SPECIFICATION

Sliding-clasp fastener stringer and method for its manufacture

The present invention relates to a sliding-clasp fastener stringer of the kind having a tape woven from warp and weft threads and a woven-in row of fastener elements formed from a plastic momofilament. The invention also relates to a method for manufacturing such sliding-clasp fastener stringer and to a sliding-clasp fastener made therefrom.

It has been proposed in FDR Auslegeschrift 1 785 363 to weave such stringers from double picks of a ground weft thread lying beside, and approximately halfway between, the arms of the fastener elements in a section perpendicular to the fastener elements with the arms projecting symmetrically on both sides of the tape plane by at least the thickness of the monofilament. In this known construction two superimposed arms of each fastener element lie in the same warp shed as the corresponding portions of the ground weft thread of the tape. This was a natural consequence of using automatic needle looms with double pick insertion and arises inevitably from the technology and operation of these automatic looms. This known form of fastener stringer makes little allowance for the demands made on fasteners in practice and has not proved particularly satisfactory. In fact, the rows of fastener elements are incorporated into the tapes virtually without affecting the conventional woven structure. Incorporating fastener elements into a tape would be no problem if the monofilament had the same physical characteristics as the ground weft and warp threads and, in particular, were sufficiently flexible. However, there are considerable problems in weaving in double picks of monofilament to form a row of fastener elements since the monofilament is usually 0.4 mm or more thick and is very rigid and inflexible compared with the ground weft and warp threads of the tape. The incorporation of such monofilament into the tape structure described introduces constraints and mechanical stresses which vary over a period of time, so that the pitch of the fastener elements produced during weaving may vary unpredictably. Further serious problems may arise when the finished fastener bends in the fastener plane or out of this plane (for example when a fastener of this type is sewn into a garment and stressed during wear), because the row of fastener elements in effect determines the bending action, and no motion relative to the adjacent parts of the tape is possible. Consequently changes in tape tensions may appear in the rows of fastener elements after bending has ceased. Such fasteners are insufficiently supple or flexible, and have not become known in practice. Probably as a direct consequence, such fastener stringers have been developed along the lines taught in FDR Auslegeschrift 20 23 005 in which, although each tape is woven from double picks of a ground weft thread the row of fastener elements is formed by winding a monofilament round a mandrel, the monofilament being guided as a warp thread which is merely linked into the tape. These features allow the monofilament of each row of fastener elements to share the technological advantages of double pick insertion, but they do not readily permit the full speed of modern automatic needle looms with double pick insertion to be used. Furthermore each monofilament only has the back bends of the fastener elements linked to the tape and the resulting fastener stringer lacks the desired degree of stability.

According to one aspect of the present invention, a sliding-clasp fastener stringer comprises a tape secured to a row of fastener elements formed from a monofilament, the tape being woven from warp and weft threads such that the weft is located in a series of warp sheds and the fastener elements are held in a separate series of warp pockets formed by a group of the warp threads which are displaced from the plane of the tape in a set sequence so that each of these warp threads extends from the plane of the tape between adjacent fastener elements, and then passes over at least one fastener element before returning to the plane of the tape.

A double pick of the monofilament may be held in each warp pocket.

Preferably, each double pick of the monofilament forms two arms and a coupling head of one of the fastener elements.

Two arms of each fastener element may be mutually superimposed. Alternatively, two arms of each fastener elements may be arranged side-by-side.

Preferably, the weft comprises a continuous ground weft thread having at least one double pick located in each warp shed.

The double picks of weft may be interlinked at an edge of the tape remote from the fastener elements.

Preferably, the warp pockets are formed on one side of the tape by a series of the warp threads being displaced from the plane of the tape.

A double pick of the ground weft thread may be positioned under each fastener element. Alternatively, only every second or third double pick of the ground weft thread may be positioned under each fastener element.

Preferably the sequence of the group of warp threads is staggered longitudinally of the stringer so that only a proportion of these warp threads pass over each fastener element.

As will be appreciated from the following description a variety of sequences may be used. For instance, the sequence may include

passing over one fastener element, between the next fastener element and the adjacent portion of ground weft, and then under a subsequent portion of ground weft adjacent the next following fastener element.

The sequence may alternatively include passing over one fastener element, under the portion of ground weft adjacent the next fastener element, and then between the next following fastener element and the adjacent portion of ground weft.

The sequence may alternatively include passing over two fastener elements, between the next fastener element and the adjacent portion of ground weft, and then under a subsequent portion of ground weft adjacent the next following fastener element.

The sequence may alternatively include passing over two fastener elements, under the portion of ground weft adjacent the next fastener element, and then between the next following fastener element and the adjacent portion of ground weft.

Other constructions may have warp threads passing over three fastener elements.

The warp threads defining the warp pockets may form two groups each having a different sequence. The group nearest the coupling heads of the fastener elements may have a sequence passing over one fastener element whilst the other group has a sequence passing over two adjacent fastener elements. The group nearest the coupling heads may have the sequence high/centre/low/centre repeated and the other group has the sequence high/ high/centre/low repeated. The group nearest the coupling heads may comprise four warp threads and the other group may comprise eight warp threads.

The warp pockets are preferably defined by eight warp threads.

Preferably, the warp threads defining the warp pockets are packed tightly adjacent each other.

According to another aspect of the present invention, a method of weaving a sliding-clasp fastener stringer from warp and weft threads, includes forming sheds between some of the warp threads and inserting a double pick of a continuous ground weft thread into each shed to form the stringer tape, forming a monofilament into a series of double picks each comprising a fastener element, each fastener element being inserted during the weaving of the adjacent portion of stringer tape, between the stringer tape and at least one of a group of warp threads which are displaced from the plane of the tape in a set sequence such that each of these warp threads extends from the plane of the tape between adjacent fastener elements, and then passes over at least one fastener element before being subsequently woven under a later insertion of the continuous ground weft thread.

Preferably, the method includes staggering the sequence with which the displaced warp threads are displaced from the plane of the tape.

The method may include inserting the double 'pick' of the continuous ground weft thread from the opposite direction to the insertion of the double pick of the monofilament.

The invention also includes a sliding clasp fastener stringer manufactured by the above method, and a sliding clasp-fastener comprising a pair of sliding clasp-fastener stringers as defined above, or manufactured by the above method.

The invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a plan view of part of a sliding-clasp fastener stringer;

Figure 2 is a transverse cross-section of the stringer shown in Fig. 1 taken in the direction of arrow A;

Figure 3 is a longitudinal cross-section along line B–B of Fig. 1;

Figures 4, 5 and 6 are sectional views similar to that of Fig. 3 but illustrating alternative warp thread sequences;

Figure 7 is a plan of part of a fastener stringer of alternative construction;

Figure 8 is a longitudinal section along line C–C in Fig. 7;

Figure 9 is similar to Fig. 7 but shows another alternative construction;

Figure 10 is a plan view of part of a fastener stringer of a further alternative construction;

Figure 11 is a longitudinal section along line D–D in Fig. 10;

Figure 12 is a longitudinal section along line E–E in Fig. 10; and

Figure 13 is similar to Figs. 9 and 10 but showing another alternative construction.

With reference to Figs. 1 to 3, a sliding-clasp fastener stringer 1 comprises a stringer tape 2 woven from a continuous ground weft thread 3 and a set of warp threads of which some are specifically identifies by references 4, 5, 6 and 7. The ground weft thread 3 is inserted as mutually adjacent double picks 8. A coiled plastics monofilament provides the arms 9 of a row of fastener elements 10, each fastener element 10 comprising a pair of the arms 9 supporting a coupling head 11 shaped from the monofilament. The monofilament is formed into the row of fastener elements during the weaving process so that the fastener elements can be attached to the tape by the warp threadsc 4, 5, 6 and 7.

For clarity, the weft thread 3 is shown in double lines, In Figs. 1 to 3 (and also in Figs. 4 to 6) whereas all the warp threads are shown as single lines. To illustrate the staggered sequences of the warp threads 4, 5, 6 and 7 in Figs. 3 to 6 they are respectively shown by chain-dotted, broken, continuous

and dotted lines. The double picks of the ground weft 3 are inserted into sheds, formed by the warp threads, from the left as seen in Fig. 1, whereas the row of fastener elements 10 is constructed by inserting double picks of the monofilament, from the right as seen in Fig. 1, so that each pair of arms 9 are substantially mutually superimposed in a projection on to the plane of the fastener. Successive fastener elements 10 are connected in the usual manner by back bends 12. The double picks 8 of the ground weft thread 3 extend as far as the coupling heads 11 which project slightly from the tape edge as shown.

It will be noted from Figs. 1 to 6 that every second double pick 8 of the ground weft thread 3 is positioned generally under a fastener element 10 and in its own warp shed 13 of the stringer tape 2. It will be noted that only every second pick 8 of the ground weft thread 3 is positioned under each fastener element 10. Dependent on the pitch of the fastener elements 10 and the thickness of the ground weft thread 3, the frequency of the picks 8 may be varied so that, for instance, every pick or every third pick is positioned under successive fastener elements 10.

From Fig. 1 it will be noted that most of the warp threads are used exclusively for defining warps sheds 13 which serve to position the double picks 8. Although there warp threads are not assigned any reference numerals, it will be noted that they are generally arranged in pairs, each pair forming a warp shed for two adjacent double picks 8, 8*a* and that adjacent pairs only form a common warp shed for one double pick 8 or 8*a*. Sixteen of the warp threads in the immediate vicinity of the arms 9 are split into four groups, the first composing four warp threads 4, the second comprising four warp threads 5, the third comprising four warp threads 6, and the fourth comprising four warp threads 7, the warps threads 4, 5, 6 and 7 following the sequence shown in Fig. 3. Each of these sequences comprises, moving downwardly in the drawing, passing over two fastener elements, between the next fastener element and the adjacent double pick 8, over the next double pick 8*a*, and then under the next two double picks 8, 8*a* and the associated fastener element. For ease of future description, this sequence is given the shorthand form of high/high/centre/low, each of these four spaces separated by the oblique strokes indicating the pasage of the warp thread relative to the positions of consecutive fastener elements, "high" indicating the passage of the warp thread over a fastener element, "centre" indicating the passage of the warp thread under a fastener element but over the adjacent weft picks, and "low" indicating the passage of the warp thread simultaneously under a fastener element and under one or more of the adjacent warp picks. As each of the sixteen warp threads 4, 5, 6 and 7 passes over the arms 9 of two fastener elements 10 and the sequence repeats every four fastener elements, each fastener element 10 is connected to the stringer tape 2 by eight warp threads comprising the warp threads of two of the groups 4, 5, 6 and 7. In this manner the sixteen warp threads 4, 5, 6 and 7 are displaced in turn from the plane of the stringer tape 2 and generate a separate series of warp pockets 14 along one side of the tape whilst also contributing to the formation of warp sheds 13 for adjacent double weft picks 8, 8a. From Fig. 3 it will particularly be noted that each warp pocket 14 contains the two arms 9 of a single fastner element 10 and lies to one side of the warp sheds 13 containing the double weft picks 8. The pairs of arms 9 are firmly held in their respective warp pockets 14 by the appropriate tensioning of the warp threads 4, 5, 6 and 7, which are packed as tightly as possible adjacent each other, and by their backbends 12 physically prevent the fastener elements 10 from being pulled out of the weft pockets in the direction of normal loading. It will also be noted from Fig. 1 that the groups of warp threads 4, 5, 6 and 7 are distributed so that each warp pocket is substantially the same length, that the warp pockets terminate just before the edge of the stringer tape which is finished with three other weft threads, and that the inserted ends of the double warp picks 8 are linked together by a stitched thread to prevent their withdrawal from the warp sheds.

Figs. 4, 5 and 6 illustrate different warp thread sequences from those shown in Fig. 3, the warp threads forming the warp pockets 14 still being separated into the four staggered groups of warp threads 4, 5, 6 and 7.

In Fig. 4 the sequence of each of the warp threads 4, 5, 6 and 7 comprises, again moving downwardly in the drawing, passing over two fastener elements, under the next double pick 8*a*, over the next two double picks 8, 8*a* whilst under the arms of the associated fastener element, and then under the next double pick 8 and the associated fastener element. That is high/high/low-centre/centre-low. In this manner the warp threads 4, 5, 6 and 7 are again displaced in turn from the plane of the stringer tape 2 and generate a separate series of warp pockets 14 along one side of the tape whilst additionally forming warp shed 13 for each of the double weft picks 8, 8*a*.

In Fig. 5 the sequence of each of the warp threads 4, 5, 6 and 7 comprises, again moving downwardly in the drawing, passing over two fastener elements, between the next fastener element and the adjacent double pick 8, under the next double pick 8*a*, and then between the next fastener element and the adjacent double pick 8. That is high/high/centre-low/centre. In this manner the warp

threads 4, 5, 6 and 7 are again displaced in turn from the plane of the stringer tape 2 and generate a separate series of warp pockets 14 along one side of the tape whilst additionally forming a warp shed 13 for each of the double weft picks 8, 8*a*.

In Fig. 6 the sequence is again varied so that each of the warp threads 4, 5, 6 and 7 passes over two fastener elements, under the next fastener element and the adjacent double picks 8*a* and 8, and then between the next following fastener element and the adjacent double picks 8*a* and 8. That is high/high/low/centre. In this manner the warp threads 4, 5, 6 and 7 are again displaced in turn from the plane of the stringer tape 2 and generate a separate series of warp pockets 14 along one side of the tape whilst additionally forming a warp shed 13 for adjacent pairs of double weft picks 8*a* and 8.

As indicated in Figs. 5 and 6, some warp threads 15 may be arranged amongst the warp threads 4, 5, 6 and 7 to improve the continuity of the warp sheds 13 although they do not contribute to the formulation of the warp pockets 14.

With the constructions taught by Figs. 3 to 6 it will be noted that, after their displacement from the plane of the stringer tape 2, the warp threads 4, 5, 6 and 7 each pass over the arms of fastener elements and then return into the structure of the stringer tape. These warp threads thus extend into the longitudinal direction of the stringer tape and pass successively between one or more of the fastener elements and the corresponding double weft picks forming the body of the stringer tape, and over at least one of the fastener elements before returning back into the plane of the stringer tape. This arrangement ensures that the finished stringer is supple and flexible as a whole and will perform particularly well when made up into a sliding-clasp fastener and subsequently bent or kinked during use.

Although sixteen warp threads 4, 5, 6 and 7 have been used for the construction illustrated in Figs. 1 to 3 and could just as well be used for the constructions illustrated in Figs. 4, 5 and 6, the total number can be varied preferably as a multiple of four so that the groups are balanced. The constructions shown in Figs. 1 to 6 do not exhaust all the sequential possibilities and these may be varied, if so desired, to modify the connection of the warp pockets 14 to the stringer tape structure. In particular the number of groups of warp threads forming the warp pockets could be varied, also the number of elements covered by a single sequence, and additionally each of the warp threads forming the warp pockets could pass over and under several weft portions. However, persons skilled in the art of weaving stringer tapes will recognise the advantages achieved by the arrangements disclosed in Figs. 1 to 6 and particularly, in the event of either bending of kinking (within or out of the fastener plane) of a sliding-clasp fastener incorporating such stringer tapes, the achievement of adequate relative movement between each row of fastener elements and both its stringer tape and its associated weft threads. Whilst avoiding undesirable constraints, these constructions also enable the pitch of the fastener elements to be easily maintained because a sufficient number of warp threads are positioned between every fastener element and this number can be readily adjusted to suit the situation, and because the pitch of the elements can be adjusted and determined by the number, thickness and tension of the warp threads 4, 5, 6 and 7 without adversely affecting the suppleness and flexibility of the entire stringer tape.

As the constructions show in Figs. 7 to 13 are easier to follow, because the warp threads 4, 5, 6 and 7 only pass over a single fastener element in each sequence, the weft thread 3 and all the warp threads are shown in double lines. The warp threads 4, 5, 6 and 7 are stippled differently to assist in the identification of warp threads in the same group, and those warp threads which only form warp sheds are left plain. As many features of Figs. 7 to 13 have already been described with reference to Figs. 1 to 6, the same reference numerals have been used to identify equivalent components or features, and only the points of difference will be described.

In Figs. 7 and 8 the double weft picks 8 are inserted, from the left of Fig. 7, between warp sheds 13 formed between the various warp threads. The right hand ends of these double weft picks 8 are looped along the edge of the stringer tape remote from the fastener elements 10 and are linked together to form a knitted selvedge 16. It will be noted that there is only one double weft pick 8 per fastener element 10. The monofilament defining the fastener elements 10 is woven in as before by insertion as a double pick, from the right of Fig, 7, into warp pockets 14 formed by displacing the eight warp threads 4, 5, 6 and 7 from plane of the stringer tape 2 in the sequence shown in Fig. 8. This sequence comprises, moving downwardly in the drawing, passing over one fastener element, between the next fastener element and the adjacent weft pick 8, under the weft pick adjacent the next following fastener element and then between the further following fastener element and the adjacent weft pick 8. This is high/centre/low/centre. As each of the eight warp threads 4, 5, 6 and 7 pass over the arms 9 of only one fastener element and the sequence repeats every four fastener elements, each fastener element is connected to the stringer tape by two warp threads comprising one of the groups 4, 5, 6 and 7. It will be noted that this sequence of the warp

threads 4, 5, 6 and 7 simultaneously forms a warp shed 13 for each double weft pick 8 and a warp pocket 14 on one side of the stringer tape for each double pick of the monofilament—that is for each pair of fastener element arms 9. The eight warp threads 4, 5, 6 and 7 are packed tightly adjacent each other whilst the remaining warp threads are less closely packed and are arranged in a simple alternating high/low repeat sequence.

The construction illustrated in Fig. 9 differs from that described in Figs. 7 and 8 only in that each pair of fastener element arms 9 have been twisted so that they lie side-by-side along the stringer tape, and in that the arms 9 are somewhat longer and are each engaged by three warp threads. That is there are now twelve warp threads 4, 5, 6 and 7 divided into four sets of three. The arms 9 accordingly lie in one plane parallel to the stringer tape and each pair of arms 9 are urged against each other by the tensioning of the warp threads 4, 5, 6 and 7. In this manner the pitch of the fastener elements is maintained particularly well since the adjoining arms 9 of each fastener element stabilize each other.

The stringer illustrated in Figs. 10 to 12 is generally similar to that described with reference to Figs. 7 and 8, the only difference being that warp threads defining the warp pockets 14 form two groups X and Y having different sequences. Group X comprises four warp threads 4, 5, 6 and 7 which are also seen in Fig. 12 and have the same sequence as described with reference to Fig. 8. On the other hand, group Y comprises eight warp threads 40, 50, 60 and 70 divided into four sub-groups of two. The sequence of each of these sub-groups is shown in Fig. 12 and comprises, again moving downwardly in the drawing, passing over two fastener elements, between the next fastener element and the associated double weft pick 8, and then under the next following fastener element and its associated double weft pick 8. That is high/high/centre/low. The twelve warp threads 4, 5, 6, 7, 40, 50, 60 and 70 are packed tightly adjacent each other. It will be noted from Fig. 11 that the tension of the warp threads 40, 50, 60 and 70 is sufficient to urge each pair of fastener element arms 9 into mutual contact, whereas the bridging effect of the coupling heads 11 prevents the warp threads 4, 5, 6 and 7 from achieving the same effect as shown in Fig. 12.

The stringer illustrated in Fig. 13 differs from that described in Figs. 10 to 12 only in that each pair of fastener elements arms 9 have been twisted so that they lie side-by-side along the stringer tape in a similar manner to that described with reference to Fig. 9.

Although in all the described examples the monofilament has been coil-shaped it could alternatively be meander-shaped.

By virtue of the present invention, high production speeds are possible on modern automatic needle looms with double pick insertion, and the stringer construction provides a supple and flexible fastener since the tape structure can move relatively to the fastener elements when the fastener is stressed in the fastener plane and when the fastener is subject to bending or kinking out of the fastener plane, thereby eliminating unacceptable constraints.

The stringer construction according to the invention ensures a well-defined and very stable pitch of fastener elements which does not vary during dyeing, washing or ironing, whether the fastener elements be made of fine or thick monofilament with appropriate thickness and strength of tape threads.

Also, since the ground weft thread and the monofilament are always inserted respectively into separate warp sheds and separate warp pockets the warp threads require only minimum opening on the loom. This feature together with the fact that warp thread tension is not increased permits high weaving speeds.

Particularly high production speeds and a very supple and flexible fastener are achieved by positioning each double weft pick, or at least every second or third double weft pick below the fastener elements and in separate warp sheds and by forming the warp pockets ¾ from the arms of the fastener members above the plane of the tape. The expression "below the fastener elements" denotes the entire area below a fastener element including any offset.

High production speeds and sliding-clasp fasteners having particularly good characteristics are obtained by positioning a double weft pick approximately halfway between adjacent fastener elements.

For fasteners which are to withstand particularly high longitudinal stresses and also high transverse stresses, it is recommended that some warps threads in the vicinity of the row of fastener elements are used solely for forming warp sheds.

The stringer tape structures disclosed herein effectively provide two separate, superimposed structures of which one binds in the double weft picks of the ground weft and the other the picks of the monofilament. These two superimposed structures are tightly enmeshed by the warps threads constantly transferring from one structure to the other so that, firstly, the double weft picks of the ground weft help to maintain the pitch of the fastener elements and, secondly, the tension of the warp threads need not be increased in order to maintain the pitch of the fastener elements. Also, since the yarn density is not increased in the vicinity of the row of fastener elements, a fastener embodying the invention will be highly flexible.

CLAIMS

1. A sliding clasp fastener stringer com-

threads 4, 5, 6 and 7 simultaneously forms a warp shed 13 for each double weft pick 8 and a warp pocket 14 on one side of the stringer tape for each double pick of the monofilament—that is for each pair of fastener element arms 9. The eight warp threads 4, 5, 6 and 7 are packed tightly adjacent each other whilst the remaining warp threads are less closely packed and are arranged in a simple alternating high/low repeat sequence.

The construction illustrated in Fig. 9 differs from that described in Figs. 7 and 8 only in that each pair of fastener element arms 9 have been twisted so that they lie side-by-side along the stringer tape, and in that the arms 9 are somewhat longer and are each engaged by three warp threads. That is there are now twelve warp threads 4, 5, 6 and 7 divided into four sets of three. The arms 9 accordingly lie in one plane parallel to the stringer tape and each pair of arms 9 are urged against each other by the tensioning of the warp threads 4, 5, 6 and 7. In this manner the pitch of the fastener elements is maintained particularly well since the adjoining arms 9 of each fastener element stabilize each other.

The stringer illustrated in Figs. 10 to 12 is generally similar to that described with reference to Figs. 7 and 8, the only difference being that warp threads defining the warp pockets 14 form two groups X and Y having different sequences. Group X comprises four warp threads 4, 5, 6 and 7 which are also seen in Fig. 12 and have the same sequence as described with reference to Fig. 8. On the other hand, group Y comprises eight warp threads 40, 50, 60 and 70 divided into four sub-groups of two. The sequence of each of these sub-groups is shown in Fig. 12 and comprises, again moving downwardly in the drawing, passing over two fastener elements, between the next fastener element and the associated double weft pick 8, and then under the next following fastener element and its associated double weft pick 8. That is high/high/centre/low. The twelve warp threads 4, 5, 6, 7, 40, 50, 60 and 70 are packed tightly adjacent each other. It will be noted from Fig. 11 that the tension of the warp threads 40, 50, 60 and 70 is sufficient to urge each pair of fastener element arms 9 into mutual contact, whereas the bridging effect of the coupling heads 11 prevents the warp threads 4, 5, 6 and 7 from achieving the same effect as shown in Fig. 12.

The stringer illustrated in Fig. 13 differs from that described in Figs. 10 to 12 only in that each pair of fastener elements arms 9 have been twisted so that they lie side-by-side along the stringer tape in a similar manner to that described with reference to Fig. 9.

Although in all the described examples the monofilament has been coil-shaped it could alternatively be meander-shaped.

By virtue of the present invention, high production speeds are possible on modern automatic needle looms with double pick insertion, and the stringer construction provides a supple and flexible fastener since the tape structure can move relatively to the fastener elements when the fastener is stressed in the fastener plane and when the fastener is subject to bending or kinking out of the fastener plane, thereby eliminating unacceptable constraints.

The stringer construction according to the invention ensures a well-defined and very stable pitch of fastener elements which does not vary during dyeing, washing or ironing, whether the fastener elements be made of fine or thick monofilament with appropriate thickness and strength of tape threads.

Also, since the ground weft thread and the monofilament are always inserted respectively into separate warp sheds and separate warp pockets the warp threads require only minimum opening on the loom. This feature together with the fact that warp thread tension is not increased permits high weaving speeds.

Particularly high production speeds and a very supple and flexible fastener are achieved by positioning each double weft pick, or at least every second or third double weft pick below the fastener elements and in separate warp sheds and by forming the warp pockets $\frac{3}{4}$ from the arms of the fastener members above the plane of the tape. The expression "below the fastener elements" denotes the entire area below a fastener element including any offset.

High production speeds and sliding-clasp fasteners having particularly good characteristics are obtained by positioning a double weft pick approximately halfway between adjacent fastener elements.

For fasteners which are to withstand particularly high longitudinal stresses and also high transverse stresses, it is recommended that some warps threads in the vicinity of the row of fastener elements are used solely for forming warp sheds.

The stringer tape structures disclosed herein effectively provide two separate, superimposed structures of which one binds in the double weft picks of the ground weft and the other the picks of the monofilament. These two superimposed structures are tightly enmeshed by the warps threads constantly transferring from one structure to the other so that, firstly, the double weft picks of the ground weft help to maintain the pitch of the fastener elements and, secondly, the tension of the warp threads need not be increased in order to maintain the pitch of the fastener elements. Also, since the yarn density is not increased in the vicinity of the row of fastener elements, a fastener embodying the invention will be highly flexible.

CLAIMS

1. A sliding clasp fastener stringer com-

prising a tape secured to a row of fastener elements formed from a monofilament, the tape being woven from warp and weft threads such that the weft is located in a series of warp sheds and the fastener elements are held in a separate series of warp pockets formed by a group of the warp threads which are displaced from the plane of the tape in a set sequence so that each of these warp threads extends from the plane of the tape between adjacent fastener elements, and then passes over at least one fastener element before returning to the plane of the tape.

2. A sliding-clasp fastener stringer, according to Claim 1, in which a double pick of the monofilament is held in each warp pocket.

3. A sliding-clasp fastener stringer, according to Claim 2, in which each double pick of the monofilament forms two arms and a coupling head of one of the fastener elements.

4. A sliding-clasp fastener stringer, according to Claim 3, in which the two arms of each fastener element are mutually superimposed.

5. A sliding-clasp fastener stringer, according to Claim 3, in which the two arms of each fastener element are arranged side-by-side.

6. A sliding-clasp fastener stringer, according to any preceding Claim, in which the weft comprises a continuous ground weft thread having at least one double pick located in each warp shed.

7. A sliding-clasp fastener stringer, according to Claim 6, in which the double picks of weft are interlinked at an edge of the tape remote from the fastener elements.

8. A sliding-clasp fastener stringer, according to any preceding Claim, in which the warp pockets are formed on one side of the tape by a series of the warp threads displaced from the plane of the tape.

9. A sliding-clasp fastener stringer, according to any of Claims 6 to 8, in which a double pick of the ground weft thread is positioned under each fastener element.

10. A sliding-clasp fastener stringer, according to Claim 9, in which only every second or third double pick of the ground weft thread is positioned under each fastener element.

11. A sliding-clasp fastener stringer, according to any preceding Claim, in which the sequence of the group of warp threads is staggered longitudinally of the stringer so that only a proportion of these warp threads pass over each fastener element.

12. A sliding-clasp fastener stringer, according to Claim 11, in which the sequence includes passing over one fastener element, between the next fastener element and the adjacent portion of ground weft, and then under a subsequent portion of ground weft adjacent the next following fastener element.

13. A sliding-clasp fastener stringer, according to Claim 11, in which the sequence includes passing over one fastener element, under the portion of ground weft adjacent the next fastener element, and then between the next following fastener element and the adjacent portion of ground weft.

14. A sliding-clasp fastener stringer, according to Claim 11, in which the sequence includes passing over two fastener elements, between the next fastener element and the adjacent portion of ground weft, and then under a subsequent portion of ground weft adjacent the next following fastener element.

15. A sliding-clasp fastener stringer, according to Claim 11, in which the sequence includes passing over two fastener elements, under the portion of ground weft adjacent the next fastener element, and then between the next following fastener element, and the adjacent portion of ground weft.

16. A sliding-clasp fastener stringer, according to Claim 14 or 15, in which the sequence includes passing over and under several adjacent weft portions.

17. A sliding-clasp fastener stringer, according to any of Claims 11 to 16, in which the warp threads defining the warp pockets form two groups each having a different sequence.

18. A sliding-clasp fastener stringer, according to Claim 17, in which group nearest the coupling heads of the fastener elements has a sequence passing over one fastener element whilst the other group has a sequence passing over two adjacent fastener elements.

19. A sliding-clasp fastener stringer, according to Claim 18, in which the group nearest the coupling heads has the sequence high/centre/low/centre repeated and the other group has the sequence high/high/centre/low repeated.

20. A sliding-clasp fastener stringer, according to Claim 18 or 19, in which the group nearest the coupling heads comprises four warp threads the other group comprising eight warp heads.

21. A sliding-clasp fastener stringer, according to any of claims 11 to 16, in which eight warp threads define the warp pockets.

22. A sliding-clasp fastener stringer, according to any preceding Claim, in which the warp threads defining the warp pockets are packed tightly adjacent each other.

23. A sliding-clasp fastener stringer constructed substantially as described herein with reference to and as shown in Figs. 1 to 3 of the accompanying drawings.

24. A sliding-clasp fastener stringer constructed substantially as described herein with reference to and as shown in Fig. 4 of the accompanying drawings.

25. A sliding-clasp fastener stringer constructed substantially as described herein with reference to and as shown in Fig. 5 of the accompanying drawings.

26. A sliding-clasp fastener stringer con-

structed substantially as described herein with reference to and as shown in Fig. 6 of the accompanying drawings.

27. A sliding-clasp fastener stringer constructed substantially as described herein with reference to and as shown in Figs. 7 and 8 of the accompanying drawings.

28. A sliding-clasp fastener stringer constructed substantially as described herein with reference to and as shown in Fig. 9 of the accompanying drawings.

29. A sliding-clasp fastener stringer constructed substantially as described herein with reference to and as shown in Figs. 10 to 12 of the accompanying drawings.

30. A sliding-clasp fastener stringer constructed substantially as described herein with reference to and as shown in Fig. 13 of the accompanying drawings.

31. The method of weaving a sliding-clasp fastener stringer from warp and weft threads, including forming sheds between some of the warp threads and inserting a double pick of a continuous ground weft thread into each shed to form the stringer tape, forming a monofilament into a series of double picks each comprising a fastener element, each fastener element being inserted, during the weaving of the adjacent portion of stringer tape, between the stringer tape and at least one of a group of warp threads which are displaced from the plane of the tape in a set sequence such that each of these warp threads extend from the plane of the tape between adjacent fastener elements, and then passes over at least one fastener element before being subsequently woven under a later insertion of the continuous ground weft thread.

32. The method, according to Claim 31, including staggering the sequence with which the displaced warp threads are displaced from the plane of the tape.

33. The method, according to Claim 31 or 32, including inserting the double pick of the continuous ground weft thread from the opposite direction to the insertion of the double pick of the monafilament.

34. The method of weaving a sliding-clasp fastener stringer substantially as described herein with reference to the accompanying drawings.

35. A sliding-clasp fastener stringer manufactured by the method of any of Claims 31 to 34.

36. A sliding-clasp fastener comprising a pair of sliding-clasp fastener stringers according to any of Claims 1 to 30 or 35.

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