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(54) A TAPE HAVING A SELVEDGE WITH PROTRUDING  
 LOOPS AND A METHOD OF, AND A LOOM FOR,  
 PRODUCING SUCH A TAPE

(71). We, INTERBREV S.A., a company of Luxembourg of 14, rue Aldringer, Luxembourg, Luxembourg, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the manufacture, with a needle weaving loom, of a tape provided along one of its edges with a selvedge having protruding loops.

For the manufacture of tapes, a needle weaving loom has several advantages over a shuttle weaving loom. However, the needle weaving loom also has a few drawbacks, in particular when it is used to manufacture a tape having a selvedge with protruding loops that are formed by the weft thread, since these loops can only be produced along that one of the tape edges at which the needle inserts the weft picks, and provided resort is had to a selvedge thread, consisting of an auxiliary thread, of metal or of synthetic material, of limited length which, at one of its ends, is secured to a point of the loom that compels this end to follow one of the warp thread sheets in its shed forming movements and which, at its other end, is trapped in the weave over a short length. This other end progressively moves out of the loops as the tape moves forward, and thus releases the weft loops, which loops form the protruding loops. It is not possible by this means to form loops along the other edge of the tape, i.e. along the edge opposite to that at which the needle enters, because along this opposite edge the weft picks must be linked to one another by any suitable means, in particular means similar to those used in sewing machines to hold the

sewing thread along the side of the material remote from the needle: chain stitch, auxiliary selvedge thread, etc. This linking is necessary to enable the last warp thread to be entwined by the weft to prevent it from escaping out of the fabric.

One object of the present invention is to provide a method for the manufacture of a tape with protruding loops in which these loops are formed, by means of an auxiliary weft needle, along that one of the tape edges which is opposite to the edge at which this auxiliary weft needle enters.

The method provided by the present invention comprises superposing, over at least a part, located on the weft insertion side, of one of the two main sheets of warp threads that are necessary for the weaving of said tape, an auxiliary sheet consisting of auxiliary warp threads, compelling this auxiliary sheet to follow the shed forming movements made by this main sheet during weaving, inserting, at least during some of these shed forming movements, a selvedge thread into the space lying between this main sheet and the auxiliary sheet, such insertion being performed by an auxiliary needle, in the manner of a double pick and in a direction opposite to that of the double picks of the tape weft, retaining externally of the sheets, to the side of the tape edge, the heads (i.e. the protruding loop ends) of the selvedge double picks thus formed, and releasing these selvedge double pick heads upon completion of several shed forming movements after this insertion, whereby these selvedge double pick heads may form, once released, said protruding loops.

This method in particular enables the manufacture of a tape with protruding loops

[Price 25p]

for use as one of the two halves of a sliding clasp fastener. In such a case, use is made of a selvedge thread which includes a deformable material at least in those portions thereof  
 5 that are intended to form the protruding loops, which material is subjected to local deformation in the region of the loop heads, thereby to provide the selvedge thread with a cross-section such as to enable the protruding loops  
 10 to come into hooking interengagement with the protruding loops of an identical tape forming the other half of the sliding clasp fastener.

The invention also provides a needle weaving loom for manufacturing a tape having a selvedge with protruding loops, which loom comprises a weft needle, associated with a selvedge knitting needle for inserting, in the form of double picks and between two main  
 15 sheets of warp threads, the weft thread of the tape, an auxiliary needle for inserting, in the form of double picks, a selvedge thread into a space between one of the main sheets and an auxiliary sheet consisting of auxiliary  
 20 warp threads held in a position overlying at least part of the warp threads of said one main sheet at the side at which are inserted the weft thread double picks, means being provided for making said auxiliary sheet  
 25 follow the shed forming movements of said one main sheet, and retaining means for retaining the heads of the selvedge thread double picks, said retaining means including  
 30 a free needle disposed parallel to the tape side which is remote from the location at which the auxiliary needle enters said space, which free needle is entwined by the heads of the selvedge thread double picks to retain them  
 35 in a transverse direction outside the tape and to enable them to slide longitudinally over the needle while moving with the tape, and maintaining means able to detain the free needle in the same position before each  
 40 entwining by the selvedge double pick heads. When this loom is intended to manufacture a tape for a sliding clasp fastener, it moreover comprises means able to produce in the cross-section of the selvedge thread, at  
 45 those places where the latter forms the heads of the protruding loops, a permanent deformation which broadens this cross-section in a direction parallel to the longitudinal axis of the tape, thereby to provide the protruding  
 50 loops with the required shape for them to act as hooking elements in a sliding clasp fastener.

The invention further provides a tape having a selvedge with protruding loops, comprising a tape body and a selvedge in which is trapped a helically arranged selvedge  
 55 thread with the external ends of the turns thereof projecting from the outer edge of the selvedge and constituting said protruding loops, said tape body having a fabric structure of single thickness formed by the  
 60 entwining of a double pick weft warp

threads, and said selvedge having a fabric structure of double thickness with intermediate links which includes a lower stratum formed by the entwining of a first series of  
 65 double picks of said weft with a first series of warp threads, said lower stratum being disposed to one side of said helix and constituting one of the surfaces of the selvedge, an upper stratum formed by the entwining of a second series of double picks of said weft  
 70 with a series of auxiliary warp threads and a second series of warp threads, said second layer being located to the other side of said helix and constituting the opposite surface of the selvedge, and intermediate links formed  
 75 by the traversing portions of the second series of double picks and by the traversing portions of the second series of warp threads, said traversing portions passing from one stratum to the other and being disposed between the consecutive turns of the helix so as to be entwined by the internal ends of the helix turns.

When this tape is intended for use as one half of a sliding clasp fastener, the selvedge thread includes a deformable material at least at those locations where it forms the protruding loops, and the cross-section of the selvedge thread is deformed at the apexes of the heads of each of the protruding loops  
 80 so as to provide the latter with the required shape to form the fastener hooking element. The protruding loops are then enabled to interengage with the corresponding protruding loops of a second tape constituting the  
 85 other half of this sliding clasp fastener.

The following description relates to a preferred method, to two examples of the needle weaving loom and to an example of the tape provided by the present invention. It is illustrated by the accompanying drawings, in which:—

Figure 1 is a diagram explaining the method,

Figures 2 and 3 are simplified side and plan views respectively, of part of this particular needle weaving loom,

Figure 4 is a plan view, on a large scale, of the tape manufactured by the loom shown in Figures 2 and 3,

Figures 5, 6 and 7 are views of a first variant of a particular element of the loom visible in Figures 2 and 3, Figures 5 and 6 being plan views and Figure 7 being a section along line VII—VII of Figure 6,

Figures 8 and 9 are views of a second variant of this particular element, Figure 8 being a plan view and Figure 9 being a section along line IX—IX of Figure 8,

Figures 10 and 11 are views of a third variant of this same particular element, Figure 10 being a plan view and Figure 11 being a section along line XI—XI of Figure 10,

Figures 12 and 13 relate to an example of

the sliding clasp tape resulting from the application of the method, Figure 12 being a side view and Figure 13 being a plan view,

Figure 14 is a section along line XIV—XIV of Figure 13,

Figure 15 represents a plan view, as well as cross-sections of part of a fourth variant of the particular element visible in Figures 2 and 3, this fourth variant being more particularly intended to the application of the method,

Figures 16 to 21 represent various examples of the form that another particular element may take for this application,

Figures 22 to 24 represent, viewed in plan, three examples of an auxiliary member which the loom visible in Figures 2 and 3 may comprise for the application of the method,

Figure 25 is a detailed diagrammatic perspective view, with parts broken away, showing the structure of the resulting tape, and

Figures 26 and 27 are respectively a diagrammatic cross-section and a diagrammatic side view of the fabric illustrated in Figure 25, which sections are taken along the directions indicated by arrows A and B respectively.

The method forming the subject of the invention is diagrammatically illustrated in Figure 1. In this Figure may be seen the two main sheets 1 and 2 in which are distributed the warp threads 3. It has been supposed, in this diagram, that the warp threads belong alternately to the two sheets, with the odd ranking threads, such as the threads  $3_1, 3_3, \dots, 3_{2n-1}$ , belonging to sheet 1 and the even ranking threads, such as the threads  $3_2, 3_4, \dots, 3_{2n}$ , belonging to sheet 2. The weft of the tape is formed by double picks, such as the double pick 4, whose head 5 delimits the two strands  $4_1$  and  $4_2$ . These double picks are inserted from the edge 6 of the tape, in the direction indicated by arrow 7. Above the sheet 2 there is an auxiliary, so-called selvedge, sheet 9 consisting of auxiliary warp threads  $8_1, 8_2, \dots, 8_n$  which lie in superposed relation to the threads  $3_1, 3_3, \dots, 3_{2n-1}$  of the main sheet 2 and directly over the latter, which threads are located towards the side of the edge 6 of tape 10 at which the insertion of the double picks 4 takes place.

The selvedge sheet 9 keeps, in relation to the main sheet 2, an invariable relative position, and it follows the shed forming movements made by the latter during weaving of the tape. At certain shed forming movements, e.g. at every second such movement, there is inserted into the space lying between the sheets 2 and 9 two strands of an auxiliary, so-called selvedge, thread that are connected by a loop, as can be seen in Figure 1 in regard to the two strands  $11_1$  and  $11_2$  that are connected by the loop 12. This loop 12 constitutes the head of the pair 11 formed by the two strands  $11_1$  and  $11_2$ . The insertion

of this pair 11 is done in the manner of a double pick and that is why this pair will henceforth be termed "selvedge (thread) double pick", although the selvedge thread behaves within the woven tape like a warp thread having a zig-zagging lay and not as a weft thread. The insertion of the selvedge double pick takes place in a direction 13 which is opposite to the direction of insertion 7 for the double pick 4 of the tape weft. The head 12 of this selvedge double pick 11 is held outside the sheets 2 and 9 and at least until the completion of several shed forming movements subsequent to such insertion; the head is then released. The heads of these double picks 11, once released, form the selvedge loops 15 that protrude from the edge 6 of the selvedge 16 of tape 10.

The above describes the very simple case where the warp threads 3 and distributed alternately between the two main sheets 1 and 2; but obviously the warp threads can be distributed in any other way. Also, the width of the selvedge 16 is arbitrary: in an extreme case, this selvedge could extend up to the edge 17 opposite to that from which protrude the loops 15. Finally, the sequence of alternation with which the double picks 4 of the weft and the double picks 11 formed by the selvedge thread (in the described example, there is inserted one selvedge double pick for every two insertions of weft double picks) can be chosen at will in dependence on the most diverse criteria: intended use of the tape, desired decorative effect, toughness and aspect of the selvedge, etc.

As for the machine for carrying out the described method, it consists of a needle weaving loom of conventional type to which modifications have been made as will now be described, with reference to Figures 2 and 3, in which are to be seen the framework 20 carrying the support 21 on which is mounted a tape guide 22. The needle 24 is the usual needle which, in any loom of this type, serves to insert the double pick weft. A known mechanism, not shown, periodically moves this needle so that it engages in a hook 27 of a selvedge knitting needle the head of the double pick that its eye 25 inserts into the shed opening. This hook 27 moves longitudinally, under the action of a mechanism not shown, so as to form the selvedge crocheting that forms the edge of the tape 23. These elements exist in any needle weaving loom and are well known, so that there is no need to describe them in greater detail here.

The modification which forms the subject of the invention first consists in the presence of an auxiliary needle 28 for inserting the selvedge thread. This auxiliary needle 28 is carried by a vertical shaft 29 which pivots about its axis 30 under the action of a drive mechanism, not shown, which causes the list

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needle 28 to move from its rest position, shown in full lines, to its insertion position, shown by the broken line outline 28'.

5 The modification moreover consists in the presence of a so-called free, needle 31 which in this example has the appearance of a hook. This hook is positioned parallel to the tape edge along which the selvedge 32 with protruding loops is to be formed. This hook is  
10 free in so far as it is not secured to any part of the machine: there is merely an abutment 33 which cooperates with its nose 34 for the support thereof, this abutment being provided with a slot 35 in which the nose engages. The  
15 shank 36 of the free needle is kept in place by the heads of the selvedge double picks that have been inserted in the course of the previous stages of the weaving operation. The abutment 33 is secured to the end of a sliding  
20 rod 37 and has imparted thereto a small reciprocatory movement parallel to the edge of the selvedge 32 each time the needle 28 completes its movement of insertion; the amplitude of this movement is just sufficient  
25 to disengage the nose 34 whereby the head of the selvedge double pick may come and entwine it. This rearward motion is brought about by a mechanism consisting of a lever which pivots about a pin 39 and of which  
30 one arm 40 is actuated by a rotary cam 42 which is formed with a flat 43 and which is mounted on a shaft 44 driven by any suitable means, not shown. A spring 45 exerts a pull on the other arm 41 of the lever, thereby to  
35 keep the arm 40 in contact with the cam 42.

The operation of this machine will be clearer if reference is made to Figure 4, which shows a plan view of the tape 23 during  
40 formation, at the instant when a double pick 4 of the weft is being inserted by the needle 24 into the shed opening (between the main warp sheets 1 and 2 of Figure 1) at the same time as a double pick 11 of the selvedge thread is being inserted by the auxiliary needle  
45 28 beneath the auxiliary warp sheet 9, between the latter and the main sheet 2. The head of the double pick 4 is brought into engagement with the nose of the selvedge crocheting hook 27, whilst the head 12 of the double  
50 pick 11 of the selvedge thread is brought into engagement with the nose 34 of the free needle 31, the abutment 33 (Figures 2, 3) being located in its withdrawn position in which it has released the nose 34. At the  
55 instant when the auxiliary needle 28 moves back to its rest position, the tension exerted by the selvedge thread feeding system (not shown) causes the head 12 of the double pick 11 to slip under the nose 34 of the free  
60 needle 31 and to form a loop similar to loop 15. The abutment 33 then returns to the position shown in Figures 2 and 3 and prevents the free needle 31 from being entrained with the tape 23 travelling in direction 46:  
65 it is the protruding loops that slide along the

shank 36 of the free needle 31 and which progressively free themselves from it by slipping off its end 47. During that time, the weft needle 24 (which inserts the weft of the tape) is withdrawn also, and the selvedge  
70 crocheting hook 27 carries out the known movement that leads to the formation of the crocheting 18.

It will be observed that one of the essential components of the needle weaving loom carrying out the method provided by the invention is the free needle 31. In the above described example (this example refers to a loom manufacturing a single tape, but it is clear that a  
80 loom manufacturing several tapes would include one auxiliary needle 28 and one free needle 31 per tape), this free needle has the appearance of a stem 36 (which forms the shank thereof) provided with a nose 34 (which forms the head thereof). This, however, is only one particular form, and many variants are possible.

Thus the head could have the form of a butt 51 (Figures 5, 6 and 7) that is delimited, along the side opposite to the tape, by a  
90 concave outline 52. This butt can possibly be provided with one, or even two bosses 53, 54 (Figures 6 and 7) to facilitate cooperation thereof with the abutment 33 discussed in connection with reference to Figures 2 and  
95 3; in that case, the abutment can assume the form of a yoke as indicated diagrammatically by the outline in broken lines 55 visible in Figure 6.

The head may also consist of a spheroidal swelling 56 (Figures 8 and 9) that is fixed to the shank in an eccentric position in relation to the latter, the off-setting being directed away from to the tape; this spheroidal swelling  
105 cooperates with the abutment, the latter having a shape adapted to this type of head.

The head may further have the form of a nail head 58 (Figures 10 and 11) of which the portion 59 adjacent the tape has been  
110 struck down.

In each of these types of free needle, the needle is rounded so as to prevent the selvedge thread from being damaged when it entwines the needle head and slides along its shank.

Numerous other free needle head variants  
115 can be imagined and it would not be appropriate to give here an exhaustive list. In all of these variants, the head has a dual function: firstly, it facilitates the entwining of the free needle by the selvedge thread and secondly,  
120 it cooperates with the abutment. In all cases, this head constitutes a protuberance located at one of the ends of the needle and directed away from the tape, and this protuberance must be located in alignment with the shed  
125 opening whereas its shank lies along the edge of the selvedge.

In some cases, the free needle can even not have a head in the true sense of the word: it suffices that the needle have a cross-section  
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that decreases from one end to the other, the law governing the decrease being so chosen that the tension exerted on the selvage thread has a longitudinal component sufficient to cause the needle to slide at each beating up motion of the comb 38 (see Figure 2) in a direction opposite to the advancing movement of the tape, the sliding movement of the free needle in relation to the loops being of the extent necessary to compensate the advancing movement of the tape, so that, by virtue of this "reversible wedge" effect, the free needle finally retains an unchanging position in relation to the loom. An arrangement as simple as this, which avoids having to resort to a reciprocating abutment to prevent the free needle from being entrained by the tape and to maintain it in an unchanged position can only be used in the relatively few cases where the value of the tension exerted on the selvage thread and where the value of the frictional coefficient between the materials from which the selvage thread and the needle are made enable it to. In most cases, however, it is not possible to avoid resorting to an abutment.

The free needle is not necessarily rectilinear: in particular, the head can be slightly offset upwards in relation to the shank, as is the case with the nose 34 of the free needle 31 shown in Figure 2.

The material used to make the free needle is of no importance, provided it can resist the stresses exerted by the tension of the selvage thread: the most usual is for it to be made of metal, of wood or of a synthetic material.

In the example illustrated in Figures 2 and 3, the abutment is a movable abutment/which performs a reciprocatory movement for the purpose of freeing the head, at least at the instant when the selvage thread must entwine the latter (at the end of the movement of insertion performed by the auxiliary needle), and to put the needle back in place, by causing it to slide longitudinally in relation to the loops already formed, so as to prevent it from being progressively entrained by the tape.

In view of the fact that the head of the free needle can, because of the off-center position of its centre of gravity, have a tendency to droop by causing the needle to rotate about its longitudinal axis, the abutment moreover serves to put the head back in position in the vertical sense by causing the free needle to perform a reverse rotary motion about its axis such as to compensate the first.

However, the abutment can also be stationary. It suffices that it be endowed with a resiliency such as to enable the selvage thread, at the instant when the latter entwines the head of the free needle, to move it away whereby the loop that the thread forms may slide towards the shank of the free needle, which resiliency causes the abutment to return to its initial position so that it can

exercise on the head of the free needle its dual anti-entrainment and anti-rotation effect.

It will be observed that the abutment, whether it be movable or stationary, constitutes a maintaining means capable of maintaining the free needle in the same position before each entwinement by the heads of the list thread picks.

As has been explained earlier, the cross-section of the shank can vary along the latter. This variation can affect either the area or the shape of the cross-section, or both together. The main purpose of a change in area is to facilitate the sliding motion of the loops, whereas a change in shape can be used to impart to the loops a particular configuration, for example with a view to providing the tape with a particular decorative aspect of a special technical effect. These variations in area and/or shape can be continuous or discontinuous.

We shall now describe an example in which a continuous variation in the shape of the cross-section is put to use for manufacturing a tape intended to constitute one of the two parts of a sliding clasp fastener, whose hooking elements are formed by the protruding loops made by the method described above. In this application, use is made for the selvage thread of a thread formed, at least partly, of a deformable material, e.g. nylon. In the following example, it will be supposed that this thread is a homogeneous monofilament. The selvage of the tape is manufactured in the manner described earlier to produce the protruding loops. Once the loops are formed, the cross-section of the monofilament constituting them is deformed to produce at the apexes of the loop thickenings of this cross-section, which thickenings are oriented along a longitudinal axis parallel to the edge of the selvage. This is what is shown in Figures 12 and 13 in which are to be seen the circular cross-section 65 of the monofilament 66 constituting the selvage thread, and the thickenings 67 and 68 that are formed at the apexes 69 of the protruding loops 70 in a direction parallel to the longitudinal axis 71 of the selvage 16. To produce these thickenings by deformation, various methods can be used. Use can in particular be made of a free needle whose shank is shaped, over at least part of its length, like a bevel. This is what is shown in Figures 13 and 14 where the shank of the free needle 31 is seen to have a cross-section 75 which is elongated towards the outside of the selvage 16, this cross-section being delimited by two lateral surfaces 76, 77 which meet along a rounded ridge 78 constituting the apex of the bevel. The fact of using a free needle bevelled in this way results in a decrease of the radius of curvature of the support on which the loops are formed and hence in an increase of

the stresses to which the material constituting the monofilament is subjected at that location, to the point that these stresses exceed the elastic limit of this material, which becomes crushed to give rise to the thickenings 67, 68. The stresses to which the material of the monofilament is subjected can be increased by resorting to a free needle whose shank has a cross-section that varies from point to point, as is apparent from Figure 15. In this Figure it will be observed that, starting from the head of the free needle, which head is supposed to be located to the left, the shank 36 first has a circular cross-section A, then it is flattened and has a substantially rectangular cross-section B; it is then bevelled, its cross-section having a shape C which is reminiscent of the cross-section 75 in Figure 14, but the height  $h_c$  is greater than the height  $h_b$  of cross-section B, thus giving rise to a bulge 79 in the bevelled part of the shank. From this bulge, the height  $h_d$  of section D returns to the value  $h_d = h_b$  that it had at B. The shank then becomes progressively thinner, with the area of its cross-section gradually decreasing, and ends in a tip 80 of circular cross-section F. This example, which illustrates one possibility for achieving the deformation of the protruding loops that is necessary to enable the tape to be used as part of a sliding clasp fastener, shows also that the shank of the free needle may have diverse forms, in particular that its cross-section may vary both as regards its shape and its area.

In the above example of embodiment of a tape intended to form part of a sliding clasp fastener, it has been assumed that the selvage thread was made up of a homogeneous monofilament of a deformable material. But other kinds of threads could come into the reckoning, in particular (Figure 16) an ordinary textile thread 82 coated with a circumferential layer 83 of deformable material forming a sheath around the thread, or (Figure 17) an ordinary textile thread 82 which is partly covered over, i.e. only over part of its cross-section, with a longitudinal layer 83 of deformable material. The thread 82, which constitutes as it were the core of the list thread, can be replaced by an element other than textile, e.g. by a metallic wire or by metallic monofilament. The cross-section of the list thread can be other than circular: this is already apparent from Figure 17 where the contour 84 of its cross-section is oval, but one could also take a flat list thread, having a substantially rectangular cross-section, whether the core 85—of textile, metallic or other material—of this thread be itself flat (Figure 18), or whether only the deformable material coating 86 (e.g. of nylon) has a substantially rectangular cross-section, with the core 85 being circular (Figure 19). The deformable material coating, whether circumferential (as in Figure 16) or partial (as

in Figure 17), may be continuous, i.e. extend over the entire length of the thread, or be discontinuous, i.e. only exist at those locations of the thread that will be located at protruding loops (see Figures 20 and 21). The selvage thread may also be hollow and assume the form of a tube, whether of metal or of deformable material. It can finally be pre-marked, i.e. be provided before-hand with local deformations that vary the shape and for area of the thread periodically located at positions that will coincide with the apexes of the loops once it has been put in place in the selvage, these local deformations constituting either "primers" for the deformations that will turn these protruding loops into the hooking elements, or constituting the final deformations themselves.

In general, the selvage thread must be made, either wholly or in part as explained above, of a material which is at the same time sufficiently flexible to form the loops, sufficiently deformable, in the case of a sliding clasp fastener tape, for its cross-section to be deformed at the apexes of the loop heads for the loops to form the hooking elements of such a fastener, and sufficiently rigid to enable these hooking elements once formed to fulfill their function in a fastener. The choice of material must therefore be the result of a compromise between the required properties of flexibility, deformability and rigidity, and this compromise depends moreover on the transverse structure of the thread, which can be either homogeneous (solid monofilament, or tubular monofilament) or heterogeneous (sheathed thread, or "reinforced" thread with a single stranded core, whether metallic or not, or with a multiple stranded core, whether made of textile fibres, of a metal or some other suitable material and whether twisted or not).

The deformation of the cross-section of the protruding loops may be facilitated by auxiliary external means. Thus, as can be seen from Figure 22, there can be fitted to the loom a crushing member 48 having a ramp 49 for progressively crushing the heads 69 of the protruding loops 70 against the shank 36 of the free needle, as they come to slide over the latter under the effect of the tape's motion. This crushing member can for instance be secured to the tape guide 22.

Resort may also be had to a hammer which carries out a crushing action by repeated impacts on the heads of the protruding loops while they travel along the shank of the free needle, which thus acts an anvil.

These are auxiliary means which are purely mechanically acting. Resort may also be had to auxiliary means which are thermally acting by heating the heads of the protruding loops, which heating, by softening the material used to make the selvage thread, facilitates the cross-sectional deformation imposed by the

outline of the needle shank. This heating can be done very simply by fitting the loom with a nozzle 88 which projects on to the heads of the loops a jet of hot air 89. The above-mentioned mechanical and thermal means can be combined; there are various ways in which this could be done and which it would be pointless to describe in detail here.

There exists however a particular means that combines the mechanical and thermal effects and that is to use vibration of high frequency, in particular of ultra-electric, quency. Such ultra-sonic vibration is applied by means of a, for instance piezo-electric, transducer, which presses the apexes of the loops against the shank 36 of the free needle. It is this means that is illustrated in Figure 24. The ultra-sonic transducer comprises a solid body 90 in which is housed the piezo-electric system and a vibrations concentrator 91 of which the tip 92 comes into contact with the apexes 69 of the loops 70, while the latter travel along the shank 36 of the free needle. It will be seen that this system combines a mechanical effect (high frequency hammering due to the vibration) and a thermal effect (heating due to the absorption of the ultra-sonic vibration within the material of which the list thread is made).

As for the tape that is produced by the method described above, its structure is diagrammatically illustrated in detail in Figures 25 to 27, the selvedge thread having here been inserted at every second shed forming operation.

The illustrated tape comprises three parts, i.e. a body 101, which has the structure of a normal fabric of single thickness, a selvedge 102, which has the structure of a fabric of double thickness with intermediate links, and a flattened spiral 103, the heads 104 of its turns forming the protruding selvedge loops (Figures 25 and 26). The tape body 101 is formed by the usual entwinement of warp threads 105 with double picks 106 and 107 of a weft thread. The selvedge 102 (Figure 26) is formed by a first entwinement 108, which involves the warp threads 109, 110, 111 and 112 and the weft double picks 106, and a second entwinement 113, which involves the warp threads 114, 115 and 116 and the weft double picks 107. The first entwinement 108 forms the bottom stratum of the double thickness fabric and the second entwinement 113 forms the top stratum thereof. Between these two strata is trapped the flattened spiral 103. The thread forming the spiral 103 is none other than the selvedge thread 11 to which reference was made in connection with Figure 1, whereas the warp threads belonging to the top stratum 113 of the list are those that form the auxiliary sheet 9 in Figure 1; as for the warp threads belonging to the bottom stratum 108, they are those forming the two main sheets 1 and 2. The warp

threads belonging to the top stratum 113 are more highly tensioned than the warp threads belonging to the bottom stratum 108, thus compelling some of these latter threads, the threads 111 and the weft double picks 107 (i.e. those that are inserted between the list double pick insertions), to "rise" up to the level of the upper stratum 113. As a result of this, the "vertical" portions 111a of the warp threads 111 and the "vertical" portions 107a and 107b of the double picks 107 constitute the intermediate links of the double thickness fabric forming the selvedge. These "vertical" portions 111a of the warp threads 111 and the "vertical" portions 107a and 107b of the weft double picks 107 moreover constitute spacing thicknesses which serve to separate consecutive turns of the spiral (e.g. turns 117 and 118) and to keep them equidistant from one another and oriented in parallel planes at right angles to the list (e.g. planes 117a and 118a in the case of turns 117 and 118); as for the "vertical" portions 107a of the double picks 107 (which double picks are entwined by the internal portions 119 of the spiral turns), they prevent the latter from escaping out of the fabric and consequently anchor the spiral 103 in the list 102. Moreover, the warp threads 114, 115 and 116 of the top stratum 113, the "outermost" warp threads 109 and 112, which, in the bottom stratum 108, delimit the selvedge 102 widthwise (these threads belong to the main sheet 2 (Figure 1) which is subjacent the auxiliary sheet 9), are subjected to a greater tension than the other warp threads 110 and 111 of this bottom stratum thereby preventing any lateral displacement of the elements forming the selvedge 102.

As stated earlier, such a tape can form one half of a sliding clasp fastener provided the selvedge thread has rigidity and provided the heads 104 of the spiral turns can be deformed so that they can come into hooking interengagement with the heads of the spiral of another, identical, tape. In such a case, the selvedge thread can assume, in addition to the various forms listed above, the form of a thread made of a metal or of a metal alloy. It can thus consist of a bundle of monofilaments made of synthetic material, of a metal or an alloy, whether twisted together or not. When the list thread assumes the form of a tube (tubular monofilament, which may be made of a synthetic material, of a metal or of a metal alloy), the tube may be filled with a material forming the core of the selvedge thread; besides the cited case where the core is made of a textile thread or of a metal thread (the selvedge thread is then a "sheathed" thread), the core can also, in another case, be made of any suitable soft material, other than textile.

Thus with the present invention tape for sliding clasp fasteners can be manufactured

in a completely continuous manner, without being subjected to the limitations that are inherent to the known methods, which limitations consist either in the necessity of having to resort to a pre-manufactured spiral, if this spiral is to be incorporated in the selvage while the tape is being woven, in the manner of a warp thread, or in the necessity of having to resort to a two-shuttle loom, if the spiral is to be manufactured from a monofilamentary yarn which is formed into a spiral during weaving of the tape, one of the shuttles containing the weft thread and the other containing this yarn, and this latter necessity has the effect of slowing production because of the need of frequently having to reload the shuttles as the latter can only contain limited lengths of thread. The possibility of resorting to a two-needle loom, such as the one described above, is of considerable advantage since the thread for the spiral and the weft thread can be supplied in an uninterrupted manner; the rate of production can then reach very high values.

#### 25 WHAT WE CLAIM IS:—

1. A method of manufacturing with a needle weaving loom, a tape provided along one of its edges with a selvage having protruding loops, which comprises superposing, over at least a part, located to the weft pick insertion side, of one of the two main sheets of warp threads that are necessary for the weaving of said tape, an auxiliary sheet consisting of auxiliary warp threads, compelling this auxiliary sheet to follow the shed forming movements made by this main sheet during weaving, inserting, at least during some of these shed forming movements, a selvage thread into the space lying between this main sheet and the auxiliary sheet, such insertion being performed by an auxiliary needle in the manner of a double pick and in a direction opposite to that of the double picks of the tape weft, retaining externally of the sheets, to the side of the tape edge, the heads of the selvage double picks thus formed, and releasing these selvage double pick heads upon completion of several shed forming movements after this insertion, whereby these selvage double pick heads may form, once released, said protruding loops.

2. A method according to claim 1, wherein the selvage thread is a monofilament of deformable material.

3. A method according to claim 1, wherein the selvage thread is a thread covered over the entire circumference of its cross-section with a layer of deformable material forming a sheath.

4. A method according to claim 1, wherein the selvage thread is a thread which is covered over part of its cross-section with a

layer of synthetic material forming a longitudinal bead.

5. A method according to claim 1, wherein the selvage thread is a thread on which a layer of deformable material is applied only at those places which are intended to constitute the selvage pick heads.

6. A method according to claim 1, wherein the selvage thread is an element having a flattened cross-section of substantially rectangular shape.

7. A method according to claim 1, wherein the selvage thread is a hollow tube of deformable material.

8. A method according to claim 1, wherein the selvage thread is an element which is premarked by a deformation of its cross-section, such deformation being localized to those places which are intended to constitute the selvage pick heads.

9. A method according to claims 1, 6 or 8, wherein the selvage thread is a monofilament element made of metal.

10. A method according to claims 1, 6 or 8 wherein the selvage thread is a monofilament made of a metallic alloy.

11. A method according to claim 1, wherein the selvage thread consists of a bundle of monofilament.

12. A method according to claim 1, wherein the selvage thread is a composite monofilament constituted by a tube filled with a soft material.

13. A method according to claim 1, wherein the selvage thread is an element having a cross-section of periodically varying area and/or shape.

14. A method according to claim 1, for the manufacture of a tape intended to form one half of a sliding clasp fastener, wherein the selvage thread is an element which, at those places which are intended to constitute the selvage double pick heads, is formed at least in part of a deformable material, and which comprises producing at the apexes of said selvage double pick heads a permanent deformation of the element's cross-section thereby to widen said cross-section in a direction parallel to the edge of the tape and to impart to said protruding loops the shape of hooking elements in said sliding clasp fastener.

15. A needle weaving loom for manufacturing a tape having a selvage with protruding loops, which loom comprises a weft needle, associated with a selvage knitting needle for inserting, in the form of double picks and between two main sheets of warp threads, the weft thread of the tape, an auxiliary needle for inserting, in the form of double picks, a selvage thread into a space between one of the main sheets and an auxiliary sheet consisting of auxiliary warp threads held in a position overlying at least part of the warp threads of said one main sheet at the side at



in a completely continuous manner, without being subjected to the limitations that are inherent to the known methods, which limitations consist either in the necessity of having to resort to a pre-manufactured spiral, if this spiral is to be incorporated in the selvage while the tape is being woven, in the manner of a warp thread, or in the necessity of having to resort to a two-shuttle loom, if the spiral is to be manufactured from a monofilamentary yarn which is formed into a spiral during weaving of the tape, one of the shuttles containing the weft thread and the other containing this yarn, and this latter necessity has the effect of slowing production because of the need of frequently having to reload the shuttles as the latter can only contain limited lengths of thread. The possibility of resorting to a two-needle loom, such as the one described above, is of considerable advantage since the thread for the spiral and the weft thread can be supplied in an uninterrupted manner; the rate of production can then reach very high values.

25 WHAT WE CLAIM IS:—

1. A method of manufacturing with a needle weaving loom, a tape provided along one of its edges with a selvage having protruding loops, which comprises superposing, over at least a part, located to the weft pick insertion side, of one of the two main sheets of warp threads that are necessary for the weaving of said tape, an auxiliary sheet consisting of auxiliary warp threads, compelling this auxiliary sheet to follow the shed forming movements made by this main sheet during weaving, inserting, at least during some of these shed forming movements, a selvage thread into the space lying between 30 this main sheet and the auxiliary sheet, such insertion being performed by an auxiliary needle in the manner of a double pick and in a direction opposite to that of the double picks of the tape weft, retaining externally of the sheets, to the side of the tape edge, the heads of the selvage double picks thus formed, and releasing these selvage double pick heads upon completion of several shed forming movements after this insertion, whereby these selvage double pick heads may form, once released, said protruding loops.

2. A method according to claim 1, wherein the selvage thread is a monofilament of 35 deformable material.

3. A method according to claim 1, wherein the selvage thread is a thread covered over the entire circumference of its cross-section with a layer of deformable material forming 40 a sheath.

4. A method according to claim 1, wherein the selvage thread is a thread which is covered over part of its cross-section with a

layer of synthetic material forming a longitudinal bead. 65

5. A method according to claim 1, wherein the selvage thread is a thread on which a layer of deformable material is applied only at those places which are intended to constitute the selvage pick heads. 70

6. A method according to claim 1, wherein the selvage thread is an element having a flattened cross-section of substantially rectangular shape.

7. A method according to claim 1, wherein the selvage thread is a hollow tube of deformable material. 75

8. A method according to claim 1, wherein the selvage thread is an element which is premarked by a deformation of its cross-section, such deformation being localized to those places which are intended to constitute the selvage pick heads. 80

9. A method according to claims 1, 6 or 8, wherein the selvage thread is a monofilament element made of metal. 85

10. A method according to claims 1, 6 or 8 wherein the selvage thread is a monofilament made of a metallic alloy.

11. A method according to claim 1, wherein the selvage thread consists of a bundle of monofilament. 90

12. A method according to claim 1, wherein the selvage thread is a composite monofilament constituted by a tube filled with a soft material. 95

13. A method according to claim 1, wherein the selvage thread is an element having a cross-section of periodically varying area and/or shape. 100

14. A method according to claim 1, for the manufacture of a tape intended to form one half of a sliding clasp fastener, wherein the selvage thread is an element which, at those places which are intended to constitute the selvage double pick heads, is formed at least in part of a deformable material, and which comprises producing at the apexes of said selvage double pick heads a permanent deformation of the element's cross-section thereby to widen said cross-section in a direction parallel to the edge of the tape and to impart to said protruding loops the shape of hooking elements in said sliding clasp fastener. 105 110 115

15. A needle weaving loom for manufacturing a tape having a selvage with protruding loops, which loom comprises a weft needle, associated with a selvage knitting needle for inserting, in the form of double picks and between two main sheets of warp threads, the weft thread of the tape, an auxiliary needle for inserting, in the form of double picks, a selvage thread into a space between one of the main sheets and an auxiliary sheet consisting of auxiliary warp threads held in a position overlying at least part of the warp threads of said one main sheet at the side at 120 125



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which are inserted the weft thread double picks, means being provided for making said auxiliary sheet follow the shed forming movements of said one main sheet, and retaining means for retaining the heads of the selvage thread double picks, said retaining means including a free needle disposed parallel to the tape side which is remote from the location at which the auxiliary needle enters said space, which free needle is entwined by the heads of the selvage thread double picks to retain them in a transverse direction outside the tape and to enable them to slide longitudinally over the needle while moving with the tape, and maintaining means able to detain the free needle in the same position before each entwinement by the selvage double pick heads.

16. A loom according to claim 15, wherein the free needle comprises a head located in alignment with the shed and a shank located in alignment with the tape, said shank having a smaller cross-section than that of the head and said head being connected to the shank by rounded surfaces.

17. A loom according to claim 16, wherein said head has the form of a butt that is partly delimited, along the side remote from the tape, by a concave outline and, along the side adjacent the tape, by a rectilinear outline.

18. A loom according to claim 16, wherein said head has the form of a ball secured at the end of said shank in an eccentric position in relation to the longitudinal axis of the shank, the offsetting being directed away from the tape.

19. A loom according to claim 16, wherein said head has the form of a nose that is curved away from the tape.

20. A loom according to any of claims 16 to 19, wherein said maintaining means include an abutment adapter to cooperate with said head so as to hold the free needle in position by preventing it from rotating about its longitudinal axis and by preventing it from being entrained longitudinally with the moving tape.

21. A loom according to claim 20, wherein said abutment is a movable abutment, having imparted thereto a reciprocatory movement in a direction parallel to the motion of the tape, said reciprocatory movement including a withdrawal phase, in the direction of said motion, during which the abutment releases said head, and an advancement phase, in a direction opposite to said motion, during which the abutment returns the head to its initial position, the withdrawal phase beginning with the entwinement of the free needle head by the list thread pick head and the advancement phase beginning after such entwinement.

22. A loom according to claim 20, wherein said abutment is a stationary abutment endowed with the resiliency that is required to enable the head of the list double pick

inserted by the auxiliary needle to entwine the head of the free needle, by moving the abutment away from said head.

23. A loom according to any of claims 16 to 22, wherein the shank of the free needle has the shape of a bevel, whose ridge is located to the side remote from the tape list.

24. A loom according to any of claims 16 to 22, wherein the shank of the free needle has a cross-section of which the shape varies along said shank.

25. A loom according to any of claims 16 to 22 wherein the shank of the free needle has a cross-section of which the area varies along said shank.

26. A loom according to claim 25, wherein the variation of said area is continuous.

27. A loom according to claim 25, wherein the variation of said area is discontinuous.

28. A loom according to any of claims 15 to 19, wherein said maintaining means consist in a variation of the shape and area of said cross-section, said variation imparting to the free needle the shape of a sharp wedge having a slope so chosen that the free needle may be subjected, under the action of the tension in the list thread, to a longitudinal force capable of moving the needle relative to the tape to compensate for the tape motion.

29. A loom according to any of claims 15 to 28 for the manufacture of a tape constituting a part of a sliding clasp fastener, which comprises deforming means capable of producing, at the apexes of said selvage pick heads, a permanent deformation of the cross-section of the selvage thread, such deformation having the effect of broadening this cross-section in a direction parallel to the longitudinal axis of the tape, whereby the tape may constitute one of the halves of a sliding clasp fastener of which the hooking elements are formed by said protruding loops.

30. A loom according to claim 29, wherein said deforming means include a stationary crushing member having a slope adapted to cause progressive crushing of said selvage pick heads against the shank of said free needle while they slide along the shank.

31. A loom according to claim 29, wherein said deforming means include a hammer adapted to crush said selvage pick heads against the shank of said free needle by hammering them while they slide along the shank.

32. A loom according to claim 29, wherein said deforming means include a heating device capable of locally heating said selvage pick heads while they slide along the shank of said free needle.

33. A loom according to claim 32, wherein said heating device include a nozzle projecting a jet of hot air on to said selvage pick heads.

34. A loom according to claim 29, wherein said deforming means include a generator of

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ultra-sonic vibrations adapted to deform with ultra-sonic waves said selvedge pick heads while they slide along the shank of said free needle.

- 5 35. A tape having a selvedge with protruding loops, comprising a tape body and a selvedge in which is trapped a helically arranged selvedge thread with the external ends of the turns thereof projecting from the  
10 outer edge of the selvedge and constituting said protruding loops, said tape body having a fabric structure of single thickness formed by the entwinement of a double pick weft with warp threads, and said selvedge having  
15 a fabric structure of double thickness with intermediate links which includes a lower stratum formed by the entwinement of a first series of double picks of said weft with a first series of warp threads, said lower stratum  
20 being disposed to one side of said helix and constituting one of the surfaces of the selvedge, an upper stratum formed by the entwinement of a second series of double picks of said weft with a series of auxiliary warp threads and  
25 a second series of warp threads, said second layer being located to the other side of said helix and constituting the opposite surface of the selvedge, and intermediate links formed by the traversing portions of the second series  
30 of double picks and by the traversing portions of the second series of warp threads, said traversing portions passing from one stratum to the other and being disposed between the consecutive turns of the helix so as to be

entwined by the internal ends of the helix turns. 75

36. A tape according to claim 35, for forming one half of a sliding clasp fastener, wherein said helix is constituted by a selvedge thread which includes a deformable material at least at those locations where it forms said protruding loops, and wherein the cross-section of the selvedge thread is deformed at the apex of each of the protruding loops to provide the latter with the required shape to form the fastener hooking elements. 40 45

37. A method of manufacturing with a needle weaving loom, a tape provided along one of its edges with a selvedge having protruding loops, substantially as hereinbefore with reference to the accompanying drawings. 50

38. A needle weaving loom for manufacturing a tape having a selvedge with protruding loops, substantially as hereinbefore described with reference to any one of the embodiments illustrated in the accompanying drawings. 55

39. A tape having a selvedge with protruding loops, substantially as hereinbefore described with reference to the accompanying drawings. 60

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