United States Patent

Uhrig

[15] **3,703,026**

[45] **Nov. 21, 1972**

[54] **APPARATUS FOR MANUFACTURING A SLIDE FASTENER**

[72] Inventor: **Wilhelm Uhrig,** Mannesmannstrasse 11, 56 Wuppertal-Elberfeld, Germany

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[30] **Foreign Application Priority Data**

May 13, 1970 Germany.....P 20 23 412.2

[52] **U.S. Cl.**.....**29/33.2,** 29/34 A, 29/207.5, 29/408, 264/284

[51] **Int. Cl.**.....**B29d 5/00**

[58] **Field of Search**.....29/33.2, 34 A, 207.5 R

[56] **References Cited**

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Primary Examiner—Francis S. Husar
Attorney—Abraham A. Saffitz

[57] **ABSTRACT**

A method of making a slide fastener unit comprising weaving a thermoplastic monofilament through the flank portions of each of two Y-tapes, the monofilament of each tape being looped back and forth through the flanks so that the vertical sections between the flanks of one tape are in staggered or alternating relation to those of the other tape, whereafter these vertical sections are folded, embossed in the middle sections, pre-curved on the side sections and molded to fix the shape with the two tapes in fastened position. A novel folding, embossing, pre-curving, molding and ironing apparatus is also disclosed for the continuous manufacture of the slide fastener separately or in conjunction with a conventional weaving loom.

14 Claims, 37 Drawing Figures

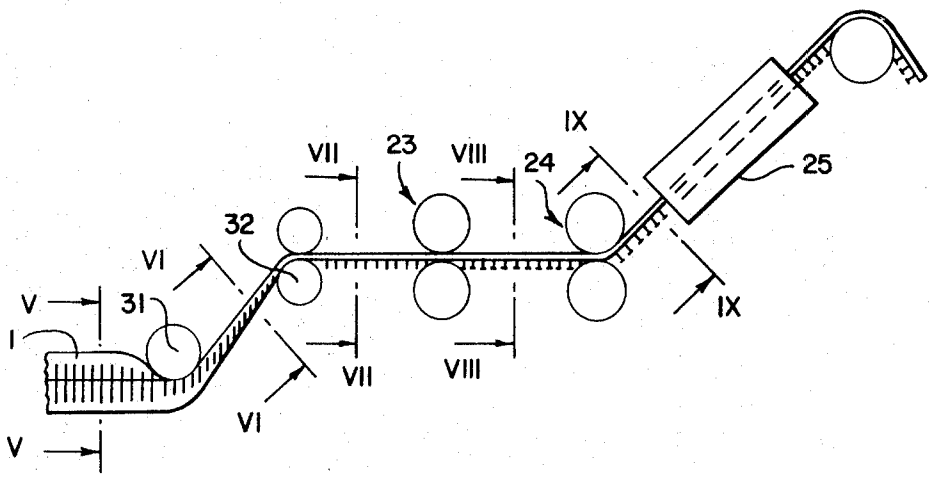


FIG. 1

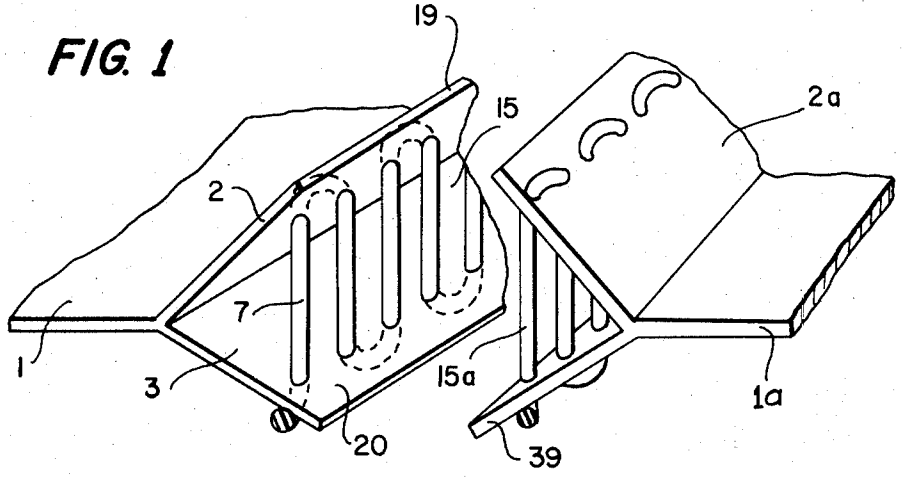


FIG. 2

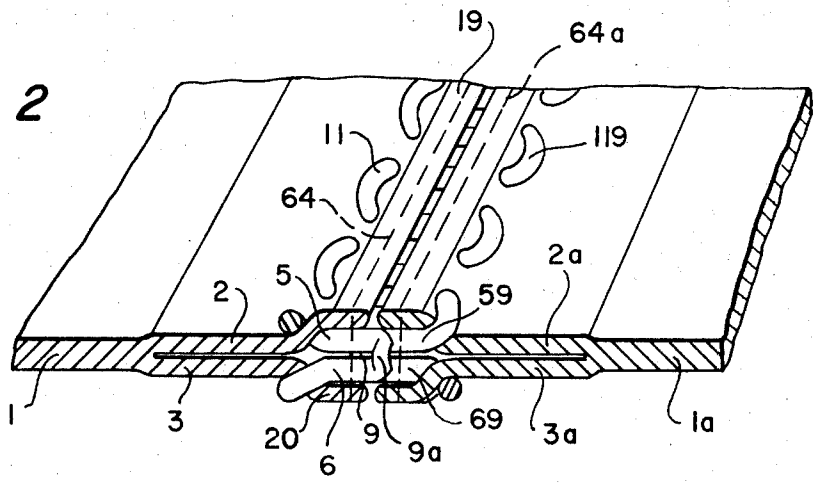
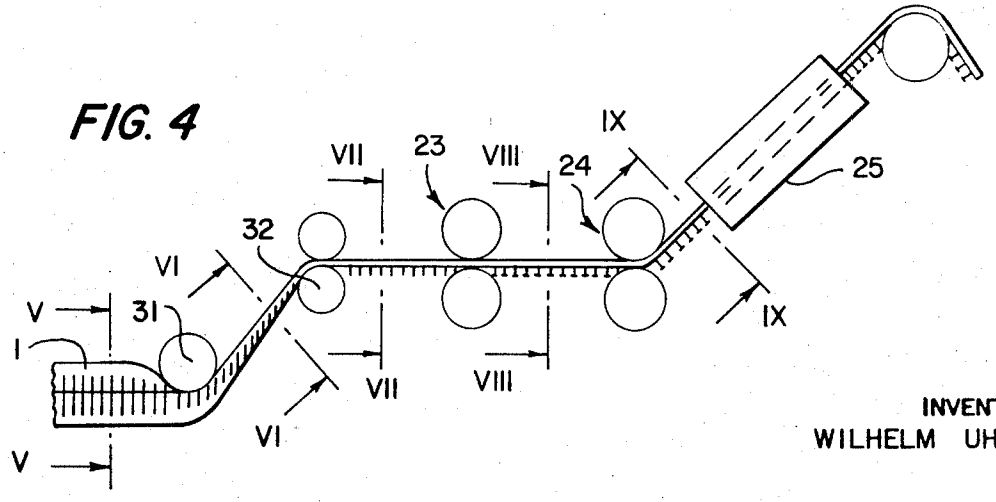


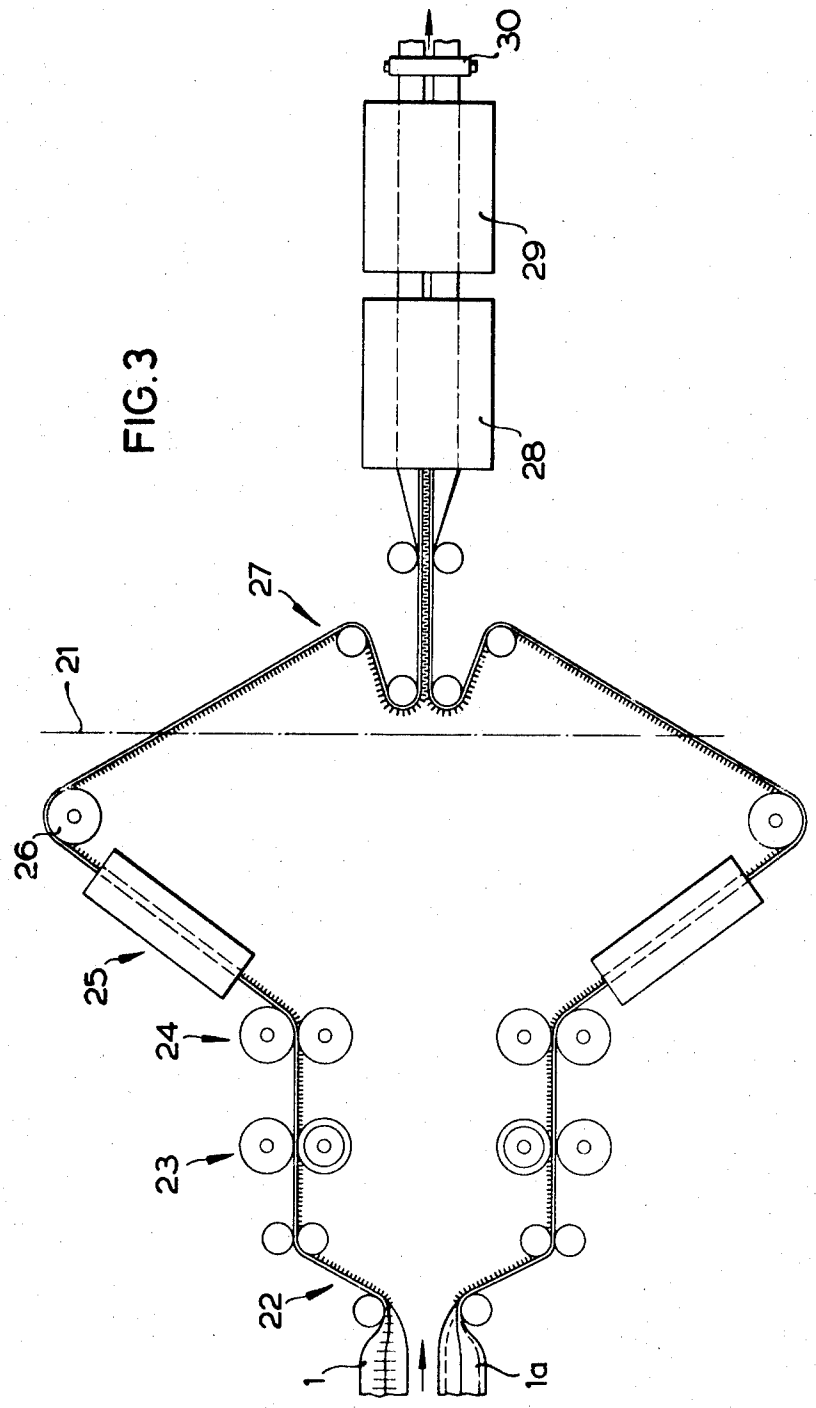
FIG. 4



INVENTOR
WILHELM UHRIG

Abraham A. Saffitz
ATTORNEY

FIG. 3



INVENTOR:
WILHELM UHRIG

Abraham & Saffitz
ATTORNEY

FIG.5

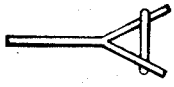


FIG.6

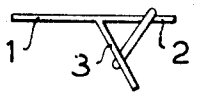


FIG.7

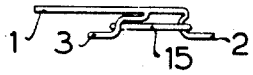


FIG.8

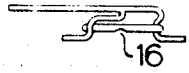


FIG.9



FIG.12

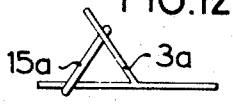


FIG.13



FIG.14

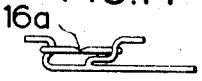


FIG.15



FIG.10

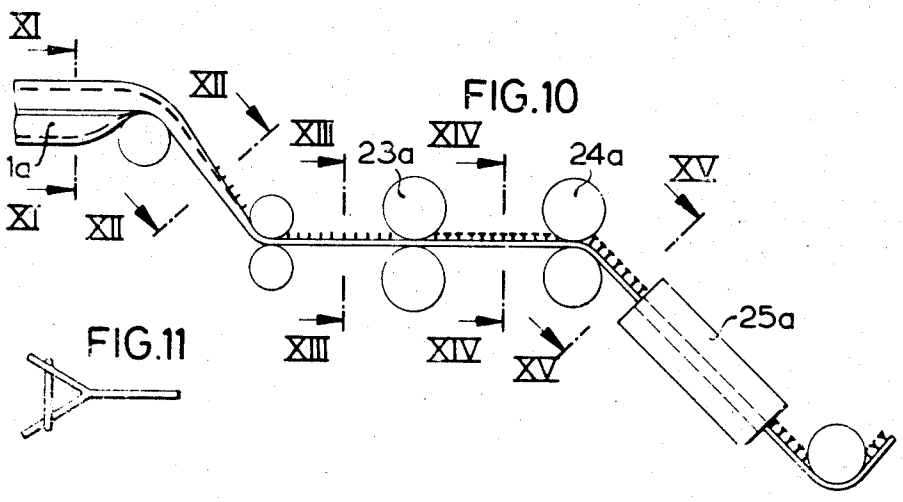


FIG.11

FIG.16

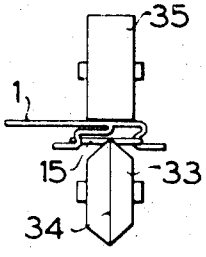


FIG.17

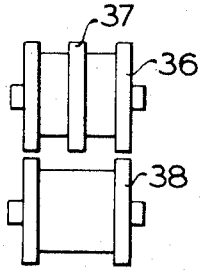
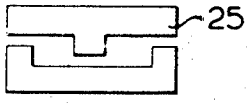


FIG.18



INVENTOR:
WILHELM UHRIG
Abraham A. Saffitz
ATTORNEY

FIG.19

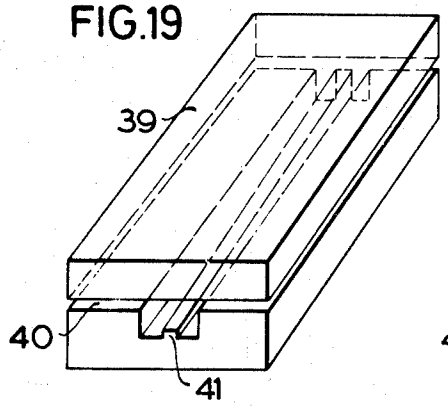


FIG.20

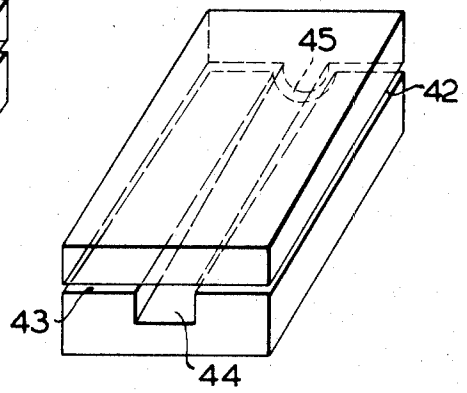


FIG.21

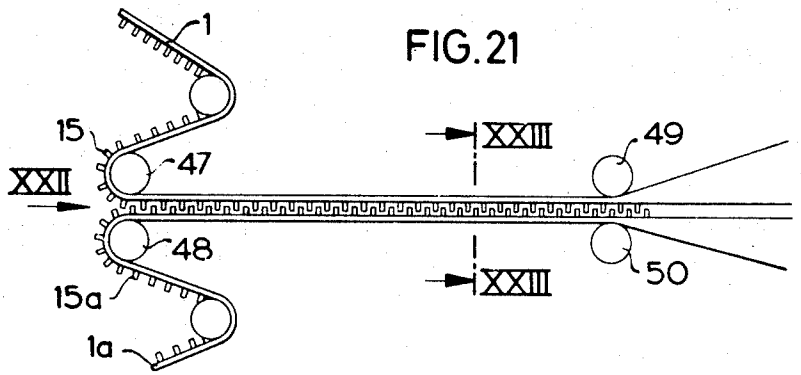


FIG.22

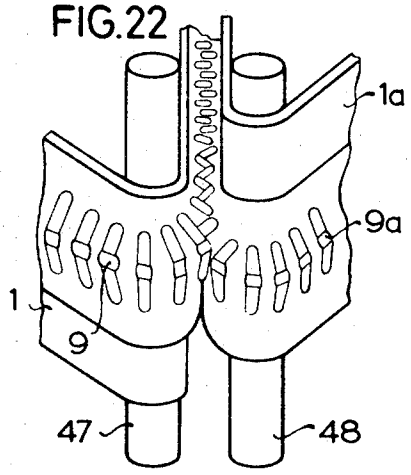
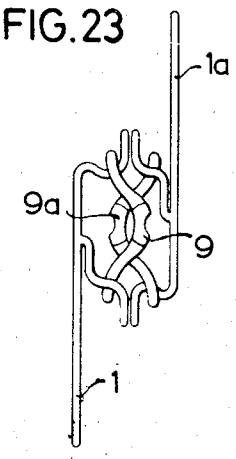


FIG.23



INVENTOR:
WILHELM UHRIG

Abelson & Saffitz
ATTORNEY.

FIG. 24

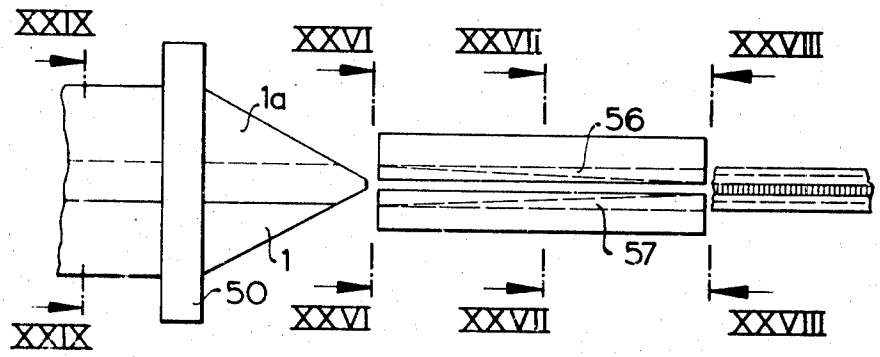


FIG. 25

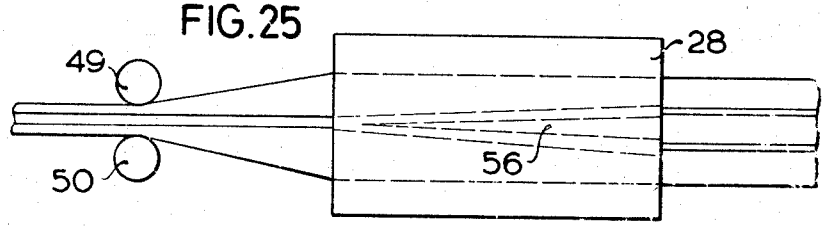


FIG. 26

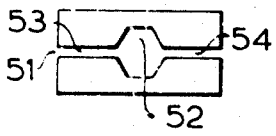


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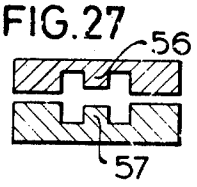


FIG. 28

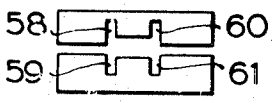


FIG. 29

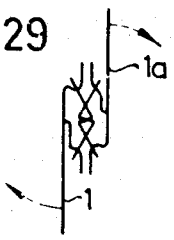


FIG. 30

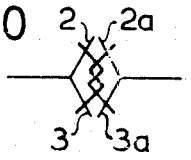


FIG. 31

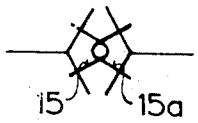
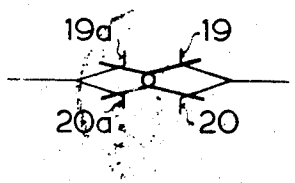


FIG. 32



INVENTOR:
WILHELM UHRIG

Abraham A. Saffitz
ATTORNEY

FIG. 33

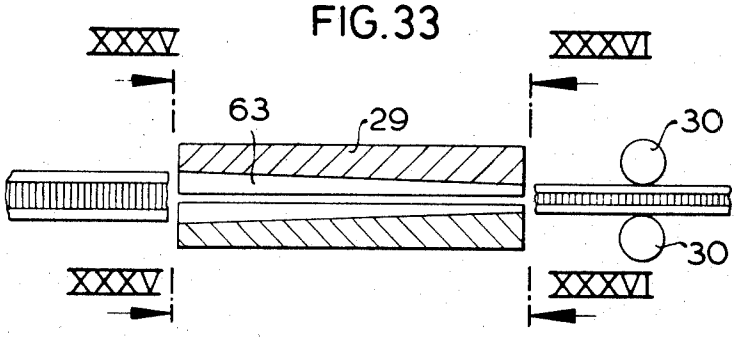


FIG. 34

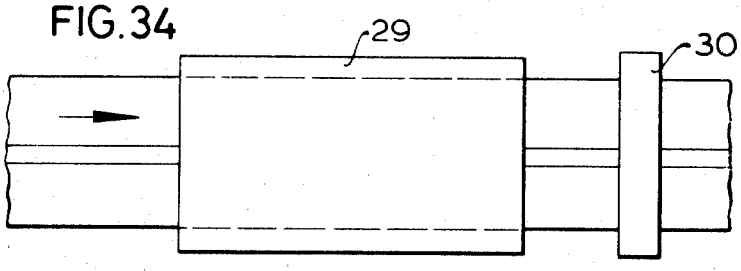


FIG. 35

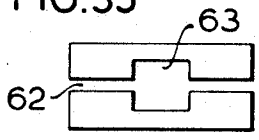


FIG. 36

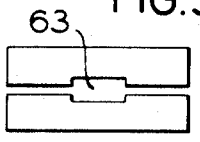
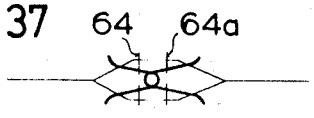


FIG. 37



INVENTOR:
WILHELM UHRIG
Graham & Saffitz
ATTORNEY

APPARATUS FOR MANUFACTURING A SLIDE FASTENER

The invention relates to the manufacture of a slide fastener by the steps of weaving a heavy thermoplastic monofilament into the flanks of a Y-tape, folding the flanks, embossing middle portions of the folded sections of the monofilament between the flanks, pre-curving the side sections of the aforesaid folded sections and molding to set the shape of these sections in alternating interlocked arrangement of the fastening monofilament of the two tapes which constitute the slide fastener.

The invention also relates to a novel weaving, folding, embossing, pre-curving and molding apparatus which is adapted for the continuous manufacture of slide fasteners, separately or in conjunction with a conventional weaving loom.

In the method according to my copending patent application, Ser. No. 45,715, filed June 12, 1970, a Y-shaped support tape is manufactured by a weaving operation, and this support tape is used as an element of a slide fastener which embodies a thermoplastic monofilament woven through and between the flanks of the Y-tape.

According to my copending application, the thermoplastic sections between the flanks provide engaging surfaces for subsequent fastening. These surfaces are deformed by heat and pressure.

The object of the present invention is to provide an improved efficient method for molding the woven Y-shaped tape.

After interlacing the flanks of the Y-tape by weaving the thermoplastic monofilament therethrough on each of the flanks with the tape open in flat condition, the tape is folded. The parts of the monofilaments between the flanks are also folded and are subsequently embossed, pre-curved, and set by molding under conditions which guide the two tapes in a fastened relation into a common plane with the thermoplastic monofilament sections constituting fastening links.

According to the invention, the two support tapes to be joined into a slide fastener are initially and individually preformed to the extent to which the two support tapes can be fastened to each other; and, with their fastening elements, they are given the final shape only when they are in the fastened condition.

While the middle portions of the monofilaments are embossed, the side section which face away from the embossing means are backed and effectively padded by the support tape which was previously woven, and this construction eliminates undesirable deformation of the side parts during embossing.

In order to facilitate the fastening engagement of the support tapes which have been separately preformed, the invention proposes that the thermoplastic filament side sections be curved in arcuate form over the flattened support tape prior to the fastening operation. After the fastening operation, the side sections and the flanks of the two Y-support tapes are folded into their final shape while passing through a plurality of intermediate continuous operations and stages of manufacture.

The tapes merge with each other in a continuous manner and are molded into the final form, after which the molded tapes are fixed by an ironing operation

under pressure, heat, and, where appropriate, by the application of moisture. Since the two support tapes are fastened during the last treatment steps, the fastening links of the two support tapes are precisely aligned relative to each other. Stresses and pitch differences between the fastening elements are thus compensated. The textile tape is smoothed during the ironing operation so that the woven interlacing is completed by fixing operations which produce a desirable degree of shrinkage.

In a further embodiment of the invention, the fastening links of the slide fastener are concealed on both sides by support tape flank parts, and, in a last operation, the flank parts which conceal the fastening links on both sides are jointed to each other by means of a seam extending in the zone of the fastening links. The resistance to kinking and breaking open of the slide fastener is substantially improved by this method.

The invention also relates to apparatus for performing the method according to the invention and is characterized by the following apparatus disposed serially in the described sequence:

Apparatus for flattening the support tape;

Heated embossing means for forming the fastening surfaces on the side parts;

Fastening means for fastening two flattened support tapes and:

Heat molding means in which the monofilament section side parts are folded into fastening links.

In a preferred embodiment, apparatus is provided between the embossing means for the fastening surfaces and the means for performing fastening to precurve the monofilament section side parts.

Further features and advantages of the invention are disclosed in the description of the drawings hereinbelow and in the claims.

The invention will now be described by reference to the drawing, in which:

FIG. **1** illustrates a pair of support tapes, woven by the method disclosed in my copending patent application and shown in the intermediate production stage after the weaving operation;

FIG. **2** is a slide fastener in the fastened state, produced from the two support tapes according to FIG. **1**;

FIG. **3** is a diagrammatic view of the entire apparatus for molding the two support tapes of FIG. **1** into the final shape of the slide fastener illustrated in FIG. **2**;

FIG. **4** shows that part of the entire apparatus according to FIG. **3** which prepares one of the support tapes as far as the fastening operation;

FIGS. **5** to **9** show support tape cross-section along lines V—V to IX—IX of FIG. **4**;

FIG. **10** shows that part of the entire apparatus according to FIG. **1** which prepares the other support tape as far as the fastening operation;

FIGS. **11** to **15** show support tape cross-section along the sectional lines XI—XI to XV—XV of FIG. **10**;

FIG. **16** shows apparatus for embossing the fastening surfaces;

FIG. **17** shows apparatus for pre-curving the thermoplastic monofilament section side parts;

FIG. **18** shows a fixing duct for fixing the precurvature of the side parts;

FIG. **19** is an alternative embodiment of the apparatus for embossing the fastening surfaces;

FIG. 20 is an alternative embodiment for pre-curving and fixing the side parts;

FIG. 21 shows the means for fastening as a plan view;

FIG. 22 shows the means for fastening as seen in the direction of the arrow XXII of FIG. 21;

FIG. 23 is a section through the fastened support tapes along the sectional line XXIII—XXIII of FIG. 21;

FIG. 24 is a view of the molding apparatus for producing the final form of the fastening links;

FIG. 25 is a plan view of the molding apparatus according to FIG. 24;

FIG. 26 is a view along the direction XXVI—XXVI of FIG. 24 of the input endface of the molding apparatus;

FIG. 27 is a section along the line XXVII—XXVII of FIG. 24;

FIG. 28 shows the exit endface of the molding apparatus seen along the line XXVIII—XXVIII of FIG. 24;

FIG. 29 is a cross-section through the fastened support tapes along the line XXIX—XXIX of FIG. 24;

FIGS. 30 to 32 show cross-sections through the fastened supporting tapes at the molding apparatus positions disclosed in FIGS. 26, 27 and 28;

FIG. 33 is a longitudinal section of ironing apparatus and draw-off apparatus for the finished slide fastener;

FIG. 34 is a plan view of the ironing apparatus according to FIG. 33;

FIG. 35 shows the inlet endface of the ironing apparatus as seen along line XXXV—XXXV of FIG. 33;

FIG. 36 shows the exit endface as seen along line XXXVI—XXXVI of FIG. 33; and,

FIG. 37 is a diagrammatic view showing a section through the fastened support tape in the final shape of the slide fastener.

FIG. 1 shows two Y-shaped support tapes 1 and 1a which are the left and right tapes respectively and which are simultaneously made by weaving on a loom, preferably a needle loom, in accordance with the method disclosed in my copending application, U.S. Ser. No. 45,715.

The Y-shaped support tapes are woven with a heavy thermoplastic continuous monofilament thread, identified as 7 for tape 1 and as 7*a* for tape 1*a*, in interlaced relation between upper and lower flanks 2 and 3 of Y-tape 1 and between upper and lower flanks 2*a* and 3*a* of Y-tape 1*a*. The spacing of interlaced sections 7 and 7*a* is such that the separate vertical portions of the filaments, 15 and 15*a* respectively, alternate and, in the closed position shown in FIG. 2, the alternate positioning is evidenced by the exterior woven anchor portions 11 and 11*a*.

FIG. 2 discloses a finished and fastened slide fastener which is produced from the two support tapes 1 and 1*a* of FIG. 1. The vertical portions 15 and 15a of the continuous monofilament are now folded between the flanks 2, 3 and 2*a*, 3*a*, respectively, this folding providing in each middle portion thereof a middle fastening surface, identified as 9 and 9*a* for tapes 1 and 1*a* respectively. It is seen from FIG. 2 that flanks 2,3 and 2*a*, 3*a* bear outwardly upon each other in abutting relation and that each continuous thermoplastic monofilament traverses through these flanks. The free flank edges 19, 20, as well as 19*a*, 20*a*, cover the folded parallel section 5 and 6 of tape 1 and 5*a* and 6*a* of tape 1a. On the side remote from the middle fastening surfaces 9, 9*a*, the thermoplastic monofilament is woven to form rearward reversed anchoring portions 11, 11*a* which are disposed on the exterior of the tape flanks and which also form a guide for the slide of a slide fastener.

FIG. 3 shows, in diagrammatic form, the preferred apparatus of the invention for converting the intermediate support tapes of FIG. 1 into the final slide fastener of FIG. 2. To the left of the dotted center line 21 is a side view of the apparatus, while a plan view is shown to the right. The two separate support tapes, 1 and 1*a*, enter at the left of the apparatus where the horizontal arrow is shown. Roller means take the tapes 1 and 1a respectively from a parallel feed into non-parallel paths and flatten the tapes in such a manner that one flank is folded back over the other flank. At the exit of the roller means 22 and 22*a*, the tapes 1 and 1a emerge parallel to each other and enter embossing station 23 where embossing occurs so that middle fastening sections 9 (and 9*a*) are provided. The tapes proceed to deforming station 24 where the side parts of the monofilament projecting from the tape are curved (also see FIG. 10).

Subsequently, the support tapes pass through heated ducts 25 in which the curvature of the side parts is fixed. Thereafter, the tapes are guided around draw-off rollers 26 (and 26*a*) and these draw off rollers send the tapes to aligning roller means 27 and 27*a* where the tapes are gathered together for fastening. The two fastened support exits are then run into a molding apparatus 28 in which the thermoplastic monofilament sections are molded into the final form of the fastening link. After molding, the fastened tape is sent through the ironing apparatus 29 in which the tapes are ironed flat under heat and pressure, and where appropriate, moisture may be furnished. The final form is shown in FIG. 2. The finished support tape exits through the draw-off roller means 30.

FIGS. 4 to 9 show in detailed form the fastening treatment of the support tape 1 or 1*a*, as far as the fastening operation. Roller means 22 comprises two reversing, spaced apart studs 31, 32 disposed in parallel. The support tape 1, with the Y-flanks spread apart (see also the cross-sectional view of FIG. 5) extends with one principal side over the reversing stud 31 to be laid into the form shown in FIG. 6 in which one support tape flank 2 is disposed in one plane with the base member of the support tape 1, while part of the other flank 3 is folded back. The other principal side of the support tape then runs over the reversing stud 32 which causes the flank 3 to be completely folded back so that the side parts 15 bear flat on the support tape 1 (see FIG. 7).

In this state, the support tape will pass through the embossing apparatus 23 which, as shown in FIG. 16, comprises a driven embossing roller 33 (driving means not shown) having an embossing bead 34 and a mating roller 35 which is also driven by means not shown. The embossing roller 33 is heated and provides the middle zone of the side parts 15 with a cross-sectional deformation 16 which, in the finished slide fastener, represents the middle fastening section or surface 9 (FIG. 2). As can be seen from FIG. 16, that side of the side part 15 which faces away from the embossing is backed and padded by the support tape 1, thus reliably

preventing any undesirable cross-sectional deformation of the side parts **15**.

The support tape **1** subsequently passes through the apparatus **24** for pre-curving the side parts **15**. As shown in FIG. **17**, the apparatus **24** comprises a driven sectioning roll **36** and sectional bead **37** which work from the rear of the flattened support tape and a hollow mating roll **38** which is also driven by means not shown. The roll **36** is heated and sectioning bead **37** thrusts into the middle zone of the side parts **15** so that the side parts are deformed to the curvature which is illustrated in FIG. **9**. When the support tape **1** subsequently passes through the fixing duct **25** which has a slit of U-shaped internal cross-section as shown in FIG. **18**, the side parts are fixed in pre-curved form, as illustrated in FIG. **9**.

FIG. **19** shows an alternative embodiment of the embossing apparatus **22** for the fastening surfaces. The embossing means **39** comprises a heated duct **40** for the flattened support tape in accordance with FIG. **7**. The underside of the duct **40** is provided with an embossing rail **41** which gradually rises in the feed direction to act centrally on the side parts **15** and to provide them with the cross-sectional shape **16** shown in FIG. **8**.

FIG. **20** shows apparatus **42**, as an alternative to deforming station **24** and heated ducts **25**, for pre-curving the side parts **15** and for fixing the pre-curvature. Apparatus **42** comprises a heated and substantially slit-shaped duct **43** having a flat, rectangular duct sector **44** which accommodates the side parts **15** and the adjoining support tape flank parts. The configuration of sector **44** gradually changes and emerges in the C-shaped exit cross-section **45** so that the passage of the support tape through the apparatus **42** causes the side parts **15** to be converted from the cross-sectional shape of FIG. **8** into the cross-sectional shape of FIG. **9**.

The other support tape **1a**, in non-parallel orientation to the support tape **1**, runs into the apparatus illustrated in FIG. **10** which is a mirror image of the apparatus illustrated in FIG. **4**. The parts corresponding to FIG. **4** are provided with the same reference numerals but are supplemented by the letter *a*. The support tape **1***a* in FIG. **10** passes the intermediate stages illustrated in FIGS. **11** to **15** which correspond to the intermediate stages of the support tape shown in FIGS. **5** to **9**.

In the manufacturing stage of FIGS. **9** to **15**, the two support tapes **1**, **1***a* are brought together through reversing rollers or reversing studs and are fastened to each other by the fastening means illustrated in FIGS. **21** and **22**. The means **27** for fastening comprise two reversing studs **47**, **48**, parallel and closely adjacent to each other, on which the sides parts **15**, **15***a* of the two support tapes **1**, **1***a*, passed around the studs, are spread apart so that, during the subsequent passage between the two reversing studs **47**, **48**, the fastening surfaces **9**, **9***a* of the side parts mutually grip behind each other. The fastening operation is completed when the tapes run into the nip. FIG. **23** is a cross-section through the two fastened support tapes **1**, **1***a*. The support tapes **1** and **1***a* extend perpendicularly to the fastening engagement direction.

The fastened support tapes then run between two guide pins **49**,**50** into the molding apparatus **28** as shown in FIG. **25**.

The molding apparatus **28** of FIG. **25** (see also FIGS. **24** to **28**) comprises a heated molding duct of substantially slit-shaped cross-section in which the principal plane of the slit-shaped duct **51** is oriented perpendicularly to the pins **49**, **50** so that the base members of the support tapes **1**, **1***a* are swung open in each case through 90° in the direction illustrated by the arrows in FIG. **29** when the tapes run into the molding duct **21** and are then laid into a common plane in accordance with FIG. **30**. The middle of the molding duct **51** is provided with a hexagonal cross-sectional expansion **52** which accommodates the fastened side parts **15**, **15***a* and the adjoining flank parts, while the principal member of the support tapes **1** and **1***a* are accommodated by the slit parts **53** and **54** of the duct, adjoining on the right-hand and left-hand side of the expanded zone **52**.

As shown in FIGS. **26** to **28**, the cross-section of the molding duct **51** merges gradually into the H-shaped exit cross-section shown in FIG. **28**. This gradual change of cross-section is obtained by the wedge shaped ribs **56**, **57** disposed on the top side and underside of the duct and which become broader towards the exit of the molding duct **28** and also extend progressively deeper into the interior of the duct. Initially, the ribs separate the flanks **2**, **2***a* and **3**, **3***a* of the two fastened support tapes from each other and then compress and progressively fold the side members **15**, **15***a* together, the side members having been converted into the final shape of the fastening links on leaving the molding apparatus **28** (see also FIG. **32**). The free support tape flank edges **19**, **20** and **19a**, **20a** are accommodated in the molding duct by the four duct grooves **58**, **59**, **60**, **61** and, after leaving the molding duct, will still be disposed perpendicularly to the principal plane of the slide fastener (see FIG. **32**). Subsequently, the two fastened support tapes run into the ironing apparatus **29**, shown as a longitudinal section in FIG. **33** and as a plan view in FIG. **34**, the ironing apparatus also comprising a heated duct **62** of slit-shaped cross-section. In its middle, the duct **62** is provided with a rectangular cross-sectional expansion zone **63** (see FIG. **35**) which becomes continuously more shallow towards the exit of the duct (FIG. **36**). The expanded sector **63** of the duct **62** accommodates the fastened side parts of the thermoplastic monofilament which represent the finished fastening links, and the flank edges **19**, **20** and **19***a*, **20***a*. The flank edges are pressed upon the fastening links in the duct sector **63** which becomes progressively narrower (see FIG. **33**). The flank edges are fixed by heat, pressure and the application of moisture, where necessary or appropriate, so that the support tapes leave the ironing apparatus **29** in the final form of the slide fastener illustrated in FIG. **37** in which the flank parts **19**, **20** and **19***a*, **20***a* cover the fastening links on both sides.

If the fastening links are not to be covered, the flank parts may also be folded outwardly, and, for this purpose, it is necessary merely to provide a suitably sectioned duct for the ironing apparatus.

In a slide fastener with covered fastening links, it is possible for the flank edges **19**, **20** and **19***a*, **20***a* to be joined to each other by means of a seam **64**, **64***a* which extends in the zone of the parallel members **5**, **6** and **5***a*, **6***a* of the fastening links (see FIGS. **2** and **37**).

The apparatus described hereinabove enables a slide fastener to be produced from a Y-shaped support tape with a thermoplastic monofilament interlaced into the flanks of the Y-tape in alternating loop form. The slide fastener of the present invention possesses planar symmetry so that its planar position is retained even when the slide fastener is subjected to mechanical stresses and water or liquids as are used in washing and cleaning. The resistance to opening when the symmetrical fastener is kinked is equally good on both sides and, because of its broader base, the resistance is greater than in a conventional tape. The manufacture of the present slide fastener may be carried out continuously with apparatus adjoining a conventional needle loom and it is possible to match any production rate characteristic of the loom. The apparatus operates reliably, using only rollers, guide ducts and reversing pins.

What is claimed is:

1. Apparatus for manufacturing a slide fastener unit from an assembly comprising two Y-support tapes having a thermoplastic monofilament woven through the flank portions of each of said tapes, the monofilament of each tape being looped back and forth through the flanks so that the vertical strand sections between the flanks of one tape are staggered in relation to those of the other tape, said apparatus comprising:

flattening and folding means for flattening one flank of each of said support tapes while swinging back the other flank to thereby fold the vertical strand sections and form intermediate engagement surfaces on each section;

heated embossing means to deform the intermediate engagement surfaces and side surfaces of each of the strands;

aligning and fastening means which brings together the two embossed tapes into interengaging relationship so that the sides of the vertical strand sections are now brought together into a common plane to engage with each other; and,

heated molding means which sets the pressed together interengaging portions of the vertical sections and thereby produces a fastened together fastener unit.

2. Apparatus as claimed in claim **1**, wherein bending means are provided for pre-curving the side parts of the vertical strands after embossing and before the two tapes are fastened in the aligning and fastening means.

3. Apparatus as claimed in claim **2**, wherein reversing rollers and reversing pins are provided to tension the two tapes prior to entering into the aligning and fastening means.

4. Apparatus as claimed in claim **3**, wherein said reversing rollers or reversing pins are offset from the feeding zone which feeds the tapes into the aligning and fastening means.

5. Apparatus as claimed in claim **1**, wherein said heated embossing means includes an embossing roller having a raised embossing bead and a mating roller.

6. Apparatus a claimed in claim **2**, wherein said bending means comprises a molding roller having a molding bead and a mating roller therefor.

7. Apparatus as claimed in claim **6**, wherein said bending means further includes a heated U-shaped duct, said heated duct serving to fix the curvature of the side portions of the vertical strands.

8. Apparatus as claimed in claim **2**, wherein said bending means comprises a heated molding duct having a rectangular cross-section in the inlet portion thereof and an arcuate cross-section in the exit portion thereof.

9. Apparatus as claimed in claim **1**, wherein said aligning means includes rollers and two reversing pins which are adjacent and parallel to each other so that the pre-curved side portions of the vertical strands are spread and each of the reversing pins guides each tape in parallel fashion.

10. Apparatus as claimed in claim **9**, wherein said heated molding means comprises a heated slit-shaped duct having an expanded portion in the middle thereof to accommodate the two fastened support tapes therein, said duct further including laterally adjoining slits which accommodate the right-hand and left-hand side of the expanded zone where the two tapes come together.

11. Apparatus as claimed in claim **10**, wherein the axes of the reversing pins are disposed perpendicularly to the plane of the molding duct.

12. Apparatus as claimed in claim **10**, wherein the molding duct has an H-shaped exit cross-section and includes end ribs expanding in the longitudinal direction of the duct to reinforce the upper and lower walls of the duct, the space between the ribs accommodating folding side parts which form four grooves, the four grooves accommodating the four outer flank parts of the two Y-support tapes.

13. Apparatus as claimed in claim **1**, wherein tubular ironing means are provided downstream of said heated molding means, said ironing means comprising a heated slit-shaped duct, a middle portion with expanded cross-section, and an exit portion.

14. Apparatus as claimed in claim **13**, wherein a draw-off roller is provided at the exit of said ironing means.

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