

"METHOD AND APPARATUS FOR MANUFACTURING
WOVEN SLIDE FASTENER STRINGERS"

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

10 Various methods and apparatus for manufacturing woven slide fastener stringers have been proposed and used. An apparatus disclosed in Japanese Laid-Open Patent Publication No. 50-36,249 published April 5, 1975 has a rotor for coiling an element-forming filamentary material of synthetic resin in a conical orbital path around a mandrel into a row of coupling elements as they are woven into a stringer tape in synchronism with the weaving of the latter. The known
15 apparatus is complex in construction and hence needs tedious and time-consuming adjustment and maintenance.

20 According to another known apparatus shown in West German Laid-Open Patent Publication No. 2,221,855 published November 30, 1972, an element-forming filamentary material is coiled into a row of coupling elements without using a rotor and a mandrel, the coupling elements being woven into a stringer tape as the latter is woven. The apparatus includes a rocker arm angularly movable in a plane substantially parallel
25 to the general plane of the stringer tape for moving a hook into and out of a warp shed across warp threads to coil the element-forming filamentary material around the hook. The hook thus arranged is likely to interfere or otherwise damage the warp threads, particularly when the apparatus operates at a relatively
30 high speed. A small-sized hook may reduce damage to the warp threads but is apt to fail to catch the element-

-forming filamentary material.

According to a first aspect of the present invention, there is provided a method of manufacturing a woven slide fastener stringer, comprising the steps of :

- 5 (a) weaving a stringer tape of warp threads and a single weft thread progressively at a fell; and
- (b) coiling an element-forming filamentary material, supplied to said fell longitudinally along a path extending between and substantially parallel to said warp threads, into a row of coupling elements as they are woven into said stringer tape in synchronism with the weaving of said stringer tape, said coiling step including
- 10 (1) displacing by pushing said element-forming filamentary material out of said path into a position outside said warp threads, remote from the fell to enable it to become hooked and then terminating the pushing,
- 15 (2) hooking said element-forming filamentary material at said position to form a coupling element, and
- 20 (3) moving said coupling element from said position to another position located outside said warp threads in alignment with said fell.

According to a second aspect of the present invention, there is provided an apparatus for manufacturing a woven slide fastener stringer, comprising :

- 25 (a) a loom for weaving a stringer tape of warp threads and a single weft thread progressively at a fell, said loom including a reed having guide slots for the passage therethrough of the warp threads and
- 30 also for the passage of an element-forming filamentary material along a path extending between and substantially parallel to the warp threads, and a filling carrier or weft inserter disposed at one edge of the warp threads and

reciprocable for introducing the weft thread into interlaced engagement with the warp threads;

5 (b) means operable in synchronism with said loom for coiling the element-forming filamentary material into a row of coupling elements, whereby the row of coupling elements are woven into the stringer tape as the latter is woven, said coiling means including :

10 (1) a hook disposed at said one edge of the warp threads and movable in a plane perpendicular to the general plane of the stringer tape being woven between a first position located in alignment with the fell and a second position remote from the fell; and

(2) means disposed at the opposite edge of the warp threads for displacing the element-forming filamentary material out of said path beyond the warp threads beyond said plane of the movement of said hook while said hook is at said second position.

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

FIGS. 1 and 2 are schematic perspective views of parts of an apparatus embodying the present invention, the views showing parts in different positions while the apparatus is in operation to produce a woven slide fastener stringer;

FIG. 3 is an enlarged perspective view of a portion of the apparatus shown in FIG. 2;

FIG. 4 is an enlarged perspective view of a portion of a slide fastener stringer in course of production, parts not shown being in the position of FIG. 1;

FIG. 5 is an enlarged schematic plan view of a woven slide fastener stringer;

FIG. 6 is a transverse cross-sectional view taken along line VI-VI of FIG. 5;

FIG. 7 is a longitudinal cross-sectional view taken along line VII-VII of FIG. 5;

FIG. 8 is a view similar to FIG. 5 of another woven slide fastener stringer; and

FIG. 9 is a longitudinal cross-sectional view taken along line IX-IX of FIG. 8.

FIGS. 1 and 2 illustrate an apparatus for manufacturing a woven slide fastener stringer in accordance with the present invention. The apparatus comprises a loom 10 for progressively weaving a stringer tape 11 of warp threads 12, 13, 14 at a fell 15, the loom 10 including conventional heddles or a shedding means 15a shown diagrammatically for forming a

pair of upper and lower warp sheds 16, 17 between the warp threads 12, 13, 14 and for selectively moving the warp threads 12, 13, 14 up and down, a filling carrier or weft inserter 18 disposed at one edge of the warp threads 12, 13, 14 and angularly movable for inserting a weft thread 19 in the upper warp shed 16 between the warp threads 12, 13, a reed 20 movable back and forth for beating the weft thread 19 inserted in the shed 16 against the fell 15, and a knitting needle 21 reciprocally disposed at the opposite edge of the warp threads 12, 13, 14 for successively knitting loops of the weft thread 19 projecting out the warp shed 16 to form a tape selvage. The reed 20 has a plurality of longitudinal slots 22 through which the warp threads 12, 13, 14 extend from the heddle 15a to the fell 15. An element-forming filamentary material of synthetic resin 23, which has a plurality of prospective coupling head portions 47 (FIGS. 5 and 6) formed in advance thereon at equal intervals, is introduced in the lower warp shed 17 through the second endmost slot 22a to the fell along a longitudinal path extending between and substantially parallel to the warp threads 12, 13, 14. The longitudinal slot 22a through which the filamentary material 23 passes is selected on the basis of the length L (FIG. 5) of a coupling element to be formed.

The apparatus also includes a coiling means operable in synchronism with the loom 10 for coiling the element-forming filamentary material 23 into a row of coupling elements 24 whereby the row of coupling elements 24 is woven integrally into the stringer tape 11 as the latter is woven. The coiling means comprises a rocker arm 25 disposed at the one edge of the warp threads 12, 13, 14 and rockingly movable about its one end. As shown in FIG. 3, the rocker arm 25 has at the opposite or distal end a hook 26 including a head

portion 26a and a nose portion 26b projecting from the head portion 26a in a direction parallel to the warp threads 12, 13, 14 and hence to the path of the filamentary material 23. The nose portion 26b is in the form of a rectangular block and has a transverse cross section which defines a space between a pair of upper and lower legs of each coupling element 24. The head portion 26a has a shape like the frustum of a pyramid defined by four slanted surfaces 27, 28, 29, 30. The slanted surfaces 27-30 enable the filamentary material 23 to slide smoothly thereon and over the nose portion 26b. Upon rocking movement of the rocker arm 25, the hook 26 moves, in a plane substantially perpendicular to the general plane of the stringer tape 11, between a first position shown in FIGS. 2 and 3 in which it is located in alignment with the fell 15 and a second position shown in FIG. 1 in which it is located remotely from the fell 15.

The coiling means also includes an arcuate pusher arm 31 disposed at the opposite edge of the warp threads 12, 13, 14 and angularly movable across the lower warp shed 17. The pusher arm 31 has a bifurcated end portion 32 for receiving therein the element-forming filamentary material 23 having the equidistantly spaced prospective coupling head portions 47 (FIGS. 5 and 6). The pusher arm 31 is actuated in timed relation to the rocker arm 25 so that while the hook 26 is at its second position shown in FIG. 1, the bifurcated end portion 32 of the pusher arm 31 engages the element-forming filamentary material 23 and displaces it by pushing the same outside the warp threads 12, 13, 14 beyond the inclined surfaces 28, 29 of the hook's head portion 26a.

The apparatus operates as follows. For purpose of illustration, a cycle of the operation of the apparatus

begins under the conditions shown in FIG. 1 in which
(1) the element-forming filamentary material 23 is
displaced by the pusher arm 31 outside the warp threads
12, 13, 14 beyond the hook 26 into hooked engagement
5 therewith, (2) the weft thread 19 inserted by the
filling carrier 18 through the upper warp shed 16 is
ready for hooked engagement with the knitting needle
21, and (3) the reed 20 is retracted in a position away
from the fell 15 of the stringer tape 11 being woven.
10 Then, the rocker arm 25 is actuated to move angularly
in the direction indicated by the arrow in FIG. 1
whereupon the hook 26 moves from the second position of
FIG. 1 to the first position of FIGS. 2 and 3. At the
same time, the reed 20 is actuated to move forward to
15 beat the weft thread 19 just inserted against the fell
15. During that time, the element-forming filamentary
material 23 is coiled around the hook's nose portion
26b substantially in parallel relation to the fell 15
to thereby form a coupling element 24.
20 Thereafter, while the rocker arm 25 and hence the
hook 26 is at rest at the first position shown in FIGS.
2 and 3, the reed 20 is retracted away from the fell
15, then the heddle 15a is actuated to move the warp
threads 12, 13, 14 up and down across the warp sheds
25 16, 17, and the filling carrier 18 is again actuated to
insert the weft thread 19 in the upper warp shed 16.
After the reed 20 has beat the weft thread 19 just
inserted against the fell 15, the rocker arm 25 moves
angularly away from the fell 15 to bring the hook 26
30 into the second position shown in FIG. 1.
Simultaneously therewith, the reed 20 is moved back
again to its retracted position. Finally, the heddle
15a is actuated to change the respective positions of

the warp threads 12, 13, 14 into those shown in FIG. 1, to thereby complete a cycle of operation of the apparatus.

FIG. 4 shows the structure of a woven slide fastener stringer being woven on the apparatus, the stringer having the row of coupling elements 24 woven integrally into the stringer tape 11. The row of coupling elements 24 is fixed to the stringer tape 11 along a longitudinal edge thereof by the binding warp threads 12a, 14 running respectively along undulated paths in symmetrical patterns in such a manner as to overlie one of the legs of the coupling elements 24 and to interlace with the weft thread 19 under the other of the legs of the coupling elements 24.

With the apparatus thus arranged, the warp threads 12, 13, 14 are protected from interfering with or otherwise being damaged by the hook 26 because the movement of the hook 26 is limited to take place only outside the warp threads 12, 13, 14, with the result that the apparatus can be operated at a high speed and hence produces the woven slide fastener stringer at a high rate of production.

FIGS. 5-7 show an example of a woven slide fastener stringer 33 produced by the apparatus of the drawings. The slide fastener stringer 33 comprises a row of coiled coupling elements 34 formed of synthetic resin fixed to a slide fastener stringer tape 35 woven of warp threads 36, 37 and a single weft thread 38, the row of coupling elements 34 extending along a longitudinal edge portion 39 of the stringer tape 35. The warp threads 36 and the weft thread 38 jointly constitute a web portion 40 of the stringer tape 35, and the

warp threads 37 and the weft thread 38 jointly constitute the longitudinal edge portion 39 of the stringer tape 35. The warp threads 36 are thicker than the warp threads 37. The row of 5 coupling elements 34 is secured to the stringer tape 35 by means of a binding thread system including a pair of first binding warp threads 41, 42 and a plurality of second binding warp threads 43, 44, 45, 46.

Each of the coupling elements 34 comprises a 10 coupling head 47 projecting transversely beyond the longitudinal edge portion 39 of the stringer tape 35, and a pair of upper and lower legs 48, 49 (FIGS. 6 and 7) extending from the coupling head 47 in a common direction and spaced from each other vertically in a 15 direction substantially perpendicular to the general plane of the stringer tape 35. The upper and lower legs 48, 49 are blended into and interconnected by a heel portion 50 located remotely from the coupling head 47. The lower legs 49 of the coupling elements 34 are 20 mounted on the longitudinal edge portion 39 of the stringer tape 35. The weft thread 38 is inserted in double picks between adjacent coupling elements 34 so that there is a pair of (double) picks of the weft thread 38, one on each side of each of 25 the lower legs 49 of the coupling elements 34 as shown in FIGS. 5 and 7.

The first binding warp threads 41, 42 of the binding thread system are disposed in contact with or adjacent to the heel portions 50 of the coupling elements 34 and are 30 interlaced with every other one of the pairs of (double) picks of the weft thread 38 in symmetrical relation substantially with respect to the general plane of the stringer tape 35. Likewise, the second



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binding warp threads 43-46 extend alternately over and under the pairs of legs 48, 49 of successive coupling elements 34 and the respectively adjacent pairs of (double) picks of the weft thread 38 in mutually staggered relation, whereby they are each
5 interlaced in mutually staggered relation with every other pair of double picks of the

weft thread 38. The warp threads 43-46 run along undulated paths in staggered relation to one another between a pair of groups of the warp threads 37 spaced laterally from each other. The first binding warp threads 41, 42 are preferably made of elastic yarns for neatly binding the coupling elements 34 and are thicker than the warp and weft threads 43-46, 37 in the longitudinal edge portion 39 of the stringer tape 35.

With the arrangement described above, the binding warp threads 41, 42, 43-46 secure the row of coupling elements 34 to the longitudinal edge portion 39 of the stringer tape 35 in substantially the same manner as rows of sewing stitches, and there is no weft thread extending between the upper and lower legs 48, 49 of the coupling elements 34 in the space between adjacent coupling elements 34. The coupling elements 34 thus secured have a certain degree of flexibility which is enough to follow the movement of the slide fastener stringer 33, and provide a sufficient degree of coupling strength which enables opposite rows of coupling elements to mesh with each other firmly against the danger of becoming accidentally separated. Furthermore, the weft thread 38 inserted in double picks makes the longitudinal edge portion 39 compact and resilient in structure, and the coupling elements 34 are secured to such longitudinal edge portion 39 with the lower legs 49 received between respective pairs of picks of the weft thread 38 and the upper legs 48 biased by the binding warp threads 43-46

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toward the lower legs 49. With this arrangement, the coupling elements 34 are strong enough to withstand not only torsional stress but also external forces applied thereto in a direction perpendicular to the general plane of the stringer tape 35.

Another woven slide fastener stringer 51 produced on the apparatus of the drawings is shown in FIGS. 8 and 9. The woven slide fastener stringer 51 is substantially the same as the stringer 33 of the foregoing embodiment with the exception that two

outer ones 52 and 53 of the four inner binding warp threads (corresponding to binding warp threads 43 and 44 of Figures 5 to 7) extend over all the pairs of legs 54, 56 and over every three out of four double picks of weft thread 56, being interlaced in mutually evenly staggered relation with one in every four double picks of the weft thread 56. Each of the binding warp threads 52, 55 has portions 57 extending between the upper legs and corresponding lower legs 58 of the coupling elements 55 substantially normal to the general plane of the woven stringer tape 59 of the stringer 51. With the binding warp threads 52, 53 having the portions 57, the coupling elements 54 can be secured more positively to a longitudinal edge portion 68 of the stringer tape.

Reference is directed to our co-pending application No. 84 25405 divided out herefrom.



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Claims:

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1. A method of manufacturing a woven slide fastener stringer, comprising the steps of:

(a) weaving a stringer tape of warp threads and a single weft thread progressively at a fell; and

5 (b) coiling an element-forming filamentary material, supplied to said fell longitudinally along a path extending between and substantially parallel to said warp threads, into a row of coupling elements as they are woven into said stringer tape in synchronism
10 with the weaving of said stringer tape, said coiling step including

(1) displacing by pushing said element-forming filamentary material out of said path into a position outside said warp threads, remote from the fell to
15 enable it to become hooked and then terminating the pushing,

(2) hooking said element-forming filamentary material at said position to form a coupling element, and

(3) moving said coupling element from said
20 position to another position located outside said warp threads in alignment with said fell.

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

(a) a loom for weaving a stringer tape of warp
25 threads and a single weft thread progressively at a fell, said loom including a reed having guide slots for the passage therethrough of the warp threads and



also for the passage of an element-forming filamentary material along a path extending between and substantially parallel to the warp threads, and a filling carrier or weft inserter disposed at one edge of the warp threads and reciprocable for introducing the weft thread into interlaced engagement with the warp threads;

(b) means operable in synchronism with said loom for coiling the element-forming filamentary material into a row of coupling elements, whereby the row of coupling elements are woven into a stringer tape as the latter is woven, said coiling means including:

(1) a hook disposed at said one edge of the warp threads and movable in a plane perpendicular to the general plane of the stringer tape being woven between a first position located in alignment with the fell and a second position remote from the fell; and

(2) means disposed at the opposite edge of the warp threads for displacing the element-forming filamentary material out of said path beyond the warp threads beyond said plane of the movement of said hook while said hook is at said second position.

3. An apparatus according to claim 2, said hook including a head portion and a nose portion projecting from said head portion in a direction normal to the fell, the element-forming filamentary material being coiled around said nose portion when said hook is at said first position.

4. An apparatus according to claim 2 or 3, said head portion being in the shape of a frustum of a pyramid defined jointly by four slanted surfaces.

5. An apparatus according to any one of claims 2 to 4, said displacing means comprising an angularly, reciprocably movable



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arcuate pusher arm having a portion engageable with the element-forming filamentary material.

6. An apparatus according to claim 5, said portion being a bifurcated distal end of said arcuate pusher arm.

5 7. An apparatus according to any one of claims 2 to 6, and further comprising heddle means dividing the warp threads into three superimposed groups of warp threads selectively movable up and down to jointly define therebetween a pair of second warp threads, said filling carrier or weft inserter being reciprocable
10 across said first warp shed for inserting the weft thread thereinto, the element-forming filamentary material being introduced in said second warp shed along said path, said displacing means comprising an arcuate pusher arm angularly reciprocably movable across said second warp shed and having a portion engageable with the element-
15 forming filamentary material.

8. A method of manufacturing a woven slide fastener stringer substantially as described with reference to the accompanying drawings.

9. An apparatus substantially as described with reference to
20 and as illustrated in Figures 1 to 3.
