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Keck

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[54] **FOLDING DEVICE FOR BOX MAKING MACHINES**

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[52] **U.S. Cl.** ..... **93/51 R;** 53/374; 93/49 R

[51] **Int. Cl.²** **B31B 1/46**

[58] **Field of Search** ..... 93/51 R, 49 R, 47, 51 HW, 93/51 M; 53/374, 207

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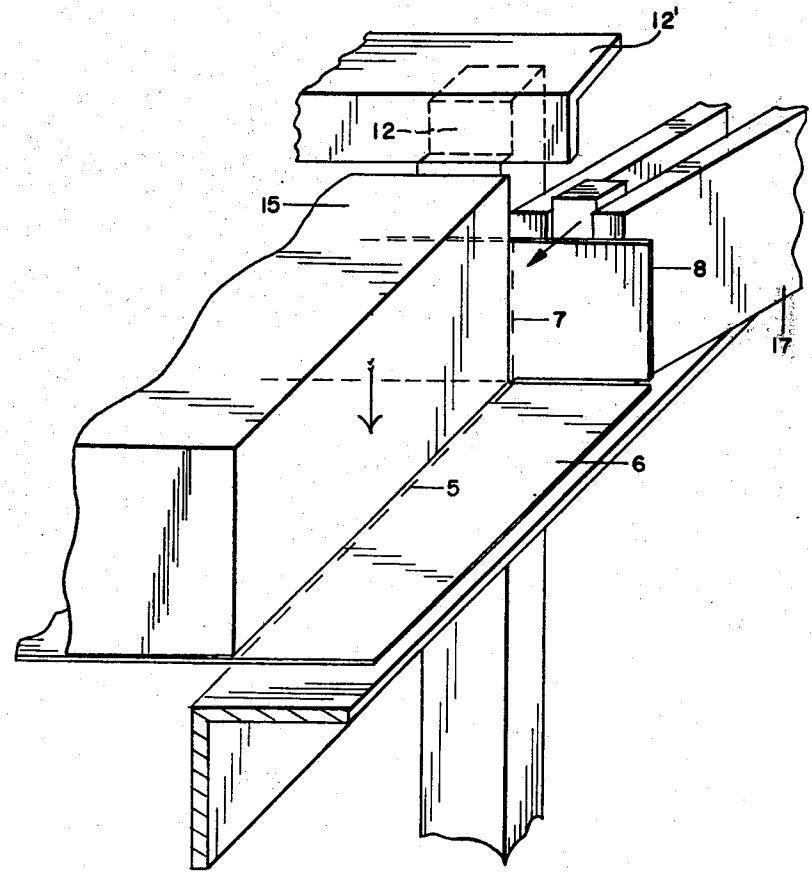
[57] **ABSTRACT**

A box folding device with four vertical guide columns, longitudinal and transverse folding rails, and four flap folding units whose folding plungers advance in an inclined direction so as to produce a motion component aimed against the end walls of the head block.

6 Claims, 7 Drawing Figures



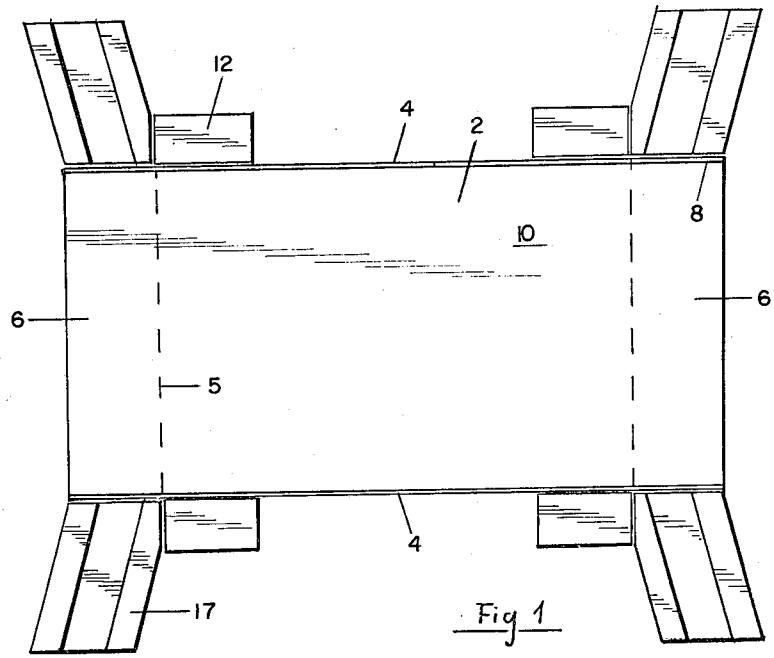


Fig 1

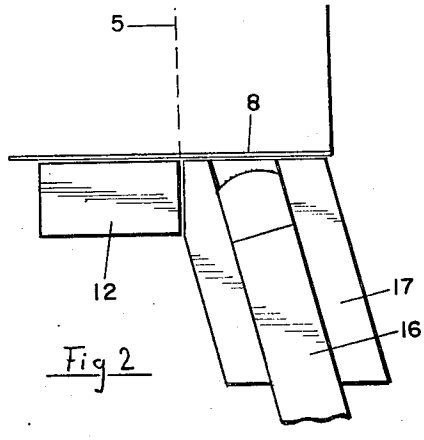


Fig 2

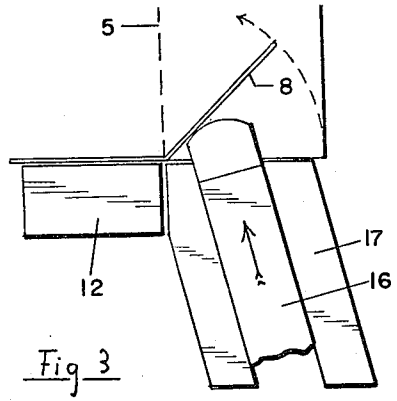


Fig 3

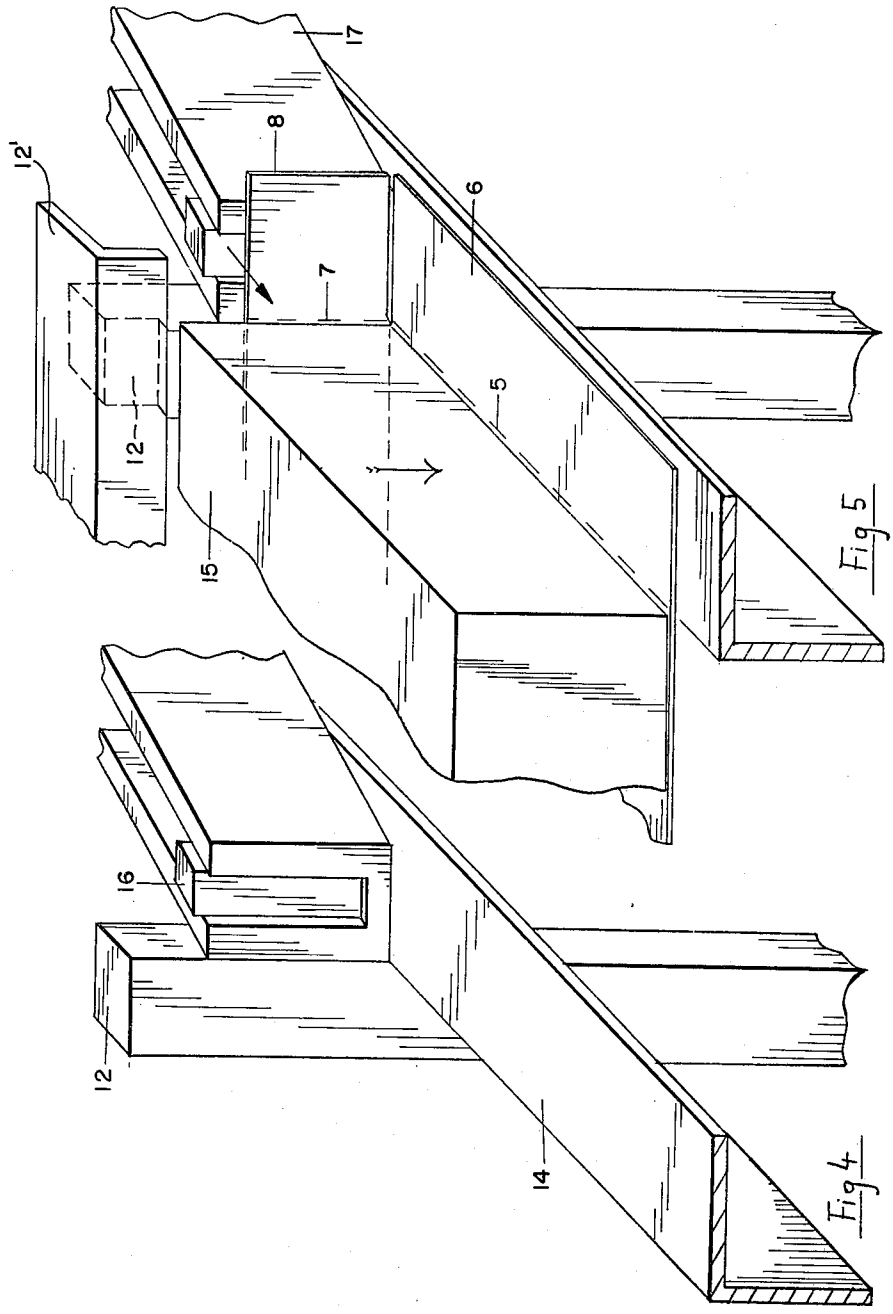


Fig 5

Fig 4

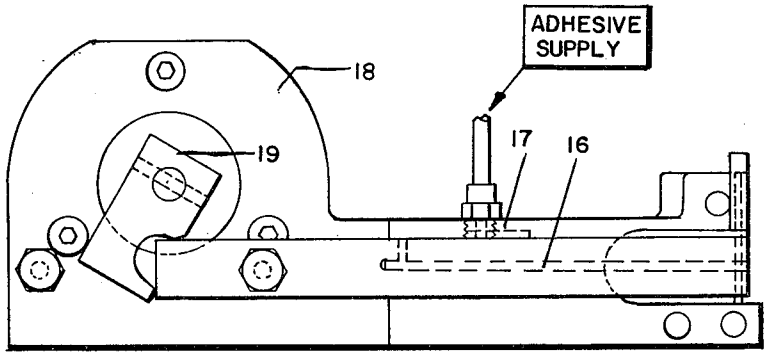


Fig 6

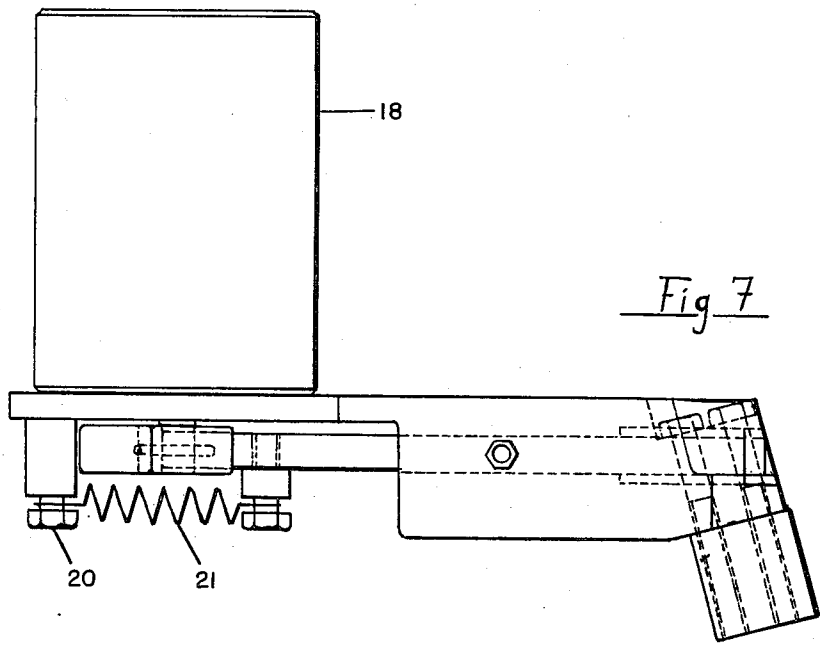


Fig 7

FOLDING DEVICE FOR BOX MAKING MACHINES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to box making machines, and in particular to devices for the folding of box blanks of cardboard or other materials such as acrylic, cellophane, etc., into boxes. For the sake of simplicity, the following disclosure concerns itself primarily with box blanks of cardboard.

2. Description of the Prior Art

The assembly of a box from a flat blank normally involves the erection of the two opposite side walls, after which the end flaps of these side walls are folded at right angles toward the inside, followed lastly by the erection of the end walls against the folded end flaps of the side walls. Various devices performing this procedure are known. Their shortcomings, however, include the disadvantage of a high incidence of distortions in the assembled boxes, when the end flaps are joined with the end walls of the box. This malfunction occurs particularly frequently in devices which are set for a very high speed of operation.

SUMMARY OF THE INVENTION

It is the primary objective of the present invention to suggest a folding device in which the aforementioned shortcomings are eliminated so that the joining of the end flaps and end walls can be performed reliably even at high operating speeds. Another objective concerns itself with a better adaptability to the processing of different-size blanks and formats.

These objectives are attained by the invention which suggests a folding device in which the folding means for the end flaps of the box engage the unfolded end flap at a distance from its vertical folding crease and fold it by moving in a direction which is inclined toward the plane of the side wall so as to produce a motion component against that plane.

In a preferred embodiment of the invention the step of folding the end flaps is performed during a short rest phase or slow-motion phase of the head block motion.

BRIEF DESCRIPTION OF THE DRAWINGS

Further special features and advantages of the invention will become apparent from the description following below, when taken together with the accompanying drawings which illustrate, by way of example, an embodiment of the invention, represented in the various features as follows:

FIG. 1 shows in a plan view a schematic arrangement of a folding device embodying the invention;

FIG. 2 shows an enlarged detail of the bottom right hand corner of FIG. 1, featuring an inclined folding plunger; FIG. 3 shows the detail of FIG. 2 with the folding plunger in a different position;

FIG. 4 shows in a perspective view a portion of the device of FIG. 1;

FIG. 5 shows the device of FIG. 4 during operation;

FIG. 6 shows in an elevational view one of the four folding plungers with its drive; and

FIG. 7 shows the unit of FIG. 6 in a plan view.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The schematic representation of FIG. 1 shows a folding device in an intermediate operating position, the

bottom wall 2 of the box blank 10 being confined laterally between four vertical guide columns 12 positioning the already erected side walls 4 of the intended cardboard box. At this point, the end flaps 8 extending from both ends of the side walls 4 are still in alignment therewith, and the end walls 6 extending longitudinally from the bottom wall 2 are likewise still in alignment with the plane of the bottom wall 2.

Longitudinally outside and laterally aligned with the four guide columns 12 are arranged four flap folding units with horizontal guides 17 and folding plungers 16 which are to bend the end flaps 8 around their folding creases 7 against the vertical end plane of the head block 15 which is shown, for example, in FIG. 5.

FIGS. 2 and 3 show typical details of one of the four end flap folding units, including the movement of the folding plunger 16. Details of the plunger itself and of its guide and drive means will be disclosed further below. As can be seen from FIGS. 1 to 3, the direction of advance of the folding plungers 16 in their guides 17 is not at right angles to the end flaps 8 before folding, but is inclined to form an acute angle of approximately 60° to 75°. This inclined motion path produces a motion component toward the vertical end plane of the head block 15. This makes it possible to avoid the previously necessary alignment of the near flank of the folding plunger with the bending line of the end flaps and to place the folding plungers 16 at a distance from the bending line. The contact face of the folding plunger 16 with the end flap 8 is preferably rounded in accordance with the shifting of the contact line therebetween.

The special advantages gained by the inclined arrangement of the folding plungers 16 reflect themselves in a smoother folding operation which permits high operating speeds without sacrificing operational reliability. The operation of this novel folding device will now be explained in more detail in connection with FIGS. 4 and 5.

The FIGS. 4 and 5 show details of the folding device, as they relate to the upper right hand corner of FIG. 1. FIG. 4 shows one of the four guide columns 12, arranged preferably in a vertical direction. Longitudinally outside the two right-hand guide columns 12 is arranged a horizontal folding rail 14. This folding rial 14 is preferably L-shaped, being for example an angle iron, with the vertical leg of the angle iron abutting against one side of the vertical guide column 12. The horizontal leg of the folding rail 14 thus extends longitudinally outwardly from the guide columns 12. Above this folding rail is arranged a plunger guide 17, preferably attached to the guide column 12 just above the horizontal face of folding rail 14 and supported by said rail.

For the adaptation to various formats and sizes of box blanks the folding device is preferably so arranged that the vertical guide columns 12 can be moved longitudinally in relation to one another by means of adjustment spindles displacing them along the side walls 4 of the blank. Other known adjustment means serve to obtain adjustment in the transverse direction between the respective pairs of guide columns 12 and the folding rails 12' for the box side walls.

As the vertical guide columns 12 are adjusted longitudinally, the earlier-mentioned folding rails 14 must undergo an identical adjustment. These rails may be either adjusted separately, or known transversely adjustable attachments may be provided between the rails and the adjacent faces of the guide columns 12. No ad-

justment is necessary for boxes of different height. Thus, only the head block **15** itself needs to be exchanged, when a different box size is to be produced, all other elements of the device being adaptable through the aforementioned adjustments.

In the course of the folding operation, the head block **15** is moved downwardly between the guide columns **12.** This motion first causes the side walls **4** of the box blank **10** to be erected, as they are engaged by longitudinal folding rails (not shown) which are arranged above the guide columns **12.** These erected side walls **4** then are maintained in their vertical position by the guide columns **12** which are accordingly spaced from the head block **15.** Note that for an easier understanding of the illustration of FIGS. **4** and **5** the front side wall of the box blank and its end flap are cut away.

As soon as the still horizontal end wall **6** passes below the bottom corner of the folding plunger **16,** and before the bottom wall **2** moves below the top surface of the transverse folding rails **14,** the downward motion of the head block **15** is stopped or slowed down to permit the inward folding of the end flaps **8.** The latter is accomplished by a very rapid advancing motion of the folding plunger **16** which is actuated by a rotary solenoid as shown in FIGS. **6** and **7.** A short energization of the solenoid **18** causes its crank **19** to rotate against the folding plunger **16,** thereby advancing it against the end flap **8,** as shown in FIG. **3.**

At this point, the downward motion of the head block **15** is again accelerated so that the end walls **6,** bearing against the stationary folding rails **14,** are bent upwardly against the folded end flaps **8.** During the initial part of this last folding step, the folding plungers **16** remain extended for a short moment, causing the end flaps to slide downwardly a short distance against the contact faces of the plungers. The latter are then quickly retracted, in order to avoid interference between these plungers and the upwardly pivoting end walls **6.** Retraction of the folding plunger **16** is acccomplished by means of a return spring **21** (FIG. **7**).

Further downward motion of the head block **15** causes the folded walls **6** to be firmly pressed against the previously folded end flaps **8,** as they move along the respective vertical legs of the transverse folding rails **14.** The necessary adhesive to provide a permanent connection between the end flaps **8** and end walls **6** may be applied in a known manner prior to the introduction of the box blank into the folding device.

In a preferred embodiment of the invention the vertical legs of the folding rails **14** are arranged at a slight incline so as to form a downwardly tapered guide against the erected end walls **6,** thereby "ironing" the box. The folded, assembled box can now be ejected downwardly from the folding station through an additional downward motion of the head block **15.**

As mentioned earlier, a typical flap folding unit with its guide and drive means, is illustrated in FIGS. **6** and **7.** The folding plunger **16** is longitudinally guided inside a plunger guide **17,** the forward portion of which is open in the manner of a U-shaped guide shown in FIG. **4.** The actuation of the folding plunger **16** is obtained by means of a rotary solenoid **18** engaging the rear end of plunger **16** over a crank **19,** thereby assuring a very rapid advancing motion. A similarly rapid return motion is obtained by means of a spring **21** which extends between a stationary pin **20** and a similar pin attached to the plunger **16.** The housing of the rotary solenoid **18** may be directly attached to the plunger guide **17** to provide a convenient assembly unit.

The use of a straight-line guide for the folding plungers and of a rotary solenoid for their drive should not be viewed as a limitation of the invention, but as a preferred exemplary embodiment. Thus, it is not a prerequisite that the folding plungers advance along a straight line motion and that their drive means have to be of the electromagnetic type.

In cases where it is desired to produce boxes of materials other than cardboard, using for example blanks of acrylic, cellophane, and the like, it may be necessary to apply the adhesive or solvent immediately prior to the establishment of contact between the end flaps and the end wall. This is the case, for example, when acetone is used. Such conditions can be conveniently accomodated by using the folding plungers **16** for the application of the glue or solvent, the plungers being provided with appropriate channels and nozzles connected to a pressurized supply of adhesive or solvent (see FIG. **6**). The forward motion of the folding plungers may then be used to control the timing of solvent application.

I claim:

1. A device for the folding of box blanks into boxes which have a bottom wall, two longitudinal side walls with end flaps extending therefrom, and two end walls, the device comprising:

a vertically descending rectangular head block having a horizontal bottom and vertical sides corresponding to the inside dimensions of a finished box;

stationary rail means for erecting the two side walls of a blank against the descending head block;

two pairs of stationary lateral guide columns, each pair guiding one erected side wall against the head block near the vertical edges of the latter;

two stationary transverse horizontal folding rails extending between the guide columns longitudinally outside thereof, their near edges being spaced from the path of the corresponding vertical end faces of the head block to cooperate therewith so as to erect the end walls of the box blank against the head block;

four flap folding units arranged laterally outside the erected box side walls and facing the four erected end flaps of the box blank, each flap folding unit including a folding plunger advancing against an erected end flap in a generally horizontal reciprocating motion along a path directed obliquely against the end flap so as to have a motion component which is directed against the end face of the head block.

2. A device as defined in claim **1,** wherein:

each flap folding unit includes a straight-line guide for the folding plunger and a solenoid-operated drive means with a return spring for advancing and retracting the folding plunger.

3. A device as defined in claim **2,** wherein:

the orientation of the plunger guide is such that the angle included between a vertical plane through the plunger path and the erected, unfolded end flap of the box is between 60° and 75°.

4. A device as defined in claim **1,** wherein:

the transverse folding rails are L-shaped in profile with a generally vertical leg abutting against the vertical guide columns and a horizontally extend-

ing leg extending longitudinally away from said columns.

5. A device as defined in claim **4,** wherein:

the lowest part of each folding plunger in that portion which moves over the unfolded end wall is vertically spaced from the horizontal leg of the transverse folding rail to allow for a certain descending motion of the head block and a corresponding partial folding of the end wall during the extension and retraction of the folding plungers against the end flaps.

6. A device as defined in claim **1,** wherein:

each folding plunger includes means for applying a bonding agent to the respective end flap, after the flap is folded against the head block.

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