This invention relates to improved apparatus for the continuous folding of articles, with particular reference to the folding of such articles as sanitary napkins, medical bandages and the like.

A primary object of the invention resides in the provision of a folding mechanism adapted continuously to iron-fold spaced articles fed thereto by a production line conveyor or the like.

A further object is to provide an improved folding mechanism operative at a speed at least equal to the output production speed of currently employed mechanisms for the automatic production of sanitary napkins.

Another object is to provide a continuously operative folding mechanism adapted to receive elongate bandages such as sanitary napkins from the output conveyor of automatic production equipment and to fold and deposit such bandages in involute configuration into a transfer mechanism in a manner to facilitate wrapping of the article thus folded by continuous production techniques.

Other objects and advantages will become apparent to persons skilled in the art upon examination of the drawings and the description, as will various modifications thereof, without departure from the inventive principles as defined in the appended claims.

In the drawings, in which like parts are identified by the same reference numeral,

FIG. 1 is a plan view, partly sectionalized, of folding mechanism employing the present concepts; FIG. 1a illustrating in plan an extension of the conveyor in FIG. 1 at the left end of the mechanism.

FIG. 2 is an elevational view, partially in broken section, of the device of FIG. 1; FIG. 2a illustrating in side elevational view the conveyor extension of FIG. 1a.

FIG. 3 illustrates in enlarged fragmentary plan the folding mechanism of the apparatus of FIG. 1.

FIG. 4 illustrates in enlarged fragmentary side elevation the folding mechanism shown in FIG. 2.

FIG. 5 is an enlarged side elevational view of the article transfer mechanism shown at the right side of FIG. 2.

FIG. 6 is an end elevation taken along lines 6-6 of FIG. 5, with portions of the mechanism broken away to illustrate constructional details.

FIGS. 7, 8 and 9 are partial transverse vertical sections through one of the conveyor-driven article supports shown in FIG. 2a in successive positions during movement through the folding mechanisms of FIGS. 3 and 4.

FIG. 10 illustrates an article having one end downfolded by a horizontal folding blade; FIG. 11 showing the one downfolded portion constrained within a passageway while the opposite end portion is downfolded by a second horizontal folding blade.

As shown in FIGS. 1 and 2, a conveyor fed folding mechanism, generally designated 10, includes an elongate frame structure 12 positioned horizontally above a floor surface, as by legs 14 and including a track portion 16 over which a double chain conveyor 18 continuously moves from left to right to return along a lower path during continuous movement between idler sprockets 20 at the left end of the conveyor, as shown, and driven sprockets 22 at the right end of the conveyor. Sprockets 22 are keyed to a drive shaft 24, coupled at 26 to a source of power 28, and shaft 24 is coupled to a second gear reduction device 32 which supplies driving power to a control shaft 34. Shaft 34, journaled at 36 and 38, is coupled to a second gear reduction device 49 from which additional power couples extend to drive two pairs of folding blades below described. Control shaft 34 is synchronously connected through reduction mechanism 32 with drive shaft 24, thus insures timing control between the various driven elements. The left end of conveyor 18 may be operatively associated with the output conveyor, not shown, of an automatic mechanism for the production of sanitary napkins, fed thereto at regular spaced intervals and sequentially transferred onto spaced article supports 42 fixed to extend transversely of conveyor chains 18 for continuous movement throughout the conveyor path. Supports 42 include a plate-like support area 44 and a trailing shoulder portion 46 preferably of a greater height than the thickness of an article such as a sanitary napkin 48 as positioned on support 42 in the symmetrical manner shown. To insure proper synchronization between a conveyor, not shown, and conveyor 18 both are preferably driven from the power source 28, the spacing between supports 42 and the speed of conveyor 18 being selected to insure sequential transfer of articles to the supports.

As sanitary napkin 48 is conveyed at a continuous speed from left to right as viewed in FIGS. 1 and 2, it moves under a pair of spaced rod-like constraining elements 50 and 52, left end portions 54 of which are swept upwardly by a feed throtto the central portion of napkin 48 as it moves thereunder firmly to be held along transverse lines which marginally define a central portion of napkin 48, which portion is maintained by elements 50, 52 against table area 44 of each article support 42. In this manner napkin 48 first moves into the operative paths of a pair of folding blades 56 and 58 mounted for like rotation toward the direction of conveyor travel about axes spaced longitudinally of the path of conveyor 18. Blades 56 and 58 are mounted on opposite sides of conveyor 18 as shown in FIG. 1 for rotation in vertical planes spaced laterally of each constraining element 50 and 52 approximately the thickness of the article to be folded.

As best shown in FIG. 4, blade 56 is mounted on a driven shaft 60 extending from gear box 40, FIG. 1, blade 56 being mounted on shaft 62 driven by gear box 66 coupled at 68 to a gear box 70 which is chain driven from shaft 34, FIG. 1, by sprocket 72. As napkin 48 approaches the path of blade 56, the outermost portion of that blade, moving clockwise as viewed in FIGS. 2 and 4, moves upwardly as shown in FIG. 7, to the FIG. 8 position, raising vertically the lateral portion of napkin 48 which previously extended outwardly of constraining rod 52. The configuration of blade 56 is such as to maintain the raised portion vertically positioned during continued movement of napkin 48 into the path of movement of the opposite downstream blade 58 which shortly thereafter moves upwardly from the FIG. 8 position to the FIG. 9 position to raise upwardly in a like manner the opposite end portion of the napkin to complete an upwardly open U configuration.

The pair of vertically rotatable blades 56 and 58, driven to rotate in a clockwise direction, as viewed in FIGS. 2 and 4, are synchronously meshed with a pair of horizontally rotatable spaced blades 74 and 76, also driven by shaft 34. As shown in FIGS. 1 and 3 blade 74 is mounted on a vertical shaft 78 radially journalcd to a gear box 80, and blade 76 is mounted on a vertical shaft 82, which is driven from gear box 70. Spaced blades 74 and 76 continuously rotate in a common horizontal plane above the path of article supports 42, both pairs of blades being synchronously locked to the speed
of shaft 34 which is driven from the common source of power which also drives conveyor 18.

As a sanitary napkin 48 moves downstream of the positions in which blades 56 and 58 have shaped napkin 48 into upwardly open U configuration, the napkin first moves into the path of movement of horizontally rotating blade 74, which is actuated by a counter-clockwise-worked motor through the position shown in FIG. 3 to a position of contact between a linear blade edge portion 94 and the vertically positioned napkin portion 86, FIG. 3. Further rotative movement of blade 74 downfolds article portion 86 against a central napkin portion, blade 74 passing therewith to retain that portion depressed. As napkin 48 moves further downstream, the opposite end portion which has previously been raised to a vertical position as shown at 68, FIG. 3, by blade 58, is engaged by linear portion 90 of blade 76. Further rotation of blade 76 in a clockwise direction results in the downfolding of napkin portion 86. Napkin 48, with both ends thus downfolded against the central portion thereof then moves under a restraining guard member 92, arcuate relieved at 94 for close clearance of blade 74, and relieved at 96 for similar clearance of blade 76.

As best shown in FIG. 3, the spaced folding rods 59 and 53, about which the lateral portions of napkin 48 are first folded into vertical position by blades 56 and 58 and about which the vertically positioned portions are thereafter downfolded by horizontal blades 74 and 76, extend under guard 92 and terminate at about the non-relied portion thereof, as shown at 98, FIG. 4, the folded napkin thereafter moving beyond rods 50, 52 toward a transfer mechanism 100, while being retained in folded configuration by guard 92.

Since it is desired involuntarily to fold napkin 48, lateral portions of which have first been elevated and then downfolded into a generally C configuration as above described, a chute-like passageway is defined by guard 92 above the path of movement of article supports 42 upon which the C-folded napkin rests, and extending in a downstream direction past a transfer mechanism 100 which functions to remove each C-folded napkin from its conveyoretained, and thereafter through a linear path to a position of registry with a folding and ejection chute 102, FIG. 5. Rotatably mounted tucker fingers 184 then force the napkin downwardly through chute 102 and into a well 106 of an indexing turret 108 to be individually rotated during sequential turret movement into a plurality of turret stations as described in applicants' co-pending applications Serial No. 132,918, (now U.S. Patent No. 3,045,239) and Serial No. 132,947 filed concurrently herewith.

As napkin 48 are individually fed from a supply conveyor, not shown, onto article supports 42, a substantially central portion thereof is supported on the table-like portion 44 of each support and thereafter constrained by folding rods 50 and 52 while the lateral portions thereof extend unsupported beyond each side of the table area 44. The articles to be folded, such as sanitary napkins, are sufficiently form-sustaining to require no additional support for those laterally extending portions during conveyor movement past the two pairs of folding blades and underneath guard 92. After downfolding of the upstanding and initially laterally extending unsupported portions the resulting C-folded napkin is fully supported by table area 44. However, since the function of transfer mechanism 100 is to remove each C-folded napkin 48 from its article support for further conveyance through linear path beyond the conveyor, a trough forming element 110 is provided to extend in the horizontal plane of article support tables 44 to provide bottom support for the C-folded napkins 48 after removal from article supports 42 and conveyance to a position of registry with feed chute 102. Element 110 is suitably positioned to allow clearance of supports 42 past the upstream end thereof while receiving the C-folded napkins during outward movement therefrom by transfer mechanism 100.

As best shown in FIGS. 5 and 6, transfer mechanism 100 comprises a vertical framework 112 for the support of a gear box 114 elevated above the conveyor path. Shaft 116 is journaled to extend horizontally from gear box 114 to be rotatably driven from shaft 34 by chain 118 and engaged sprocket chains. A link-type pawl mechanism, reciprocally driven by shaft 116, includes a radial arm 124, fixed thereto, a connecting rod 126 of adjustable length journaled at 128 to the free end of arm 124, and a pair of spaced pawls 130 slidably mounted on a track mechanism 132 to the free end of rod 126 for reciprocating movement thereof formed by element 110 and guard 92 with lower pawl portions extending into the trough through lateral channels 133 defined by marginally relieved portions of guard 92.

As shown in FIG. 6, mechanism 132 includes a track formed by a pair of channel bars 134 and 136. Shaft 138 is mounted on guide bearings 140 to slide along the track, rod 126 being journaled to shaft 138 at 142. Pawls 130, spaced inwardly of bearings 140, are biased to the position shown in FIG. 5 by a pair of helical springs 144, anchored in fixtures element 146. Rotation of shaft 116 moves the pawl mechanism from the heavy to the dotted line position shown in FIG. 5 and upon subsequent retraction to the heavy line position, pawls 130 move in a linear path adjacent the relieved margins of guard 92 with the lower ends thereof in contact with the bottom wall 110 of the transfer trough. Pawls 130 are retractable in a direction counter to their normal spring biased position to allow their passage over a successively fed napkin. As shown in FIG. 1b, the trailing shoulder 46 extending upwardly of the table of each article support 42 is confined to a lateral area of the table, thus permitting spaced pawls 130 to move past opposite sides thereof during movement of the transfer mechanism from the heavy to the dotted line position of FIG. 5, during which folded napkin 48 is pushed through the transfer trough from the FIG. 5 position to a position of registry with ejection trough 102, its article support 42 having passed downwardly over sprocket 22 to enter its return path.

The present invention is directed to the concepts inherent in the above described mechanism for C-folding of sanitary napkins or the like and subsequent transfer thereto to a position of registry with an ejector chute. The relation of tucker blades 184, in respect to the chute for the involute folding and transfer of the napkin to a wrapping turret is illustrated in FIG. 6, although the tucker mechanism is not a part of the present invention and is disclosed in detail and claimed in applicants' above mentioned co-pending application Serial No. 132,947 as part of the wrapper turret mechanism.

A plurality of circumferentially spaced tucker fingers 104, FIG. 6, are positioned radially outwardly of a driven shaft 148 to rotate clockwise through a circular path. Fingers 104 engage a central portion of napkin 48 when in registry with chute 102 to feed the napkin downwardly through the chute and into turret well 106 which moves into registry with chute 102 as the turret rotates counter-clockwise. The napkin is thus involutely folded as deposited in well 106, and a suitable mechanism thereafter axially retracts tucker finger 104. The turret thereafter moves the folded portions and a conveyo-step motion into various work stations ultimately to complete a wrapping operation in accordance with concepts taught in said co-pending applications.

We claim:

1. In folding apparatus, the combination with a plurality of article supports, and for the linear movement of said supports in mutually spaced relation in a horizontal plane, of a pair of spaced folding elements positioned on opposite sides of the path of said.
supports and mounted for like rotation in vertical planes about axes spaced in the direction of conveyor movement, a second pair of spaced folding elements mounted for like rotation in a horizontal plane or in the path of said article supports, the element of said last mentioned pair being mounted for rotation about axes spaced longitudinally of said path, the path of said first pair of elements intersecting the path of said second pair of elements, means synchronously driving said first and second pairs of elements to prevent interference therebetween, and means continuously driving said conveyor and said two pairs of rotatable elements.

2. In folding apparatus, the combination with a plurality of spaced article supports and a conveyor for linear movement of said supports in a horizontal plane, of a pair of spaced folding elements closely positioned on the opposite sides of the path of said supports and mounted for like rotation in vertical planes about axes spaced longitudinally of said path, a second pair of spaced folding elements mounted for counter rotation in a horizontal plane above the path of said article supports and intersecting the paths of said first mentioned folding elements, means synchronously driving said conveyor and said two rotatable elements to prevent interference between said elements and an elongate member in parallel spaced relation to and above the path of said article supports and extending through the positions of said two pairs of folding elements.

3. In folding apparatus, the combination with a plurality of spaced article supports and a conveyor for the movement of said supports in a linear path, of a pair of spaced folding blades closely positioned on the opposite sides of the path of said supports and mounted for like rotation in vertical planes about axes spaced longitudinally of which leads the other in the direction of conveyor movement, a second pair of spaced folding blades mounted for counter rotation in a horizontal plane above the path of said article supports about axes spaced in the direction of conveyor movement, the trailing axis of said second pair being positioned downstream of the leading axis of said first pair, the paths of said first and second pair of blades having portions of mutual intersection, means synchronizing said blade pairs to prevent interference therebetween and an article constraining member positioned above the path of said article supports and extending from a position upstream of said first pair of folding blades to a position downstream of said second pair of folding blades.

4. In folding apparatus, the combination with a plurality of spaced article supports and a conveyor for the movement of said supports in a linear path, of a pair of spaced folding blades closely positioned on the opposite sides of the path of said supports and mounted for like rotation in vertical planes about axes spaced longitudinally of which leads the other in the direction of conveyor movement, a second pair of spaced folding blades mounted for counter rotation in a horizontal plane above the path of said article supports about axes spaced in the direction of conveyor movement, the trailing axis of said second pair being positioned downstream of the leading axis of said first pair, the paths of said first and second pair of blades having portions of mutual intersection, means synchronously driving said blade pairs to prevent interference therebetween, means for constraining the central portions of said article supports during movement past said two pairs of folding blades, and an article constraining member positioned above the path of said article supports and extending from a position adjacent the downstream blade of said second pair of folding blades, said second pair of folding blades further supporting portions of the supported articles against upward displacement during conveyance away from said blades, whereby said first mentioned blades sequentially raise vertically lateral portions of articles carried by said supports, and said horizontally rotatable blades thereafter sequentially fold inwardly said vertically positioned article portions against the central portion thereof.

5. In a device for folding bandages and the like, a stationary frame, a conveyor mounted in said frame, spaced supports mounted on said conveyor for the movement of articles through a linear path, means for sequentially feeding articles to be folded onto said supports, a pair of vertically rotatable blades positioned laterally and spaced longitudinally of the path of said supports, a pair of spaced folding elements positioned in a common plane above the path of said supports and mounted on axes spaced from the axes of said first mentioned blades in the direction of conveyor movement, the paths of said blade pairs having overlapping portions, and means synchronously driving said blade pairs to prevent interference between said blade pairs, and means for the continuous movement of said conveyor and the continuous rotation of said blades, whereby a foldable article, positioned on one of said support with portions extending laterally thereof is sequentially folded into an upwardly open U configuration by said first mentioned blades and thereafter the portions forming the legs of the U are downfolded by said second mentioned blades against the central portion of the article.

6. In a device of the character described, means for conveying a horizontally positioned foldable article through a linear path means for constraining the central portion of said article during conveyance with lateral portions thereof non-constrained, a pair of folding blades spaced in the direction of conveyor movement mounted for vertical rotation on opposite sides of said conveyor path, means for driving said blades in like rotation, said non-constrained article portions being conveyed into the path of said folding blades to be raised vertically thereby, and a pair of spaced folding blades driven in counter-rotation about axes spaced longitudinally of said paths and disposed in a horizontal plane spaced above the path of said article and partially overlapping the path of said first mentioned blade, and within the path of said upwardly raised portions of said article to effect down-folding thereof against the constrained central portion of said article, said pairs of blades having relieved portions, and means synchronously driving said blades to prevent interference therebetween.

7. The device of claim 6 including means for transferring the folded articles from said constraining means and means for thereafter center folding the article into involute configuration.

8. Apparatus for the folding of articles comprising in combination, means for the conveyance of spaced articles along a linear path while positioned transverse to the direction of movement, means for the support of the central portion of said articles during conveyance along said path, means fixed to extend along and above said path to constrain the central portions of said articles against upward displacement during movement thereunder, a pair of folding blades spaced laterally of said constraining means and driven in like rotation toward the direction of conveyor movement through paths vertically of the path of said articles, said folding blades being mounted on axes spaced longitudinally of said path of article conveyance, and a second pair of folding blades mounted for counter rotation in a common plane spaced horizontally above said path of article conveyance, the paths of said first blade pair partially overlapping the paths of said second blade pair, and means synchronously driving said blade pairs to prevent interference therebetween, whereby conveyance of a supported and centrally constrained article through the paths of said blade pairs, and the other of said vertically mounted folding blades results in first one and then the other of the non-constrained lateral portions thereof being folded vertically about said constraining means into an upwardly open U configuration, and further conveyance of the article as thus folded into the path of movement of said horizontally rotating
7 folding blades results in first one and then the other of said upwardly folded portions being downfolded against the constrained portion of said article.

9. In a device for the folding of bandages or the like, a continuous conveyor provided with equally spaced article supports for the conveyance of bandages through a linear path with central portions thereof resting on said supports and end portions extending laterally therefrom, means spaced above and extending along the path of article conveyance in constraining engagement with the supported central portions of said bandages, a pair of folding blades closely spaced on opposite sides of said path, said blades being mounted for rotation in vertical planes spaced in the direction of conveyor movement and driven in like rotation to fold upwardly the lateral unsupported portions of said bandages about fold lines defined marginally of said restraining means, a pair of folding blades positioned downstream of said first blades and mounted on vertical axes spaced longitudinally of said path for counter-rotation in a horizontal plane through paths that intersect the paths of said first mentioned blades and spaced closely above the path of said bandages to C-fold said upwardly positioned portions against the central bandage portion thereof, means synchronously driving said first and second blade pairs to prevent interference therebetween, means maintaining said bandage folded while continuing linear movement away from said folding blades, said last mentioned means comprising a guide element extending along said path and positioned thereabove for engagement by the upper surfaces of said C-folded bandages, and means associated with the downstream end of the conveyor for removing said bandages from the conveyor supports and continuing further movement thereof in a linear path while constrained in folded configuration.

10. The device of claim 9, wherein said folding elements are of blade configuration.

11. The device of claim 9 wherein said folding elements are of blade configuration with all portions thereof lying in a common plane.

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