Sept. 9, 1952 H. E. MONTGOMERY 2,609,736

MACHINE FOR FOLDING PAPER BOX BLANKS ON A STACK THEREOF

Filed June 3, 1948 3 Sheets-Sheet 1

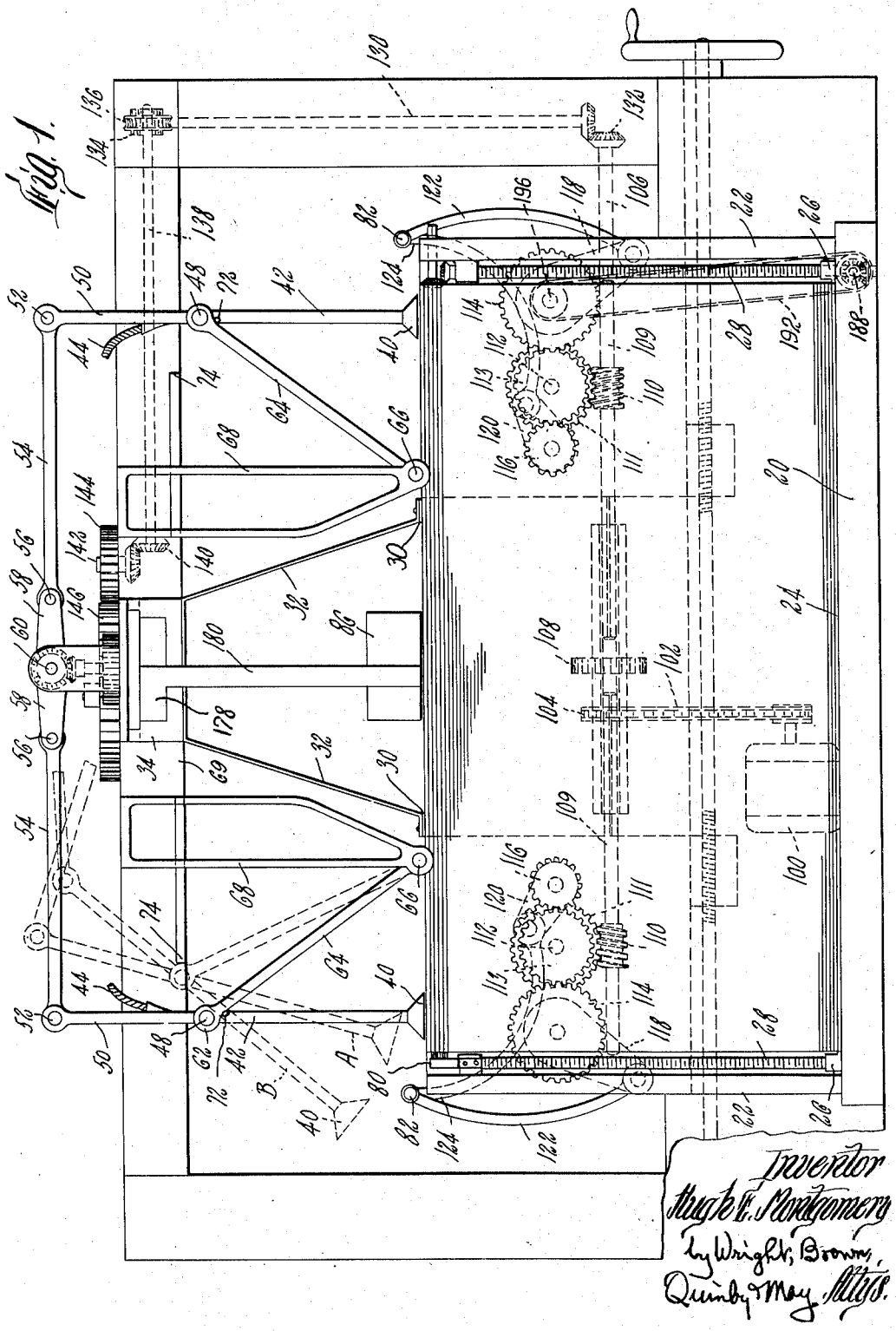


Fig. 1.

Inventor
Hugh E. Montgomery
by Wright, Brown, Quinby & May Attys.

Sept. 9, 1952 H. E. MONTGOMERY 2,609,736

MACHINE FOR FOLDING PAPER BOX BLANKS ON A STACK THEREOF

Filed June 3, 1948 3 Sheets-Sheet 2

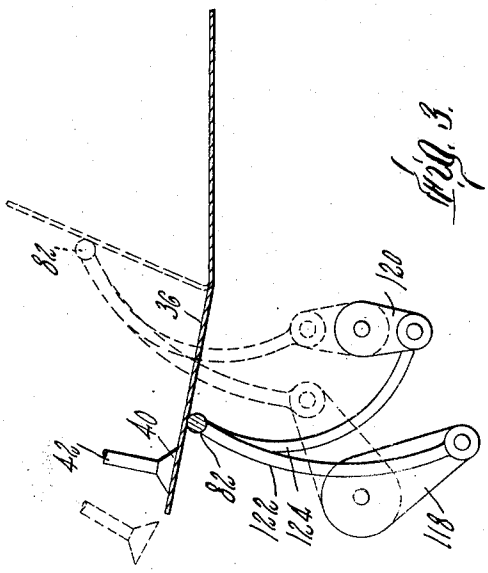


Fig. 3.

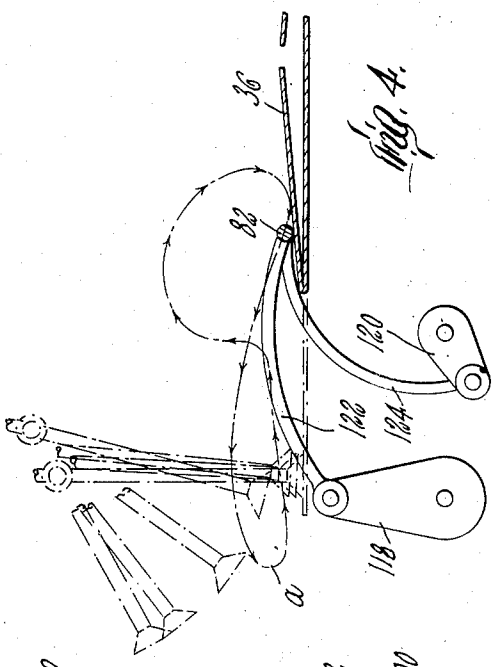


Fig. 4.

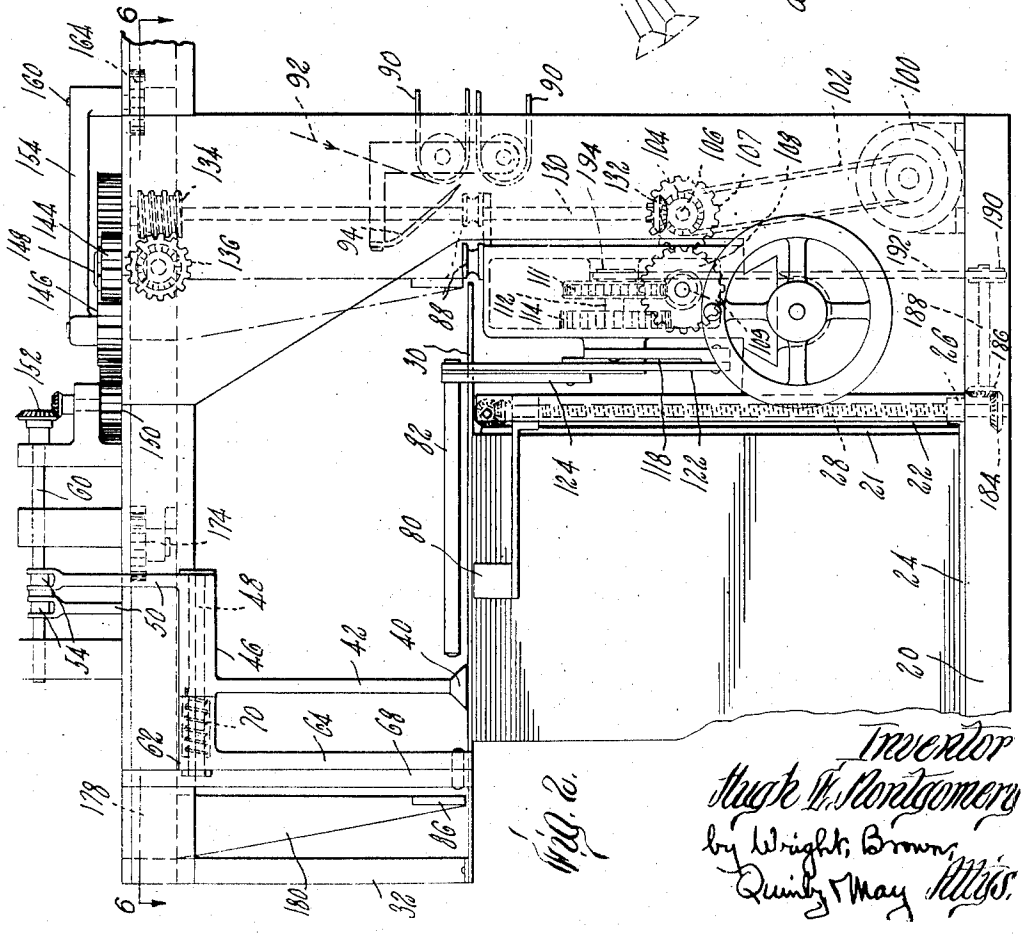


Fig. 2.

Inventor
Hugh E. Montgomery
by Wright, Brown, Quinby & May
Attys.

Sept. 9, 1952 H. E. MONTGOMERY 2,609,736

MACHINE FOR FOLDING PAPER BOX BLANKS ON A STACK THEREOF

Filed June 3, 1948 3 Sheets-Sheet 3

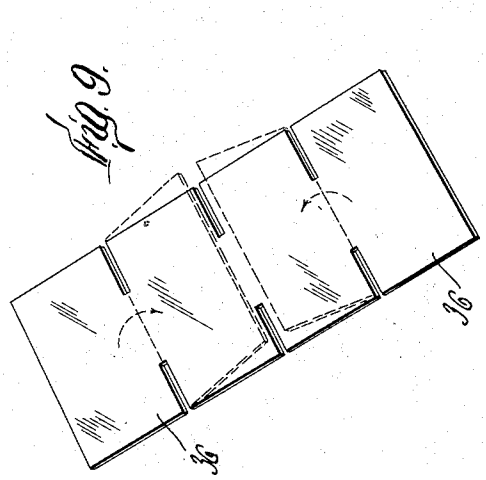


Fig. 9.

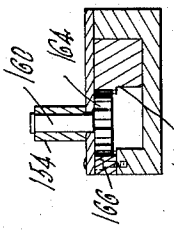


Fig. 8.

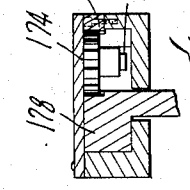


Fig. 7.

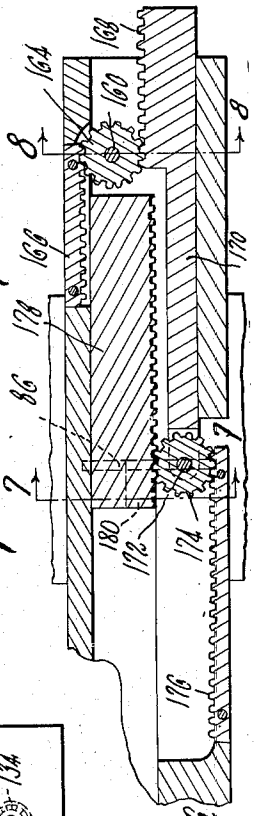


Fig. 6.

Fig. 5.

Inventor
Hugh E. Montgomery
by Wright, Brown, Quinby & May
Attys.

Patented Sept. 9, 1952 2,609,736

UNITED STATES PATENT OFFICE

2,609,736

MACHINE FOR FOLDING PAPER BOX BLANKS ON A STACK THEREOF

Hugh E. Montgomery, Jacksonville, Fla.

Application June 3, 1948, Serial No. 30,847

6 Claims. (Cl. 93—49)

1

This invention relates to a machine for folding the topmost paper box blank of a stack of blanks before removing the blank from the stack. Folding machines which have heretofore been made have withdrawn the blanks, one by one, from the top or bottom of a stack to a folding station where the end portions of the blank are folded over the central portion, the overlapping or abutting extremities of the folded portions being thereafter joined by adhesive tape, metal staples, or other means.

According to the present invention, a machine is provided which holds a stack of blanks and operates on the topmost blank while it is still in the stack to fold its end portions or flaps over the mid-portion. The folded blank is then removed from the stack and transferred to a stitcher or to a tape-applying mechanism. The mechanism hereinafter described and claimed operates to apply suction cups to the flaps or end portions of the topmost blank of the stack and to rock these flaps upward, while the center portion is held down, so as to permit the introduction of suitable folding arms under the raised flaps to complete the folding operation.

A more complete understanding of the invention may be had from the following description thereof and from the drawings, of which—

Figure 1 is a front elevational view of a machine embodying the invention;

Figure 2 is a partial side elevation of the same;

Figure 3 is a fragmentary elevational view of a suction cup and the linkage for actuating one of the folding arms;

Figure 4 is a similar view, showing the parts in different positions of operation;

Figure 5 is a partial plan view of the machine;

Figure 6 is a fragmentary sectional view, on the line 6—6 in Figure 2, the parts shown being in a different position of operation;

Figure 7 is a section on the line 7—7 of Figure 6;

Figure 8 is a section on the line 8—8 of Figure 6; and

Figure 9 is a perspective view of a typical blank to be folded.

The machine is provided with a magazine holding a stack of blanks to be folded, and this magazine may be supported on a base 20 from which rise a wall 21 and suitable uprights 22. These uprights support mechanism for elevating the stack of blanks gradually so that as the topmost blanks are folded and removed, one by one, the level of the top of the stack is maintained substantially constant. Any suitable apparatus

2

may be employed for elevating the stack during the operation of the machine. As shown, the blanks are stacked on a platform 24 which is provided with extensions 26 interiorly screw-threaded for threaded engagement with vertical screws 28. The latter are rotated slowly during the operation of the machine so as to elevate the platform 24 and the stack of blanks supported thereon, the rate of rotation being adjusted in accordance with the individual thickness of the blanks in the stack.

The folding operation is performed on the topmost blank while it is still on the stack. This operation comprises essentially two steps, namely, a preliminary lifting of the end portions or flaps of the topmost blank, and, second, the completion of the folding operation by another instrumentality. During the folding operation, the central portion of the blank is held down by suitable horizontal strips 30 which are supported by suitable members 32 from a longitudinal beam 34 at the top of the main frame.

A typical blank is shown in Figure 9, this blank having end portions or flaps 36 which are folded toward each other over the mid-portion of the blank until their end edges abut or overlap each other.

The initial lifting of the flaps of the topmost blank is done by lifting mechanisms, including suction cups 40 which are located over the end flaps of the blank, preferably near the extreme end thereof. The suction cups 40 and their supporting and operating apparatus are symmetrical in arrangement and movement so that a description of one supporting means will suffice for both. Referring to the lifting mechanism shown at the left in Figure 1, the cup 40 is mounted at the lower end of a vertical member 42 which is hollow and communicates at its upper end with a flexible tube 44 leading to a suction pump (not shown). The member 42 is integral with a horizontal hub member 46 in which is a short shaft or pin 48. From the hub member 46 rises a vertical extension 50 which is pivotally connected, as at 52, to a horizontal link 54, the other end of which is pivoted, as at 56, to a crank 58 mounted on a shaft 60. Rockable on the shaft 48 is a hub member 62 of a link 64 which extends down to a bearing 66 at the lower end of a vertical frame member 68 secured to a transverse frame member 69.

The bearing 66 is preferably located so that its rocking axis is near the line of bend of the flap of the blank which is to be folded. The hub 62 is made hollow around the shaft 48 for a portion of its length so as to provide clearance for

a spring 70 which is coiled about the shaft 48 and engages the hub 62 and also the hub 46. The spring is tensioned in such a manner as to impress on the hub 46 and the members 42 and 50 which are integral therewith, a counterclockwise torque. A stop pin 72 is mounted on the vertical member 42 and is arranged to engage the link 64 to maintain the member 42 in a vertical position when the mechanism is in the position shown in full lines in Figure 1.

When the crank 58 is revolved, the link 54 pulls the members 50 and 42 toward the right, tending to rock these members about the shaft 48. Since such rocking movement is opposed by the spring 70, the members 50 and 42 and the link 64 rock as a unit about the axis of the bearing 66 to the position shown at A in dotted lines in Figure 1. Since the axis of the bearing 66 is near the fold line of the flap, the cup 40 follows an arcuate path substantially identical with that of the portion of the flap which it touches. When the cup frame reaches the position A, the hubs 46 and 62 bring up against a stop 74 whereupon further movement of the link 54 to the right rocks the members 42 and 50 about the axis of the shaft 48 so as to swing the suction cup 40 rapidly outward to the position indicated in dotted lines at B in Figure 1, the cup 40 then being clear of the flap which is being folded. Immediately prior to the outward movement of the cup 40 from its normal position on the upper surface of the flap, suction is applied through the hose 44 so as to cause the flap to cling to the cup. When the cup is elevated to position A, the flap is brought up with it. The underlying flap of the next blank is prevented from coming up with the top of the topmost blank by suitable retarding means, such as a brush 80 supported with its bristles bearing against the end edges of the uppermost blanks.

When the cup 40 reaches the position A, a horizontal arm 82 moves into the wedge-shaped space between the flap of the uppermost blank and the underlying flap of the next blank so as to engage the under surface of the uppermost flap, whereupon the suction is released so that the cup 40 is free to move away from the flap to position B. The arm 82, as indicated in Figure 4, continues its inward motion in an approximately horizontal path for about two-thirds of the distance between the end of the flap and the line of fold. The arm thereupon moves through a substantially semi-circular path pushing the flap ahead of it until the flap is folded to the position shown in Figure 4. The arm 82 thereupon moves outward to the position indicated at *a* and is then ready for the next folding operation. The suction cup 40 and the arm 82 at the right hand portion of the machine, as shown in Figure 1, move through paths symmetrical with those of the left-hand cup and arm, hereinbefore described, and simultaneously therewith.

When the folding arms 82 are reaching the position shown in Figure 4, completing the folding operation, a pusher 86 is actuated to push the blank toward the rear so that it passes between two successive pairs of narrow rolls 88 which are deeply grooved circumferentially, the rolls of each pair being so spaced apart that the folded edges of the blank engage in the grooves of the rolls. This maintains the blank in its folded condition while it is passing from the folding arms 82 either to conveyor belts 90 by which a gummed tape 92 is applied to join the ends of the folded flaps, or to a stitching mechanism (not shown). If desired, an inclined guide member 94 may be mounted adjacent to the upper conveyor belt 90, as indicated in Figure 1, to be engaged by the leading edges of the folded flaps as the blank approaches the conveyor.

The suction cups 40, the folding arms 82, and the pusher 86 are operated in suitably timed relation by any suitable driving apparatus. As shown by way of example, a prime mover, such as an electric motor 100, is mounted on the main frame and is connected by a chain 102 to a sprocket 104 mounted on a shaft 106. The shaft 106 is connected by gear wheels 107 and 108 to a parallel shaft 109 which carries two worms 110. Each of these worms is in mesh with a suitable worm gear 111 on a short shaft 112. On the same shaft with the worm gear 111 is a gear wheel 113 which meshes with gear wheels 114 and 116 of different sizes so that the gear wheel 114 revolves once for each two revolutions of the gear wheel 116. Mounted to revolve with the gear wheel 114 is a crank 118, a crank 120 being mounted to revolve with the gear wheel 116.

The folding arm 82 is connected to and supported by the respective cranks 118 and 120 by means of links 122 and 124. The result of this linkage and the movements of the cranks 118 and 120 is to impart to the folding arm 82 a Figure 8 movement, such as is illustrated in Figure 4 of the drawings, the arm moving inward from the extreme position indicated at *a* to a position beneath the uptilted flap of the topmost blank, then in a somewhat semi-circular path about the line of fold of the blank as an axis, then outwardly to the position *a*.

In order to actuate the suction cups 40 in suitably timed relation with the movements of the folding arms 82, the shaft 60 is preferably driven by suitable connections from the motor 100. As shown, a vertical shaft 130 is connected by bevel gears 132 to the shaft 106 so as to be driven thereby. At the upper end of the shaft 130 is a worm 134 which meshes with a gear 136 mounted on a horizontal shaft 138. This shaft is connected by bevel gears 140 to a short vertical shaft 142 on which is also mounted a gear wheel 144. The latter meshes with a larger gear wheel 146 which is mounted on top of the main frame to rotate about a pivot 148. The large gear wheel drives a smaller gear wheel 150 which is connected by bevel gears 152 to the shaft 60.

For the actuation of the pusher 86, a connecting link 154 is pivotally connected, as at 156, to an eccentric point of the gear wheel 146, the other end of the link 154 carrying a pin 160 which slides in a slot 162 in the main frame. Rotatably mounted on the pin 160 is a pinion 164 which meshes with a fixed rack 166 and also with a sliding rack 168. The rack 168 has an extension 170, at the end of which is a pin 172 carrying a pinion 174 which meshes with a fixed rack 176 and a sliding rack 178. The pusher 86 is mounted on an arm 180 which is secured to the rack 178 and projects downward therefrom, as shown in Figure 2. The pinions 164 and 174, together with the fixed and movable racks with which they are meshed, are for the purpose of multiplying the strokes of the stud shaft 160 at the end of the link 154 so that the pusher 86 will travel through a considerably greater distance in pushing the folded blanks, one by one, from the top of the stack.

The long screws 28 which elevate the platform 24 on which the stack of blanks is carried are operatively connected to one or both of the short shafts 112 by any suitable means such as bevel

gears 184 and 186, the latter being mounted on a shaft 188 which also carries a pulley 190. A belt 192 connects the wheel 190 with a corresponding pulley 194 mounted on a shaft 196 on which is also mounted the gear wheel 114. Thus, with every revolution of the gear wheel 114 the stack of blanks is elevated a predetermined amount substantially equal to the average thickness of a blank.

I claim:

1. A machine of the class described, comprising a magazine for holding a stack of paper box blanks to be folded, hold-down means bearing on the mid-portion of the topmost blank in the stack, and means for folding the end portions of the topmost blank over upon the mid-portion thereof, said folding means including a suction cup arranged to engage the upper face of an end portion of the topmost blank at a point spaced from the line of fold of said end portion, means for causing said cup to travel upward in an arcuate path concentric with said line of fold and thereafter to swing out beyond the end edge of the blank, means for completing the folding of said end portion, and means for driving said cup actuating means and said completing means in timed relation.

2. A machine of the class described, comprising a magazine for holding a stack of paper box blanks to be folded, hold-down means bearing on the mid-portion of the topmost blank in the stack, means for initially bending the end portions of said topmost blank up to inclined positions, said means including suction cups arranged to engage said end portions and mechanisms for moving said cups through predetermined paths, automatic means for engaging under said inclined end portions and completing the folding of said end portions over on the mid-portion, and means for thereafter discharging the folded blank from the stack.

3. A machine of the class described, comprising a magazine for holding a stack of elongated paper box blanks, the end portions of which are to be folded over the mid-portions, hold-down means engaging the mid-portion of the topmost blank in the stack, a suction cup movable to engage each end portion of the topmost blank, a supporting frame for each said cup operable to lift the cup from a position upon the adjacent end portion of the top blank through an arcuate path approximately concentric with the axis of fold of the said end portion of the blank to elevate said end portion to an inclined position with reference to the plane of the mid-portion, said frame being further operable to swing the cup outward to clear the corresponding end of the blank so as not to interfere with the completion of the folding of the end portions, means for actuating said supporting frames to cause the cups carried thereby to describe said arcuate paths and perform said outward swings in a predetermined time relation.

4. In a machine for folding the end portions of a paper box blank over the mid-portion thereof,

a suction cup arranged to engage the upper face of an end portion of a blank to be folded at a point spaced toward the end of the blank from the nearest line of fold, a vertical support member having said cup secured to its lower end, a fixed pivot in substantial alignment with said line of fold, a lower link rockable at one end about said fixed pivot and pivotally connected at its upper end to said vertical support member at an intermediate point thereof, spring means at the joint of the link and vertical member tending to rock the lower portion of said vertical member toward said link, a stop to maintain a minimum angle between said vertical member and link, an upper link pivotally attached to the upper end of said vertical member, means for periodically actuating said upper link to rock said vertical member and lower link as a unit about said fixed pivot, and a fixed stop engageable by said lower link to stop the rocking thereof at a predetermined point, whereby further movement of said upper link results in rocking said vertical member relatively to the lower link, whereby the cup at the lower end of the vertical member is swung out clear of the end of the box blank.

5. Apparatus of the class described, comprising means for supporting a paper box blank in a horizontal position, means for rocking an end portion of said blank upward about its line of fold through an acute angle, and means for completing the fold of said end portion, the last mentioned means including a horizontal rod extending transversely with respect to the long axis of the blank, two supporting links each pivotally secured at its upper end to the same end of said rod, two cranks rotatable about parallel axes and connected respectively to the lower ends of said links, and common means for driving said cranks in timed relation.

6. In a machine for folding paper box blanks, means for folding an end portion of a blank over upon its mid-portion, said means comprising a pusher element adapted to engage under said end portion at a point spaced from the line of fold and means for moving said pusher element through a predetermined path, said moving means including two cranks of different length mounted to revolve about parallel axes, driving connections for rotating the shorter crank at twice the angular speed of the longer crank, and links operatively connecting each crank to said pusher element.

HUGH E. MONTGOMERY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
669,027	Crosby	Feb. 26, 1901
1,742,863	Jurgens	Jan. 7, 1930
2,055,984	Pepper	Sept. 29, 1936
2,113,052	Kemp	Apr. 5, 1938
2,336,507	Shields	Dec. 14, 1943