United States Patent

Baum

[15] **3,656,416**

[45] **Apr. 18, 1972**

[54] BOX BLANK FOLDER

[72] Inventor: **Theodore Baum,** Mount Laurel, N.J.

[73] Assignee: **Harris-Intertype Corporation,** Cleveland, Ohio

[22] Filed: **Oct. 5, 1970**

[21] Appl. No.: **77,788**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 745,889, July 18, 1968, Pat. No. 3,572,221.

[52] **U.S. Cl.** **93/52**

[51] **Int. Cl.** **B31b 1/36**

[58] **Field of Search** 93/52

[56] **References Cited**

UNITED STATES PATENTS

2,931,277	4/1960	La Bombard	93/52
3,270,628	9/1966	Clem	93/52
3,371,585	3/1968	Moser et al.	93/52

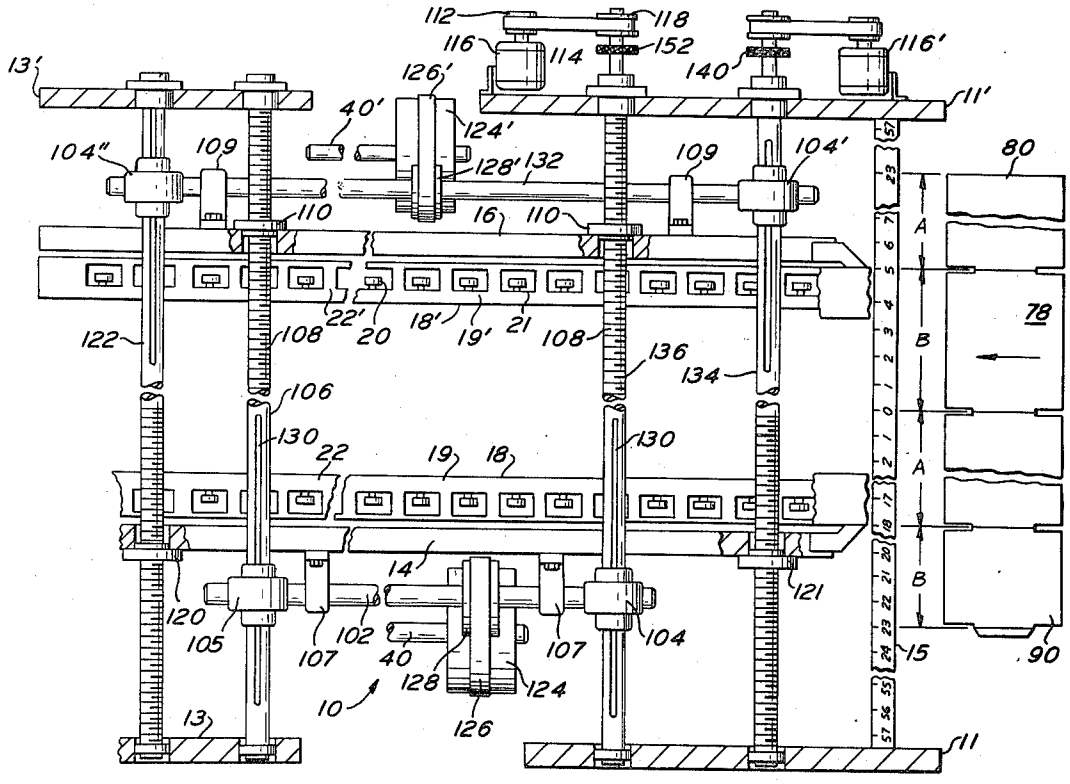
Primary Examiner—Bernard Stickney

Attorney—Seidel, Gonad & Goldhammer

[57] **ABSTRACT**

A machine is disclosed for folding box blanks along a fold line and interconnecting the end panels of the box blank by gluing or taping. Means are provided to permit simultaneous adjustment of longitudinally extending box blank contact members, said plates, and conveyor supports for the box blanks so that optimum position for folding of the blank may be achieved.

9 Claims, 17 Drawing Figures



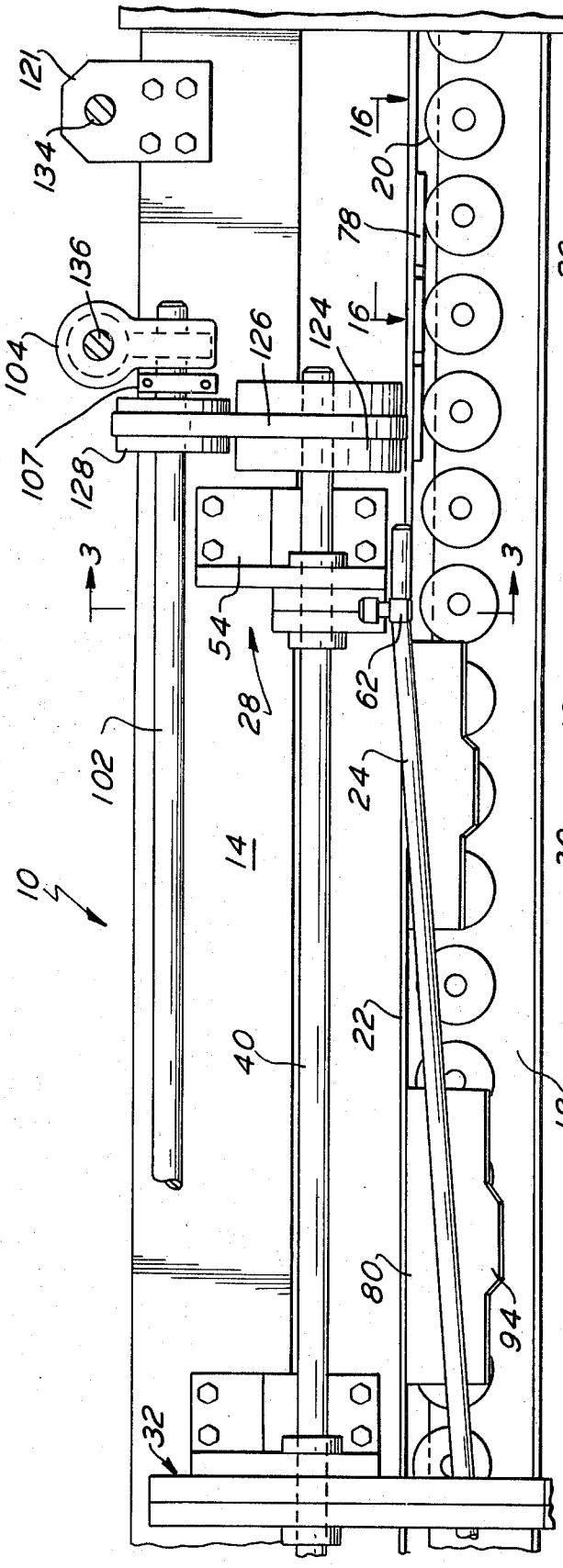


FIG. 1A

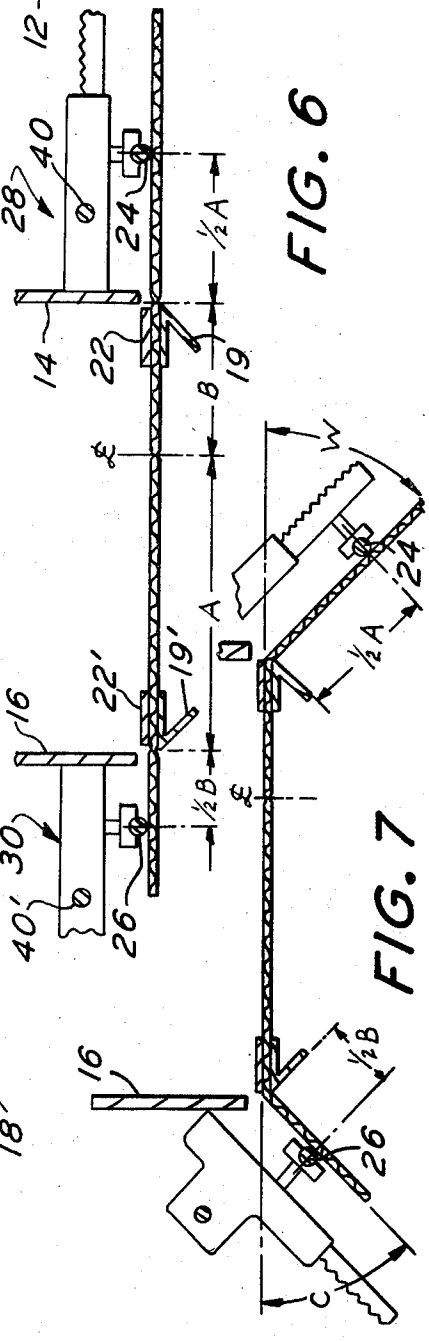


FIG. 6

FIG. 7

INVENTOR
THEODORE BAUM
BY
Seidel, Gonda, & Goldhammer
ATTORNEYS

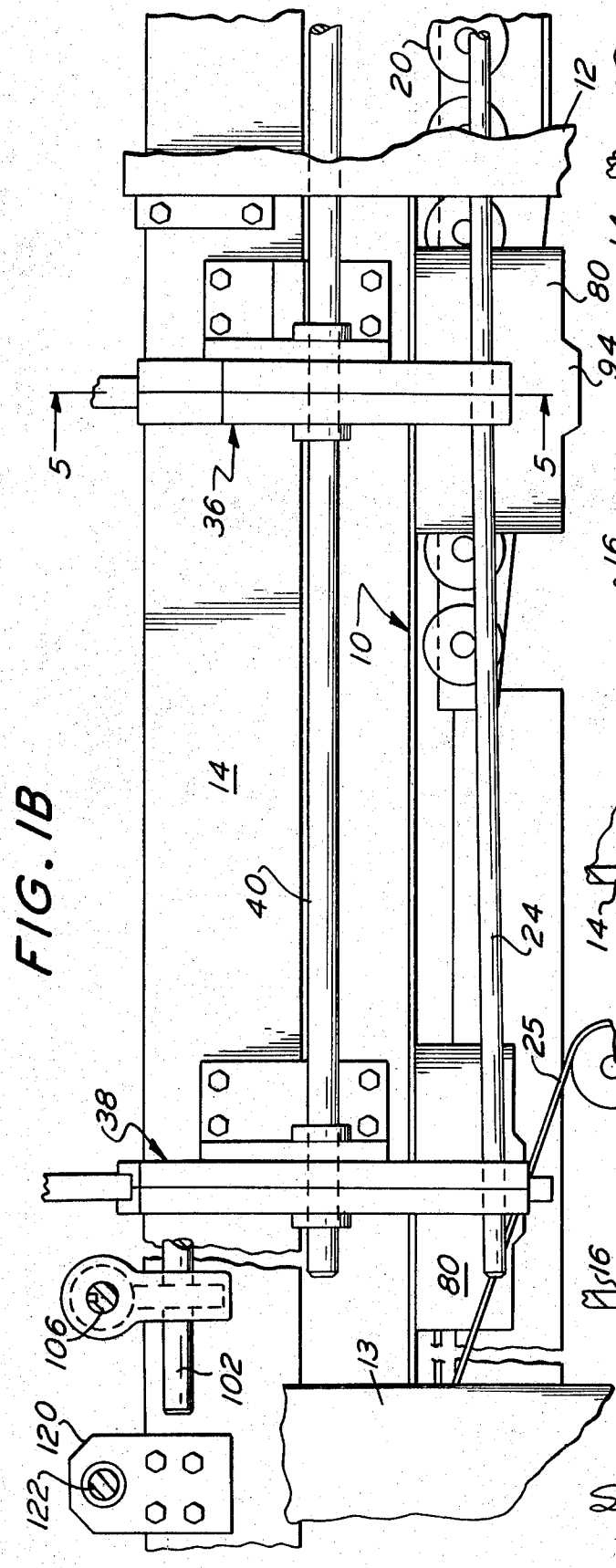


FIG. 1B

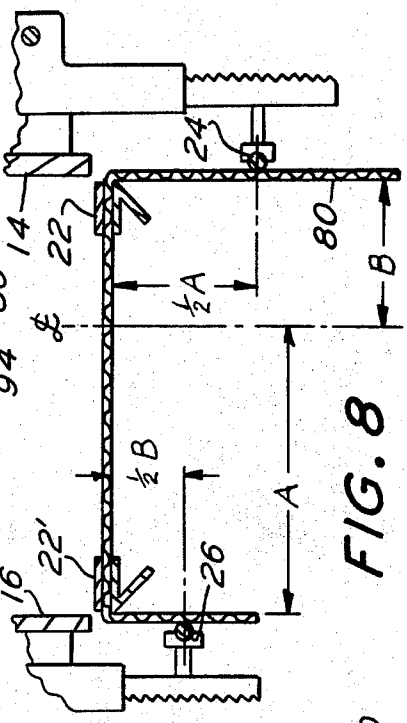


FIG. 8

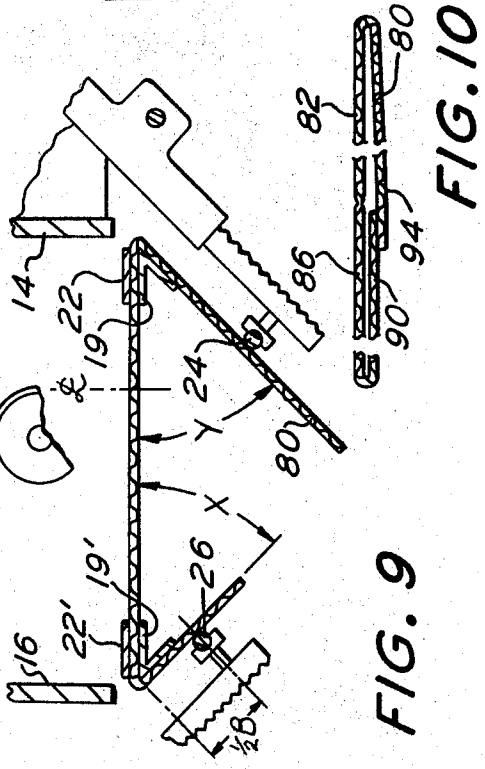


FIG. 10

FIG. 9

INVENTOR
THEODORE BAUM
BY
Seidel, Gonda & Goldhammer
ATTORNEYS

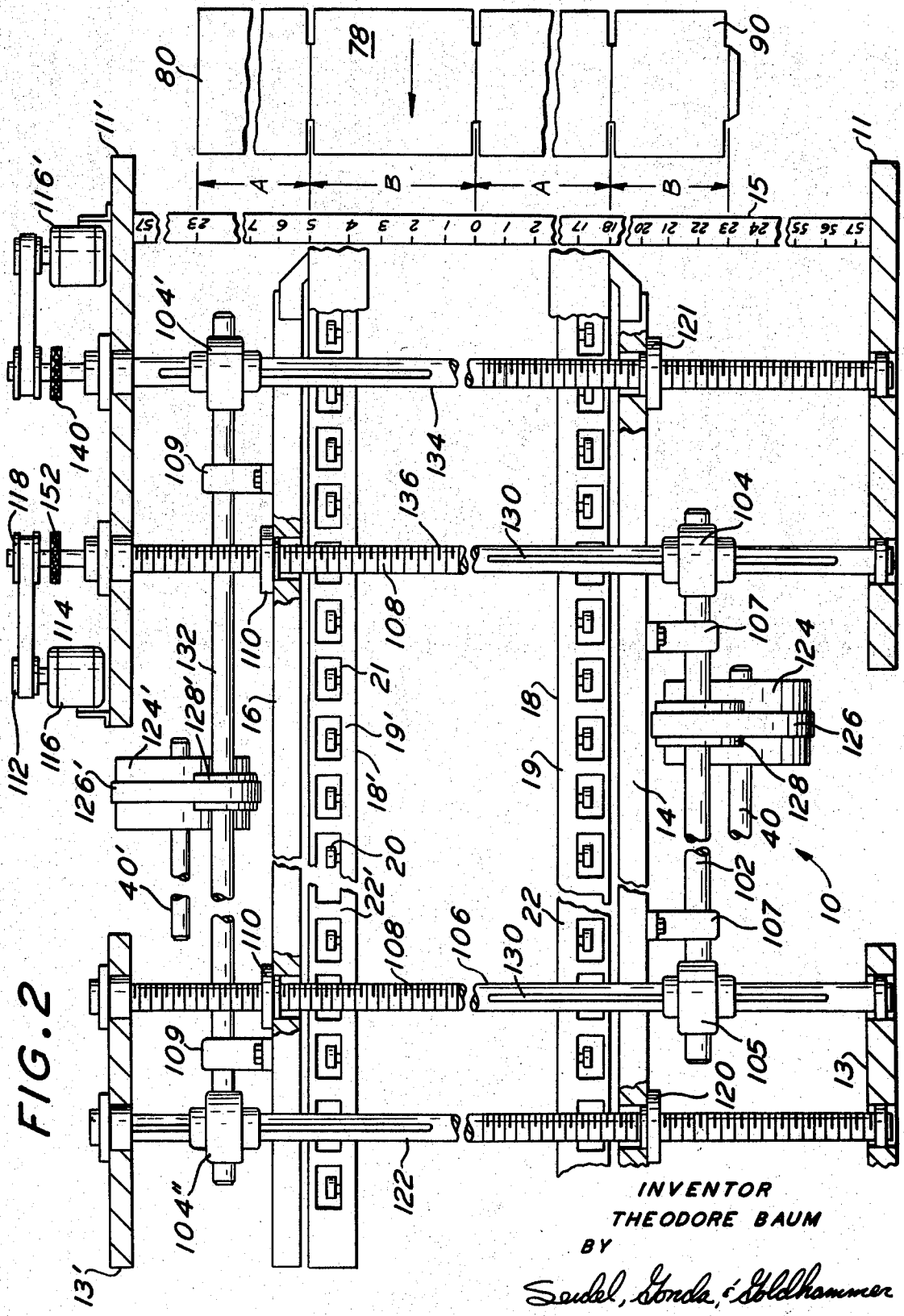


FIG. 2

INVENTOR
THEODORE BAUM
BY
Seidel, Gonda, & Goldhammer
ATTORNEYS

FIG. 3

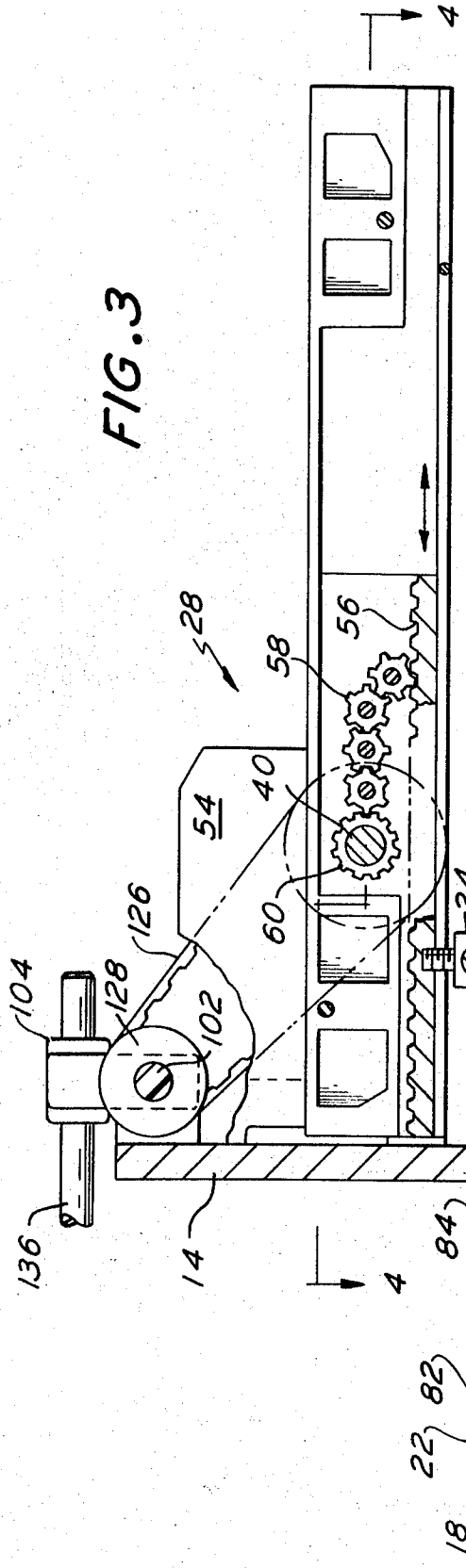
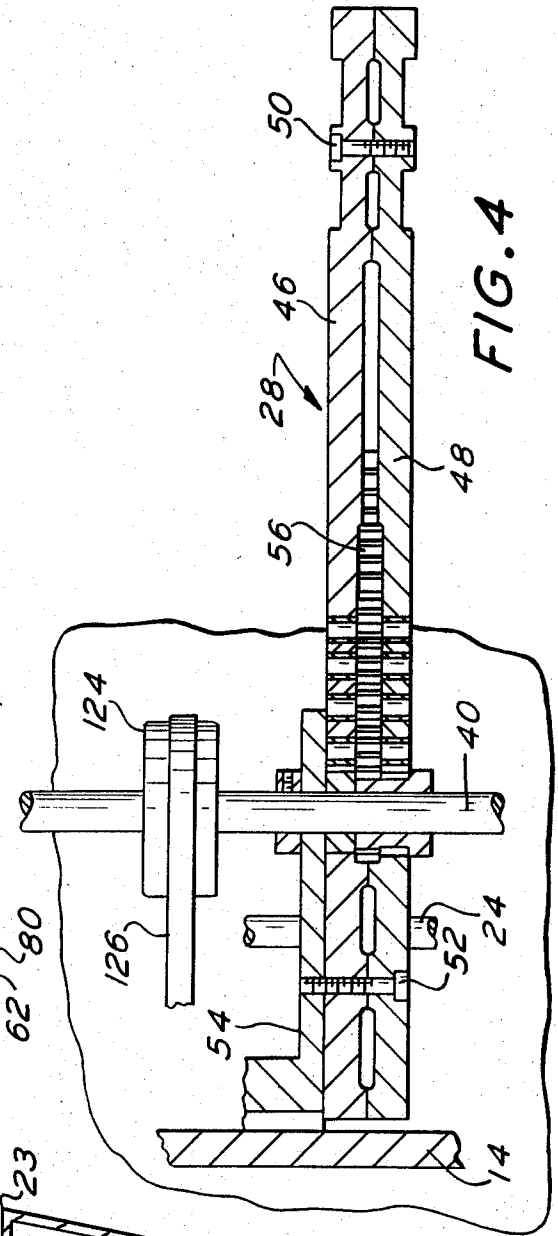


FIG. 4



INVENTOR
THEODORE BAUM
BY
Seidel, Gonda & Goldhammer
ATTORNEYS

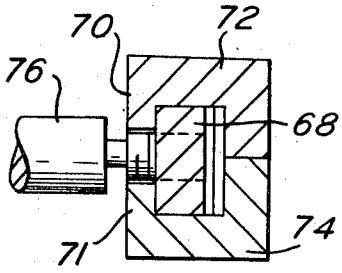
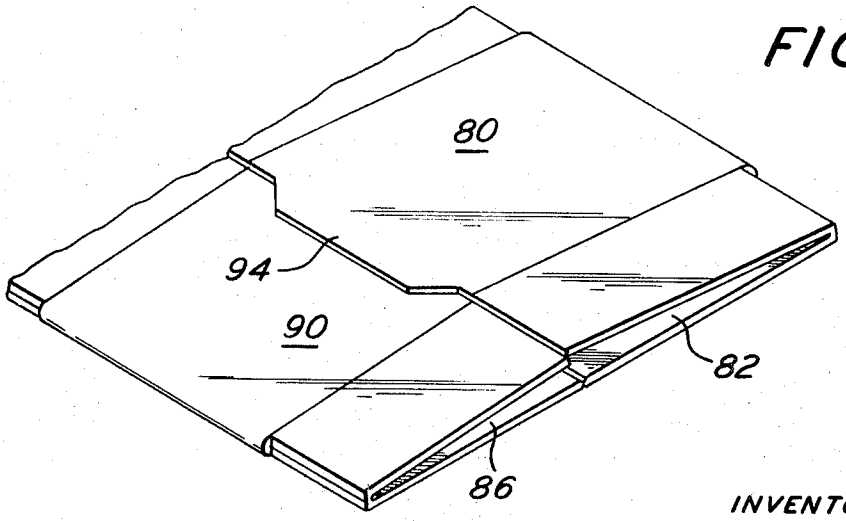


FIG. 11

FIG. 5

FIG. 14



INVENTOR
THEODORE BAUM
BY
Seidel, Gonda & Goldhammer
ATTORNEYS

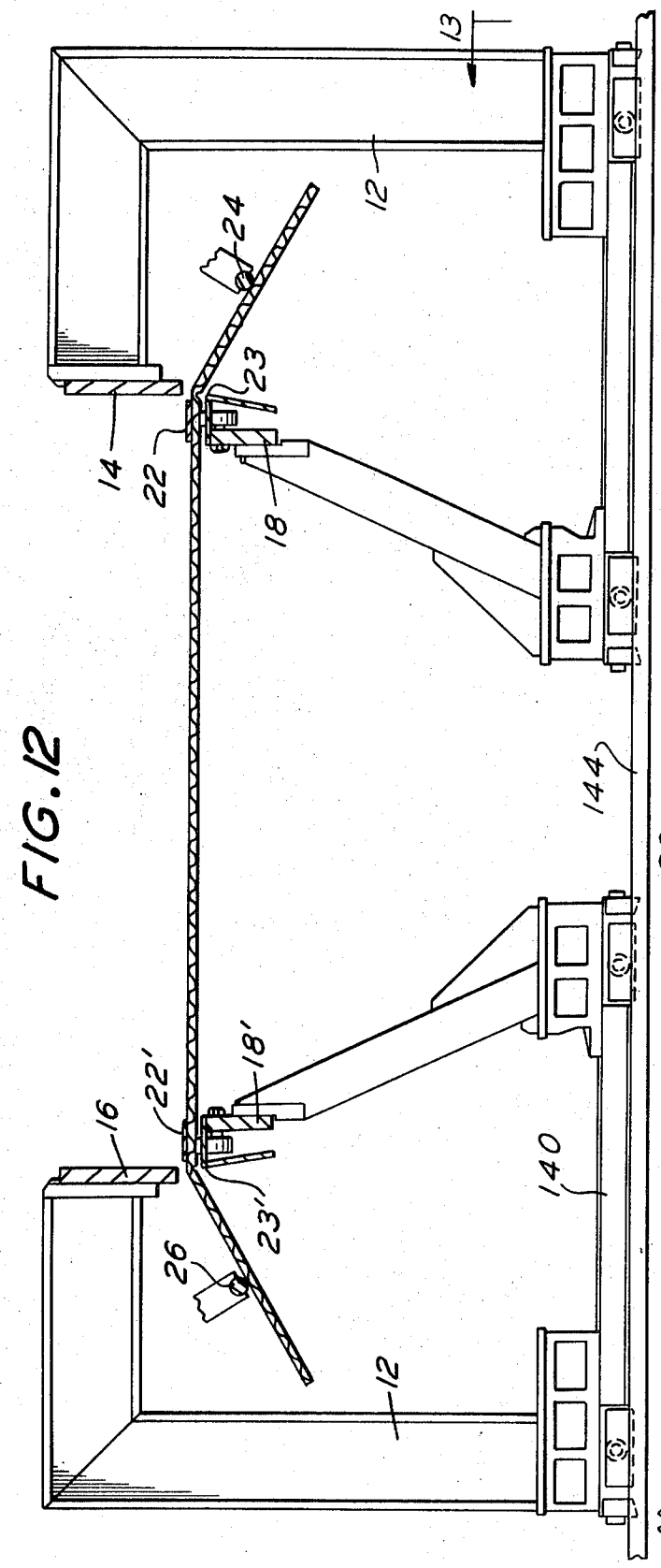


FIG. 12

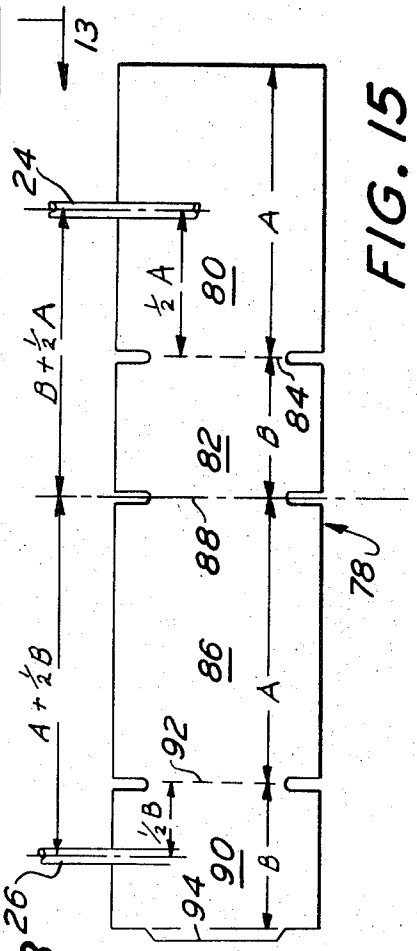


FIG. 15

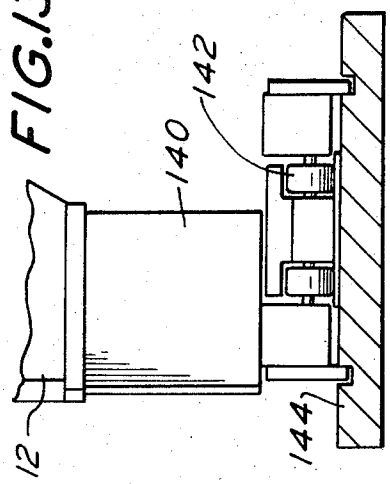


FIG. 13

INVENTOR
THEODORE BAUM
BY
Seidel, Gonda & Goldhammer
ATTORNEYS

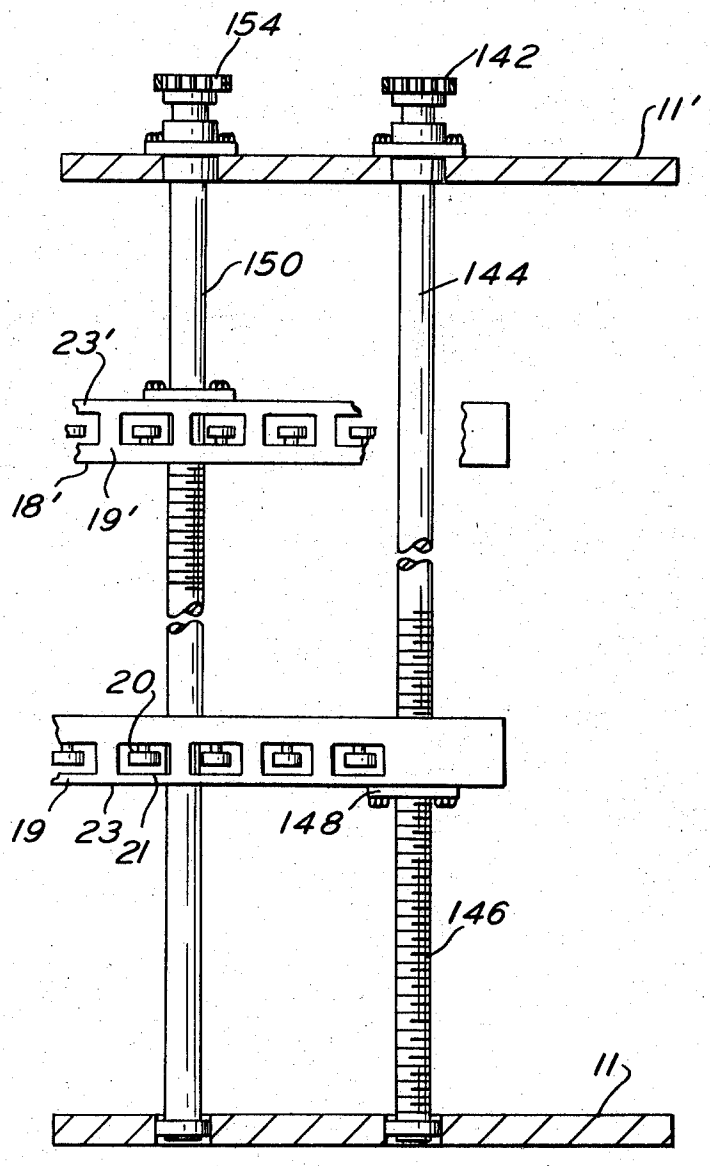


FIG. 16

INVENTOR
THEODORE BAUM
BY
Seidel, Gonda & Goldhammer
ATTORNEYS

BOX BLANK FOLDER

This application is a continuation-in-part of my copending application Ser. No. 745,889 filed July 18, 1968 and entitled Box Blank Folder, now U.S. Pat. No. 3,572,221, issued Mar. 23, 1971.

The present invention relates to a machine for folding paperboard box blanks. Paperboard box blanks are normally fed through a slotter-scorer machine which slots the box blank and scores the same so as to define parallel fold lines. Thereafter, the blank is fed to a contiguous folder-gluer machine which folds end panels out of the plane of the remainder of the box blank and joins the end panels generally by gluing or taping. The folding of the end panels may be upwardly or downwardly with respect to a horizontal plane containing the remainder of the box blank.

In accordance with the present invention, the end panels of the box blank are folded by means of contact members disposed so that one such member is on each side of the machine generally parallel to the path of movement of the box blanks. The contact members are preferably made from a flexible material having a low friction coefficient so that they may be bent by positioning mechanisms at spaced points therealong whereby the contact members will engage the blank at a preselected distance from the fold line. Preferably each contact member contacts a panel along the median of the panel. Due to different end panel width, the corresponding contact members will generally not be equidistant from the centerline of the blank.

The positioning mechanisms deform the contact members so as to assume a simulated helical configuration. Each positioning mechanism will position the contact member at a location therealong so as to interruptedly and progressively fold the end panels. Means are provided for simultaneously adjusting each positioning means and the conveying means when it is desired to change the fold or to commence with a new run of different sized box blanks.

The progressive structural interrelationship of the folder positioning means is such that any tendency to distort the box blank is avoided. Quality is improved in that there is minimal possibility of an end panel being skewed with respect to the next adjacent panel and because of the low friction characteristics of the contact members.

It is an object of the present invention to provide a paperboard box blank folder which permits adjustment of the folding members and the conveyor means for the box blanks simultaneously and in a manner which is simple and reliable.

It is another object of the present invention to provide a paperboard box blank folder wherein spaced portions of a panel contact member are simultaneously positioned so that they automatically assume their optimum folding positions.

It is another object of the present invention to provide a paperboard box blank folder which may be rapidly and easily adjusted.

Other objects will appear hereinafter.

For the purpose of illustrating the invention, there is shown in the drawings a form which is presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1A is a side elevation view of the leading end portion of the folder and

FIG. 1B is a side elevation view of the trailing end of the folder.

FIG. 2 is a partial top plan view of the structure shown in FIGS. 1A and 1B.

FIG. 3 is a sectional view taken along the line 3—3 in FIG. 1A.

FIG. 4 is a sectional view taken along the line 4—4 in FIG. 3.

FIG. 5 is a sectional view taken along the line 5—5 in FIG. 1B.

FIG. 6 is a diagrammatic view illustrating the structure existing in cross section in the location of the positioning means shown in FIG. 3.

FIG. 7 is a view similar to FIG. 6 but showing the structure as it exists adjacent the positioner at the lefthand end of FIG. 1A.

FIG. 8 is a view similar to FIG. 5 but showing the structure as it exists at the righthand end of FIG. 1B.

FIG. 9 is a view similar to FIG. 6, but showing the structure as it appears adjacent the lefthand end of FIG. 1B.

FIG. 10 is a sectional view of a folded glued box blank.

FIG. 11 is a sectional view taken along the line 11—11 in FIG. 5.

FIG. 12 is a transverse sectional view taken across FIG. 1B with various positions of the structure eliminated for purposes of clarity of the disclosure.

FIG. 13 is a sectional view taken along the line 13—13 in FIG. 12.

FIG. 14 is a perspective view of the folded box blank in FIG. 10.

FIG. 15 is a top plan view of a box blank and the cooperating contact members as seen in FIG. 6.

FIG. 16 is a sectional view of part of the lower portion of the structure as seen in FIG. 1A along the line 16—16.

Referring to the drawing in detail, a folder in accordance with the present invention is shown in FIGS. 1A and 1B designated generally as 10. The folder 10 includes two entrance frames 11 and 11' supporting a set-up scale 15, and exit frames 13 and 13'. There is also a transverse frame 12. The frame 12 includes longitudinally extending side plates 14 and 16. Below the plane of the plates 14 and 16, the folder includes additional longitudinally extending rails 18 and 18'. The rails 18 and 18' support rollers 20 at spaced points therealong in a cantilever manner and extending in opposite directions from the rails 18 and 18'. See FIGS. 2 and 12. The rollers 20 partially extend through openings 21 in the horizontal portion of angled folding supports 19 and 19'.

The rollers 20 support the box blank during at least a portion of its travel through the folder of the present invention. The lower run of a pair of belts 22 and 22' is illustrated for contacting the upper surface of the box blanks and causing them to move through the folder 10. Each belt is associated with and supported by one of the side plates 14 and 16.

A contact member 24 extends along one side of the machine 10. A similar contact member 26 extends along the opposite side of the machine. The members 24 and 26 extend generally in the direction of travel of the box blank being processed. The contact members are preferably flexible rods three-fourths inch in diameter, made from a plastic material with a low coefficient of friction such as nylon having a modulus of elasticity from about 250,000 to 400,000 psi so that they may be bent into a helical configuration. Other flexible materials such as chrome-plated, thin wall steel tubing could be used as the contact member as desired.

A plurality of positioning means is coupled to each of the contact members 24 and 26 at spaced points therealong. Each of the positioning means is identical except as may be pointed out hereinafter. At a location where the box blanks are flat and lie in a horizontal plane, a positioning means 28 is coupled to contact member 24. At the same general area, a positioning means 30 is coupled to the contact member 26. See FIG. 1A and FIG. 6. The positioning means 28 and 30 are identical. Hence, only means 28 will be described in detail.

Referring to FIGS. 3 and 4, it will be seen that the positioning means 28 includes housing portions 46 and 48 coupled together by bolts 50 and 52. Bolt 52 secures the housing portions to bracket 54. Bracket 54 is connected to the side plate 14. Accordingly, positioning means 28 will move as a unit with the side plate 14 when the latter is moved toward and away from side plate 16.

The positioning means 28 is horizontally disposed as shown in FIG. 3. A positioning means 32 is secured to contact member 24 and is disposed at an angle approximately 45° with respect to a horizontal plane. See FIG. 7. A similar positioning means 34 is connected to the contact member 26. Another positioning means designated generally as 36 is connected to

the contact member 24 and is disposed vertically as shown more clearly in FIG. 5. A positioning means similar to means 36 is connected to the contact member 26 on the opposite side of the machine.

A positioning means 38 is connected to the contact member 24 and is inclined at an angle of approximately 135° from the horizontal plane. A similar positioning means is connected to the contact member 26. The various positioning means coupled to contact member 24 are connected to a means for operating them simultaneously, namely shaft 40. A similar shaft 40' is provided for operating the positioning means connected to the contact member 26. A greater or lesser number of positioning means may be provided if desired so as to effect a complete folding of the box blank. If desired, a supplementary folding belt 25 may be provided, see FIG. 1B.

Referring to FIG. 3, shaft 40 is coupled to a pinion 60 which is in meshing engagement with gears 58. Gears 58 are meshed with a rack 56. Rack 56 is supported by inwardly extending flanges on the housing portions 46 and 48. A jaw 62 embraces the contact member 24, extends through a slot in the housing, and is threadedly coupled to the rack 56 for movement therewith.

Positioning means 32, 36 and 38 are all identical except for their angular disposition. Positioning means 32 is angularly disposed so that the box blank will have been folded downwardly through an angle of approximately 45° at the location thereof. Positioning means 36 is located so that the box blank will have been folded through a total angle of 90° at the location thereof as shown in FIG. 5. Positioning means 38 is located so that the box blank will have been folded downwardly through an angle of approximately 135° at the location thereof. See FIG. 9.

Referring to FIG. 5, the positioning means 36 includes a housing supported from the side plate 14 by a bracket 64. The housing includes housing portions 72 and 74. See FIG. 11. The rack designated as 68 is supported by the inwardly extending flanges 70 and 71 and is in meshing engagement with pinion 66 on shaft 40. A jaw 76 has one end embracing the contact member 24, and its other end is threadedly coupled to rack 68. The flanges 70 and 71 are spaced apart from one another so as to define a channel within which the reduced diameter portion of the jaw 76 may reciprocate. Only one of the above-mentioned jaws is fixed to member 24. All other jaws permit member 24 to slide in an axial direction. In view of the above description of positioning means 28 and 36, a more detailed description of the remaining positioning means is not deemed necessary since they are identical to means 36 except for their angular disposition.

Referring to FIGS. 6 and 15, there is illustrated a flat box blank 78 which has been scored and slotted so as to have panels 80 and 82 connected together by a fold line 84. Panel 82 is connected to a panel 86 by fold line 88. Panel 86 is connected to panel 90 by a fold line 92. For purposes of illustration, the panels 80 and 90 will be interconnected by a glue tab designated as 94. See FIG. 14.

As shown in FIG. 2, motors 116 and 116' are mounted on fixed entrance frame 11'. Motors 116 and 116' are preferably reversible gear motors for rotating the shafts 134 and 136, respectively, through a number of revolutions so as to actuate the various positioning means to the optimum position to effect folding. In the optimum folding position, members 24 and 26 contact a panel of the box blank 78 at a median location.

The shaft 136 is supported by bearings in frame 11 and 11'. Motor 116 drives shaft 136 by belt 114 through conventional sheaves 112 and 118. Shaft 136 extends transversely across the folder 10 and is slidably engaged in right angle gear coupling 104 so as to drive shaft 102. See FIG. 2. Shaft 102 drives shaft 106 through right angle coupling 105. Couplings 104 and 105 may be a helical gear coupling such as TOL-O-MATIC.

Shafts 106 and 136 are provided with individual keys 130 which slidably engage a helical gear, not shown, in the right angle gear couplings 105 and 104. The opposite ends of shafts 106 and 136 are provided with threads 108 screwed into nuts 110. Nuts 110 are each fastened to the side plate 16.

Shaft 102 is supported by pillow blocks 107 which are rigidly fastened to side plate 14. In a like manner shaft 132 is supported by pillow blocks 109 rigidly fastened to side plate 16.

Coupled to shaft 102 is timing belt sprocket 128. Rotation of shaft 102 causes rotation of shaft 40 through timing belt sprocket 128, timing belt 126 and planetary gear reducer 124, such as ROTOMISSION speed reducer. The speed ratio of reducer 124 being such that when side plate 16 moves to the proper folding position, contact member 24 moves to the midline of panel 90.

Rotation of shafts 106 and 136 by motor 116 causes nuts 110 and side plate 16 to move laterally toward or away from side plate 14. Contact member 26 and the belt 22' will move horizontally as a unit with the side plate 16.

The rail 18' and the rollers 20 supported thereby will move horizontally with side plate 16 because of the interconnection of frame 12, see FIG. 12, and screw and nut as shown in FIG. 16. The plate 16 and the rail 18' are supported by the frame 12 on a carriage 140. Carriage 140 is mounted on wheels 142 which ride in tracks on a base 144. See FIG. 13.

In a like manner, motor 116' causes rotation of shaft 134 and shaft 122 whereby plate 14 moves laterally toward or away from side plate 16. Shaft 134 is coupled to shaft 132 by right angle coupling 104'. Shaft 132 is coupled to shaft 122 by right angle coupling 104''. Rotation of shaft 132 drives shaft 40' through sprocket 128', timing belt 126' and planetary reducer 124'. In order for rotation of shafts 122 and 134 to cause horizontal movement of side plate 14, these shafts are threaded to plates 120 and 121 fixed to plate 14.

A chain sprocket 140 is coupled to shaft 134, see FIG. 2. An endless drive chain, not shown, links chain sprocket 140 with sprocket 142 therebelow. Chain sprocket 142 is coupled to shaft 144, see FIG. 16, which extends across folder 10 and is supported by bearings in the entrace frames 11 and 11'. One end of shaft 144 is provided with threads 146 screwed into nut 148. Nut 148 is rigidly secured to rail 18.

Rotation of shaft 134 by motor 116' causes rail 18 to move laterally and simultaneously with side plate 14 and contact member 26. In a like manner, rotation of shaft 136 causes shaft 150 to rotate, translating rail 18' either toward or away from rail 18. Thus, sprocket 152 on shaft 136 is connected to sprocket 154 on shaft 150 by a chain, not shown.

Transversely extending shafts 122 and 134 are driven by motor 116' in the same manner that shafts 106 and 136 are driven by motor 116. Rotation of shaft 134 will cause rotation of lateral shaft 132 through right angle gear coupling 104'. Shaft 132 is also fitted in right angle coupling 104'', thereby driving shaft 122. Shaft 122 is provided with a threaded portion coupled to a nut 110. The nut 110 is fixedly secured in any convenient manner to the side plate 14. As shown more clearly in FIG. 12, the side plate 14 is interconnected with the rail 18 by way of the frame 12' mounted on a carriage reciprocable toward and away from the carriage 140.

The positioning means are preferably located so that the contact members 24 and 26 contact their respective end panels in the middle thereof. As shown more clearly in FIG. 15, a typical box blank 78 has a relationship wherein end panel 80 is substantially wider than end panel 90. In a typical box blank, the panels 80 and 86 are substantially of the same width and panels 82 and 90 are also substantially the same width. Thus, it will be apparent that the contact members 24 and 26 are not at the same distance from the centerline of the box blank 78.

When the side plate 16 moves towards the side plate 14, the shaft 40 will be rotated so as to cause the respective positioning members to move the adjacent portion of contact member 24 toward fold line 84 one-half the distance traversed by the side plate 16. Panel 80 is twice as wide as the panel 90. When the relationship between the size of these panels changes, then the proportional relationship of movement of the side plates and contact members will not change.

Thus, the motor **116** will operate to rotate shafts **106**, **102** and **136** to thereby locate the positioning means **28**, **32**, **36** and **38** to a predetermined location wherein contact member **24** will always contact the center of panel **80**. In a like manner, motor **116'** will rotate shafts **122**, **132** and **134** to locate the positioning means **30**, **34**, etc., to a predetermined location wherein contact member **26** will contact the center of panel **90**. Simultaneously, the side plates **14** and **16** as well as their respective conveying means (one set of the elements **18**, **19**, **20** and **22**) will be moved laterally repositioning the conveyor means. Each of the folding supports **19** and **19'** on the rails **18**, **18'** has an upper surface which is slightly below the upper surface of the rollers **20** and a folding edge **23** and **23'**, respectively, opposite one of the fold lines **84** and **92** on the box blank **78**. See FIGS. **3**, **6–9** and **12**.

Adjustment of the positioning means can be effected by synchronized operation of motors **116** and **116'**. Since the line of contact between member **24** and its distance from the fold line **84** is uniform, and the similar distance of line contact between member **26** and the fold line **92** is uniform, improved quality of folding is attained while avoiding distortion, whereby panel **80** would be skewed with respect to panel **90**. If desired, the contact members **24** and **26** may be hollow and provided with perforations along their lengths whereby pressurized air issuing through the perforations would provide a film of air between the box blank and the contact members so as to reduce friction.

Operation of the motors **116** and **116'** will selectively provide for movement of the side frames **14** and **16** toward and away from one another with simultaneous movement of the adjacent contact member together with its positioning means and the conveying means associated therewith as well as proportional movement of the contact member on the opposite side of the machine. Such motorized control greatly enhances the speed with which the folder **10** may be set up for the next job wherein the box blanks may be different from a run of box blanks previously completed.

From the above description, it will be apparent that the box blanks are moved in a plane along a predetermined path. The contact members **24** and **26** extend generally parallel to the path of movement of the box blank panels. The contact members **24** and **26** fold the end panels on the box blank out of the plane of the remainder of the panels. Such folding may be upwardly or downwardly through an angle of 180°.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. A machine for folding paperboard box blanks as the blanks are moved in a plane along a predetermined path, comprising a conveying means, means for moving end panels of the blank on the conveyor means out of the said plane so that they overlie adjacent panels and are adjoined to each other, said means including a contact member extending generally parallel to said path and adapted to engage the blank end panel and fold it out of said plane, separate positioning means at spaced points along the path and coupled to spaced portions of said member for positioning said portions substantially equal distances from a fold line on the blank, means for simultaneously shifting said contact member transversely of said path in synchronism with transverse movement of the conveyor means.

2. A machine in accordance with claim **1** wherein each of the positioning means is connected to a side plate for movement therewith, and the conveyor means being connected to the side plate for transverse movement therewith.

3. A machine for folding paperboard box blanks comprising a pair of movable conveying means for supporting box blanks as the blanks are moved in a plane along a predetermined path, means for moving end panels of the blanks supported by said conveying means out of the said plane so that they may overlie adjacent panels and be joined to each other, said last-mentioned means including a pair of contact members extending generally parallel to said path, each contact member being adapted to engage one blank end panel and fold it out of said plane and through an arc of approximately 180°, a pair of side plates one on each side of the conveyor means, means coupling each conveyor means to one of the side plates adjacent thereto for movement as a unit in a direction transverse to said path, means coupling each contact member to a side plate on the opposite side of the machine so that transverse movement of each side plate will result in a proportional transverse movement of the contact member on the opposite side of the machine and in an opposite direction, and motor means connected to each side plate for moving the side plates transversely of said path.

4. A machine in accordance with claim **3** including a transversely movable carriage coupled to each side plate and the conveyor means associated therewith, each carriage being supported for movement toward and away from each other.

5. A machine in accordance with claim **3** wherein said last-mentioned means includes a motor connected to a side plate by a pair of transverse shafts, and a shaft coupled to one of said transverse shafts and to one of said positioning means.

6. A machine in accordance with claim **3** including a plurality of positioning mechanisms coupled to each contact member at spaced locations therealong, said motor means including a separate motor for each side plate, a shaft coupled to each mechanism associated with respective ones of said members, and means connecting each shaft to a separate one of said motors.

7. A method of folding box blanks comprising moving box blanks along a path defined by spaced conveyors, pivoting end panels of box blanks in the conveyors so that the end panels overlap, said pivoting step including engaging each of the end panels with line contact by separate flexible contact members having a low coefficient of friction orientated so contact by each member is a uniform distance from the adjacent fold line on the box blank, supporting the box blanks from below by a pair of adjustable conveyor means, and simultaneously moving one contact member together with its adjacent conveyor horizontally while moving the other contact member toward the closest fold line thereto on the box blank through a distance one-half the distance travelled by said one contact member.

8. A method in accordance with claim **7** including positioning a folding edge on the conveyors below and opposite one of the fold lines on the box blank.

9. A method in accordance with claim **7** wherein said engaging of panels by said contact members is accomplished in a manner so that one member has line contact at a location spaced from the adjacent fold line by a distance substantially less than the corresponding distance between the line contact of the other contact member and its adjacent fold line.

* * * * *