March 13, 1962 C. E. CLARKE 3,024,709

BOX FORMING MACHINE

Filed March 28, 1960 3 Sheets-Sheet 1

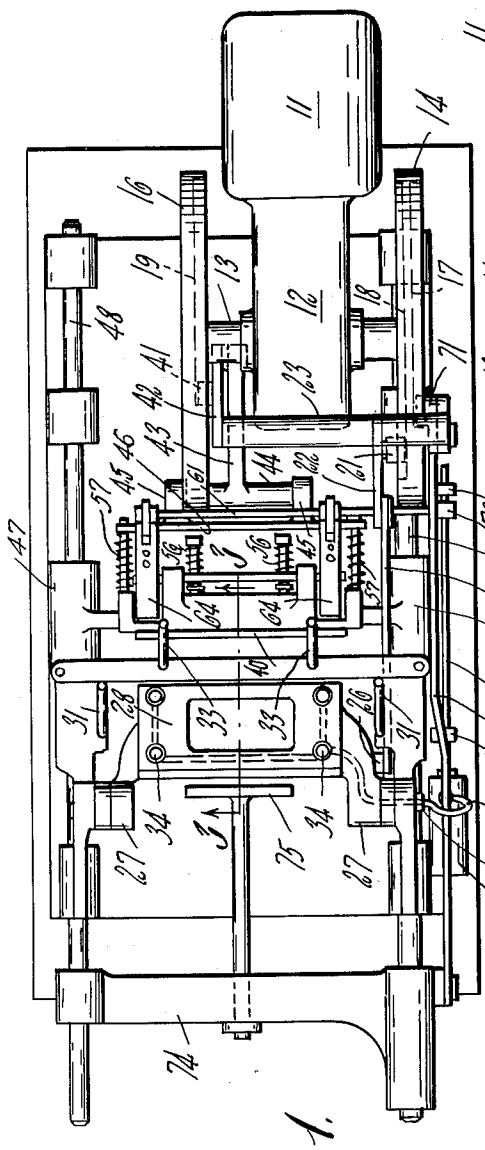


Fig. 1.

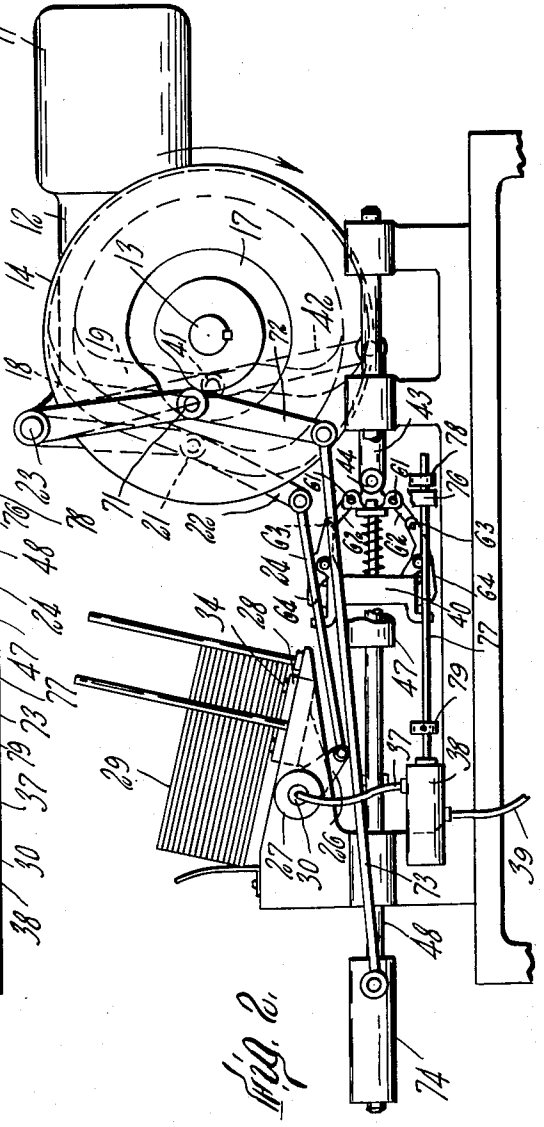


Fig. 2.

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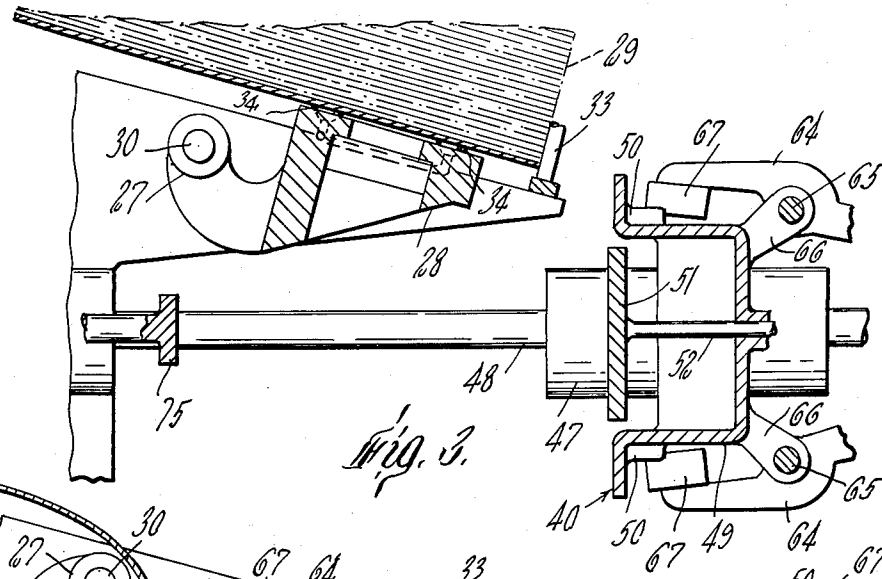


Fig. 3.

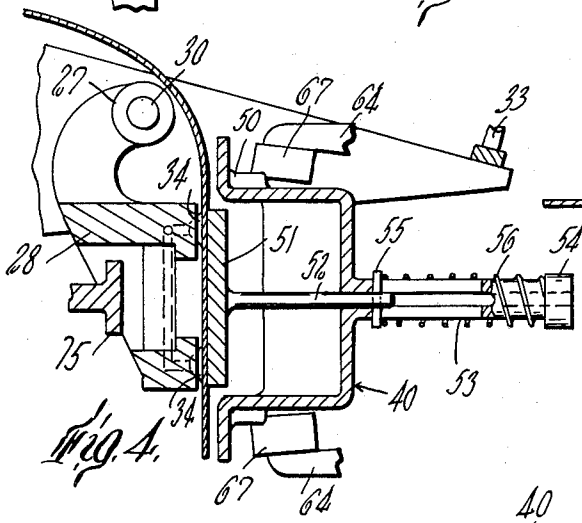


Fig. 4.

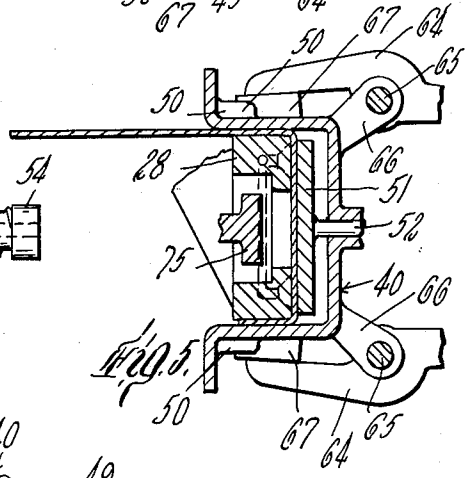


Fig. 5.

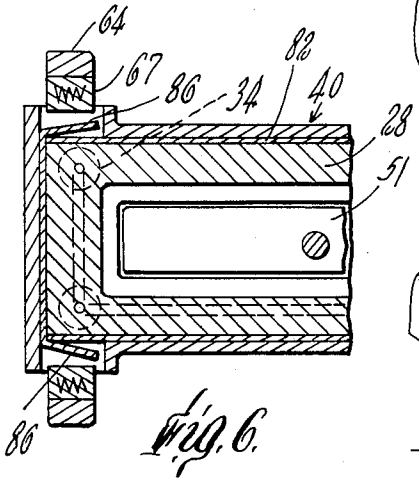


Fig. 6.

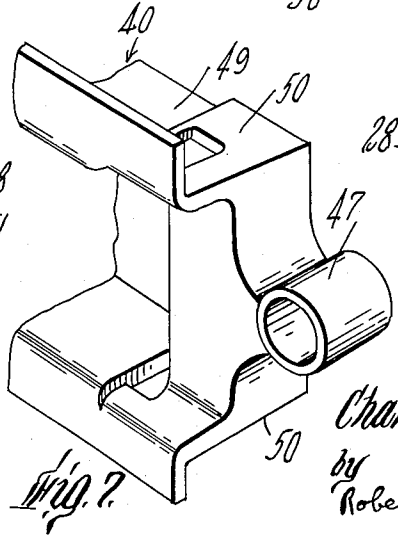


Fig. 7.

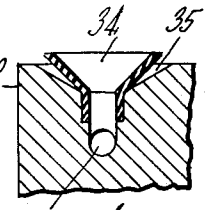


Fig. 8.

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BOX FORMING MACHINE

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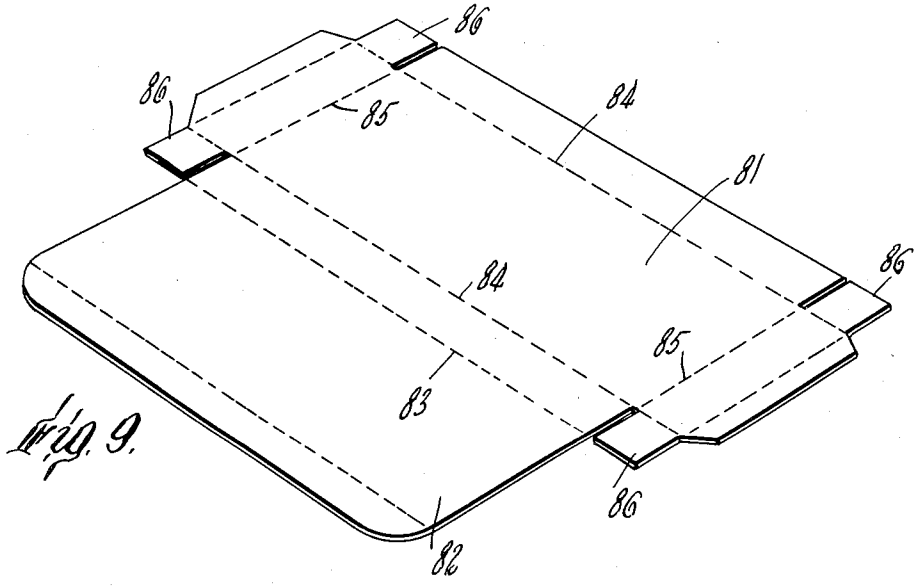


Fig. 9.

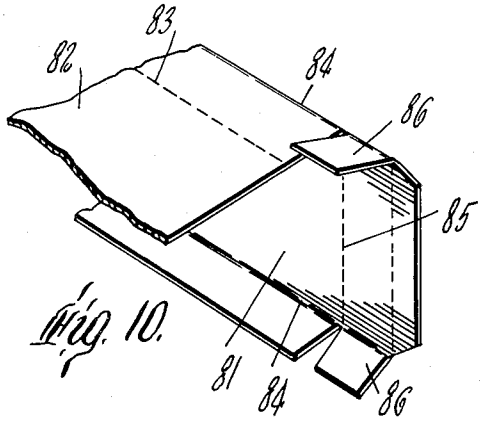


Fig. 10.

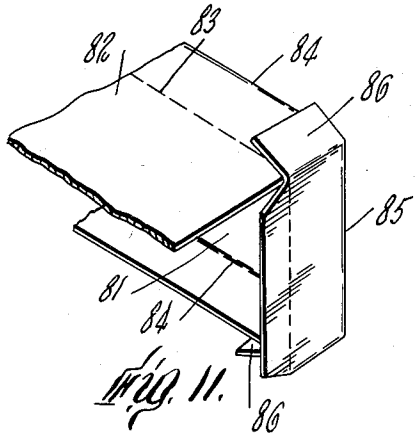


Fig. 11.

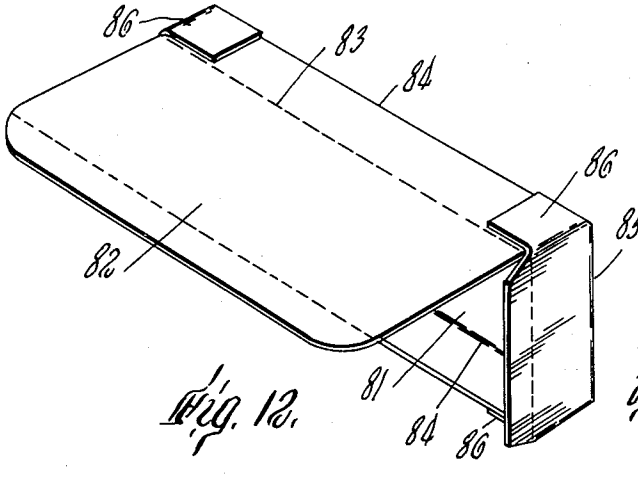


Fig. 12.

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3,024,709

BOX FORMING MACHINE

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Filed Mar. 28, 1960, Ser. No. 17,967
12 Claims. (Cl. 93—51)

This invention relates generally to the making of small boxes from cardboard and in particular it is concerned with a machine for folding box blanks and converting them into finished boxes by fastening parts of the folded blanks together.

It is an object of the invention to provide a reliable, high-speed box forming machine for use with box blanks having a thermoplastic coating.

It is a more specific object to provide a die part in a machine of the above-mentioned character which is self-loading.

The novel features of the invention together with further objects and advantages will become apparent from the following detailed description and the drawing to which it refers.

In the drawing:

FIG. 1 is a plan view of the machine according to the present invention;

FIG. 2 is a side view in elevation of the machine;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 1;

FIG. 4 is a sectional view similar to a portion of FIG. 3 but with the outer die of the machine more nearly in registry with the inner die;

FIG. 5 is a view similar to that of FIG. 4 with the outer die in registry with the inner die;

FIG. 6 is a sectional view of a portion of the die;

FIG. 7 is a perspective view of a portion of the outer die;

FIG. 8 is a view in section of the pneumatic suction element employed in the machine according to the present invention;

FIG. 9 is a perspective view of a box blank for use with the machine according to the invention;

FIG. 10 is a perspective view of a part of the blank after two of its opposite sides have been folded into shape;

FIG. 11 is a view similar to that of FIG. 10 with the other pair of sides partially folded; and

FIG. 12 is a view of the blank after it has been completely folded and fastened by the machine according to the present invention.

With reference now to the drawing and more particularly to FIGS. 1 and 2, it will be observed that the machine according to the present invention is driven by a motor 11 through a gear box 12. The output shaft 13 from the gear box mounts a pair of cam plates 14 and 16 in which grooves are provided. In particular there is an outer groove 17 and an inner groove 18 in the cam plate 14 and there is a single groove 19 in the cam plate 16.

Cooperating with the groove 18 is a follower 21 carried by a pivot arm 22. Pivot arm 22 is mounted on a fixed shaft 23 at one end, and at its other end is pivotally joined to a connecting rod 24. To the connecting rod, in turn, is joined an arm 26 which is rigid with trunnions 27 and hence has as its center of rotation, the trunnion support shaft 30. Trunnions 27 mount an inner die 28 for movement between a position adjacent a stack of blanks 29 and a position spaced therefrom. The blanks are maintained in a stack by elements 31—33 acting in the manner of guides.

With reference now to FIGS. 3 and 8, it will be observed that the face of the inner die 28 has recesses 35 in which are located suction cups 34. These communicate

with a vacuum hose 37 through passages in the die designated at 36. The vacuum hose 37 leads to an air valve 38 which, as shown in FIG. 2, has an outlet 39 leading to a source of vacuum.

Disposed in the cam slot 19 is a follower 41 carried by a pivot arm 42. Arm 42 at one end is pivoted about the same shaft 23 as is arm 22, and at its other end is joined to a connecting rod 43. The latter, in turn, is joined to a shaft 44 and on the shaft are mounted trunnions 45. By means of a cross bar 46 extending between the trunnions an outer die 40 is resiliently coupled to the shaft. Guides 47 slidably mounted on spaced guide rods 48 constrain the outer die to move linearly toward and away from the inner die.

More particularly, the outer die is seen to include a folding part 49 with wing portions 50 at the corners thereof, and a holding part 51 in the nature of a flat plate. The holding part has a pair of stems 52 which extend rearwardly, as shown, into sleeves 53 which are rigid with the folding part. Passing through each stem and through guide slots in the corresponding sleeve is a pin 55. The pin and a flange 54 on the end of each sleeve retain a compression spring 56. Springs 57, on the other hand, connect the folding part of the outer die to the cross bar 46.

In addition to the outer die there is coupled to the cross bar 46, rigidly in this case, a pair of pivot shafts 61 which mount pivot arms 62 for relative rotational movement with respect to the shafts. The opposite ends of the arms 62 are joined by pivot shafts 63 which serve to connect jaws 64 to the arms. Shafts 65 passing through the jaws constrain them to pivot with respect to the folding part of the outer die which has lugs 66 to rigidly support the shafts 65. The jaws 64 include resistance heating units 67 as best shown in FIGS. 3–5.

With reference once again to FIGS. 1 and 2, it will be observed that there is a follower 71 which rides in the groove 17 in cam plate 14, which follower is carried by a pivot arm 72. Arm 72 pivots about shaft 23 as do arms 22 and 42 and has pivotally joined to its free end a connecting rod 73. A guide assembly 74 is in turn pivotally connected to rod 73, the former being slidably carried by guide rods 48. Guide assembly 74 serves to mount for linear movement toward and away from the inner die, a stripper 75.

There is also rigidly joined to the cross bar 46 a depending valve actuating member 76 which slides on a plunger 77. Plunger 77 constitutes the actuating element for the valve 38 and has rigidly attached thereto at spaced points stops 78 and 79. As is apparent, depending member 76 upon encountering the stops will cause the valve to open and close in timed relation to the movement of the cross bar.

In FIGS. 9–12 there is shown in more detail a box blank for use with the machine according to the present invention. The base portion of the blank has been designated by the numeral 81 and the cover portion by the numeral 82. Defining the boundary between the cover and the base is a score line 83. In addition to score line 83, score lines 84 are provided to define the boundary between the bottom wall of the box and the longer side walls. Also score lines 85 define the boundary between the bottom wall and the shorter side walls. The numeral 86 designates tabs that extend from the shorter side walls, while the remaining score lines which are undesignated are used in closing up the box after packing.

In operation, a machine cycle begins with the various parts in the positions shown in FIGS. 1 and 2. That is, the inner die is disposed directly beneath the stack of blanks, and the air valve to control the withdrawal of air

from the suction cups is open. The last or bottom blank in the stack is thus gripped by the die and caused to adhere thereto. Accordingly, upon rotation of the cam shaft by the motor and the resulting pivotal movement of the inner die, the bottom blank is carried from the position shown in FIG. 3 to the position shown in FIG. 4. Continued rotation of the crank shaft and specifically cam groove **17** then causes the outer die to move forwardly until the holding part encounters the blank with the inner die in back of it which stops the holding part. The folding part however, continues to move compressing the spring and urging the holding part against the blank, until it too is stopped. In this way, first, the longer side walls of the blank (FIG. 10) and then the shorter side walls (FIG. 11) are folded at right angles to the base wall. Because of the configuration of the die at its corners, however, the tabs are only partially folded as shown in FIG. 11. Rather it remains for the jaws to close on the tabs to fold them completely and heat them, which causes them to adhere to the longer side walls. Upon termination of this operation, the jaws open, the outer die retracts, and the stripper moves forwardly, pushing the blank away from the inner die. At this time, the air valve is closed. Finally, the stripper is returned to its initial position away from the inner die which is likewise returned to its initial position adjacent the stack of blanks, completng one cycle of operations.

Although the invention has been described in connection with a single preferred embodiment, it will be appreciated by those skilled in the art that this embodiment is susceptible of various modifications that are within the spirit and scope of the invention. Therefore, the invention should not be deemed to be limited to the details of what has been described herein by way of example, but rather it should be deemed to be limited only by the scope of the appended claims.

What is claimed is:

1. A machine for forming boxes from flat blanks having a rectangular bottom portion, side portions, and end portions with extensions forming tabs at each end thereof, and including a seal producing coating for sealing said tabs to said side portions having, in combination, an inner die having means for positioning a blank thereon, and an outer die, said dies being relatively movable, and said outer die having relatively high side walls of sufficient length to engage said tabs, side and lower end walls shaped first to fold said side portions and tabs and thereafter to fold said end portions during relative approaching movements of said dies, jaws movable on the machine to engage and seal said tabs against said side portions, said side walls having formed therein apertures to receive said jaws for engaging and sealing said tabs, and actuating means operable to impart relative advancing movements to said dies to fold said side portions and thereafter said end portions of the blank, and thereafter to move said jaws with relation to said outer die to engage and seal said tabs against said side portions.

2. In a machine for forming boxes from flat blanks having a rectangular bottom portion, side portions, and end portions with extensions forming tabs at each end thereof, and including a seal producing coating for sealing said tabs to said side portions, the combination of an inner die having means for positioning a blank thereon, an outer die arranged to be advanced with relation to the inner die to fold said blank, said outer die having walls shaped to fold the side portions and end portions of said blank through the fold producing advancing movement of said outer die, a holding part yieldably supported in a relatively advanced position on said outer die to engage the bottom portion of said blank against said inner die, and jaws supported on said machine for movement to engage and seal said tabs against said side portions, actuating means operable to advance said outer die to engage said holding part against said blank and inner die, further advancing said outer die to fold said side portions and end portions of said blank, and thereafter moving said jaws with relation to said outer die to engage and seal said tabs against said side portions.

3. In a machine for forming boxes from flat blanks having a rectangular bottom portion, side portions, and end portions with extensions forming tabs at each end thereof, and including a seal producing coating for sealing said tabs to said side portions, the combination of an inner die having means for positioning a blank thereon, an outer die arranged to be advanced with relation to the inner die to fold said blank, said outer die having walls shaped to fold the side portions and end portions of said blank during the fold producing advancing movement of said outer die, a holding part yieldably supported in a relatively advanced position on said outer die to engage the bottom portion of said blank against said inner die, and jaws supported on said machine to engage and seal said tabs against said side portions, and actuating means for said machine including an actuator having cyclical advancing and retracting movements, a yieldable operating connection between said actuator and said outer die for advancing said outer die to engage said holding part against said blank and inner die, and thereafter to fold said side portions and end portions of said blank, and a toggle connection between said actuator and said jaws rendered operative by the continued advance of said actuator to move said jaws with relation to said outer die to engage and seal said tabs against said side portions.

4. In a machine for forming boxes from flat blanks having a rectangular bottom portion, side portions, end portions, and corner tabs having an inner die for positioning a blank thereof, the combination of an inner die shiftable between a blank receiving and blank folding position, an outer die arranged to be advanced with relation to the inner die to fold said blank, said outer die having walls shaped to fold the side portions and end portions of said blank through the fold producing advancing movement of said outer die, a stripper member movable with relation to the inner die for stripping a folded blank therefrom, a holding part yieldably supported in a relatively advanced position on said outer die to engage the bottom portion of said blank against said inner die, jaws movable on the machine to fold said corner tabs, and actuating means comprising a cam and follower means for shifting said inner die from one to the other said position, a cam and follower means for advancing and retracting said stripper member, and a cam and follower means including an actuator connected to advance said outer die with relation to said inner die to engage said holding part against the blank and inner die, and to fold said blank, and means controlled by said latter cam and follower means to thereafter actuate said jaws.

5. A machine for forming boxes from flat box blanks having thermoplastic surfaces, said machine comprising an inner die mounted for pivotal movement between a position adjacent a stack of blanks and a position spaced therefrom, gripper means carried by said inner die to grip the last blank in the stack when the inner die is positioned adjacent thereto and to separate the blank from the stack when the die moves away therefrom, an outer die mounted for slidable movement between a position spaced from said inner die and a position in registry therewith, said outer die acting to form the blank into a box with tabs at the corners in the course of its movement into registry with said inner die, jaws carried by said outer die to press said tabs against the sides of the box once said outer die is positioned in registry with said inner die, said outer die being provided with apertures through which said jaws pass to engage said tabs, heating elements retained in the faces of said jaws to join by heat sealing said tabs and said sides of the box, stripper means mounted for movement into and out of engagement with the blank to remove it from said inner

die after it has been formed, and a mechanism to move said stripper means, said inner die, and said outer die cyclically in a predetermined timed relation, said mechanism including means to close and open said jaws while said outer die is positioned in registry with said inner die.

6. A machine according to claim 5 wherein said outer die includes relatively movable parts to hold a portion of the blank against the inner die and to fold the remaining portion of the blank with respect thereto.

7. A machine according to claim 6 wherein the part of said outer die adapted to fold said blank has bottom and side walls corresponding to the walls of the formed box, a first pair of opposite side walls of said die part being of lesser height than the other pair of side walls thereby to cause adjacent side walls of the box to be formed successively.

8. A machine according to claim 7 wherein said first pair of opposite side walls include corner portions spaced apart a greater distance than the remainder of the walls, said corner portions being adapted to effect the partial folding of said tabs.

9. A machine according to claim 8 wherein said means to open and close said jaws includes a toggle linkage forming a part of the mechanism to move said outer die.

10. A machine for forming boxes from flat box blanks having thermoplastic surfaces, said machine comprising an inner die mounted for pivotal movement between a position adjacent a stack of blanks and a position spaced therefrom, a source of vacuum, at least one suction cup carried by said inner die and connected to said vacuum source, said suction cup being adapted to grip the last blank in the stack when the inner die is positioned adjacent thereto and to separate the blank from the stack when the die moves away therefrom, an outer die mounted for slidable movement between a position spaced from said inner die and a position in registry therewith, said outer die acting to form the blank into a box with tabs at the corners in the course of its movement into registry with said inner die, jaws carried by said outer die to press said tabs against the sides of the box, once said outer die is in registry with said inner die, said outer die being provided with apertures through which said jaws pass to engage said tabs, heating elements retained in the faces of said jaws to join by heat sealing said tabs and said sides of the box, stripper means mounted for movement into and out of engagement with the blank to remove it from said inner die after it has been formed, and a mechanism to move said stripper means, said inner die, and said outer die cyclically in a predetermined timed relation, said mechanism including means to close and open said jaws while said outer die is positioned in registry with said inner die.

11. A machine for forming boxes from flat box blanks having thermoplastic surfaces, said machine comprising an inner die mounted for pivotal movement between a position adjacent a stack of blanks and a position spaced therefrom, a source of vacuum, at least one suction cup

carried by said inner die and connected to said vacuum source, said suction cup being adapted to grip the last blank in the stack when the inner die is positioned adjacent thereto and to separate the blank from the stack when the die moves away therefrom, an outer die mounted for slidable movement between a position spaced from said inner die and a position in registry therewith, said outer die acting to form the blank into a box with tabs at the corners in the course of its movement into registry with said inner die, jaws carried by said outer die to press said tabs against the sides of the box, once said outer die is in registry with said inner die, said outer die being provided with apertures through which said jaws pass to engage said tabs, heating elements retained in the faces of said jaws to join by heat sealing said tabs and said sides of the box, a reciprocating plunger mounted for movement toward and away from said inner die in the opposite direction from the movement of said outer die, said inner die being provided with an aperture through which said plunger passes to engage the blank and to remove it from said inner die after it has been formed.

12. A machine for forbing boxes from flat box blanks having thermoplastic surfaces, said machine comprising an inner die mounted for pivotal movement between a position adjacent a stack of blanks and a position spaced therefrom, a source of vacuum, at least one suction cup carried by said inner die and connected to said vacuum source, said suction cup being adapted to grip the last blank in the stack when the inner die is positioned adjacent thereto and to separate the blank from the stack when the die moves away therefrom, an outer die mounted for slidable movement between a position spaced from said inner die and a position in registry therewith, said outer die acting to form the blank into a box with tabs at the corners in the course of its movement into registry with said inner die, jaws carried by said outer die to press said tabs against the sides of the box, once said outer die is in registry with said inner die, said outer die being provided with apertures through which said jaws pass to engage said tabs, heating elements retained in the faces of said jaws to join by heat sealing said tabs and said sides of the box, stripper means mounted for movement into and out of engagement with the blank to remove it from said inner die after it has been formed, a driven cam shaft, a series of camming elements mounted on said shaft, pivotally mounted follower elements in engagement with said camming elements, connecting linkages between said follower elements and said stripper means, said inner die, and said outer die, respectively, said linkage connected to said outer die including a toggle to open and close said jaws.

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