

SPECIFICATION

Method and apparatus for producing a coupling element assembly for sliding clasp fasteners

The present invention relates to zippers or sliding clasp fasteners and more particularly to a method and an apparatus for producing a coupling element assembly for sliding clasp fasteners.

U.S. Patent Nos. 3,445,915 and 4,033,014 exemplify the prior art in the field of methods and apparatus for producing a coupling element for sliding clasp fasteners which includes a row of spaced coupling elements of synthetic resin and a plurality of connecting threads having their portions embedded in the coupling elements to interconnect the spaced coupling elements. The known methods and apparatus, however, are not suitable for manufacturing coupling element assemblies having coupling elements securely fastened to connecting threads and, at the same time, laterally shiftable just enough for smooth engagement and disengagement between an opposed pair of rows of coupling elements.

According to a first aspect of the invention there is provided a method of producing a coupling element assembly for sliding clasp fasteners, comprising the steps of: providing a warp-knit elongate structure having a pair of spaced warp-knit elongate webs and a plurality of transverse thread portions spaced longitudinally of and interconnecting said warp-knit elongate webs; correcting the shape of said warp-knit elongate structure into a substantially ladder-like configuration with said transverse thread portions extending parallel to each other; introducing said warp-knit elongate structure into an elongate mould cavity having the shape of a blank coupling element so that said webs extend across the elongate mould cavity at its end portions and one of said transverse thread portions is disposed longitudinally in the mould cavity at a time; moulding synthetic resin around the portion of said webs and the transverse thread portion which are disposed in the mould cavity, thereby forming a blank coupling element product which is a portion of a coupling element assembly; separating said moulded blank coupling element product from the mould cavity; and bending said moulded blank coupling element product about its transverse central axis into the shape of a U.

According to a second aspect of the invention, there is provided an apparatus for producing a coupling element assembly for sliding clasp fasteners which includes a row of spaced coupling elements of synthetic resin and a warp-knit elongate structure having a pair of spaced webs and a plurality of transverse thread portions interconnecting the

spaced webs and embedded in the coupling elements, said apparatus comprising: a rotatable moulding wheel having on its periphery a series of elongate mould cavities with their longitudinal axes spaced by a distance from each other extending axially of said moulding wheel for receiving the transverse thread portions, and a pair of parallel annular grooves intersecting the end portions of each of said mould cavities for receiving the spaced webs; an injection shoe fixedly disposed in slidable contact with a portion of the periphery of said moulding wheel and having a sprue opening toward said periphery portion of the moulding wheel; a guide drum rotatably disposed adjacent to said moulding wheel on one side of said injection shoe for guiding the warp-knit elongate structure onto said moulding wheel, said guide drum having on its periphery a series of substantially rectangular raised portions spaced circumferentially from each other with axial channels therebetween spaced from each other by said distance, each of said raised portions having a width which is substantially the same as said distance and a length which is substantially the same as a distance between the annular groove; means disposed adjacent to said moulding wheel on the other side of said injection shoe for separating a moulded product from one of said mould cavities at a time; and means disposed adjacent to said separating means for bending the moulded product about its transverse central axis into the shape of a U.

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

Figure 1 is an enlarged fragmentary perspective view of a coupling element assembly produced by a method and an apparatus of the invention;

Figure 2 is an end elevation view of the coupling element assembly as attached to a stringer tape;

Figure 3 is a plan view of the coupling element assembly shown in Fig. 2;

Figure 4 is a plan view of a sliding clasp fastener having a pair of the coupling element assemblies;

Figure 5 is a schematic side elevation view of an apparatus according to the present invention;

Figure 6 is an enlarged fragmentary plan view of a moulding wheel;

Figure 7 is an enlarged longitudinal cross-section of a mould cavity;

Figure 8 is an enlarged fragmentary plan view of a guide drum;

Figure 9 is a perspective view, on an enlarged scale, of a guide drum;

Figure 10 is a view similar to Fig. 9, showing another embodiment of guide drum;

Figure 11 is an enlarged transverse cross-section view of a cooling device;

Figure 12 is an enlarged longitudinal cross-

section view of a coupling element assembly;

Figure 13 is a point diagram for a warp-knit sliding clasp fastener stringer;

Figure 14 is a fragmentary plan view of the warp-knit sliding clasp fastener stringer of Fig. 13;

Figure 15 is an enlarged end elevation view of the warp-knit sliding clasp fastener stringer of Fig. 13; and

Figure 16 is an end elevation view of the warp-knit sliding clasp fastener stringer of Fig. 15 with its coupling element assembly folded on itself into the shape of a U.

In Fig. 1, a coupling element assembly 1 as it is spread before being bent into the shape of a U includes a row of laterally spaced coupling elements 2 of synthetic resin, each having a coupling head portion 3 and a pair of leg portions 4, 5 extending from the coupling head portion 3, and a warp-knit elongate, ladder-like structure 6 extending transversely of the laterally spaced coupling elements 2 having longitudinal portions embedded in the coupling elements 2.

The warp-knit elongate structure 6 comprises a group of first threads 7, 8, 9 and 10 forming a plurality of wales 11, 12, 13 and 14 of chain stitches, respectively, and a pair of second threads 15, 16 interlaced with the wales 11, 12 and with the wales 13, 14, respectively, thereby providing a pair of warp-knit elongate webs 17, 18. The warp-knit elongate structure 6 further includes a pair of sets of third threads 21, 22 interlaced or interknitted with the wales 11, 12, 13 and 14 in opposite symmetrical patterns.

The warp-knit elongate webs 17, 18 have longitudinal portions extending through and embedded in the leg portions 4, 5 of each of the coupling elements 2. The pair of sets of third threads 21, 22 have a plurality of parallel portions 23 spaced longitudinally on the first threads 7, 8, 9 and 10 and extending transversely of the wales 11, 12, 13 and 14. The parallel spaced portions 23 are embedded longitudinally in the coupling elements 2 and extend substantially the full length of the coupling elements 2.

Thus, prior to being bent into a U shape ready for attachment to a stringer tape, the coupling element 1 has a ladder-like structure. Each of the warp-knit webs 17, 18 also has a ladder-like structure which is composed of the wales 11, 12 or 13, 14 interconnected by the second thread 15 or 16. With such a ladder-like structure of the webs 17, 18, the leg portions 4, 5 of the coupling elements 2 are fastened to the webs 17, 18 with an increased degree of bonding strength. The warp-knit webs 17, 18 allow material of the coupling elements 2 to enter into their interstices, and have a roughened surface engaging the coupling elements 2, so that the coupling elements 2 can be anchored in place on the webs 17, 18.

The embedded parallel spaced portions 23 stabilize the coupling elements 2 positionally against any displacement particularly in the transverse direction thereof. This reinforcing arrangement is advantageous especially where the coupling elements 2 are made of an unstretched plastic material that is easily deformable, ductile, and soft. The portions of the wales 11, 12, 13 and 14 which are positioned between the coupling elements 2 are longitudinally stretchable sufficiently for smooth engagement and disengagement between a pair of companion rows of coupling elements.

The coupling element assembly 1 shown in Fig. 1 is folded over on itself about a longitudinal axis 24 before the assembly is mounted on a sliding clasp fastener stringer tape.

As shown in Figs. 2 and 3, the coupling element assembly 1, when folded, has a substantially U-shaped cross section and is attached astride a longitudinal marginal edge portion of a sliding clasp fastener stringer tape 25 by means of threads with sewing stitches 26.

The coupling elements 2 may be bonded at their opposed surfaces 27, 28 to the stringer tape 25 by welding or adhesive bonding. As an alternative, the warp-knit webs 17, 18 may be woven or knit into a woven or knit fabric stringer tape.

Fig. 4 shows a pair of sliding clasp fastener stringers 29, 30 having a pair of the coupling element assemblies 1, respectively, partly intermeshed by a slider 31 movable therealong.

An apparatus according to the present invention for producing the coupling element assembly 1 is shown in Fig. 5, generally indicated by 32. The apparatus 32 basically comprises a moulding wheel 33 rotatably supported on a frame (not shown) and drivable by a suitable motor to revolve in the direction of the arrow 34 about an axle 35, and an injection shoe 36 disposed adjacent to the moulding wheel 33 in slidable contact with a portion of the periphery 37 of the moulding wheel 33.

The apparatus 32 additionally includes a guide drum 38 disposed adjacent to the moulding wheel 33 upstream of the injection shoe 36 with respect to the direction 34 of rotation of the moulding wheel 33.

The moulding wheel 33 has on its periphery 37 a plurality of elongate mould cavities 39 with their longitudinal axes spaced by a distance 40 (Fig. 6) from each other extending axially of the moulding wheel 33. Each mould cavity 39 has a contour corresponding to the shape of the coupling element 2 as it is in a blank form before being bent into a U shape. The distance 40 determines an element-to-element distance or pitch 41 in a produced coupling element assembly.

The moulding wheel 33 also has on its periphery 37 a pair of parallel annular grooves

42, 43 (Fig. 6) intersecting the end portions of each of the elongate mould cavities 39. Each of the annular grooves 42, 43 has a cross-sectional shape which is substantially the same as that of one of the warp-knit elongate webs 17, 18. When the warp-knit elongate webs 17, 18 are received in the annular grooves 42, 43, respectively, the webs 17, 18 have their upper surfaces held substantially flush with or lower than the periphery 37 of the moulding wheel 33.

The injection shoe 36 has a segmental shape having an arcuate lower surface 44 facing the moulding wheel 33. The injection shoe 36 is normally urged in a direction to cause the arcuate lower surface 44 to contact slidably with the periphery 37 of the moulding wheel 33 by means of a spring 45 acting between the injection shoe 36 and a portion 46 of the frame.

The injection shoe 36 has a passageway or sprue 47 opening toward the moulding wheel 33. The sprue 47 is located centrally lengthwise of the mould cavities 39, as shown in Fig. 7. Molten synthetic resin is forced from a heating chamber 48 into the sprue 47.

As better shown in Figs. 8 and 9, the guide drum 38 has on its periphery 49 a plurality of substantially rectangular raised portions 50 spaced circumferentially from each other. Each of the raised portions 50 is defined by a pair of radial sidewalls 51, 51 spaced axially from each other and a substantially semicylindrical surface 52 extending between the sidewalls 51, 51. Each raised portion 50 has a width 53, or a length of each sidewall, which is substantially the same as the distance 40 between the longitudinal axes of the mould cavities 39, and has a length 54, or a distance between the sidewalls 51, 51 of each raised portion 50, which is substantially the same as a distance 55 between the annular grooves 42, 43 on the moulding wheel 33.

A plurality of axial channels 56 are each disposed between adjacent two of the raised portions 50. The axial channels 56 are spaced circumferentially from each other by the distance 40 between the longitudinal axes of the mould cavities 39.

The periphery 49 of the guide drum 38 includes a pair of annular surfaces 57, 58 located one on each side of the series of the raised portions 50.

The guide drum 38 rotates about its own axis in the direction of the arrow 59 (Fig. 5) to feed the warp-knit elongate structure 6 in the direction of the arrow 101 onto the periphery 37 of the moulding wheel 33 being rotated. The warp-knit elongate structure 6 while it is being longitudinally tensioned is positively fed by the guide drum 38 because the transverse thread portions 23 become placed one after another in the channels 56, and engaged by adjacent raised portions 50.

While the warp-knit elongate structure 6 is

being driven around and by the guide drum 38, the shape of the warp-knit elongate structure 6 is rectified or corrected into a predetermined ladder-like configuration.

More specifically, the rectangular raised portions 50 enter successively into a series of openings 60 each defined between adjacent two of the transverse thread portions 23 of the warp-knit elongate structure 6. The openings 60, or the surrounding thread portions, are forcibly contoured into the rectangular shape of the raised portions 50 by the sidewalls 51, 51 and the channels 56. Accordingly, the warp-knit elongate structure 6 as it leaves the guide drum 38 has the transverse thread portions 23 spaced from each other more accurately by the distance 53 and the warp-knit webs 17, 18 spaced from each other more accurately by the distance 54.

The warp-knit elongate structure 6 is then introduced between the injection shoe 36 and the moulding wheel 33 while it is being rotated about its own axis. The warp-knit webs 17, 18 are placed in the annular grooves 42, 43, respectively, on the moulding wheel 33, and the transverse thread portions 23 are located centrally in the mould cavities, as shown in Figs. 6 and 7.

Molten synthetic resin is forced from the heating chamber through the sprue 47 into one of the mould cavities 39 which is positioned just beneath the sprue 47 and is supplied with the webs 17, 18 and one of the transverse thread portions 23. The synthetic resin is then moulded in said one of the mould cavities 39 around the webs 17, 18 and said one of the transverse thread portions 23, thereby producing one of the coupling elements 2.

Since the sprue 47 is located at the center of the length of the mould cavities 39, the molten synthetic resin, when injected into the mould cavity 39, displaces a central portion of the transverse thread portion 23 downwardly. Such displaced thread portion assists in making a more secure union between the coupling element material and the transverse thread portion 23.

When the annular grooves 42, 43 have a deeper bottom such that the warp-knit webs 17, 18 have their upper surfaces located below the periphery 37 of the moulding wheel 33, a layer 61 of synthetic resin is formed on each of the upper surfaces of the warp-knit webs 17, 18, as shown in Fig. 12. The synthetic resin layers 61 become bonded together when the coupling element assembly is bent into a U shape with the layers 61 are fused together.

Continued rotation of the moulding wheel 33 enables the mould cavity 39 filled with the molten synthetic resin to move past the sprue 47. A portion 100 (Fig. 6) of the periphery 37 of the moulding wheel 33 which is disposed between the filled mould cavity 39 and

the following mould cavity 39 comes under the sprue 47 and blocks the flow of the molten synthetic resin. As the moulding wheel 33 rotates further, the next mould cavity 39 underlies the sprue 47, whereupon the molten synthetic resin is allowed to flow out of the sprue 47 into the mould cavity 39. The moulding of the coupling elements 2 is thus repeated.

As shown in Fig. 5, a roller 62 is rotatably disposed adjacent to the moulding wheel 33 downstream of the injection shoe 36. The coupling elements 2 as they are moulded around the warp-knit structure 6 are separated from the mould cavities and transported around the roller 62. The coupling element assembly 1 is then supplied into a bending device 63 in which the coupling element assembly 1 is bent about its own longitudinal axis into the shape of a U ready for attachment to a stringer tape.

The moulding apparatus 32 additionally includes a cooling device 64 (Figs. 5 and 11) having a jacket 65 with a pair of jacket walls 66, 67 held in slidable contact with the periphery 37 and one of its sidewalls of the moulding wheel 33. The jacket 65 includes a passageway 68 through which a coolant such as water flows to cool the mould cavities 39. The coolant is supplied from an inlet pipe 69 and discharged out of an outlet pipe 70, the pipes 69, 70 being mounted on the jacket 65.

For cooling the moulding wheel 33 effectively, the moulding wheel 33 has a plurality of openings 71, and the axle 35 has a bore 72 for the passage therethrough of a coolant.

Fig. 10 illustrates an embodiment of guide drum 73 having a series of substantially rectangular raised portions 74 circumferentially spaced from each other on a periphery 75 of the guide drum 73. Each of the raised portions 74 is dome-shaped so that it can easily enter one of a plurality of openings 76 defined between transverse thread portions 77 of a warp-knit elongate structure 78 to be wound around and fed by the guide drum 73.

The guide drum 73 is advantageous particularly where the transverse thread portions 77 do not initially extend parallel to each other. The transverse thread portions 77 can be rectified by the dome-shaped raised portions 74 into a substantially parallel arrangement when they leave the guide drum 73.

Figs. 13 to 16 inclusive show a warp-knit sliding clasp fastener stringer 79 that can be produced on the moulding apparatus 32.

The sliding clasp fastener stringer 79 comprises a coupling element assembly 80 and a warp-knit stringer tape 81 interknitted therewith. The coupling element assembly 80 includes a pair of spaced warp-knit elongate webs 82, 83 each comprising a pair of first threads 84, 85 forming a pair of wales of chain stitches having a pattern of 1-0/0-1, a

second thread 86 knitted with the first threads 84, 85 in a pattern of 1-0/1-2, and a reinforcing warp thread 87 extending longitudinally between the first threads 84, 85. The warp-knit elongate webs 82, 83 are interconnected by a pair of sets of third threads 88, 89 interlaced with the webs 82, 83 in opposite symmetrical patterns of 5-5/4-4/5-5/0-0/1-1/0-0 and 0-0/1-1/0-0/5-5/4-4/5-5.

The stringer tape 81 comprises a plurality of fourth threads 90 forming a plurality of wales of chain stitches having a pattern of 1-0/0-1, a plurality of fifth threads 91 knitted with the fourth threads 90 in a pattern of 1-0/1-2, and a plurality of sixth threads 92 knitted with the wales in a pattern of 1-0/4-5.

The coupling element assembly 80 and the stringer tape 81 are interconnected by one of the fifth threads 91 and a pair of the sixth threads 92. A row of coupling elements 93 is moulded around transverse parallel portions 94 of the third threads 88, 89 interconnecting the warp-knit elongate webs 82, 83 and around longitudinally spaced portions of the warp-knit elongate webs 82, 83.

As best shown in Fig. 16, the formed coupling element assembly 80 is bent about its longitudinal axis into the shape of U, thereby finalizing the manufacture of the sliding clasp fastener stringer 79.

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

CLAIMS

1. A method of producing a coupling element assembly for sliding clasp fasteners, comprising the steps of: providing a warp-knit elongate structure having a pair of spaced warp-knit elongate webs and a plurality of transverse thread portions spaced longitudinally of and interconnecting said warp-knit elongate webs; correcting the shape of said warp-knit elongate structure into a substantially ladder-like configuration with said transverse thread portions extending parallel to each other; introducing said warp-knit elongate structure into an elongate mould cavity having the shape of a blank coupling element so that said webs extend across the elongate mould cavity at its end portions and one of said transverse thread portions is disposed longitudinally in the mould in cavity at a time; moulding synthetic resin around the portion of said webs and the transverse thread portion which are disposed in the mould cavity, thereby forming a blank coupling element product which is a portion of a coupling element assembly; separating said moulded blank coupling element product from the mould cavity; and bending said moulded blank coupling element product about its transverse central axis into the shape of a U.



the following mould cavity 39 comes under the sprue 47 and blocks the flow of the molten synthetic resin. As the moulding wheel 33 rotates further, the next mould cavity 39 underlies the sprue 47, whereupon the molten synthetic resin is allowed to flow out of the sprue 47 into the mould cavity 39. The moulding of the coupling elements 2 is thus repeated.

As shown in Fig. 5, a roller 62 is rotatably disposed adjacent to the moulding wheel 33 downstream of the injection shoe 36. The coupling elements 2 as they are moulded around the warp-knit structure 6 are separated from the mould cavities and transported around the roller 62. The coupling element assembly 1 is then supplied into a bending device 63 in which the coupling element assembly 1 is bent about its own longitudinal axis into the shape of a U ready for attachment to a stringer tape.

The moulding apparatus 32 additionally includes a cooling device 64 (Figs. 5 and 11) having a jacket 65 with a pair of jacket walls 66, 67 held in slidable contact with the periphery 37 and one of its sidewalls of the moulding wheel 33. The jacket 65 includes a passageway 68 through which a coolant such as water flows to cool the mould cavities 39. The coolant is supplied from an inlet pipe 69 and discharged out of an outlet pipe 70, the pipes 69, 70 being mounted on the jacket 65.

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Fig. 10 illustrates an embodiment of guide drum 73 having a series of substantially rectangular raised portions 74 circumferentially spaced from each other on a periphery 75 of the guide drum 73. Each of the raised portions 74 is dome-shaped so that it can easily enter one of a plurality of openings 76 defined between transverse thread portions 77 of a warp-knit elongate structure 78 to be wound around and fed by the guide drum 73.

The guide drum 73 is advantageous particularly where the transverse thread portions 77 do not initially extend parallel to each other. The transverse thread portions 77 can be rectified by the dome-shaped raised portions 74 into a substantially parallel arrangement when they leave the guide drum 73.

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second thread 86 knitted with the first threads 84, 85 in a pattern of 1-0/1-2, and a reinforcing warp thread 87 extending longitudinally between the first threads 84, 85. The warp-knit elongate webs 82, 83 are interconnected by a pair of sets of third threads 88, 89 interlaced with the webs 82, 83 in opposite symmetrical patterns of 5-5/4-4/5-5/0-0/1-1/0-0 and 0-0/1-1/0-0/5-5/4-4/5-5.

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As best shown in Fig. 16, the formed coupling element assembly 80 is bent about its longitudinal axis into the shape of U, thereby finalizing the manufacture of the sliding clasp fastener stringer 79.

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CLAIMS

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2. A method of producing a coupling element assembly for sliding clasp fasteners according to claim 1, including the step of forcibly cooling said moulded product between said moulding step and said separating step.

3. A method of producing a coupling element assembly for sliding fasteners according to claim 1, said moulded product being bent into the shape of a U with one of said warp-knit elongate webs overlying the other.

4. An apparatus for producing a coupling element assembly for sliding clasp fasteners which includes a row of spaced coupling elements of synthetic resin and a warp-knit elongate structure having a pair of spaced webs and a plurality of transverse thread portions interconnecting the spaced webs and embedded in the coupling elements, said apparatus comprising: a rotatable moulding wheel having on its periphery a series of elongate mould cavities with their longitudinal axes spaced by a distance from each other extending axially of said moulding wheel for receiving the transverse thread portions, and a pair of parallel annular grooves intersecting end portions of each of said mould cavities for receiving the spaced webs; an injection shoe fixedly disposed in slidable contact with a portion of the periphery of said moulding wheel and having a sprue opening toward said periphery portion of the moulding wheel; a guide drum rotatably disposed adjacent to said moulding wheel on one side of said injection shoe for guiding the warp-knit elongate structure onto said moulding wheel, said guide drum having on its periphery a series of substantially rectangular raised portions spaced circumferentially from each other with axial channels therebetween spaced from each other by said distance, each of said raised portions having a width which is substantially the same as said distance and a length which is substantially the same as a distance between the annular grooves; means disposed adjacent to said moulding wheel on a side opposite said one side of said injection shoe for separating a moulded product from one of said mould cavities at a time; and means disposed adjacent to said separating means for bending the moulded product about its transverse central axis into the shape of a U.

5. An apparatus for producing a coupling element assembly for sliding clasp fasteners according to claim 4, including means disposed between said injection shoe and said separating means for forcibly cooling the moulded product.

6. A method according to claim 1 and substantially as described with reference to any of the accompanying drawings.

7. An apparatus according to claim 4, and substantially as described with reference to and as illustrated in the accompanying drawings.

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