June 19, 1962 O. P. WELSH 3,039,369

BOX FOLDING APPARATUS

Filed March 23, 1960 3 Sheets-Sheet 1

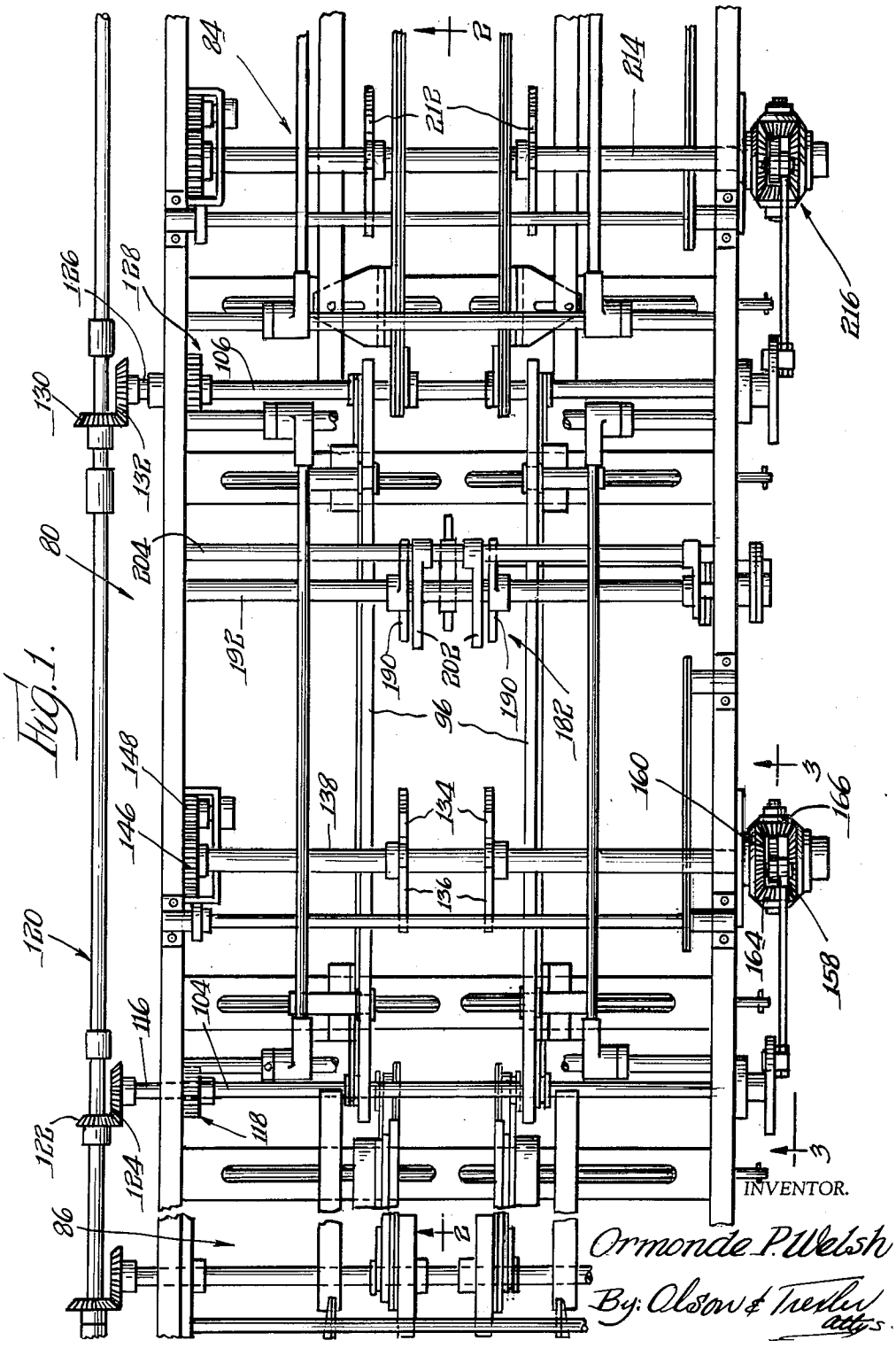


FIG. 1.

June 19, 1962 O. P. WELSH 3,039,369

BOX FOLDING APPARATUS

Filed March 23, 1960 3 Sheets-Sheet 2

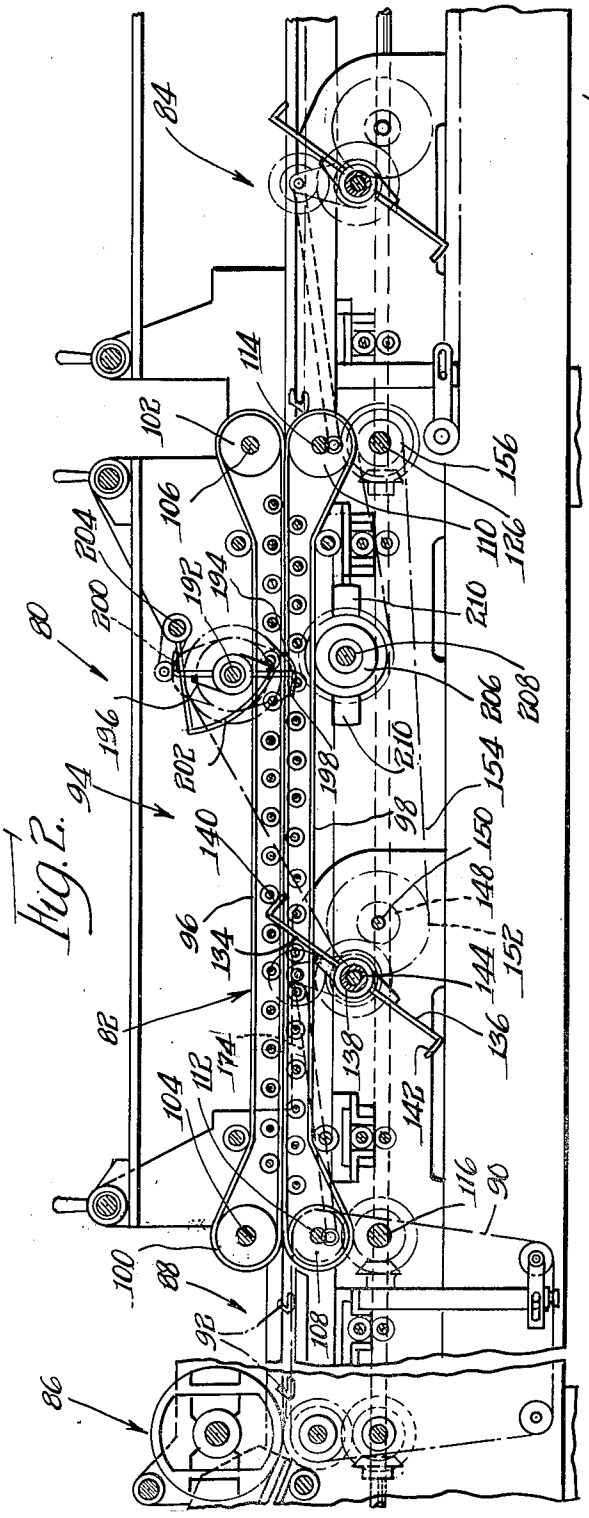


Fig. 2.

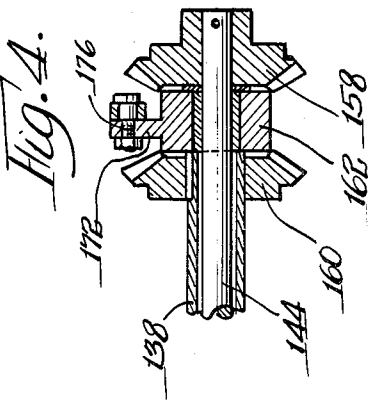


Fig. 4.

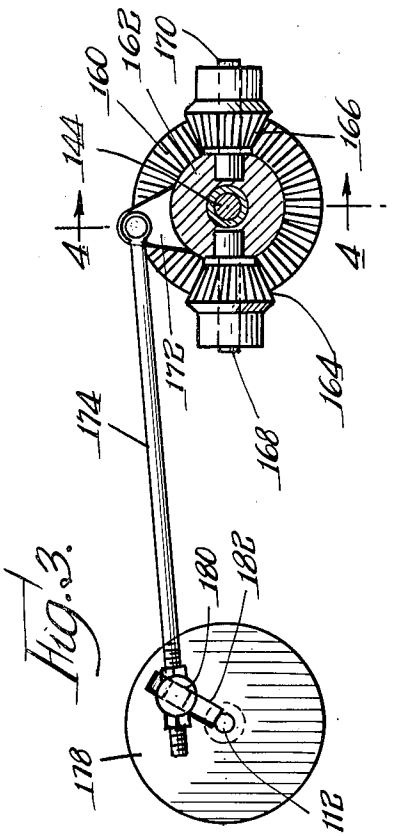


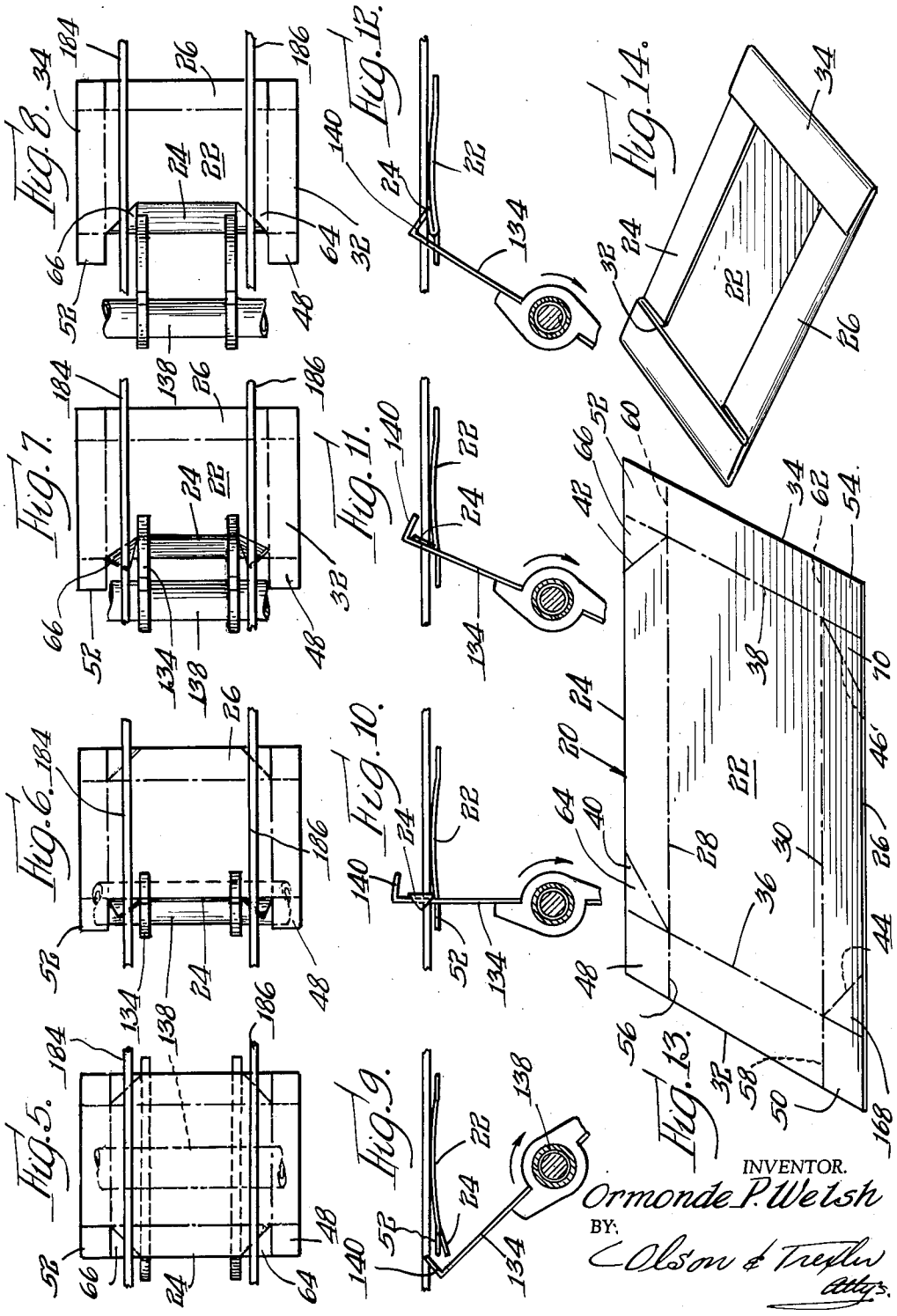
Fig. 3.

INVENTOR.
Ormonde P. Welsh
BY:
Olson & Treyler
Attys.

June 19, 1962 O. P. WELSH 3,039,369

BOX FOLDING APPARATUS

Filed March 23, 1960 3 Sheets-Sheet 3



INVENTOR.
Ormonde P. Welsh
BY:
Olson & Trevithick
attys.

United States Patent Office 3,039,369 Patented June 19, 1962

3,039,369

BOX FOLDING APPARATUS

Ormonde P. Welsh, 311 Portland Ave.
Minneapolis, Minn.

Filed Mar. 23, 1960, Ser. No. 17,089
5 Claims. (Cl. 93—49)

The present invention relates to a novel apparatus for folding box blanks, and more particularly to a novel apparatus for folding knocked down or collapsible type boxes so that the folded blank is substantially flat to facilitate shipping and storing.

In my United States Patent 2,911,889, there is disclosed and claimed an apparatus for folding knocked down or collapsible type box blanks to a flattened condition, which apparatus represents a substantial advance in the box blank folding art. An object of the present invention is to provide an improvement in an apparatus of the type disclosed in the above mentioned patent.

A more specific object of the present invention is to provide a novel apparatus of the above described type with materially simplified means for accomplishing folding of trailing flaps of successive blanks while the blanks are continuously moving at high speeds. A further object of the present invention is to provide blank flap folding means which may be used in an apparatus of the above described type or with various other apparatus, which means is constructed so that a single element is adapted to fold a trailing flap of a blank forwardly and over a leading portion of the blank, or in other words, the folding means is adapted to fold the trailing flap about 180 degrees while the blank is continuously moving at a high speed.

Other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings wherein:

FIG. 1 is a fragmentary plan view showing a portion of an apparatus incorporating the features of the present invention;

FIG. 2 is a longitudinal sectional view taken generally along line 2—2 in FIG. 1;

FIG. 3 is an enlarged fragmentary partial sectional view taken generally along line 3—3 in FIG. 1;

FIG. 4 is a fragmentary cross sectional view taken along line 4—4 in FIG. 3;

FIGS. 5 through 8 are plan views respectively showing successive steps in the folding of a trailing flap of a blank over the body of the blank by the apparatus of the present invention;

FIGS. 9 through 12 are simplified vertical sectional views respectively corresponding to FIGS. 5 through 8;

FIG. 13 is a perspective view showing a blank of the type adapted to be folded by the apparatus of the present invention; and

FIG. 14 is a perspective view showing a fully folded blank.

As will be understood, apparatus incorporating features of the present invention may be adapted for processing various box structures, and the apparatus shown for the purpose of illustrating the present invention is especially suitable for folding box blanks 20 shown best in FIGS. 13 and 14. Each blank 20 comprises a central bottom panel 22 and opposite side panels or flaps 24 and 26 articulated to the bottom panel along scored bend lines 28 and 30, respectively. The blank is provided with opposite end panels or flaps 32 and 34 which are articulated to the bottom panel along scored bend lines 36 and 38. In order to connect the ends and the sides of the box blanks in a manner to permit clamping thereof, the sides are provided with diagonal scored bend lines 40—42 and 44—46, and the end sections 32 and 34 are respectively provided with flaps 48—50 and 52—54 joined thereto

along scored bend lines 56, 58, 60 and 62, respectively. When folding the flat blank in the condition shown in FIG. 13 to the fully folded condition shown in FIG. 14, the sides are first folded over and substantially against the bottom section 22 and corner portions 64, 66, 68 and 70 of the sides are reversely bent along the diagonal bend lines. The end flaps 48—50 and 52—54 are then bent over the end sections and patches of glue are applied thereto whereupon the end sections are bent over the bottom panel as shown in FIG. 14 so that the glued flaps are pressed against the folded corner portions of the sides. The specific structure of the box blank 20 is well known and forms no part of the present invention.

An apparatus 80 which is shown, in part, in FIGS. 1 and 2 is provided for folding a plurality of successive blanks in the manner described above. The apparatus 80 is substantially identical to the apparatus disclosed in the above mentioned co-pending application except for the means generally designated by the numerals 82 and 84 and adapted to fold trailing sections of the blanks. Therefore, reference is hereby made to the above mentioned co-pending application for a disclosure of portions of the apparatus not shown in the drawings of this application and also for a more complete disclosure of portions of the apparatus shown herein but only briefly described.

The apparatus 80 is provided with sheet feeding means generally designated by the numeral 86 for feeding successive blanks to a timing section 88 of the apparatus at which there is provided timing chain means 90 which carries dogs 92 for positively engaging and advancing successive blanks received from the feeding means. It is to be noted that the blanks are arranged and fed into the apparatus so that one of their side flaps, for example, the side flap 26 is in a leading position and the other side 24 is in a trailing position and the end sections 32 and 34 are arranged at opposite sides of the path of travel of the blanks. The blanks are successively delivered from the timing section to a first folding section of the apparatus generally designated by the numeral 94 in which the trailing sides 24 are folded and then the leading sides 26 are folded. More specifically, the folding section 94 is provided with pairs of cooperable upper and lower endless belts 96 and 98 disposed adjacent opposite margins of the path of travel of the blanks as shown in FIG. 1 so as to grip the opposite end portions of successive blanks received from the timing chain. The endless belts 96 and 98 serve to convey the blanks continuously through the folding section 94 of the apparatus while leaving the leading and trailing side sections 26 and 24 free to be folded in the manner described below. The endless belts 96 extend around pulleys 100 and 102 respectively mounted on shafts 104 and 106, and the belts 98 are similarly mounted on pulleys 108 and 110 secured to rotatable shafts 112 and 114. The shafts 112 and 104 are driven from a rotatable shaft 116 through suitable gear means 118, and the shaft 116 is, in turn, driven from drive shaft means 120 extending along the side of the apparatus by cooperable bevel gears 122 and 124. The shafts 114 and 106 are similarly driven from a shaft 126 by suitable gear means generally designated by the numeral 128, which shaft 126 is also driven from the drive shaft means 120 by beveled gears 130 and 132.

The blanks entering the folding section 94 of the apparatus and being conveyed by the endless belts 96 and 98 are first acted upon by the folding means 82 which functions to fold the trailing side 24 of successive blanks forwardly substantially 180 degrees around the bend line 28 and substantially against the body section 22 of the blanks as shown in FIGS. 5 through 12. It is to be noted that the generally corresponding folding means disclosed in the above mentioned co-pending application includes

rotatable finger means beneath the blanks for partially folding the trailing flaps or sides of the blanks, and additional rotatable finger means above the blanks for finishing the folding operation. In accordance with the present invention, this previously suggested folding means has been greatly simplified in that the second mentioned or upper rotatable finger means has been completely eliminated along with the necessary drive mechanism therefor while at the same time the apparatus is constructed so that it will accomplish the folding operation previously performed by such upper rotatable finger means.

The folding means 82 comprises pairs of oppositely extending folding members or fingers 134 and 136 mounted on a rotatable hollow shaft 138 and disposed for engaging the trailing edges of the blanks. Major portions of these fingers extend radially from the shaft 138, but it is important to note that the fingers respectively include short end portions 140 and 142 which project forwardly in the direction of rotation of the shaft 138 and at substantially right angles to the major portions of the fingers. These end or hook portions function to complete the folding of the trailing flaps against the blank bodies in the manner described fully below. The hollow shaft 138 is driven at a speed which varies during each rotation thereof so that the fingers, when approaching a blank trailing edge, will be accelerated sufficiently to engage and fold the trailing blank portion and decelerated sufficiently to become disengaged from the blanks. More specifically, a shaft 144 extends through and is rotatably mounted within the hollow shaft 138, which shaft carries a gear 146 secured to one end thereof. The gear 146 and thus the shaft 144 are driven from a gear 148 fixed on a shaft 150 which also carries a sprocket wheel 152 and is driven by a drive chain 154. The chain 154 is driven from a sprocket 156 on the shaft 126 and serves also to drive other portions of the apparatus as mentioned below.

As shown best in FIGS. 1, 3, and 4, a beveled gear 158 is keyed or otherwise secured to an end of the shaft 144 opposite from the gear 146. A similar but oppositely disposed beveled gear 160 is keyed or otherwise secured to the adjacent end of the hollow shaft 138, and a cage member 162 which is freely disposed on the shaft 144 and carries a pair of oppositely disposed beveled gears 164 and 166 on stub shafts 168 and 170, respectively. The beveled gears 164 and 166 mesh with and provide a driving connection between the gears 158 and 160. An arm 172 is formed integral with or connected to the cage member 162 and has its outer end pivotally connected to a rod 174 by pin means 176. An opposite end of the rod 174 is pivotally connected to a disk 178 fixed on the shaft 112 by eccentrically disposed pin means 180 so that as the disk 178 is rotated, the cage member 162 is oscillated. The pin means 180 is adjustable along a radial slot 182 in the disk 178 so that the oscillating movement of the cage member may be adjusted.

FIGS. 5 through 12 illustrate the manner in which the apparatus functions to fold the trailing side 24 of a continuously moving blank. In FIGS. 5 and 9, the blank has been advanced to a position over the hollow shaft 138 and the folding finger 134 is approaching but slightly spaced behind the trailing edge of the blank. The folding finger is then accelerated relative to the blank and in the direction of movement of the blank and this is accomplished by timing the drive means of the apparatus so that the cage member 162 is moved in a counterclockwise direction as viewed in FIGS. 2 and 3 with the result that the clockwise speed of the gear 160 and thus the folding fingers is increased. In addition, further acceleration is obtained by the inherent increase of the component of movement of the finger 134 in the direction of movement of the blanks as the finger approaches the vertical position. The accelerating finger 134 engages the trailing edge of the side flap 24 and initially folds the side through an arc of about 90 degrees to an upright position as shown in FIGS. 6 and 10. It is to be noted that at the same time the blank is passed beneath fixed parallel folding bars 184 and 186 which are disposed for engaging the corner portions 64 and 66 of the trailing side and folding these corner portions along the diagonal bend lines as the side 24 is folded by the finger 134. As the blank and the folding finger advance to the position shown in FIGS. 7 and 11, movement of the finger in the direction of movement of the blank is retarded but is still sufficient to enable the finger 134 to fold the side 24 forwardly and over the body portion 22 as the trailing edge or bend line 28 of the blank advances sufficiently to avoid interference with the folded finger. Then as the blank and folding finger approach the positions shown in FIGS. 8 and 12, the folding finger is relatively rapidly retarded, and this is accomplished by timing the driving mechanism so that the cage member 162 is moved in a clockwise direction as viewed in FIGS. 2 and 3. Movement of the finger 134 is retarded sufficiently so that it will not unduly interfere with or pull down on the blank, but at the same time the movement of the finger 134 is such that the forwardly projecting end or hook portion 140 thereof engages the blank side portion 24 and folds it down against the body portion 22 after which the blank is advanced from beneath the folding finger. It has been found that the beveled gear differential means enables a greater variation in the speed of the folding fingers to be obtained than the corresponding differential means disclosed in the above mentioned application, and this greater speed variation enables the folding fingers to be utilized for folding the trailing sides of the blanks through arcs of about 180 degrees in the manner described above.

The leading portions or sides of the blanks are folded by means generally designated by the numeral 188 and including a pair of folding members 190 mounted on a rotatable shaft 192. Each of the folding members includes a pair of oppositely extending arms 194 and 196 respectively having arcuate end portions 198 and 200 extending in a direction opposite to the direction of rotation thereof. These arms are proportioned and driven so that the end portions thereof extend beneath the path of travel of the blanks, which blanks are advanced along their path of travel at a rate in excess of the rate of movement of the rotating arms along the path of travel whereby the leading portions of successive blanks are engaged by the arcuate finger portions 198 and 200 of the arms and folded upwardly about 90°. Complete folding of the leading sides of the blanks is obtained by providing a pair of fixed elongated folding bars not shown. The diagonal corner portions of the leading blank sides are folded by elongated folding bars, not shown, similar to the above mentioned bars 184 and 186. The trailing sides of the blanks are retained in a folded condition by hold down members 202 mounted on an oscillating shaft 204 while the forward portions of the blanks are being folded. The oscillating shaft is operated so that the hold down members 202 are withdrawn to permit folding of the leading blank sides and then advanced downwardly to hold the folded trailing sides of the blanks. If desired, a member 206 mounted on a rotatable shaft 208 may be provided beneath the path of travel of the blanks, and arranged so that lifting block portions 210 thereof will engage and initially slightly lift the leading edge of a blank prior to engagement of the balnk with one of the folding arms. The shafts 192 and 208 are provided with sprocket wheels thereon which are engaged and driven by the chain 154.

The blanks having their leading and trailing sides folded in the manner described above are advanced to another section of the apparatus in which the leading and trailing flaps 50—54 and 48—52 of the opposite blank end sections are folded over and against their respective end sections. As shown in FIGS. 1 and 2 this section of the apparatus includes the above mentioned folding means 84 which is identical to the above described

folding means 82 with the exception that folding fingers 212 thereof are disposed for engaging the trailing end flaps 48 and 52 rather than the trailing side portions of a blank. Since the folding means 84 is identical to the folding means 82, it need not be described in detail and it suffices to state that the folding fingers 212 are mounted on a rotatable hollow shaft 214 which is driven at variable speeds by differential means 216 identical to the differential gear means described above. The blanks leaving the folding means 84 are further processed in the manner and by the means briefly mentioned above and fully disclosed in the above mentioned co-pending application, and since the remaining portions of the apparatus form no part of the present invention, they will not be further described herein.

While the preferred embodiment of the present invention has been shown and described herein, it is obvious that many structural details may be changed without departing from the spirit and scope of the appended claims.

The invention is claimed as follows:

1. An apparatus for folding a trailing portion of a blank moving continuously along a predetermined path of travel forwardly and substantially against one side of a leading section of the blank, comprising folding means rotatable about an axis disposed at a side of said path of travel opposite from said one side for engaging and folding said blank portion, and means for moving said blank and said folding means at predetermined variable relative lineal speeds along said path of travel so that said folding means is successively relatively advanced and retarded with respect to the blank to accomplish folding of said blank portion, said folding means comprising a generally radially extending portion projecting for traversing said path of travel for initially engaging and folding said blank portion forwardly over said blank section, and said folding means including an outer end portion projecting forwardly of said radially extending portion for engaging and folding a partially folded blank portion substantially against the blank section.

2. An apparatus for folding a trailing portion of a blank moving continuously along a predetermined path of travel forwardly over and substantially against one side of a leading section of the blank, comprising folding means rotatable about an axis disposed at a side of said path of travel opposite from said one side for engaging and folding said blank portion, and drive means including a differential gear assembly and means for periodically actuating said differential gear assembly for driving said folding means at predetermined variable lineal speeds so that said folding means is successively advanced and retarded along said path of travel with respect to a blank to accomplish folding of said blank portion, said folding means comprising a generally radially extending portion projecting for traversing said path of travel for initially engaging and folding said blank portion, and said folding means including an outer end portion projecting forwardly of said radially extending portion for engaging and folding said blank portion substantially against said blank section.

3. An apparatus for folding a trailing portion of a blank moving continuously along a predetermined path of travel forwardly and over one side of a leading section of the blank, comprising folding means rotatable about an axis disposed at a side of said path of travel opposite from said one side for engaging and folding said blank portion, and drive means connected with said folding means for moving said folding means at predetermined variable lineal speeds along said path of travel so that said folding means is successively advanced and retarded with respect to the blank to accomplish folding of said blank portion, said drive means comprising opposing axially aligned driving and driven beveled gears, a cage member pivotally disposed between said gears, beveled gear means rotatably mounted on said cage member and meshing with both of said beveled gears, and means for oscillating said cage member, said folding means comprising a generally radially extending portion projecting for traversing said path of travel for initially engaging and folding said blank portion, and said folding means including an outer end portion projecting forwardly of said radially extending portion for engaging and further folding said blank portion.

4. An apparatus for folding a trailing portion of a blank moving continuously along a predetermined path of travel forwardly and over one side of a leading section of the blank, comprising folding arm means rotatable about and extending generally radially from an axis disposed at a side of said path of travel opposite from said one side for engaging and folding said blank portion, said arm means projecting from said axis for traversing said path of travel, and drive means for moving said folding arm means at predetermined variable lineal speeds along said path of travel so that said folding arm means is successively advanced and retarded with respect to the blank to accomplish folding of the blank portion, said drive means including a driven beveled gear connected with said rotatable arm means, an oppositely disposed axially aligned drive beveled gear, a cage member pivotally disposed between said gears, beveled gear means mounted on said cage member for rotation about an axis extending radially with respect to said first mentioned axis and meshing with both of said gears, and means for oscillating said cage member.

5. An apparatus for folding a trailing portion of a blank moving continuously along a predetermined path of travel forwardly and over one side of a leading section of the blank, comprising folding means rotatable about an axis disposed at one side of said path of travel and including a pair of oppositely disposed radially extending arms projecting for traversing said path of travel for initially engaging trailing edges of successive blanks moving along said path of travel, each of said arms having an end portion projecting forwardly therefrom for subsequently engaging trailing portions of successive blanks and further folding said trailing portions, means including a rotatable shaft supporting said folding means, a beveled gear fixed on said shaft, a second rotatably supported and driven beveled gear oppositely disposed with respect to and axially aligned with said first mentioned gear, a cage member pivotally mounted adjacent said gears for movement about the axis of said gears, beveled gear means rotatably mounted on said cage member and disposed between and meshing with both of said gears, and means for oscillating said cage member and the beveled gear means carried thereby for driving said folding means at predetermined variable lineal speeds along said path of travel so that said arms are successively relatively advanced and retarded with respect to successive blanks to accomplish folding of said blank portions.

References Cited in the file of this patent

UNITED STATES PATENTS

2,399,685	McCoy	May 7, 1946
2,574,916	Gordon	Nov. 13, 1951
2,911,889	Welsh	Nov. 10, 1959