

## APPARATUS FOR MANUFACTURING WOVEN

SLIDE FASTENER STRINGER

The present invention relates to a woven slide fastener stringer having a row of continuous filamentary coupling elements woven integrally into a stringer tape, and an apparatus for manufacturing such a woven slide fastener stringer.

Various woven slide fastener stringers and apparatus for manufacturing the same have been proposed and used in the art. Such a woven slide fastener stringer includes a row of coiled or meandering coupling elements of synthetic resin which are woven into and fixed to a longitudinal edge portion of a stringer tape as the coupling elements are formed of a filamentary material. Some woven slide fastener stringers have been found unsatisfactory in that a binding thread system which fastens the coupling elements to the stringer tape forces upper and lower legs of the coupling elements toward each other to a point where coupling heads are inclined with respect to the plane of the stringer tape. The coupling heads thus formed fail to provide a sufficient coupling strength when opposite rows of coupling elements on stringer tapes are brought into interdigitating engagement with each other.

(12)  
According to the present invention there is provided an apparatus for manufacturing a woven slide fastener stringer, comprising:

5 (a) a loom for weaving a stringer tape of warp threads progressively at a fell, the loom comprising heddle frames with heddles for selectively moving the warp threads up and down, and a reed;

(b) a support;

10 (c) a mandrel fixed to said support for being disposed alongside of the warp threads and extending toward the fell;

15 (d) a rotor rotatably mounted on said support and having a guide hole for passage therethrough of an element-forming filamentary material, said rotor being rotatable for coiling said element-forming filamentary material in a conical orbital path around said mandrel into a row of coupling elements as they are woven into the stringer tape in synchronization with the weaving of the stringer tape;

20 (e) a second set of heddles disposed on the opposite side of the mandrel to said first set of heddles for supplying binding warp threads onto the coupling elements to fasten the latter to the stringer tape;

25 (f) a third set of heddles, on the same side of the mandrel as said first set of heddles, for selectively moving further warp threads up and down which also serve to bind the coupling elements on to the

stringer tape; and

- (g) a pair of filling carriers positioned alongside of said mandrel for introducing a pair of weft threads respectively over and under the coupling elements into interlooped engagement with said binding warp threads and said further warp threads.

It is believed possible by means of the present invention to provide a woven slide fastener stringer including a row of coupling elements fixedly secured to a stringer tape and having coupling heads, respectively, extending substantially perpendicularly to the plane of the stringer tape for an increased degree of coupling strength when a pair of such slide fastener stringers are mated together.

In the accompanying drawings:-

Fig. 1 is an enlarged front elevational view of a row of coupling elements of a woven slide fastener stringer made by an apparatus embodying the present invention;

Fig. 2 is an enlarged schematic perspective view of a woven slide fastener stringer made by an apparatus embodying the present invention;

Fig. 3 is a cross-sectional view taken along line III - III of Fig. 2;

Fig. 4 is an enlarged schematic perspective view of another such woven slide fastener stringer;

Fig. 5 is a cross-sectional view taken along line V - V of Fig. 4;

5 Fig. 6 is a schematic plan view of an apparatus for manufacturing a woven slide fastener stringer in accordance with the present invention;

10 Figs. 7 and 8 are enlarged schematic perspective views of the apparatus shown in Fig. 6, the views showing different parts positions while the apparatus is in operation to produce a woven slide fastener stringer;

Fig. 9 is an enlarged schematic cross-sectional view of a conventional woven slide fastener stringer; and

15 Fig. 10 is an enlarged front elevational view of a row of coupling elements of the woven slide fastener stringer illustrated in Fig. 9.

As shown in Figs. 9 and 10, a conventional woven slide fastener stringer disclosed in Japanese Laid-Open Patent Publication No. 56-116403, published on September 12, 25 1981, comprises a row of coupling elements A each having a pair of upper and lower legs B, E, and a binding thread system that fixes the row of coupling elements A

to a stringer tape (not shown). The binding thread system includes warp threads C, D running over and under the upper legs B, warp threads F, G underlying and overlying the lower legs E, a warp thread H extending vertically (Fig. 9) between adjacent coupling elements A, and weft threads I, J having loops interlaced with these warp threads. The binding thread system tends to press the upper legs B downwardly and the lower legs E upwardly to a point where coupling heads K (Fig. 10) are inclined with respect to the plane of the stringer tape. With such an arrangement, the coupling heads K provide a weaker coupling strength when opposite rows of coupling elements are interengaged than do the coupling heads of filamentary coupling elements sewn to a stringer tape. It has been found that the larger the size of slide fasteners, the greater the tendency for confronting coupling heads or fastener stringers to fail to produce a sufficient degree of coupling strength when they are coupled together.

The present invention will now be described by way of example with reference to Figs. 1 through 8.

In Figs. 2 and 3, a woven slide fastener stringer according to an embodiment of the present invention comprises a row of coiled coupling elements 1 formed of synthetic resin fixed to a slide fastener stringer tape 3 woven of weft and warp threads, the row of coupling

elements 1 extending along a longitudinal edge portion 4 of the stringer tape 3. The row of coupling elements 1 is secured to the stringer tape 3 by means of a binding thread system 7 including a pair of upper warp threads 8, 9, a pair of lower warp threads 10, 11, an upper weft thread 12, a lower weft thread 13, and a pair of binding warp threads 14, 15.

Each of the coupling elements 1 comprises a coupling head 2 projecting transversely beyond the longitudinal edge portion 4 of the stringer tape 3, and a pair of upper and lower legs 5, 6 (Fig. 2) extending from the coupling head 2 over and across the longitudinal tape edge portion 4 and spaced from each other vertically in a direction substantially perpendicular to the plane of the stringer tape 3. The upper and lower legs 5, 6 are blended into and interconnected by a heel portion 2a located remotely from the coupling head 2. The lower legs 6 of the coupling elements 1 are mounted on the longitudinal edge portion 4 of the stringer tape 3. A longitudinal core cord 1a extends through a space defined through the coiled coupling elements 1 and is positioned closer to the heel portions 2a than to the coupling heads 2 as best shown in Fig. 2.

The binding warp threads 14, 15 of the binding thread system 7 are intertwined with the upper and lower legs 5, 6 of the coupling elements 1 at a position adjacent

to the coupling heads 2. As best illustrated in Fig. 3, the binding warp thread 14 alternately overlies and underlies the upper and lower legs of the adjacent coupling elements 1. More specifically, the binding warp thread 14 overlies an upper leg 17 of a coupling element 1, underlies a lower leg 18 of an adjacent coupling element 16, and again overlies an upper leg 20 of an adjacent coupling element 19, and so on.

Likewise, the binding warp thread 15 underlies a lower leg 21 of the coupling element 1, overlies an upper leg 22 of the adjacent coupling element 16, and underlies a lower leg 23 of the adjacent coupling element 19. Thus, the binding warp threads 14, 15 run symmetrically in a vertical sense with respect to a horizontal line

parallel to the plane of the stringer tape 3. The binding warp threads 14, 15 cross each other obliquely with respect to the direction normal to the plane of the stringer tape 3 at positions between adjacent coupling elements.

The binding warp threads 14 thus extending along an undulated path has a plurality of upper loops running over the upper legs and a plurality of lower loops running under the lower legs. Similarly, the binding warp thread 15 has a plurality of lower loops running under the lower legs and a plurality of upper loops running over the upper legs. The upper weft thread 12 is interlooped with the upper loops of the binding warp

thread 14 such that the upper weft thread 12 is located inwardly of the upper loops of the warp thread 14 at points L, N, and outwardly of such upper loops at points M, O. Stated otherwise, the upper weft thread 12 has a plurality of loops each interlaced with a corresponding one of the upper loops of the binding warp thread 14. The upper weft thread 12 also includes a plurality of loops which are interlooped with the lower weft thread 13 adjacent to the heel portions 2a of the coupling elements 1.

Likewise, the lower weft thread 13 is interlooped with the lower loops of the binding warp thread 15 such that the lower weft thread 13 is located inwardly of the lower loops of the warp thread 15 at the points L, N, and outwardly of such lower loops at the points M, O. The lower weft thread 13 thus has a plurality of loops each interlaced with a corresponding one of the lower loops of the binding warp thread 15. The lower weft thread 13 also extends into the stringer tape 3 as shown in Fig. 2 in which the weft thread 13 cooperates with warp threads in making up the stringer tape 3.

The warp threads 8, 9 of the binding thread system 7 overlie the upper legs of the coupling elements and are interlooped with the lower weft thread 13 between the adjacent coupling elements. The warp threads 10, 11 of the binding thread system 7 are interwoven with the

lower weft thread 13.

With the arrangement described above, the binding warp threads 14, 15 extend around the upper and lower legs of the coupling elements in a symmetrical pattern as best shown in Fig. 3, so that the coupling heads 2 extend perpendicularly to a direction in which the coupling elements extend, as shown in Fig. 1, or to the plane of the stringer tape 3. The coupling heads 2 thus arranged provide a sufficient degree of coupling strength which enables opposite rows of coupling elements to mesh with each other firmly against the danger of getting accidentally separated.

A woven slide fastener stringer according to another embodiment shown in Figs. 4 and 5 includes a binding thread system having a pair of binding warp threads 24, 25 and upper and lower weft threads 26, 27 which are interlooped with the binding warp threads 24, 25 in a pattern different from that illustrated in Figs. 2 and 3. More specifically, the upper and lower weft threads 26, 27 are disposed inwardly of loops of the binding warp threads 24, 25 at points L, M, N. O such that the upper and lower weft threads 26, 27 have loops each interlaced with two adjacent loops of the binding warp threads 24, 25. Thus, the binding warp threads 24, 25 cross each other between adjacent coupling elements 28, 29, 30 (Fig. 5) in a direction substantially



perpendicular to the plane of a stringer tape of the slide fastener stringer, or parallel to a direction in which upper and lower legs of the coupling elements 28, 29, 30 are spaced from each other. The upper and lower legs of the coupling elements are thus fastened by the binding warp threads 24, 25, enabling coupling heads connected to the coupling element legs to retain higher perpendicularity to the plane of the stringer tape.

Fig. 6 illustrates an apparatus for manufacturing a woven slide fastener stringer embodying the present invention. The apparatus comprises a loom 55 for weaving a stringer tape 3 of warp threads W progressively at a fell F, the loom 55 including heddle frames 51 (with a first set of heddles, not shown) for selectively moving the warp threads W up and down, a reed 52 for beating a weft thread inserted in a shed between separated warp threads W against the fell F, and a knitting needle 54 reciprocally disposed alongside of the stringer tape 3 for successively knitting loops of the weft thread projecting out of the warp shed to form a tape selvage.

The apparatus also includes a support 31 positioned alongside of the warp threads W, a mandrel 32 fixed to the support 32 and extending to the fell F, an annular rotor 37 rotatably mounted on the support 31 and having

(16)

a guide hole 39 for passage therethrough of an element-forming filamentary material 38 of synthetic resin, the rotor 37 being drivable for rotation by a drive mechanism 36 operatively coupled to a follower gear 35 held in mesh with a drive gear 34 connected to a motor (not shown) and rotatably mounted on a fixed shaft 33 disposed in eccentric relation to the rotor 37. When the rotor 37 is rotated, it coils the filamentary material 38 in a conical orbital path around the mandrel 32 into a row of coupling elements as they are woven into the stringer tape 3 in synchronization with the weaving of the latter.

A pair of further heddles 44, 45 (best shown in Figs. 7 and 8) are disposed on the opposite side of the mandrel 32 from the first set (not shown) of heddles and are vertically movable individually for supplying a pair of binding warp threads 41, 42 along a path 43 extending toward the fell F onto the coupling elements as formed to fasten the latter to the stringer tape 3.

A pair of filling carriers or weft inserters 48, 49 are positioned alongside of the mandrel 32 and supported by an actuator arm 53 angularly movable back and forth to swing the filling carriers 48, 49 in unison along an arcuate path. One of the filling carriers 48 carries an upper weft thread 46 and the other filling carrier 49

carries a lower weft thread 47, the upper and lower weft threads 46, 47 when inserted being engageable with the binding warp threads 41, 42 to fix the coupling elements in position on the stringer tape 3. A set of yet  
5 further heddles 50, on the same side of mandrel 32 as the first set (not shown) of heddles, selectively move further warp threads w up and down which also serve to bind the coupling elements on the stringer tape 3.

The support 31 and the fixed shaft 33 have holes for  
10 feeding therethrough a core cord 40 into a space defined through the coupling elements as the latter are successively produced.

In operation, the annular rotor 37 rotates to coil the  
15 filamentary material 38 around the mandrel 32 as shown in Figs. 7 and 8 to form a succession of coupling elements as they are fastened to the stringer tape 3 by a binding thread system that is composed of the warp threads 41, 42 supplied from the heddles 44, 45, the warp threads w supplied from the heddles 50, and the  
20 upper and lower weft threads 46, 47 fed by the filling carriers 48, 49 over and under the coupling elements where the weft threads 46, 47 are interlaced with the warp threads 41, 42, the warp threads w and the warp threads W. Fig. 7 shows the position of the parts taken  
25 just before the stringer is woven to the point L ( Figs.

(28)

2 and 3), and Fig. 8 shows the position which the parts assume immediately before the stringer is woven at the point M (Figs. 2 and 3).

5 With the apparatus thus arranged, the binding warp threads and weft threads of a binding thread system can be supplied from the heddles and filling carrier of their own which are simple in structure and located adjacent to the other parts of the apparatus without involving modifications therein.

10 Reference is directed to our co-pending patent application No. 8137356 (230P43388 ) from which this is divided.



Claims:

An apparatus for manufacturing a woven slide fastener stringer, comprising:

5 (a) a loom for weaving a stringer tape of warp threads progressively at a fell, the loom comprising heddle frames with a first set of heddles for selectively moving the warp threads up and down, and a reed;

(b) a support;

10 (c) a mandrel fixed to said support for being disposed alongside of the warp threads and extending toward the fell;

15 (d) a rotor rotatably mounted on said support and having a guide hole for passage therethrough of an element-forming filamentary material, said rotor being rotatable for coiling said element-forming filamentary material in a conical orbital path around said mandrel into a row of coupling elements as they are woven into the stringer tape in synchronization with the weaving of the stringer tape;

20 (e) a second set of heddles disposed on the opposite side of the mandrel to said first set of heddles, for supplying binding warp threads onto the coupling elements to fasten the latter to the stringer tape;

25 (f) a third set of heddles, on the same side of the mandrel as said first set of heddles, for selectively moving further warp threads up and down



which also serve to bind the coupling elements on to the stringer tape; and

5 (g) a pair of filling carriers positioned alongside of said mandrel for introducing a pair of weft threads respectively over and under the coupling elements into interlooped engagement with said binding warp threads and said further warp threads.

---