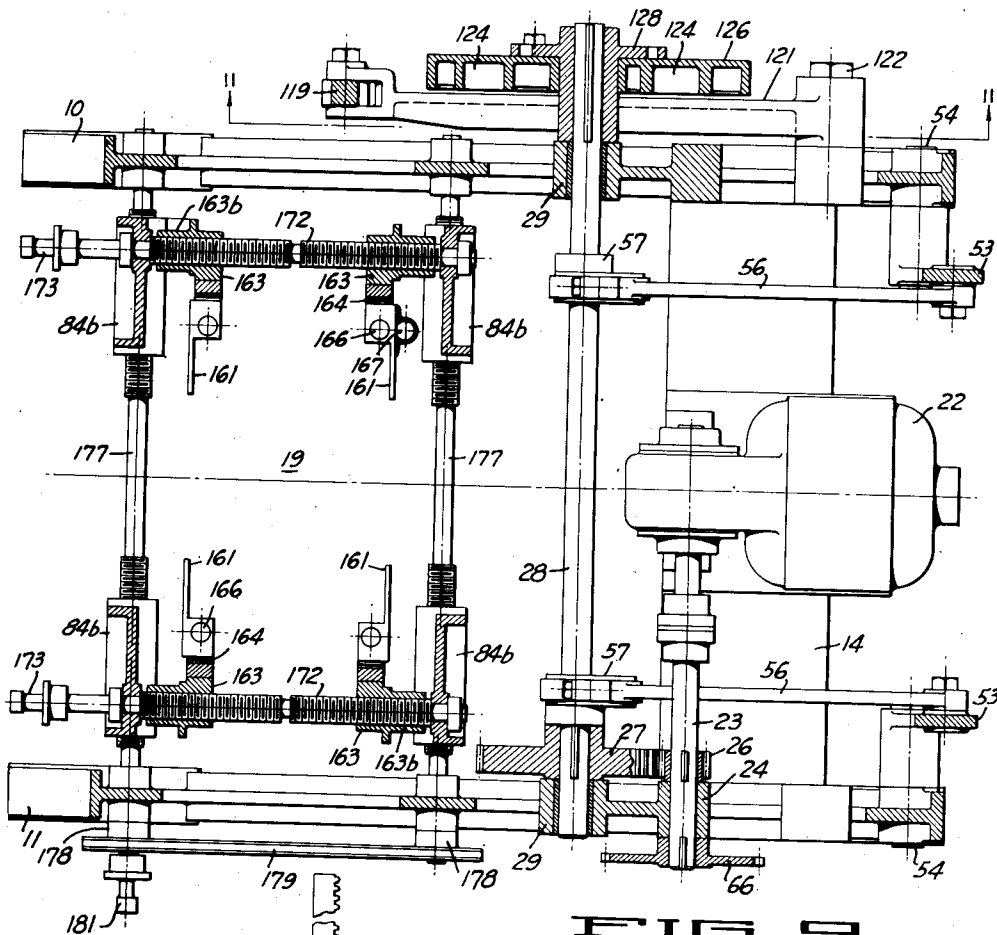


FIG. 9.

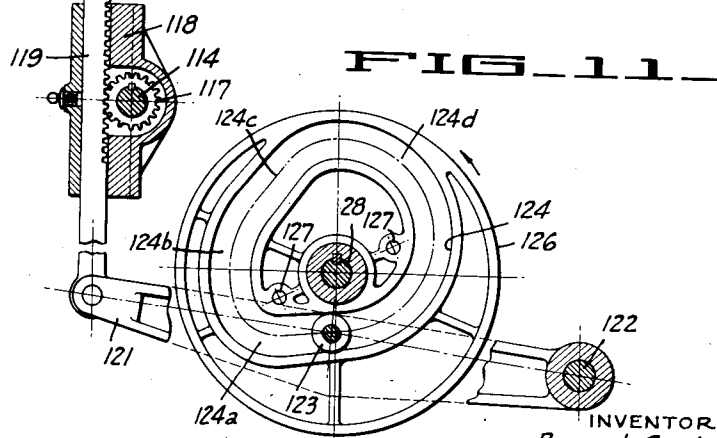


FIG. 11.

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FIG. 12

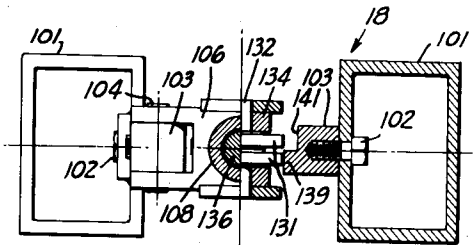
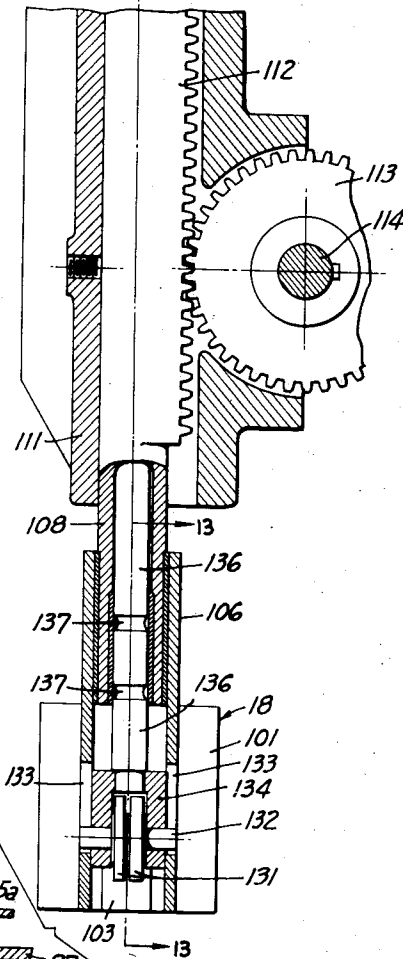
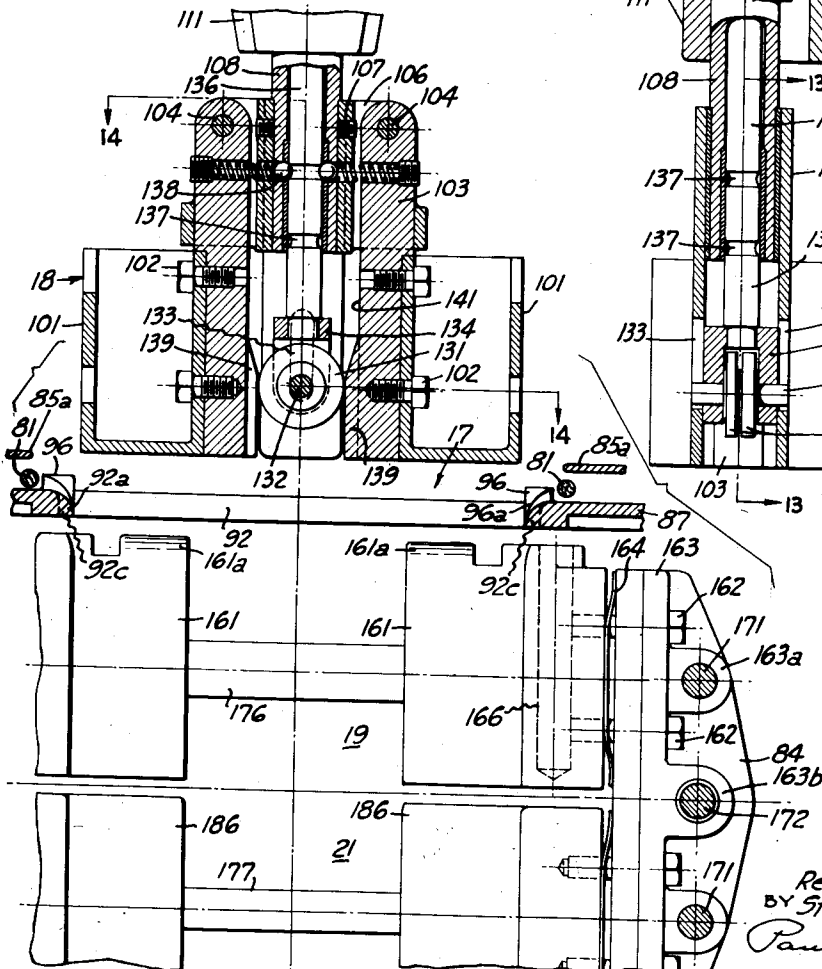


FIG. 14
FIG. 13



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BOXMAKING MACHINE

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Application December 3, 1946, Serial No. 713,766

5 Claims. (Cl. 93—51)

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This invention relates to box-making machines, and is concerned more particularly with the provision of a machine of this character in which the overlapping portions of the box are secured together by heat-sealing.

It is a general object of the invention to provide a box-making machine which will form the box from a blank and secure the box in formed relation by heat-sealing of selected portions thereof.

Another object of the invention is to provide a box-making machine of the above character which is automatic in operation.

A further object of the invention is to provide a box-making machine of the above character which is adjustable for operation on different sizes of box blanks.

Another object of the invention is to provide a box-making machine of the above character which operates in a cyclic fashion to carry a box blank through the machine in successive operating steps so that the box blank is formed, heat is applied to the overlapping portions carrying the heat-sealing material, and the box is held at a cooling station until the sealing material has cooled sufficiently to maintain the box shape.

Other objects and advantages of the invention will be apparent in the following description of a preferred embodiment thereof, as illustrated in the accompanying drawings, in which:

Figure 1 is a right side elevational view of the machine when viewing the machine with the box forming station as located at the front end thereof.

Figure 2 is a left side elevational view of the machine.

Figure 3 is a rear elevational view of the machine.

Figure 4 is a front elevational view of the machine.

Figure 5 is a longitudinal sectional view taken as indicated by the line 5—5 in Figure 4.

Figure 6 is a fragmentary sectional view taken as indicated by the line 6—6 in Figure 5.

Figure 7 is a sectional view in plan of the machine taken as indicated by the line 7—7 in Figure 4.

Figure 8 is a reduced plan view of a box blank.

Figure 9 is another sectional view in plan taken as indicated by the line 9—9 in Figure 1.

Figure 10 is a plan view of the completed box.

Figure 11 is a fragmentary sectional view of a portion of the cyclic control means taken as indicated by the line 11—11 in Figure 9.

Figure 12 is a sectional view through the box forming mandrel.

Figure 13 is a fragmentary sectional view of the box forming mandrel taken as indicated by the line 13—13 in Figure 12.

Figure 14 is a plan view, partially in section, of

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the box forming mandrel taken as indicated by the line 14—14 in Figure 13.

In general, the box-making machine of the instant invention operates in conjunction with a pre-fabricated box blank having certain portions thereof coated with a suitable heat-sealing material. The machine performs the functions of forming the box blank to the desired shape, heating the coated portions to effect heat-sealing of the overlapping portions together and then cooling the box. The preferred embodiment illustrated comprises a frame including respective side plates 10 and 11 (Figures 1 to 5) which are connected adjacent the top by an arched transverse frame bracket 12 and a bracket or partition 13, and adjacent the bottom by a transverse channel-shaped bracket 14. The various brackets are bolted to the side plates 10 and 11. The frame provides a mounting for means forming various operating stations in the machine including a blank holding station 16 (Figure 5), a box forming station 17 having a box forming and feeding mandrel 18 associated therewith, a heat-sealing station 19, and a cooling station 21. Both of the latter stations are also cooperative with the mandrel 18. As will be described, the machine functions to feed a box blank from a blank holding station 16 to the forming station 17 where it is engaged by the mandrel 18 and carried thereby successively through the forming station 17, the heat-sealing station 19, and the cooling station 21.

The drive mechanism of the machine includes a suitable source of power such as an electric motor 22 (Figures 3 and 9) of the gear-head type which operates a drive shaft 23 journaled in a boss 24 of the side plate 11. The shaft 23 carries a pinion 26 meshing with the gear 27 on a transverse main drive shaft 28 of the machine which is journaled in respective bosses 29 of the side plates and has various drive mechanisms of the machine connected thereto in a manner later described.

Blank holding station

The blank holding station 16 (Figures 1, 2, 3 and 5) includes a movable bottom wall 36 which is mounted for sliding movement on respective horizontal supporting and guide plates 37 secured on the side plates 10 and 11. An end wall of the station is formed by the bracket partition 13, and side walls are formed by adjustable side plates 39, each supported by a bracket 41 which in turn engages a track 42 formed along the upper edge of the partition 13. A set screw 43 associated with each bracket 41 holds the side walls 39 in the selected laterally adjusted position which is determined by the size of box blank being used in the machine. Each side wall 39 also carries an inclined rear guide arm 44, which extends downwardly along the side wall 39. Its upper end

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is provided with an L-shaped bracket 46 engaging over the cooperating side wall 39 and having a set screw 47 for maintaining a desired adjusted position. The upper face of the bottom wall 36 is provided with a longitudinal groove 48 in which there is adjustably secured a cam feed element 49 having a shoulder 49a and a tapered portion 49b. This element is adapted to engage under the lowermost one of a stack of box blanks whereby the lowermost blank is moved by engagement with shoulder 49a when wall 36 is moved to the left as viewed in Figure 5. A blank is thereby fed through a gap below the depending fingers 51.

To control the size of the feed gap below the fingers 51 of the end wall 13, an L-shaped strap 50 (Figure 3) is mounted for adjustment within a guide-way formed in the wall 13 so that its lower end is spaced from the bottom wall 36 slightly more than the thickness of a box blank. The strap 50 is slotted to accommodate a pair of retaining screws 50a, and at its upper end carries an adjusting screw 50b which engages the upper edge of the end wall 13 at a central cut-away portion thereof.

The box blank feeding movement of the bottom wall 36 is effected by means including a pair of respective parallel links 52, each of which is pivotally secured to the wall 36 and to the upper end of a lever 53 pivoted at 54 on each side plate 10 and 11, respectively. Intermediate its ends each lever 53 is connected by an eccentric follower 56 with an eccentric 57 on the main drive shaft 28. This main drive shaft 28 revolves once for each cycle of operation of the machine so that the bottom wall 36 will be moved rearwardly from the position shown in Figure 5 during the first half cycle and then advanced again, as shown, during the ensuing half cycle of the operation of the machine to feed another box blank.

Feed means

A box blank advanced from the box blank holding station by movement of the bottom wall 36 thereof is engaged between respective upper and lower feed rolls 61 and 62 (Figures 1, 3, 5 and 7) which extend transversely of the machine for transfer to the box forming station. The upper roll 61 is journaled in the respective side plates 10 and 11 and at one end carries a sprocket 63, which is driven through a chain 64 from a sprocket 66 on the shaft 23. The lower feed roll 62 has its ends journaled in respective bearing blocks 67 guided for vertical sliding movement in guide-ways 68 of the respective side plates 10 and 11 and urged upwardly by a spring 69 at each end so that the roll sections of the lower roll 62 are spring-urged upwardly into engagement with the roll sections of the upper feed roll 61. The two feed rolls are geared together by gearing 71 (Figure 3) so that the rolls rotate in opposite directions as indicated by the arrows in Figure 5.

Forming station

The rolls 61 and 62 (Figures 5 and 7) operate to pick-up a box blank introduced therebetween and to initiate its transfer from the blank holding station 16 to the blank forming station 17. The blank, in feeding from the rolls 61 and 62, is delivered to a pair of spaced apart parallel feed belts 81 (Figures 5 and 7) which are trained over respective upper rollers 82 and lower rollers 83, said rollers being carried by adjustable brackets 84 of the heating and cooling stations referred to in greater detail hereinafter. The belts 81

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receive their drive through gearing 89 (Figures 2 and 7). The box blank is carried rapidly by the belts 81 between respective guide strips 85 which are adjustably mounted by bolts 86 on a removable forming plate 87. Plate 87 is removably secured to the side plates 10 and 11 by bolts 88. The respective strips 85 carry adjustable stops 91 against which the box blank is held by the belts 81 in position for the forming operation.

The forming plate 87 is provided with a central rectangular opening 92 corresponding in cross sectional area to the major cross sectional area of the formed box. The side guide strips 85 and the stops 91 are so located with respect to the opening 92 that the bottom portion 93a of the cardboard or fiberboard box blank 93 (Figure 8) is aligned with and above the opening 92, with the side walls 93b extending over the side portions of the plate 87 and the end walls 93c over the end portions of this plate. Studs 96 are carried by the forming plate adjacent the corners of opening 92 and are adapted to underlie the tabs 93d of the blank. The inner corners of these studs are beveled off or cut away as indicated at 96a to more effectively guide the tabs 93d during a folding operation. Retaining fingers 85a are attached to strips 85 and have their free inner ends spaced above the adjacent upper surfaces of plate 87. Thus these fingers overlie the end walls 93c of the blank to retain the same for an interval during initial movement of the blank downwardly through opening 92. During such initial movement, however, the side walls 93b are bent upwardly by engagement with edges 92b, and tabs 93d are bent inwardly to insure positioning of the same inwardly of walls 93c when the latter are permitted to bend upwardly. Retention of walls 93c is made possible during such initial movement by rounding off the end edges of the plate opening 92, as indicated at 92a. The corners of opening 92 are relieved as indicated at 92c in order to accommodate blank stock material which may project from the box corners as a result of the blank folding operation.

Box forming mandrel

The box forming mandrel (Figures 4, 5, 12 and 13) includes a pair of removably mounted box-like sections 101, each of which is secured by cap screws 102 to a depending support arm 103. Each support arm 103 is pivoted at 104 to a member 106. The hub of the member 106 is secured by set screws 107 on a vertically extending sleeve 108.

The sleeve 108 (Figure 5) extends upwardly from the support member 106 and the mandrel sections 101 through a guide head 111 carried by the cross bracket 12. The sleeve 108 is provided with a gear rack 112 which meshes with and is driven by a gear 113 on a transverse shaft 114. The shaft is journaled on head 111 between the main body of the same and the cap 116. The shaft 114 (Figure 11) carries a pinion 117 adjacent one end thereof and enclosed within a housing 118 which is pivoted on the shaft 114. The pinion 117 is engaged with a drive rack 119 mounted for vertical sliding movement within the housing 118. Rack 119 is pivotally connected at its lower end to a cam follower arm 121 which is pivoted on the frame at 122. The follower arm 121 has a cam roller 123 engaged with a track 124 of a cam member 126 carried at one end of the drive shaft 28. The cam member 126 (Figure 2) has an adjustable bolted connection at 127 with a drive plate 128 which is

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keyed to the shaft 28, so that the cam 126 can be assembled thereon in properly timed relation.

The box forming mandrel referred to generally above is adjustable between collapsed and expanded conditions so that it varies its dimensions between the desired box form size and a smaller size for withdrawal from the box. In order to control this change in size, the support arms 103 for the mandrel sections 101 (Figures 12, 13 and 14) are gravity engaged with respective rollers 131 carried by a transverse shaft 132 which is journaled in a fork 134 at the lower end of a shaft 136. The shaft 132 is also guided in slots 133 formed in downward extensions of bracket 108. The shaft 136 extends upwardly through the sleeve 108 and is provided with spaced locking grooves 137 for engagement by spring-urged latching or detent balls 138. The grooves 137 are so spaced that rollers 131 can be latched in engagement with either the raised portions 139 of the mandrel sections 101 or with the planar wall portions 141 thereof. In other words, the mandrel is latched in either the expanded condition or the collapsed condition thereof.

To control the conditioning of the mandrel, an upward extension of the head 111 (Figure 5) carries an adjustable stop screw 146 for engagement with the upper end of shaft 136, and also a second adjustable stop screw 147 for engagement with a finger 148 which is clamped on the shaft 136. With the parts positioned as shown in Figures 5 and 13, the mandrel sections 101 are in expanded condition to form a cross sectional area corresponding to the bottom of the box blank so that, upon downward movement of the mandrel 18, it will engage the bottom of the box blank resting on the forming plate 87 and will carry the box blank down through the opening 92. This operation serves through the buttons 96 to bend the ears 93d of the blank before the sides 93b engage the side edges of the opening 92. The end walls 93c do not engage the depressed curved end walls 92a of the opening 92 until after the side walls 93b engage the side walls 92b of the opening 92. In addition, the end walls 93c are restrained from bending upwardly by retaining fingers 85a on the guide bars 85. As the downward travel of the mandrel 18 continues, the box is folded to the form shown in Figure 10, and is carried through the plate 87 to the heating station.

Heating station

The heating station comprises four angle-shaped heating elements 161 (Figures 4, 5, 9 and 13) which are arranged to form an opening corresponding in shape to the box, with the upper edges thereof flared as at 161a to receive the box blank. Each of the angle-shaped heating elements 161 is carried by a pair of studs 162 which extend loosely through a vertically extending bracket 163. A leaf spring 164 interposed between each heating block 161 and the bracket 163 provides a resilient mounting of the heating element in receiving a box and provides a spring pressure for holding the formed box between the heating elements and the box forming mandrel. Each of the heating elements 161 includes a conventional form of electrical heater 166 and one of the blocks is provided with a control thermostat 167 of conventional construction.

Each bracket 163 (Figures 4, 5 and 9) is provided with respective guide bosses 163a engaged with respective guide shafts 171 extending be-

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tween the cooperating brackets 84 previously referred to, and each bracket 163 is also provided with a threaded boss 163b engaged with a threaded shaft 172 journaled in the cooperating brackets 84 and provided with an operating handle 173. The threaded shaft 172 is formed in two sections, as seen in Figure 9, which are threaded in opposite directions so that turning of the shaft serves to adjust the cooperating pair of heating elements 161 toward and from each other to provide an adjustment for the size of box being made.

Each of the brackets 84 (Figures 4, 5 and 9) is in turn provided with an upper guide boss 84a engaged with a cross guide shaft 176 extending between the side plates 10 and 11, and a lower threaded boss 84b engaged with a transverse threaded shaft 177 which is also journaled in suitable bearings in the side frame plates. There are two guide shafts 176, and two threaded adjusting shafts 177 for the respective pairs of support brackets 84. Each shaft 177 is provided with two oppositely threaded sections so that the opposite sets of brackets 84 are adjusted towards and away from each other on turning of the threaded shafts 177. These shafts 177 (Figure 1) are provided with sprockets 178 engaged by a chain 179 so that turning of the handle 181 on the left-hand shaft 177 (as viewed in Figure 1) will cause simultaneous adjustment of the opposite sets of brackets 84 with respect to each other. In this way the heating elements 161 can be adjusted in rectangular fashion in accordance with the size of box to be formed.

Cooling station

Below the heating elements 161 (Figure 13) each of the supporting brackets 163 therefore carry a similar array of L-shaped cooling elements 186 which are mounted on the brackets 163 in the same fashion and in vertical alignment with the heating elements 161. The cooling elements cooperate with the mandrel 18 to receive the boxes in heated condition, and serve to withdraw sufficient heat so that the heat-sealing material will harden or set as will now be described. They are formed of suitable metal with sufficient heat dissipation to cause them to remain at a relatively low temperature range. These elements can also be cooled as by means of a circulating system, as by providing them with passages through which the cooling liquid can be passed.

Operation

Reviewing briefly the operation of the machine, the respective adjustable parts of the machine including the guides 44 and the feed block 49 at the box blank station, the stops 91 and the guide strips 85 at the forming station, and the heating and cooling blocks 161 and 186 are all adjusted to the desired position in accordance with the size of box being made. Also, the removable mandrel sections 101 and the forming plate 87 corresponding to the box size are installed.

With the parts positioned as shown in Figure 5, a box blank has just been fed by the feed rolls 61-62 and the feed belts 81 to the box folding or forming station in engagement with the stops 91 thereon. This blank is provided with a coating of suitable heat-sealing material over certain portions thereof as shown at 191 in Figure 8. Tabs 93d may be provided with a similar coating on their outer surfaces (bottom surfaces as viewed in Figure 8) which are to be bonded to coating 191. Referring to Figure 11, it will be

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noted that with the cam 124 turning counter-clockwise, the mandrel 18 will be lowered by the cam rise 124a and this operation serves to carry the box blank through the opening 92 in the forming plate 87 so that the box is formed to the shape shown in Figure 10. In the folding operation, the ears 93d of the blank are folded inwardly and the side walls 93b folded upwardly, and then the end walls 93c are folded upwardly.

The downward movement of the mandrel 18 continues until the folded box is positioned between the mandrel sections 101 and the heating elements 161. The rise portion 124a (Figure 11) of the cam 126 is followed by a dwell portion 124b thereof during which the box is held between the mandrel and the heating elements, so that the heat-sealing material is softened to cause adherence of the overlapping portions of the box blank. During this time the coated surfaces are being pressed together. The dwell portion 124b of the cam is followed by a cam rise 124c which serves to further move the mandrel 18 downwardly so that the box is carried from the heating station to the cooling station. During the last portion of this travel the shaft 136 is retarded by engagement of lug 148 with screw 147 so that dent balls 138 are disengaged from the upper groove 137 and engaged with the lower groove 137. At the same time the rollers 131 move into engagement with the depressed portions 141 of the mandrel sections 101 (Figure 13) and the mandrel 18 is collapsed. Thus as the descending portion 124d of the cam becomes effective to again raise the mandrel, the collapsed mandrel is free to lift from the box and will not again be expanded until its upper position when the shaft 136 will engage the stop screw 146.

At this time the parts have returned to the position shown in Figure 5 and the feeding of another box blank to the feed rolls 61 and 62 has been completed by the movable bottom 36 of the blank holding station so that the sequence of the operations described above will be repeated.

The box remains in the cooling station for an interval of time sufficient to reduce the temperature of the adhesive and thus form a relatively strong bond. It is ejected from the cooling station by the next box formed by the succeeding cycle.

As shown in Figure 7, the stops 91 and the guide strips 85 at the forming station 17 are of a character for use with a box blank and box of the character shown in Figures 8 and 10. By providing guide strips of greater length and by adjusting the position of the stops 91 outwardly, the forming station can be adapted for use with a box having an attached folding lid. In this case the box blanks are positioned to be fed lid first through the feed rolls.

While the invention has been illustrated and described in connection with a preferred embodiment thereof, it is capable of other variations and modifications within the scope of the claims appended hereto.

We claim:

1. In a box making machine, a folding station for receiving a blank to be folded to box form and including a detachably mounted apertured folding member of rectangular contour, a heat-sealing station comprising four angle-shaped sealing members mounted in alignment with the corners of the rectangular aperture, and a cooling and holding station comprising a similar rectangular arrangement of four angle-shaped members.

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2. In a box making machine, a heat-sealing station comprising four angle-shaped sealing members forming a rectangular aperture, and means mounting said members for adjustment to vary the size of the rectangular opening in accordance with the size of box being formed.

3. In a box making machine, a folding station for receiving a blank to be folded to box form and including a detachably mounted apertured folding member of rectangular contour, a heat-sealing station comprising four angle-shaped sealing members mounted in alignment with respective corners of the rectangular aperture, a cooling and holding station comprising a similar rectangular arrangement of four angle-shaped members, and means common to said members of said sealing station and said holding station mounting said members for adjustment to vary the size of box being formed.

4. In a box making machine, a folding station for receiving a blank to be folded to box form and including a detachably mounted folding member having an opening of rectangular contour, a heat-sealing station comprising four angle-shaped sealing members mounted in alignment with respective corners of said rectangular opening, a cooling and holding station comprising a similar rectangular arrangement of four angle-shaped members, means mounting said members of said sealing station and said holding station for adjustment in accordance with the size of box being formed, and a mandrel for progressing blanks and formed boxes through said stations and comprising detachably mounted elements.

5. In a box making machine, a blank folding station including an apertured structure, means for positioning a flat blank on said structure, a mandrel comprising two parts movable relative to each other between expanded and collapsed positions, a support member for the mandrel parts, arms extending from said parts and pivotally attached to the support member to thereby permit movements of said parts between expanded and collapsed positions relative to each other, means for cyclically reciprocating said support member and mandrel to force the blank through the aperture to thereby fold side margins of the same to form a box and to thereafter retract the mandrel from the box and the aperture, said last means including a member adapted to be reciprocated and having limited lost motion sliding engagement with said support member, and means for moving said parts to said collapsed position at the end of the stroke of the mandrel through said structure and for expanding said parts at the end of the return stroke, said last means including cam elements actuated by relative movement between the support member and said reciprocated member.

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