

SPECIFICATION

Method of and apparatus for joining opposed leg portions of molded coupling elements for sliding clasp fasteners

This invention relates generally to the production of a coupling element assembly for sliding clasp fasteners, and more particularly to a method of and apparatus for welding opposed leg portions of individual coupling elements of such assembly.

Various attempts have been made to join together opposite leg portions of each of a row of molded coupling elements to provide a complete coupling assembly for sliding clasp fasteners. To this end, it is known to fuse the coupling element leg portions by ultrasonic vibrations applied in a direction perpendicular to the plane of their confronting surfaces. This necessitates a discontinuation of travel of the whole coupling element assembly at each cycle of fusing operation, which would literally retard the rate of production.

According to one aspect of the invention, there is provided a method of welding a row of interconnected thermoplastic coupling elements of sliding clasp fasteners at opposed leg portions of each coupling element with the use of an ultrasonic horn, said method comprising the steps of: pressing the opposed leg portions of the coupling elements against the ultrasonic horn on opposite sides of the horn while the coupling elements are being fed at constant speed; concurrently with this pressing step, fusing the opposed leg portions of the coupling elements at their confronting inner surfaces by ultrasonically vibrating the ultrasonic horn in a direction parallel to the confronting inner surfaces; and pressing the opposed leg portions of the coupling elements; after the latter are disengaged from the ultrasonic horn, against each other so as to be united at their confronting inner surfaces that have been fused.

According to another aspect of the invention, there is provided an apparatus for welding a row of interconnected thermoplastic coupling elements for sliding clasp fasteners at opposed leg portions of each coupling element, said apparatus comprising, in combination; a shaping die member having a channel extending through its length for the passage therethrough of the coupling elements; means for feeding the coupling elements through said channel at constant speed; means disposed in said channel for fusing the opposed leg portions of the coupling elements; first press means on or in said shaping die member or forming part thereof for pressing the opposed leg portions of the coupling elements against said fusing means on opposite sides of the fusing means; and second press means on or in said shaping die member or forming part thereof for pressing the opposed leg portions of the coupling elements against each other, said second press means being located downstream of said first press means.

The invention will now be described by way of example with reference to the accompanying drawings, wherein:-

Figure 1 is a side elevational view, with parts broken away, of a welding apparatus embodying this invention;

Figure 2 is a cross-sectional view taken along line II - II of *Figure 1*;

Figure 3 is a cross-sectional view taken along line III - III of *Figure 1*;

Figure 4 is a schematic view illustrating an apparatus by means of which a coupling element assembly for sliding clasp fasteners is proformed;

Figure 5 is a fragmentary, enlarged plan view of the coupling element assembly of *Figure 4*, with the periphery of a molding wheel fragmentarily shown;

Figure 6 is an enlarged cross-sectional view taken along line VI - VI of *Figure 5*;

Figure 7 is an enlarged cross-sectional view taken along line VII - VII of *Figure 5*; and

Figure 8 is a fragmentary cross-sectional view of a sliding clasp fastener stringer which is manufactured with use of the coupling element assembly processed in accordance with the invention.

Figure 5 shows a coupling element assembly for sliding clasp fasteners generally designated at 10, as it is spread flat before being bent into a U shape. The coupling assembly includes a row of laterally spaced coupling elements 11 made of a thermoplastic material, and a warp-knit elongate, ladder-like structure 9. Each coupling element 11 has a coupling head portion 12 and a pair of leg portions 13, 14 extending in opposite directions from the head portion 12. The warp-knit elongate structure 9 includes a pair of elongate warp-knit webs 15, 16 extending transversely of the coupling elements 11 and embedded in the leg portions 13 and 14 respectively of each coupling element 11 to interconnect adjacent ones of the coupling elements 11. Each of the warp-knit webs 15, 16 comprises a pair of first threads 17, 17 each forming a wale and a second thread 18 interlaced or interknitted with the first threads 17, 17. At least one third thread 19 is interlaced and interknitted with two pairs of first threads 17, 17 and has portions 20 spaced at regular intervals longitudinally of the first threads 17, 17 and embedded longitudinally in the coupling elements 11. This coupling element assembly is described and illustrated in our co-pending patent application No. 79 19662 (serial No. 2023714) Ref: 230P 38294, see *Figure 1* thereof.

As shown in *Figure 4*, the warp knit elongate structure 9 is wound on a molding wheel 21 with the portions 20 of the third thread 19 disposed in a plurality of mold cavities 22 formed at regular spaced intervals in and along the periphery 23 of the molding wheel 21.

Reference is directed to our aforementioned copending patent application No. 79 19662 (Serial No. 2023714) Ref: 230P 38294 - see *Figure 5* thereof - for further description of the apparatus of *Figure 4*. As the molding wheel 21 rotates, the warp knit elongate structure 9 is fed past an extrusion machine 24 which discharges from its nozzle 25 a predetermined amount of thermoplastic material in molten or semi-molten state which is delivered to the mold cavities 22. A closure shoe 26 coacts with the profile of the molding wheel 21 to hold the

thermoplastic material in the mold cavities 22. Subsequently, the thermoplastic material in the mold cavities 22 is cooled so as to solidify by a cooling machine 27. The resultant coupling element assembly 10 is generally of a ladder-like structure, as shown in Figure 5. After it is removed from the molding wheel 21, the coupling element assembly 10 is folded on itself by a bending machine 28 along its longitudinal center line so as to present a substantially U-shaped end elevation, the individual coupling elements 11 being bent into the shape shown in Figure 2. Designated at 29 in Figure 4 is a guide roller for the elongate warp-knit, ladder-like structure 9 and at 30 is a coupling element assembly removal roller.

Figures 1 to 3 inclusive show a welding apparatus 31 embodying the invention. The apparatus 31 essentially comprises a shaping die member 32 having an elongated channel 33 provided for the passage of the coupling element assembly 10, and an ultrasonic horn 34 having its tip end 35 (Figure 2) projecting into the channel 33 for fusing the leg portions 13, 14 of the individual coupling element 11 at their confronting inner surfaces 36, 37.

As best shown in Figure 1, the tip end 35 of the ultrasonic horn 34 is in the form of a vane having a central portion 38 of uniform thickness, and a pair of first and second wedge-like portions 39, 40.

The channel 33 in the shaping die member 32 varies in width to provide a first press station A where the coupling element leg portions 13, 14 are fused at their confronting inner surfaces 36, 37 by the ultrasonic horn 34, and a second press station B where the opposed leg portions 13, 14 are pressed against each other and united together at the confronting inner surfaces 36, 37 that have been fused. The channel 33 has a mouth 42 flaring toward its inlet end to facilitate introduction of the coupling element assembly 10 into the first press station A. The channel 33 is further provided along its upper and lower edges with a pair of flanges 43, 44 respectively to prevent the coupling element assembly 10 from transverse displacement in the channel 33. It is preferable to coat the wall surfaces of the channel 33 with "Teflon" (Trademark for polytetrafluoroethylene) or other suitable coating material to provide for smooth movement therealong of the coupling element assembly 10.

The ultrasonic horn 34 projects into the channel 33 by the tip end 35 such that the central portion 38 and the first wedge-like portion 39 are positioned in the first press station A, the first wedge-like portion 39 tapering toward and terminating immediately short of the second press station B. The second wedge-like portion 40 extends from the central portion 38 into the channel mouth 42.

The first press station A is subdivided into a first half section where the channel 33 has a uniform thickness W_1 , and a second half section where the channel 33 has width W_2 decreasing progressively toward the second press station B. At each of these two sections, the width (W_1 or W_2) of the channel 33 is slightly smaller than the sum of a total thickness ($H_1 + H_2$) of the opposed leg portions 13, 14 of the individual coupling element 11 and the thickness (h_1

or h_2) of the ultrasonic horn tip 35. Such geometry of the first press station A is calculated to ensure that the coupling element leg portions 13, 14 be pressed against the ultrasonic horn tip 35 precisely on opposite sides of the horn so that their confronting inner surfaces 36, 37 can be fused to an extent sufficient to be welded.

In the second press station B, the channel 33 has a substantially uniform width W_3 that is slightly smaller than the total thickness ($H_1 + H_2$) of the opposed leg portions 13, 14 of the individual coupling element 11. This geometry ensures that the coupling element leg portions 13, 14 be pressed against each other lightly on the confronting fused surfaces 36, 37 to permit proper welding.

The ultrasonic horn 34 functions to ultrasonically vibrate toward and away from the head portions 12 of the coupling elements 11, such direction being parallel to the confronting inner surfaces 13, 14 that engage the ultrasonic horn tip 35. This completely obviates the necessity of discontinuing the feed of the coupling element assembly 10 at the fusing (first press) station A. Alternatively, the ultrasonic horn 34 may be arranged to apply ultrasonic vibrations in the longitudinal direction of the coupling element assembly 10.

The welding apparatus 31 further includes a pair of radially spaced feed wheels 45, 46 which are disposed adjacent the outlet end of the channel 33 for feeding the coupling element assembly 10, each wheel 45, 46 having a plurality of peripheral teeth 47 engageable with the coupling elements 11 at the second press station B as the wheels 45, 46 rotate on their respective shafts 48, 49. The two wheels 45, 46 rotate continuously in opposite directions at constant speed with the coupling element assembly 10 moving at constant speed in the direction of the arrow 50.

According to the method of invention, the coupling element assembly 10 with each coupling element 11 bent into U-shape is continuously fed through the channel 33 at constant speed. The opposed leg portions 13, 14 of the successive coupling elements 11 are pressed against the ultrasonic horn tip 35 on opposite sides of the horn, as best shown in Figure 2, so that only the confronting inner surfaces 36, 37 of the leg portions 13, 14 are fused by ultrasonic vibrations with the coupling element assembly 10 continuously fed at constant speed. During this period of time, the ultrasonic horn tip 35 vibrates in a direction parallel to the contacting surfaces 36, 37 of the coupling elements 11 are pressed against each other, and the confronting fused surfaces 36, 37 are united together, as best shown in Figure 3. Thus, the welding of the opposed leg portions 13, 14 of the coupling elements 11 is completed.

Figure 8 shows fragmentarily a sliding clasp fastener stringer 50 which is manufactured with use of the coupling element assembly 10 processed in accordance with the invention, only one coupling element 11 being herein illustrated. The coupling element assembly 10 is attached to a knitted stringer tape 51 along one of its edges by means of at least one connecting thread 52 extending around both

longate warp knit webs 15, 16 at their portions between adjacent coupling elements 11.

Reference is also directed to our co-pending patent application No: 79 19588 (Serial No: 2023222) Ref: 230P38293.

CLAIMS

1. A method of welding a row of interconnected thermoplastic coupling elements for sliding clasp fasteners at opposed leg portions of each coupling element with the use of an ultrasonic horn, said method comprising the steps of: pressing the opposed leg portions of the coupling elements against the ultrasonic horn on opposite sides of the horn while the coupling elements are being fed at constant speed; concurrently with this pressing step, fusing the opposed leg portions of the coupling elements at their confronting inner surfaces by ultrasonically vibrating the ultrasonic horn in a direction parallel to the confronting inner surfaces; and pressing the opposed leg portions of the coupling elements, after the latter are disengaged from the ultrasonic horn, against each other so as to be united at their confronting inner surfaces that have been fused.

2. A method according to claim 1, wherein the ultrasonic horn is vibrated in a direction perpendicular to the longitudinal axis of the coupling element row.

3. An apparatus for welding a row of interconnected thermoplastic coupling elements for sliding clasp fasteners at opposed leg portions of each coupling element, said apparatus comprising, in combination: a shaping die member having a channel extending through its length for the passage therethrough of the coupling elements; means for feeding the coupling elements through said channel at constant speed; means disposed in said channel for fusing the opposed leg portions of the coupling elements; first press means on or in said shaping die member or forming part thereof for pressing the opposed leg portions of the coupling elements against said fusing means on opposite sides of the fusing means; and second press means on or in said shaping die member or forming part thereof for pressing the opposed leg portions of the coupling elements against each other, said second press means being located downstream of said first press means.

4. An apparatus according to claim 3, said fusing means comprising an ultrasonic horn having a central portion of a uniform thickness and a pair of first and second wedge-like portions each having a progressively decreasing thickness.

5. An apparatus according to claim 4, said first press means being defined by a pair of first and second portions of said channel, said channel having at said first portion a uniform width slightly smaller than the total thickness of the opposite leg portions of one of the coupling elements plus the thickness of said central portion of the ultrasonic horn, and at said second portion a progressively decreasing width slightly smaller than the total thickness of the opposite leg portions of one of the coupling

elements plus the thickness of said first wedge-like portion of the ultrasonic horn.

6. An apparatus according to claim 4 or 5, said ultrasonic horn being ultrasonically vibratable in a direction parallel to confronting inner surfaces of the coupling element leg portions.

7. An apparatus according to claim 6, said ultrasonic horn being vibratable in a direction perpendicular to the longitudinal axis of the coupling element row.

8. An apparatus according to claim 6, said ultrasonic horn being vibratable in the longitudinal direction of the coupling element row.

9. An apparatus according to any one of claims 3 to 8, said second press means being defined by a third portion of said channel, said channel having at said third portion a substantially uniform width slightly smaller than the total thickness of the opposed leg portions of one of the coupling elements.

10. An apparatus according to any one of claims 3 to 9 said feeding means including a pair of radially spaced wheels disposed adjacent said second press means and driven to rotate in opposite directions at constant speed, each of said wheels having a plurality of peripheral teeth engageable with the coupling elements in said channel.

11. An apparatus according to any one of claims 3 to 10, said channel further having a mouth flaring toward an inlet end of said channel in order to facilitate the introduction of the coupling element to be welded to said first press means.

12. A method substantially as herein described with reference to and as illustrated in Figures 1 to 3 inclusive of the accompanying drawings.

13. An apparatus substantially as herein described with reference to and as illustrated in Figures 1 to 3 inclusive of the accompanying drawings.



longate warp knit webs 15, 16 at their portions between adjacent coupling elements 11.

Reference is also directed to our co-pending patent application No: 79 19588 (Serial No: 2023222)

5 Ref: 230P38293.

CLAIMS

1. A method of welding a row of interconnected
10 thermoplastic coupling elements for sliding clasp fasteners at opposed leg portions of each coupling element with the use of an ultrasonic horn, said method comprising the steps of: pressing the opposed leg portions of the coupling elements
15 against the ultrasonic horn on opposite sides of the horn while the coupling elements are being fed at constant speed; concurrently with this pressing step, fusing the opposed leg portions of the coupling elements at their confronting inner surfaces by
20 ultrasonically vibrating the ultrasonic horn in a direction parallel to the confronting inner surfaces; and pressing the opposed leg portions of the coupling elements, after the latter are disengaged from the ultrasonic horn, against each other so as to
25 be united at their confronting inner surfaces that have been fused.

2. A method according to claim 1, wherein the ultrasonic horn is vibrated in a direction perpendicular to the longitudinal axis of the coupling
30 element row.

3. An apparatus for welding a row of interconnected thermoplastic coupling elements for sliding clasp fasteners at opposed leg portions of each coupling element, said apparatus comprising,
35 in combination: a shaping die member having a channel extending through its length for the passage therethrough of the coupling elements; means for feeding the coupling elements through said channel at constant speed; means disposed in said channel
40 for fusing the opposed leg portions of the coupling elements; first press means on or in said shaping die member or forming part thereof for pressing the opposed leg portions of the coupling elements against said fusing means on opposite sides of the
45 fusing means; and second press means on or in said shaping die member or forming part thereof for pressing the opposed leg portions of the coupling elements against each other, said second press means being located downstream of said first press
50 means.

4. An apparatus according to claim 3, said fusing means comprising an ultrasonic horn having a central portion of a uniform thickness and a pair of first and second wedgelike portions each having a
55 progressively decreasing thickness.

5. An apparatus according to claim 4, said first press means being defined by a pair of first and second portions of said channel, said channel having at said first portion a uniform width slightly smaller
60 than the total thickness of the opposite leg portions of one of the coupling elements plus the thickness of said central portion of the ultrasonic horn, and at said second portion a progressively decreasing width slightly smaller than the total thickness of the
65 opposite leg portions of one of the coupling

elements plus the thickness of said first wedge-like portion of the ultrasonic horn.

6. An apparatus according to claim 4 or 5, said ultrasonic horn being ultrasonically vibratable in a
70 direction parallel to confronting inner surfaces of the coupling element leg portions.

7. An apparatus according to claim 6, said ultrasonic horn being vibratable in a direction perpendicular to the longitudinal axis of the coupling
75 element row.

8. An apparatus according to claim 6, said ultrasonic horn being vibratable in the longitudinal direction of the coupling element row.

9. An apparatus according to any one of claims 3
80 to 8, said second press means being defined by a third portion of said channel, said channel having at said third portion a substantially uniform width slightly smaller than the total thickness of the opposed leg portions of one of the coupling
85 elements.

10. An apparatus according to any one of claims 3 to 9 said feeding means including a pair of radially spaced wheels disposed adjacent said second press means and driven to rotate in opposite directions at
90 constant speed, each of said wheels having a plurality of peripheral teeth engageable with the coupling elements in said channel.

11. An apparatus according to any one of claims 3 to 10, said channel further having a mouth flaring
95 toward an inlet end of said channel in order to facilitate the introduction of the coupling element to be welded to said first press means.

12. A method substantially as herein described with reference to and as illustrated in Figures 1 to 3
100 inclusive of the accompanying drawings.

13. An apparatus substantially as herein described with reference to and as illustrated in Figures 1 to 3 inclusive of the accompanying drawings.