

- [54] **TEXTILE FOLDING APPARATUS**
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- [52] **U.S. Cl.** **223/37**
 [51] **Int. Cl.**..... **A41h 33/00**
 [58] **Field of Search** 223/1, 37; 270/66, 86, 270/93, 94, 62, 61 R, 61 F; 38/2

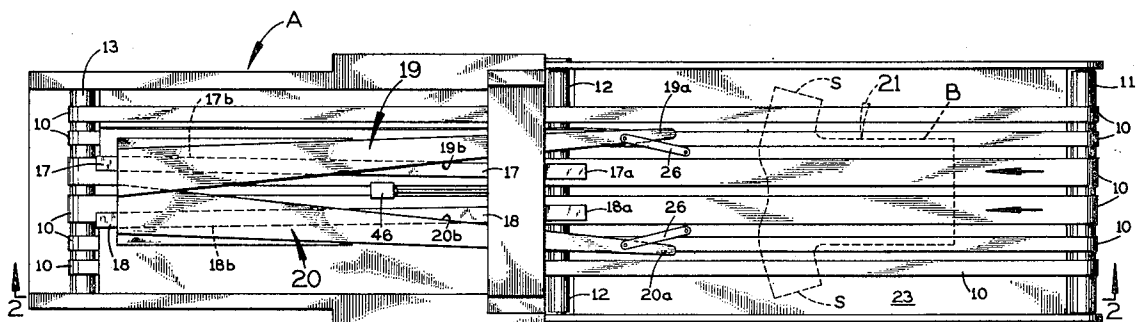
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[57] **ABSTRACT**

An apparatus for folding a T-shirt or other textile article as it is advanced by a conveyor. The middle of the article passes under guide plates that closely overlie the conveyor. The article is folded in from opposite sides over the top of these guide plates by overlying folding plates with inner folding edges that converge toward one another. The opposite side extremities of the article where it is the widest (such as the sleeves of a T-shirt) slide over the top of the folding plates and they are folded out over the top of the in-folded side portions of the article.

13 Claims, 7 Drawing Figures



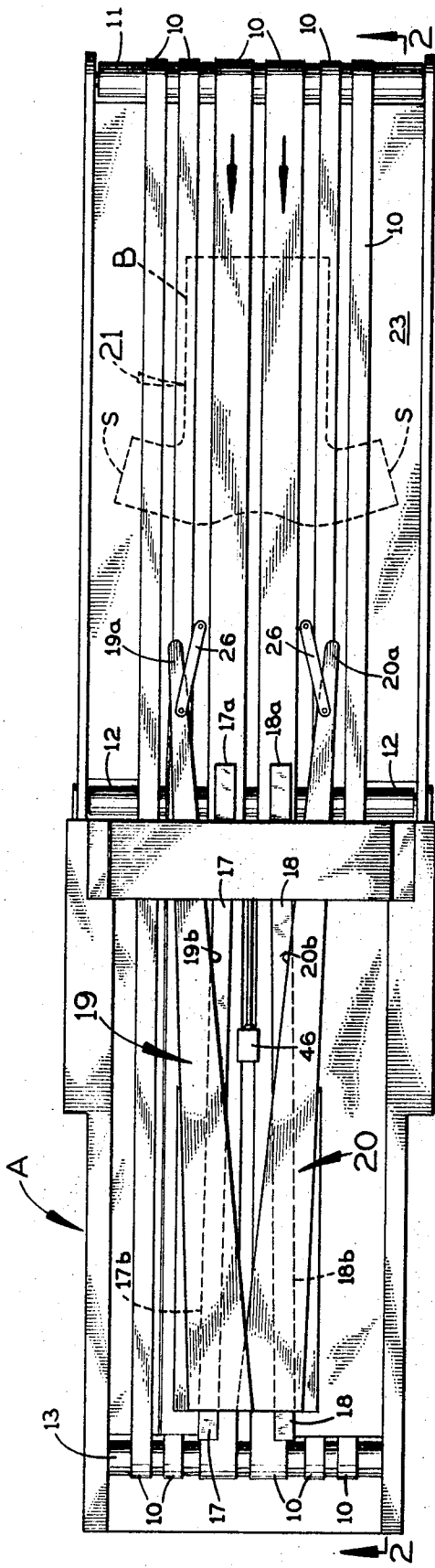


FIG. 1

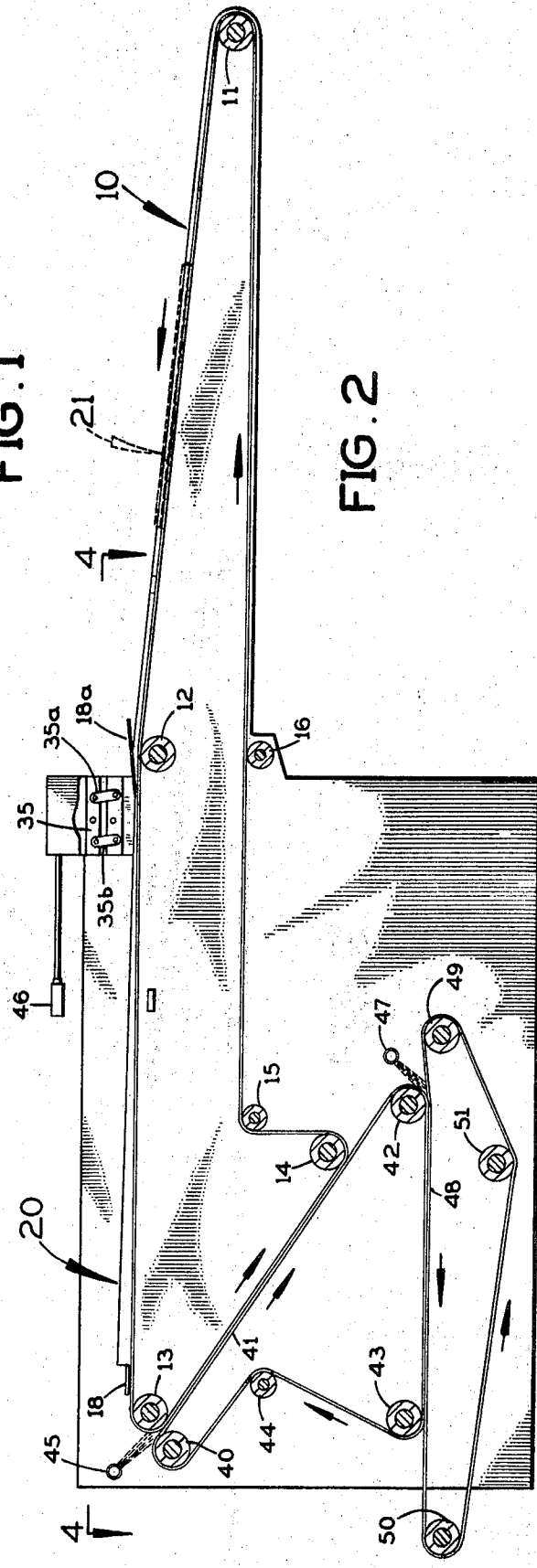


FIG. 2

FIG. 3

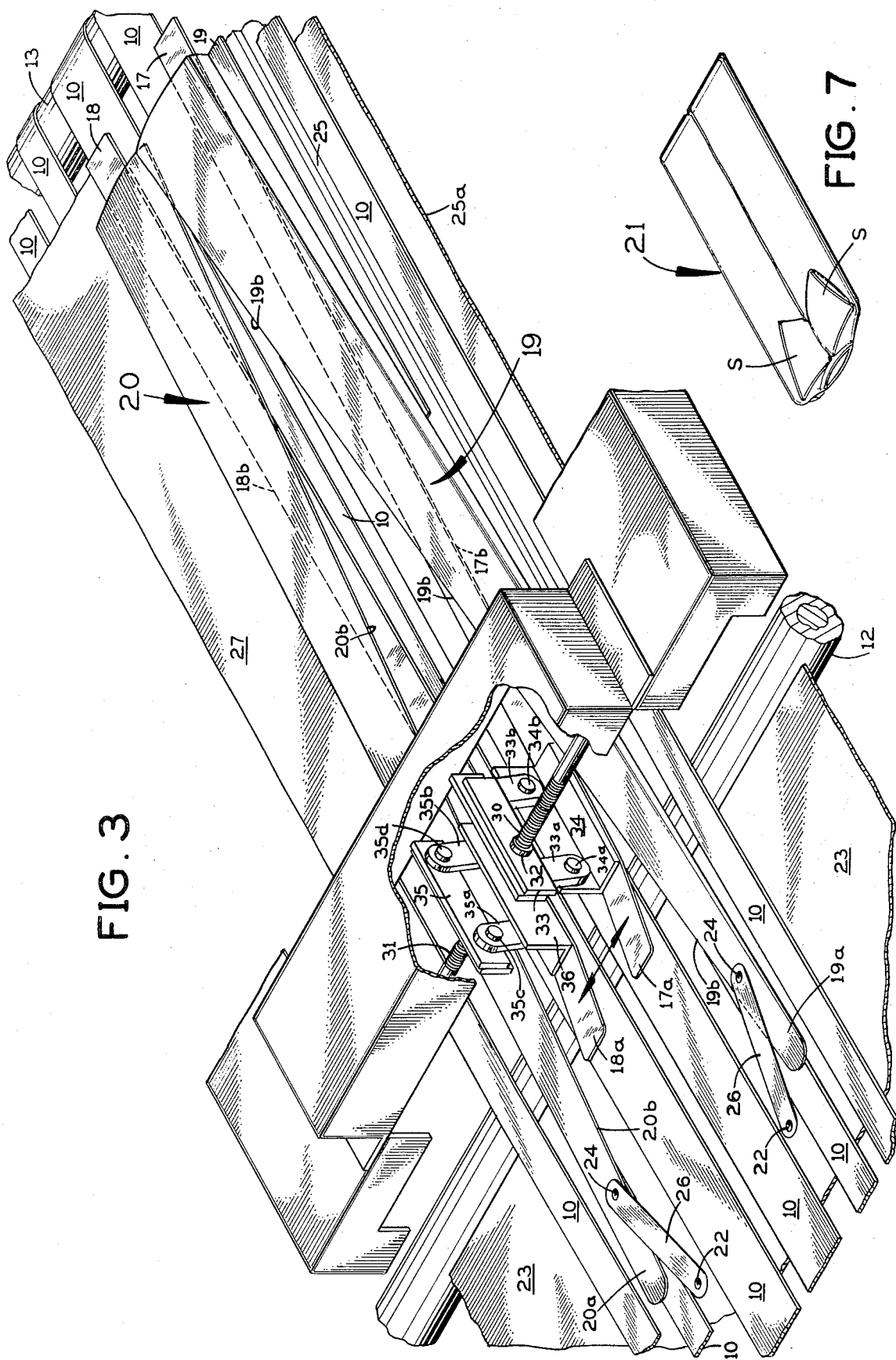


FIG. 7

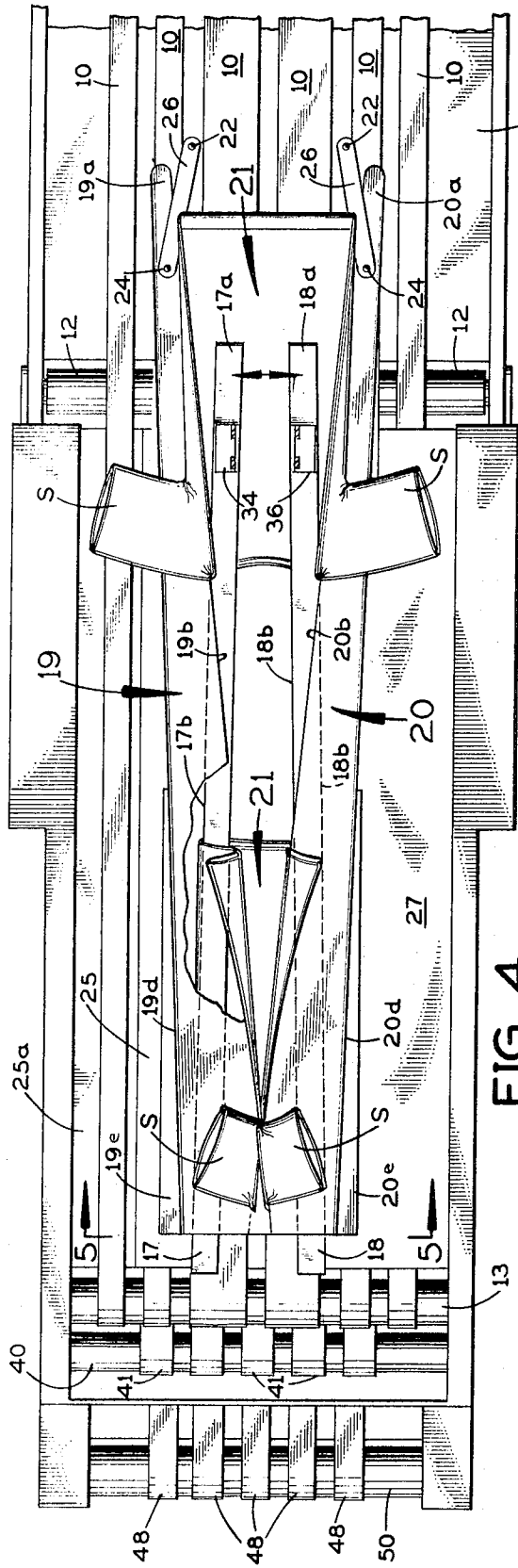


FIG. 4

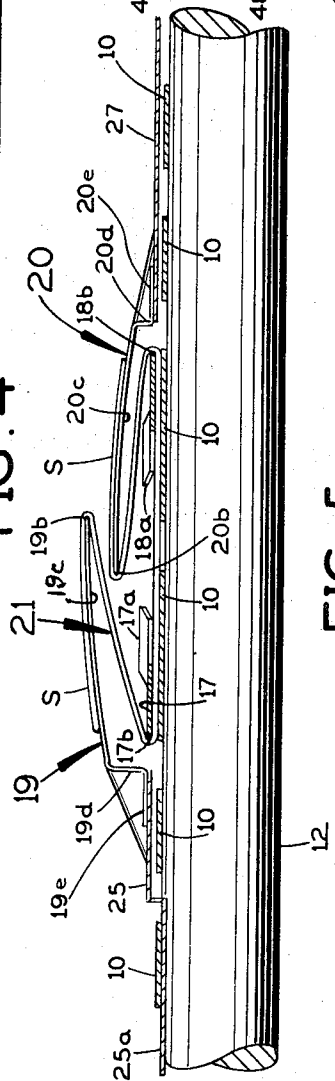


FIG. 5

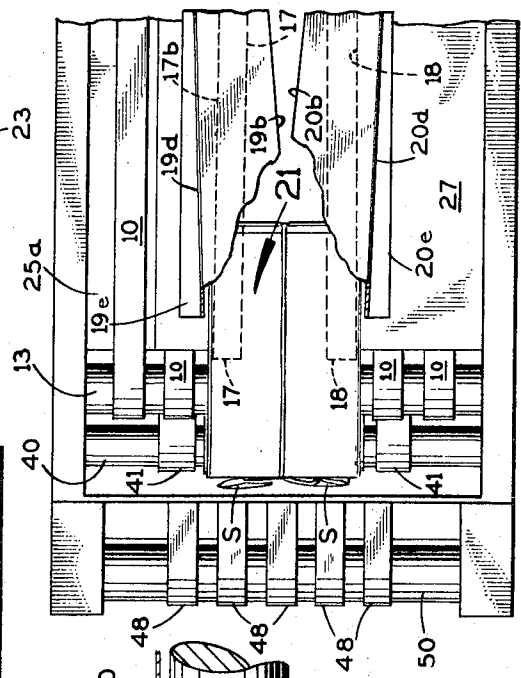


FIG. 6

TEXTILE FOLDING APPARATUS

BACKGROUND OF THE INVENTION

Various textile folders have been proposed heretofore in which, at one stage or another, a textile article on a conveyor is folded along one or two lines extending longitudinally of the direction of the conveyor. Such prior folders have been intended primarily for folding textile articles of uniform width, such as sheets and towels, but they are not completely suitable for folding articles of non-uniform width, such as T-shirts which are wider at the sleeves than in the body.

SUMMARY OF THE INVENTION

The present invention is directed to a novel apparatus for folding textile articles in a different manner that is especially advantageous for articles of non-uniform width, such as T-shirts.

A principal object of this invention is to provide a novel and improved apparatus for folding textile articles such that the article is folded in over the middle from opposite sides and then is folded out over these folded-in portions.

Another object of this invention is to provide such an apparatus for folding T-shirts by folding in the opposite side portions of the shirt over the middle and then folding out the sleeves over these folded-in side portions.

Further objects and advantages of this invention will be apparent from the following detailed description of a presently-preferred embodiment thereof, which is shown in the accompanying drawings, in which:

FIG. 1 is a top plan view of a complete folding machine which embodies the folding apparatus of the present invention;

FIG. 2 is a front elevational view of this machine;

FIG. 3 is a fragmentary top perspective view, partly broken away for clarity, showing the essential parts of the present folding apparatus in the FIG. 1 machine;

FIG. 4 is a top plan view of the FIG. 3 apparatus and shows two T-shirts in successive stages of the folding sequence;

FIG. 5 is a vertical cross section taken along the line 5—5 in FIG. 4 at the exit end of this folding apparatus;

FIG. 6 is a fragmentary top plan view of the exit end of the folding apparatus, with parts broken away for clarity;

FIG. 7 is a perspective view showing a folded T-shirt as it comes out of the present folding apparatus in the machine.

Before explaining the disclosed embodiment of the present invention in detail, it is to be understood that the invention is not limited in its application to the details of the particular arrangement shown, since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.

Referring first to FIGS. 1 and 2, the machine has an endless conveyor comprising several laterally spaced, flexible, endless belts 10 which extend from a roller 11 at the right end in these Figures to the left and upward at a slight angle. The forward direction of the upper run of this endless belt conveyor is from right to left in FIGS. 1, 2 and 4, and from left to right in FIG. 3. The

belts 10 extend across the top of a roller 12 at the entrance end of the longitudinal folding apparatus A, and from this roller they extend horizontally to a roller 13 and then back down at an acute angle to the right, up around a lower roller 14 and then up around a roller 15 and horizontally across a roller 16 and back to the first-mentioned roller 11. One of these rollers is driven from an electric motor (not shown) and the others are idler rollers that are rotated by the movement of the conveyor belts 10.

The longitudinal folding apparatus includes a frame A and has guide plate means in the form of a pair of laterally spaced, laterally adjustable guide plates 17 and 18 which are closely spaced above the middle conveyor belts 10. These guide plates extend horizontally, except at their entrance end segments 17a and 18a (FIG. 3), which incline downward and forward to where they are joined to the horizontal major portions of these plates. As shown in the drawings, these guide plates are flat. However, it is to be understood that they may have rounded, depending flanges along their outer and inner longitudinal edges. Both guide plates 17 and 18 extend generally longitudinally in the direction of forward movement of the upper run of the conveyor belts 10, but they diverge laterally outward at a slight angle in the forward direction, so that the laterally outward edges 17b and 18b of guide plates 17 and 18, respectively, become progressively farther apart laterally of the conveyor in the forward direction of the conveyor's movement beneath them.

First and second longitudinally coextensive folding plates 19 and 20 are provided for folding a textile article over the guide plates 17 and 18, respectively. As shown in phantom in FIG. 1, this textile article is a T-Shirt 21 that is substantially wider at the sleeves S than at the body B of the shirt. The guide plates 17 and 18 are adjusted laterally so that the maximum spacing between their outer edges 17b and 18b is less than half the maximum width of the textile article (at the sleeves S), and preferably is half the width of the textile article at the body portion B.

As best seen in FIG. 3, the folding plate 19 has an entrance end segment 19a that is located in front of the entrance end of the guide plates 17, 18 and is inclined forward and upward from a position in which it contiguously overlies one of the conveyor belts 10 so as to permit the belt to pass beneath it with only a minimum clearance between them. A fastener strap 26 has one end pivotally attached at 22 directly to a flat, upwardly and forwardly inclined conveyor table 23 that is located directly beneath the conveyor belts in front of the entrance end of the guide plates 17 and 18. The attachment at 22 is located between two neighboring conveyor belts 10 slightly in front of the front end of folding plate 19. This fastener strap 26 is flat and it is inclined upwardly and forwardly from its connection at 22 to a pivotal connection of its opposite end at 24 to the inclined entrance end segment 19a of folding plate 19.

The folding plate 19 has an inner folding edge 19b that inclines upward and laterally inward along its entrance end segment 19a, and then continues horizontally at substantially the same laterally inward inclination with respect to the direction of movement of the conveyor belts 10 beneath. Throughout most of its extent forward, the folding plate 19 has a top surface 19c

(FIG. 5) that is convex transverse to the direction of conveyor movement.

The folding plate 19 has a depending, vertical, outer side wall 19d (FIG. 3) and a horizontal bottom flange 19e extending laterally outward from the lower end of this side wall. This bottom flange 19e rests on a flat, horizontal shelf 25 (FIG. 5) that closely overlies the second conveyor belt 10 inward from this side of the apparatus. This shelf has a downwardly-offset extension 25a that extends beneath the outermost belt 10 of the conveyor at this side of the apparatus.

The second folding plate 20 is essentially a mirror image of folding plate 19, except that its height at the exit end of the apparatus is substantially less, as best seen in FIG. 5. From this Figure it will be apparent that folding plate 20 crosses under folding plate 19 and is spaced vertically below it at the exit end. The parts of the second folding plate 20 are given the same letter suffixes as the corresponding parts of the first folding plate 19, and the detailed description of these parts will not be repeated. A fastener strap 26 (FIG. 3) attaches the entrance end segment 20a of folding plate 20 to the conveyor table 23 beneath the conveyor belts 10 in the same manner as the previously-described fastener strap 26 for the first folding plate 19.

At its exit end (FIG. 5) the second folding plate 20 has its downwardly-offset, horizontal, lateral flange 20e resting on top of a horizontal shelf 27 that closely overlies the second conveyor belt inward and the outermost conveyor belt at this side of the apparatus.

Referring to FIG. 3, the two guide plates 17 and 18, over which the textile article is folded, are laterally adjustable horizontally, transverse to the direction of forward movement of the conveyor belts 10 directly beneath them, by means of a pair of screw-threaded, horizontal rods 30 and 31 which overlie the conveyor transversely. The screw-thread inner end of rod 30 is engaged in a nut 32 carried by a plate 33. A pair of depending legs 33a and 33b are pivoted at their upper ends to this plate at locations spaced apart longitudinally of the conveyor. An angle iron 34 has its horizontal bottom leg welded or otherwise rigidly secured to the top of guide plate 17 and its upstanding vertical leg pivotally connected at 34a and 34b to the lower ends of the respective pivoted legs 33a and 33b.

The screw-threaded inner end of rod 31 is threadably received in a nut (not shown) carried by a plate 35. A pair of longitudinally spaced legs 35a and 35b have their upper ends pivoted to plate 35 at 35c and 35d, respectively. These legs are pivotally connected at their lower ends to an angle iron 36 attached to the top of the second guide plate 18.

Preferably, there is enough play in the pivotal connections to permit one or both guide plates 17 and 18 to be displaced upwardly by the textile article as it passes beneath, so as to prevent jamming.

Preferably, but not necessarily, the folding plates 19 and 20 are coupled to the corresponding guide plates 17 and 18 so as to be adjusted laterally in or out in unison with the guide plates.

In the operation of the folding apparatus as described thus far, as shown by the position of the T-shirt 21 in FIG. 1, the middle of the T-shirt will pass directly beneath the guide plates 17 and 18 as it is carried forward by the conveyor belts 10. The opposite side portions of the T-shirt, which are laterally beyond the guide plates 17, 18, respectively ride up over the fastener strap 21

and the entrance end segment 19a of guide plate 19 on one side and over the fastener strap 26 and the entrance end segment 20a of guide plate 20 on the other side.

As shown in FIG. 4, these opposite side portions of the T-shirt slide along the top of the respective folding plates 19 and 20, and the inner folding edges 19b and 20b on these plates gradually and progressively fold these side portions in over the top of the underlying guide plates 17 and 18. These inner folding edges 19b and 20b extend at equal and opposite acute angles to the direction in which the T-shirt is being advanced by the conveyor, and they are coextensive with each other longitudinally so that they fold in simultaneously the opposite side portions of the T-shirt while the middle of the T-shirt is passing beneath the guide plates 17 and 18.

If, as shown, the maximum lateral spacing between the outer edges 17b and 18b of these guide plates is equal to substantially half the width of the T-shirt at the body B, the opposite sides of the body of the T-shirt will be folded in so that their side edges will abut each other along the longitudinal centerline of the shirt.

However, the sleeves S will not be folded in, but instead they will slide over the top of the folding plates and will be folded out by the action of the inner folding edges 19b and 20b in cooperation with the guide plates 17 and 18 as the conveyor carries the shirt forward.

If desired, by spacing the guide plates 17, 18 closer together the opposite side portions of the T-shirt may be caused to overlap one another partially. Alternatively, by spacing the guide plates 17, 18 farther apart, the opposite side portions may be folded over so that they neither overlap nor adjoin each other.

With the inner folding edges 19b and 20b of the folding plates 19, 20 crossing over one another slightly at the exit end, as shown, the fold at one sleeve S will overlap the other sleeve slightly. However, if desired, the slight overlap of the folding plates may be omitted so that the fold line of one sleeve will abut directly against the fold line of the other or be spaced from it.

Referring now to FIG. 2, after emerging from this folding apparatus the longitudinally-folded T-shirt passes to the left over roller 13 and down over the adjacent upper roller 40 for a second endless belt conveyor 41. This conveyor presents a straight downwardly-inclined run from roller 40 down past roller 14 and around a lower roller 42, then horizontally to the left and up around another lower roller 43, and then up around an intermediate roller 44 to the upper roller 40.

The T-shirt is cross folded a first time by air jets that are discharged by a tube 45 located in front of and upward from the gap between rollers 18 and 40. The timing of these air jets is controlled by a photoelectric sensor 46, which senses the leading edge of each T-shirt and then, after a predetermined time delay that is determined by the speed of the conveyor belts 10, causes the tube 45 to discharge its air jets to cross-fold the longitudinally-folded T-shirt between rollers 13 and 40 at the desired location along the length of the T-shirt.

The T-shirt is cross-folded a second time by a second air jet tube 47 located near the lower roller 42 in the second conveyor. A third endless belt conveyor 48 passes up around a roller 49 and then more or less hori-

zontally beneath rollers 42 and 43 to the left in FIG. 2, down around a roller 50 and then under an intermediate roller 51 back up to roller 49. The air jets are discharged from tube 47, under the control of photocell 46, at a time when they will impinge on a line across the T-shirt where the second cross-fold is to be made. These air jets force the T-shirt between the conveyor belts 41 and 48 and underneath roller 42, so that it is carried to the left in FIG. 3 over to roller 50, where it is dropped or removed for ultimate packaging.

I claim:

1. In an apparatus for folding textile articles, said apparatus having a frame, and a conveyor for carrying the articles along a predetermined path including a substantially horizontal portion from an entrance end to an exit end of the apparatus, the improvement which comprises:

guide plate means mounted on said frame closely overlying said conveyor along said substantially horizontal portion of its path and having opposite outer longitudinal edges over which the articles may be folded,

a pair of folding plates having respective inner folding edges which extend from the entrance end of said guide means diagonally upward and laterally inward across said guide means from opposite sides thereof and then converge toward each other, overlying said guide means substantially horizontally, at opposite acute angles to the direction of the conveyor movement, said folding plates presenting respective top surfaces which slidably support the respective opposite marginal edge portions of the article while it is being folded over said guide plate means by said inner folding edges, and each folding plate having an inclined entrance end segment located in front of the entrance end of said guide plate means and extending forward and upward from a position contiguously overlying the conveyor,

and a pair of fastener straps, each having a fixed connection at one side of the entrance end segment of a respective folding plate and inclined forward and upward from said fixed connection to a connection to said entrance end segment of the respective folding plate.

2. An apparatus according to claim 1, wherein the top surfaces of said folding plates are convex transverse to said folding edges.

3. An apparatus according to claim 1, wherein said folding plates are substantially coextensive with each other longitudinally.

4. An apparatus according to claim 1, wherein said folding edge of one folding plate crosses over said edge of the other folding plate close to the exit end of said guide plate means.

5. An apparatus according to claim 1, wherein said connection of each fastener strap to the respective folding plate and said fixed connection of each fastener strap are pivotal connections.

6. An apparatus according to claim 1, wherein said conveyor comprises laterally spaced flexible belts, and further comprising a table directly underlying said conveyor belts beneath said entrance end segments of the

folding plates, and wherein each fastener strap is connected to said table between neighboring conveyor belts.

7. An apparatus according to claim 6, wherein each fastener strap is pivotally connected to said table and is pivotally connected to said entrance end segment of the respective folding plate.

8. In an apparatus for folding textile articles, said apparatus having a frame, and a conveyor for carrying the articles along a predetermined path including a substantially horizontal portion from an entrance end to an exit end of the apparatus, and guide plate means mounted on said frame closely overlying said conveyor along said substantially horizontal portion of its path and having opposite outer longitudinal edges over which the articles may be folded, the improvement which comprises:

a pair of folding plates overlying said guide plate means and cooperable therewith to fold in opposite side portions of a textile article on the conveyor over the top of said guide plate means and then to fold out the opposite side extremities of the article over said in-folded side portions, and each folding plate having an inclined entrance end segment located in front of the entrance end of said guide plate means and extending forward and upward from a position contiguously overlying the conveyor,

and a pair of fastener straps, each having a fixed connection at one side of the entrance end segment of a respective folding plate and inclined forward and upward from said fixed connection to a connection to said entrance end segment of the respective folding plate.

9. An apparatus according to claim 8, wherein said folding plate means comprises a pair of folding plates having inner folding edges which overlie said guide plate means and converge toward each other in the direction of said exit end, said folding edges converging substantially coextensive with each other longitudinally so that the two folding plates simultaneously fold in the opposite side portions of the article over said guide plate means as the middle of the article is advanced beneath said guide plate means by the conveyor.

10. An apparatus according to claim 9, wherein said folding plates have convex top surfaces.

11. An apparatus according to claim 1, wherein said inner folding edges on the folding plates converge substantially coextensive with each other longitudinally so that the two folding plates fold in simultaneously the opposite side portions of the textile article over the top of said guide plate means while the middle of the article is being advanced by the conveyor beneath said guide plate means.

12. An apparatus according to claim 11, wherein said folding plates have top surfaces which are convex transverse to said inner folding edges.

13. An apparatus according to claim 12, wherein said inner folding edge of one folding plate crosses over said inner folding edge of the other folding plate near the exit end of said guide plate means.

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