June 24, 1958 R. A. LABOMBARDE 2,839,972

APPARATUS FOR FOLDING TRAILING FLAPS

Filed Aug. 9, 1954 2 Sheets-Sheet 1

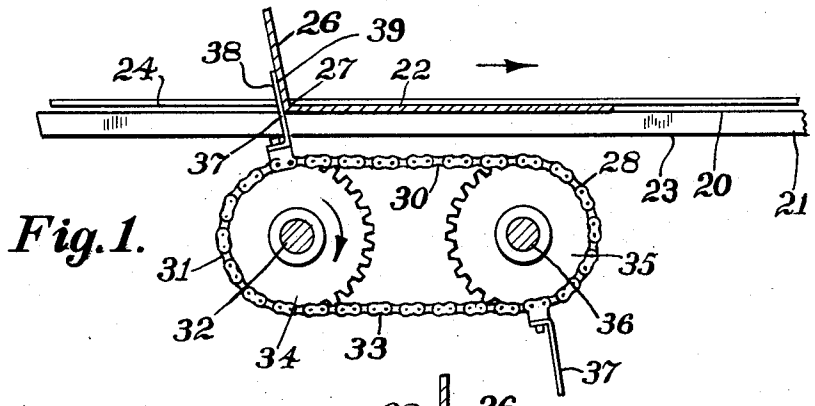


Fig. 1.

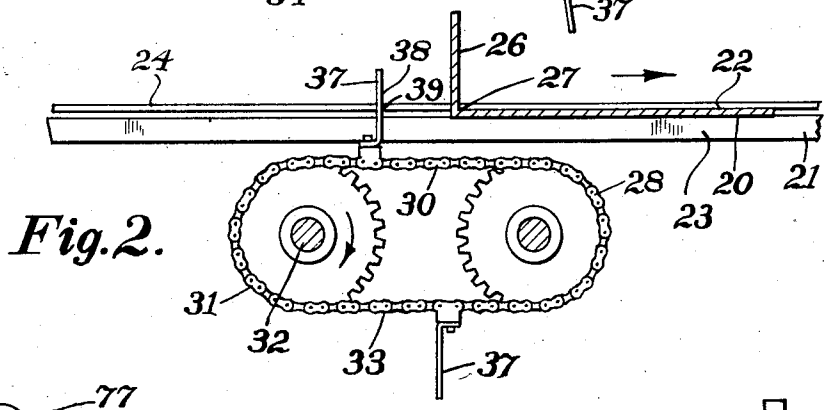


Fig. 2.

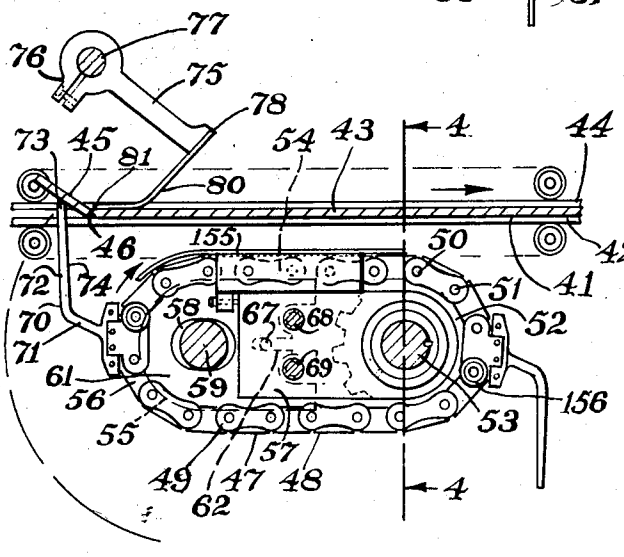


Fig. 3.

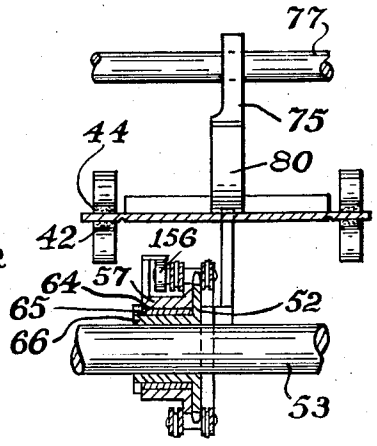


Fig. 4.

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APPARATUS FOR FOLDING TRAILING FLAPS

Filed Aug. 9, 1954 2 Sheets-Sheet 2

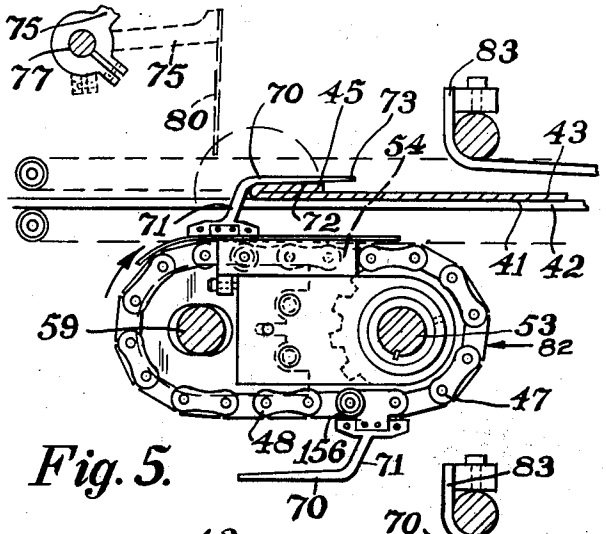


Fig. 5.

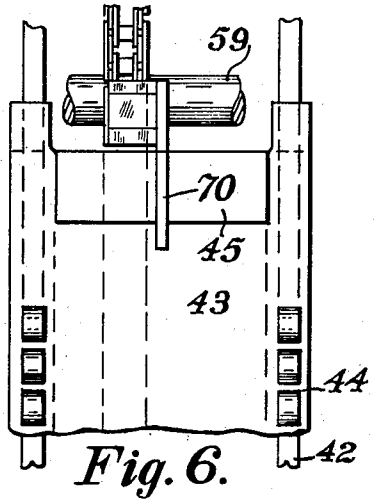


Fig. 6.

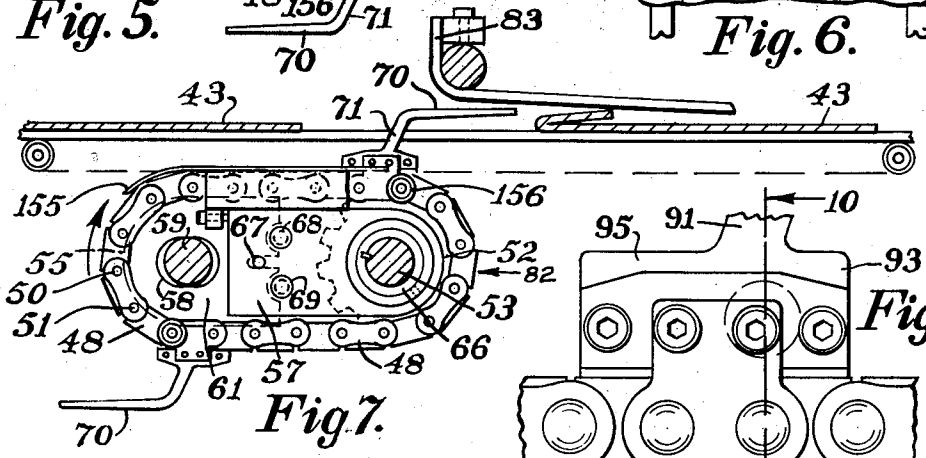


Fig. 7.

Fig. 9.

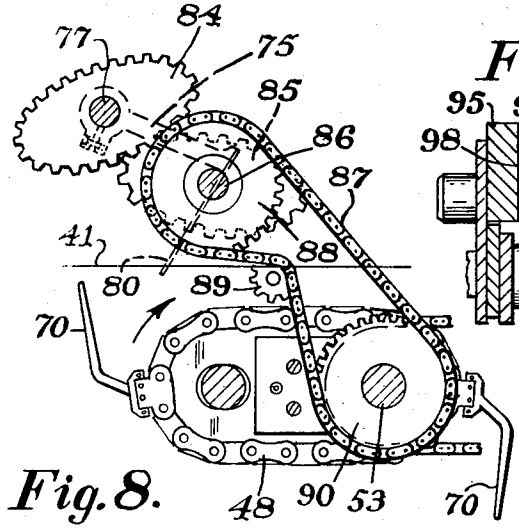


Fig. 8.

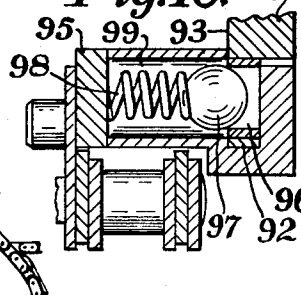


Fig. 10.

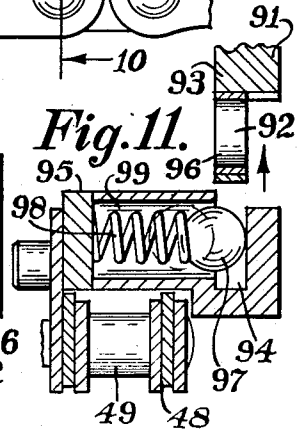


Fig. 11.

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APPARATUS FOR FOLDING TRAILING FLAPS

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Application August 9, 1954, Serial No. 448,720

18 Claims. (Cl. 93—49)

This invention relates to apparatus for folding an articulated flap of a flat foldable article as the article is advanced at a predetermined speed along a path in a folding machine.

Many devices have heretofore been proposed for accomplishing such folding and this invention proposes to improve the same by simplifying the mechanism thereof while assuring greater accuracy and speed in operation. In some such devices, each successive flat article has been stopped at one or more folding stations in a folding machine while a trailing flap of the article, such as a box blank, is folded. It will be apparent that such stops tend to slow the rate of production of the machine and that it is more desirable to accomplish the folding while the articles are continuously advancing at the highest speed possible.

To accomplish folding of trailing flaps while the flat articles continuously advance, it has been proposed to use an endless chain advancing below the path of the articles and at the same speed, through a folding station and to provide pivoted dogs or pivoted folding fingers upstanding from the chain and engageable on a longitudinally extending cam for causing the flaps to fold. Typical of such devices are those shown in the U. S. Patent No. 1,980,604, of November 13, 1934, to Von Thien; U. S. Patent No. 2,291,063, of July 28, 1942, to Staude; U. S. Patent No. 2,349,204, of March 16, 1944, to Staude, and U. S. Patent No. 2,598,809, of June 3, 1952, to Liebl. The folding fingers or dogs used in this type of device are usually pivotally mounted on a link of a chain and the path of the tip portion thereof may become erratic after a time, especially when the pivot pins, cam followers and cams become worn. Typical of devices which depend on a folding finger mounted for rotation around a fixed centre of rotation below or above the path of the articles is U. S. Patent No. 2,197,089, of April 16, 1940, to Anderson, wherein the pivoted finger for infolding the trailing flaps of a box blank must strike the flap with considerable impact to accomplish its folding as the blank advances.

The principal object of this invention is to provide means for folding a trailing flap of a continuously advancing flat article such as a box blank with a smooth gradual pressure on the flap and without the use of pivoted folding dogs and cams for the same.

Another object of the invention is to provide folding mechanism for folding a trailing flap of an advancing flat article such as a box blank which mechanism travels in an endless path but does not have parts which rock or oscillate while following such path.

Another object of the invention is to provide trailing flap folding mechanism capable of accomplishing a fold in an unusually small portion of the path of an advancing article thereby saving in floor space by reducing the required length of a folding machine.

Still another object of the invention is to provide trailing flap folding mechanism which causes a folding finger

to fold by rotating the same around a centre of rotation and then advances the folding finger in the direction of advance of the flap while the flap is drawn forwardly away from the finger.

A further object of the invention is to provide an endless carrier having a straight stretch advancing at less speed than the speed of an advancing article, but having a folding finger fixed thereto which advances at a greater speed than the article to fold the same forwardly as the finger rounds a parti-circular path at a spaced distance from a fixed pivot.

A still further object of the invention is to provide novel flexible holddown means for applying pressure on the line of articulation of a trailing flap as the flap is advancing and is being folded by the folding finger of the invention, together with novel driving means for the same.

Still further objects of the invention are to provide a folding finger carried by an endless conveyor wherein the finger performs an important flap holddown function, wherein a novel conveyor support is provided for the finger, and wherein a safety release is incorporated into each folding finger.

Still further objects of the invention are to provide a flap folding mechanism so positive in operation as to eliminate the need for costly hand pre-breaking of lines of articulation in articles being folded, to also eliminate the need for mechanical pre-breaking of the same, to reduce the weight and cost of such mechanism, and to eliminate the need for endless chain holddown mechanism now required by traveling, pivotable folding fingers.

Other objects and advantageous features of the invention will be apparent from the following description of the invention taken with the accompanying drawings and it will be understood that the invention is not confined to the exact features shown therein since various other embodiments of the invention may be adopted within the scope of the claims.

In the drawings:

Fig. 1 is a side elevation of the endless carrier and folding finger of this invention folding a trailing articulated flap of an advancing flat article.

Fig. 2 is a view similar to Fig. 1 showing the article with its folded flap drawing away from the folding finger.

Fig. 3 is a view similar to Figs. 1 and 2 of the endless carrier and folding finger of the invention completely infolding an articulated flap of an advancing flat article in cooperation with the blank holddown means of the invention.

Fig. 4 is a fragmentary end view on line **4—4** of Fig. 3.

Fig. 5 is a view similar to Fig. 3 showing the position of the parts at the completion of an infold.

Fig. 6 is a fragmentary plan view of the device shown in Fig. 5.

Fig. 7 is a view similar to Fig. 3 showing the article with its infolded flap drawn away from the folding finger sufficiently to allow the finger to pass downwardly below the path of the article.

Fig. 8 is a fragmentary side view of the driving means for the endless carrier and article holddown means of the invention.

Fig. 9 is an enlarged side view of a folding finger having safety release mechanism for preventing breakage under unusual stress.

Fig. 10 is a sectional view on line **10—10** of Fig. 9, and

Fig. 11 is a view similar to Fig. 10 showing the safety mechanism for the folding finger in released position.

In the drawings the invention is illustrated as applied to a typical folding machine such as are well known in the paper box, bag, envelope and allied trades. The en-

tire machine is therefore not shown, but only the zone of the same in which it is desired to fold the trailing flap of an advancing article.

In Figs. 1 and 2 one embodiment of the invention is illustrated wherein 21 is a folding machine having a paper line 20 along which flat foldable articles 22 are individually and successively advanced at a predetermined speed by any convenient means, not shown, such as conveyor belts. A longitudinally extending article support 23, or its equivalent, is usually provided together with suitable elongated holddown belts 24, all well known in the art and forming no part of this invention. The paper line 20 constitute a horizontal path through the folding machine and the articles 22 are usually fed to it from a stack of flat articles in a magazine not shown. One or more folds are made simultaneously or successively in the article as it advances in the direction of the arrows. Initially the trailing flap 26 is flat and connected to the article 22 by a line of articulation 27 which line extends transversely of the path of the articles.

The folding mechanism of this invention includes an endless carrier 28, the carrier 28 having an upper stretch 30 extending substantially parallel to, but at a spaced distance under, the path of the articles 22 along paper line 20. The endless carrier 28 also includes a curved end stretch 31 advancing in a parti-circular path around an axis of rotation transverse to the path of articles 22 formed by shaft 32. The endless carrier 28 is preferably a roller chain, made up of separate links 33 and may be trained around a pair of identical sprockets 34 and 35 rotatably mounted on shafts 32 and 36. The shafts 32 and 36 and the sprockets 34 and 35 are driven in any convenient manner by the driving mechanism of the folding machine whereby the upper stretch 30 advances at a lesser speed than the predetermined speed of advance of articles 22.

The folding mechanism of the invention also includes at least one upstanding flap folding finger such as 37 mounted on the endless carrier 28 and having a portion 38 adapted to extend above the path of the articles 22 along paper line 20 near the end of curved end stretch 31 and while travelling along upper stretch 30. It should be noted that finger 37 is not mounted to oscillate, pivot or otherwise change its fixed angular relationship to the particular link 33 upon which it is fixed and that it therefore has no wearing parts to become loose, vibrate or chatter. The finger 37 is preferably of rigid material, it may be integral with a link 33 or affixed thereto by rivets, bolts or welding and preferably it includes a flat, comparatively broad, flap engaging surface at 39 for supporting a substantial area of a flap.

As indicated in Fig. 1, although the upper stretch 30 of endless carrier 28 is travelling at less speed than the articles 22, the rotation of the terminal portion 38 of each finger 37 around the curved end stretch 31 increases its speed to more than that of the articles 22 and causes the portion 38 to fold the trailing flap 26 in the direction of advance of the articles. As indicated in Fig. 2 after leaving the curved end stretch 31 and commencing to travel along the upper stretch 30 of endless carrier 28, finger 37 slows down to advance at less speed than the speed of advance of articles 22 along upper stretch 30, thereby lagging behind and permitting the articles to draw away and thus clearing the path for the downward rotation of the finger 37 around sprocket 35. While straight finger 37 will upfold a flap to ninety degrees for further overfolding by frictional contact with an advancing belt, it is preferred that the fingers be forwardly inclined relative to their base whereby partial or complete overfolding is accomplished by the finger alone.

In Figs. 3–11 the invention is illustrated as especially adapted to not only fold a trailing flap of an advancing article but to completely overfold a trailing flap flatwise against the body of an article. In Fig. 3 a flap folding zone of a typical folding machine is shown wherein 41 is the paper line, 42 is a typical conveyor support for the flat foldable articles 43 and 44 is a typical holddown member such as an endless belt. As is customary, the belts 42 and 44 are spaced transversely on the paper line 41 to operate on portions of the article not being folded and to leave the portion to be folded, such as trailing flap 45, free to be bent on its transverse line of articulation 46.

The endless carrier 47 is preferably in the form of a chain 48 made up of links 49, each link having rollers such as 50 and 51. In place of a pair of sprockets for supporting the chain 48, a single toothed driving sprocket 52 is provided mounted on a drive shaft 53. Shaft 53 is synchronized with the driving mechanism of the conveyor support 42, in a well known manner, to cause the upper stretch 54 of chain 48 to advance at less speed than the speed of advance of articles 43. A smooth surfaced stationary inner track 55 supports the rollers 50 and 51 of the links 49 as they travel around the incoming, curving end stretch 56 and along the upper stretch 54, the track 55 being formed on a plate 61. Plate 61 includes an elongated slot 58 through which a transversely extending supporting rod 59 extends and plate 61 is adjustably connected to a block 57 by a slot 62 in the plate and a set screw 67. Block 57 includes a hole 64 for a bearing 65, the bearing 65 being carried by a sleeve 66 integral with sprocket 52 whereby the block 57 is slidable transversely with, and supported by sprocket 52 but does not revolve with the sprocket. The plate 61 may be moved lonigtudinally relative to block 57 by means of set screw 67 in order that proper tension of chain 48 may be obtained and maintained.

A pair of transversely extending threaded rods 68 and 69 are provided for supporting block 57 and for moving the entire unit sidewise in either direction, as desired.

A smooth surfaced, rigid, outer track 155 may be substantially coextensive with the inner track 55 to support, restrain and guide the rollers 50 and 51 of links 49 or preferably, as shown, to restrain, support and guide spaced extra rollers 156 mounted at the sides of certain links 49, in the folding portion of the path of the fingers.

At least one upstanding folding finger such as 70 is mounted on endless carrier 47 with a fixed angular relationship to a link such as 49. While finger 70 is upstanding from a link 49 with its base portion 71 extending outwardly from the chain 48, the terminal portion 72 of the finger is bent forwardly in the direction of travel of the chain to form a hooked finger. It is this portion 72 that extends above the path of the articles 43 as the folding finger 70 accelerates around the curved end stretch 56 and then decelerates to travel along upper stretch 54. Because a smooth track 55 is provided for the link rollers 50 and 51 rather than a toothed sprocket, the folding action of finger 70 is smooth and chattering due to the chordal or polygonic action of the chain links or sprocket teeth is eliminated.

As shown in Fig. 3 the tip 73 of the terminal portion 72 first contacts the underside of a trailing flap 45 and, since it is following a curved path around the rod 59 as a fixed centre of rotation, tip 73 travels faster than article 43 to not only upfold, but also overfold the flap 45. As the article 43 and flap 45 advance and the portion 72 follows its curved path above the paper line 41, the tip 73 gradually slips up the flap 45 and the flat flap engaging surface 74 of the finger 70 comes into contact with the flap as shown in Fig. 5.

The complete folding of a trailing flap through an angle of 180°, by a hooked folding finger such as 70 takes place in a short zone defined longitudinally of the machine by the forward and rear limits of the curved path of the terminal portion 72. It is not, therefore, necessary to hold down the body of the blank, in alignment with the path of the finger, over an elongated, extended zone by endless chain supported holddown members as is usually necessary with pivoted endless chain folding fingers operated by elongated cams.

Article holddown means is provided including a rigid arm 75, having a split base 76, fixed around a shaft 77, the shaft 77 being driven by any suitable means whereby its rotation is synchronized with the speed of conveyor 42 and endless carrier chain 48. Arm 75 is of less length than the distance between shaft 77 and the path of articles 43 along paper line 41 in order that its terminal end 78 will not strike the advancing articles 43. A flexible, resilient holddown member 80 trails rearwardly from the end 78 of arm 75 preferably at about a right angle thereto, member 80 being of spring metal or the like to flex upon contact with, and press resiliently down on an article 43. The terminal end 81 of member 80 is arranged to extend below paper line 41, if no article 43 were present, but to contact each successive article passing thereunder on conveyor 42 with end 81 just in advance of the line of articulation 46. As arm 75 rotates, the end 81 of member 80 advances with the article 43, its terminal portion flexed upwardly and pressing down on the body of each article 43 with a resilient holddown pressure. Any bow in the articles 43 is thus pressed flat while the portion 72 of fingers 70 upfold the trailing flap 45 on line 46 and during the down fold the member 80 continues in an upward rotary path out of the way of the descending flap 45, as shown in Fig. 5.

As indicated in Fig. 5 the hooked, or forwardly bent, portion 72 of finger 70 performs an important flap holddown function. The portion 72, as it travels along upper stretch 54 of carrier 47 may extend parallel to the paper line 41 or may be inclined slightly upwardly therefrom, but in any case it entirely or partially overlies the folded flap 45 to hold it down in infolded position. However, since the upper stretch 54 of chain 48 is traveling more slowly than the articles 43 on conveyor 42, the folded trailing flap 45 gradually draws away from the portion 72 until as indicated in Fig. 7 it is completely free thereof and enters under a holddown bar such as 83. This occurs in time for finger 70 to rotate downwardly around the outgoing, or forward end stretch 82 of carrier 47 without striking the flap 45 or article 43.

Preferably the driving means for holddown member 80, as shown in Fig. 8, includes a pair of enmeshed gears 84 and 85 having predetermined speed change cycle and preferably oval, gear 84 being fixed to shaft 77 and gear 85 being carried by a shaft 86. A chain 87 is trained around a sprocket 88 on shaft 86, an idler sprocket 89 and a sprocket 90, the sprocket 90 being fixed to shaft 53 which drives chain 48 of endless carrier 47. The oval gears cause arm 75 and member 80 to advance at the same speed as articles 43, when member 80 is initially engaged therewith and then cause the arm 75 and member 80 to rotate rapidly out of the way of the article to clear the fingers 70 and the overfolded flap and to engage the next succeeding article 43. Two complete speed cycle changes occur with each revolution of the gears whereby two holddown arms 75, with their flexible members 80 may be used if desired with four folding fingers 70 on a single carrier by suitable synchronization of the machine well understood in the art.

Preferably also, while the flap folding fingers 37 or 70 are normally at a fixed anglular relationship to the portion of the carrier by which they are carried, and thus are normally non pivotally mounted, safety release means are provided for releasing the fingers under abnormal stress. As shown in Figs. 9–11, a flap unfolding finger 91, similar to fingers 37 or 70, is provided with a tongue 92 depending from its base 93, there being a correspondingly shaped, open ended V shaped groove 94 facing outwardly from a bracket member 95 carried on a link 49, by bolts or the like. At least one laterally recessed ball socket 96 is provided in the tongue 92 of base 93 of finger 91, in which a ball 97 is pressed by a spring 98 mounted in a spring recess 99 intermediate of the length of a wall of groove 94 in bracket 95. Under normal operating conditions the spring pressed ball 97 holds the finger 91 in a fixed upstanding position relative to link 49 of a chain 48. Upon a jam, or other malfunction occurring, however, the extra pressure on the flap engaging surface of the finger 91 in any direction causes socket 96 to be released from ball 97 and permits the finger 91 to yield and slide out of the groove 94 to drop on the floor before it can damage an article 43 or do damage to itself.

I claim:

1. Mechanism in a folding machine for folding a trailing articulated flap of a flat foldable article on a lateral fold line while the article is continuously advanced along a path of said folding machine at a predetermined speed; said mechanism comprising an endless carrier having a straight upper stretch extending substantially parallel to, but under, said article path and having an incoming and an outgoing curved end stretch each extending in a parti-circular path around an axis of rotation transverse to and under the said article path; means supporting said endless carrier in a plane normal to said article path; synchronized drive mechanism advancing said endless carrier with said upper stretch travelling at less speed than the speed of advance of said article and an upstanding flap folding finger, immovably mounted on said endless carrier and having a portion adapted to extend above the path of, and forwardly in the direction of travel, of said article near the end of said incoming parti-circular path, said portion being at a spaced distance from said axes of rotation and travelling around said incoming parti-circular path at greater speed than the speed of advance of said endless carrier to overfold a trailing flap on its lateral fold line and thereafter travelling at lesser speed than said article along the upper stretch of said endless carrier to lag behind and clear said lateral fold line before travelling around the outgoing curved end stretch of said carrier.

2. Mechanism as specified in claim 1 wherein said endless carrier is a link chain, said upstanding flap folding finger is non pivotally fixed to a link of the chain to maintain a constant angular relationship to the link and the forwardly extending portion of said finger when travelling along said upper stretch is substantially parallel thereto for holding a folded flap in overfolded position therealong.

3. Mechanism as specified in claim 1 wherein said endless carrier is a roller link chain, said flap folding finger is rigidly mounted on a link of the chain and said carrier includes a stationery smooth track supporting the rollers of the chain on said incoming curved stretch and on said straight upper stretch for avoiding chordal and polygonic action of the links of said chain during folding.

4. Mechanism as specified in claim 1 plus an arm rotatable on an axis of rotation transverse to, and above the path of advance of said article; a flexible holddown member trailing rearwardly from the terminal end of said arm, adapted to press resiliently down on the upper surface of the article during part of its path, and synchronized drive means rotating said arm and member in a circular path, said member being arranged to advance with and resiliently hold down said article in advance of the line of articulation of the trailing flap while said flap folding finger folds the flap from in rear of said line of articulation.

5. Mechanism as specified in claim 4 wherein said flexible holddown member and said upstanding flap folding finger both travel in a common vertical plane longitudinally of said machine and said synchronized drive means includes speed change cycle gears for enabling said member to clear said finger and the flap overfolded thereby.

6. Mechanism as specified in claim 4 wherein said synchronized drive means includes a pair of gears having a predetermined speed change cycle for rotating said arm in synchronization with the rate of advance of an advancing article to resiliently hold the article down just in advance of said lateral fold line during overfolding and

thereafter to advance at a greater speed than the article and finger to clear the path of said finger and flap.

7. Mechanism as specified in claim 4 wherein said synchronized drive means includes a pair of enmeshed oval gears, said oval gears having two speed change cycles in each revolution thereof, for rotating two oppositely disposed arms in synchronization with the rate of advance of an article and the rate of advance of a flap folding fingers on said endless carrier.

8. Mechanism as specified in claim 4 wherein said flexible holddown member trails rearwardly from said arm at substantially a right angle for resiliently pressing down a substantial longitudinal strip of an article during folding to flatten the same during folding.

9. Mechanism as specified in claim 4 wherein said arm is of less length than the distance between its centre of rotation and the path of said article but the distance between the terminal portion of said trailing member and the arm centre of rotation is greater than the distance from said centre to the article path whereby the terminal portion of said member would extend below the article path except for the presence of an article in its path.

10. Mechanism as specified in claim 1 plus safety release means at the junction of said upstanding flap folding finger and its endless carrier for enabling said finger to yield under excessive stress on said forwardly extending portion in any angular direction in a longitudinal plane.

11. Mechanism as specified in claim 10 wherein said safety release means includes a block fixed to said carrier and provided with an open ended groove extending longitudinally along and facing outwardly from said carrier; a tongue depending from the base of said folding finger, said tongue conforming in shape with, and seated in, said groove and being slidable endwise or outwardly from said groove and a resilient, yieldable ball and socket connection positioned intermediate of the length of said tongue and groove for securing said tongue in said groove under normal stress but releasing said tongue from said groove under abnormal stress on said finger.

12. Mechanism as specified in claim 1 plus a ball socket at the base of said finger and a spring pressed ball seated in said socket and carried on said endless conveyor, said spring pressed ball and socket being arranged to normally hold said finger in a fixed position relative to the carrier, but to release said finger from said position under abnormal stress on said forwardly extending portion in any angular direction in a longitudinal plane.

13. Mechanism for infolding a trailing articulated flap of a flat box blank while the blank advances along the paper line of a folding machine at a predetermined speed, said mechanism comprising an endless carrier chain having a substantially straight upper stretch advancing parallel to, but below the plane of said paper line and having a curved end stretch advancing in a particircular path around an axis of rotation transverse to, and below said paper line; means supporting said chain; synchronized mechanism driving said chain with said upper stretch advancing at less speed than the speed of a blank, and a flap folding finger, having an upstanding base portion rigidly, and non-pivotally, fixed to a link of said carrier chain and having a terminal portion bent in the direction of travel of said chain, said terminal portion describing a parti-circular path at a spaced distance from said axis of rotation and extending above the paper line near the end of said parti-circular path thereby travelling at greater speed that the speed of said trailing flap of said blank to infold the same forwardly and travelling at lesser speed than said blank along the upper stretch of said chain to permit the folded flap to pass from thereunder after such infolding.

14. Mechanism as specified in claim 13, plus an arm rotatably mounted above the paper line on an axis of rotation transverse to the paper line; synchronized drive means for rotating said arm and a flexible, resilient holddown member trailing rearwardly from the terminal end of said arm, the tip of said holddown member advancing with the line of articulation of said flap and resiliently pressing down on said article during the infolding of the flap by said folding finger.

15. A device for folding forwardly a trailing flap of a flat box blank as said blank advances at a predetermined speed along a paper line, said device comprising a pair of spaced apart sprockets rotatably mounted to revolve in a longitudinally extending, vertical plane spaced below the path of said flap on said paper line; an endless chain trained around said sprockets and having oppositely disposed parti-circular end stretches and a horizontal upper stretch; at least one rigid hooked finger having its base immovably fixed to a link of said chain and having its terminal portion bent forwardly and slightly upwardly in the direction of travel of said chain and of said blank and means for revolving said sprockets to advance said chain along its upper stretch at less speed than the speed of advance of said blanks, whereby the terminal portion of said finger travels at greater speed than said blank when rounding the parti-circular end stretch of said chain for overfolding a flap forwardly and travels at less speed than said blank when advancing on the upper stretch of said chain for permitting the folded flap to pass from thereunder after such overfolding.

16. A flap folding finger for use on an endless carrier to fold a trailing flap of an advancing flat article, said finger comprising a block adapted to be fixed to an endless carrier, said block having a longitudinally extending V-shaped groove with each opposite end thereof open; a folding finger of rigid material having a flap engaging portion and a base portion; a longitudinally extending tongue depending from said base portion and slidably engageable in said groove, both downwardly and endwise thereof, a ball socket recessed laterally in said tongue and a spring pressed ball movable laterally in one wall of said groove and seated in said socket for yieldably resisting the sliding movement of said tongue in said groove.

17. An endless carrier for use in supporting and guiding a folding finger in a folding machine, said carrier comprising an endless roller chain; abutting side plates on the links of said chain for preventing whip thereof, a sprocket for supporting and driving said chain around one loop of its path; an inner smooth stationary rigid track curved around the opposite loop of said chain path and straight under the straight upper stretch thereof for supporting the rollers of said chain against chordal, polygonic action and an outer, smooth, stationary track extending partially along said opposite loop and along said straight stretch of said chain path for restraining said chain against outward movement due to centrifugal force.

18. A hold down device for use in paper box folding machines, said device comprising an arm of rigid material adapted to rotate on an axis of rotation transverse to the path of a foldable sheet through said machine, said arm being of less length than the distance from its axis of rotation to said sheet path and a flexible hold down member at the terminal end of said arm, said member being adapted to trail rearwardly from said terminal end during rotation of said arm, at substantially a right angle thereto, and being adapted to press resiliently down on the upper face of a foldable sheet, during part of its rotational path, for flattening and holding down said sheet while a flap thereof is overfolded on a lateral fold line.

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