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**(54) IMPROVEMENTS IN OR RELATING TO SLIDING CLASP  
FASTENERS, THEIR METHODS OF PRODUCTION  
AND EQUIPMENT THEREFOR**

(71) We, OPTI PATENT- FOR-  
SCHUNGS- UND FABRIKATIONS-AG,  
a Company organised under the laws of  
Switzerland, of Burgstrasse 24, 8750 Glarus,  
Switzerland, 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 sliding clasp  
fasteners and is particularly concerned with  
those having rows of interlocking members  
made from plastics monofilament, in which  
interlocking member is formed by a pair of  
arms and a connecting loop with an  
interlocking head formed on the loop, the  
connecting loops and interlocking heads  
projecting beyond the warp threads of a  
supporting fabric with the arms lying  
alongside each other in the longitudinal  
plane of the sliding clasp fastener, there  
being a rearward connecting loop  
connecting one arm of the interlocking  
member with the adjacent arm of the next  
interlocking member, the rows of  
interlocking members being secured to the  
supporting fabric with the aid of textile  
warp threads. The breadth of the  
supporting fabric can be restricted to the  
length of the arms of the members or  
increased to form a stringer tape. The  
invention further relates to a process and  
equipment for producing the said sliding  
clasp fasteners.

Sliding clasp fasteners of this type must  
be distinguished from those with a similar  
interlocking head and also made from  
plastics monofilament, but lacking the arms  
and having the loops on which the heads

are formed directly attached to the  
rearward connecting loops. In this case, the  
loops of plastics monofilament on which  
the heads are formed are so short that the  
pitch is entirely determined by the rearward  
connecting loops. The pitch in this context  
denotes the distance between successive  
interlocking members or heads. In such  
sliding clasp fasteners, the rows of  
interlocking members are usually sewn to  
textile stringer tapes by means of a sewing  
thread or woven into the stringer tapes  
more or less like twill threads.

In the known sliding clasp fasteners of  
the type to which the invention relates each  
interlocking member is individually  
incorporated as weft in a weave in which  
the warp threads act as twill threads and  
which includes additional textile weft  
threads. As a result, the arms meander like  
weft threads and do not lie directly  
alongside each other, and moreover, they  
do not directly support each other, because  
they are always separated by the textile  
weft threads and/or the twill threads  
running between them. Consequently, the  
pitch is unstable, being dependent on the  
behaviour of the textile threads (e.g.  
swelling when moisture is absorbed,  
stretching under the influence of  
mechanical loads but above all shrinkage  
under the influence of humidity and  
temperature when laundered, cleaned or  
the like). The rearward connecting loops  
cannot act as pitch stabilizers, since the  
arms are virtually free and too unstable.  
This applies particularly to fine sliding clasp  
fasteners having rows of interlocking  
members made from fine plastics  
monofilament, as are required for example  
in the clothing industry, and presumably

14

explains the lack of commercial interest in this type of sliding clasp fastener.

As regards the process and the equipment the known sliding clasp fasteners of this type are mainly produced on ribbon looms. The shuttles in ribbon looms can only carry a limited amount of plastics monofilament, which is a disadvantage. Attempts have of course been made to employ automatic needle looms, which avoid this problem, but they can only make one half of a fastener at a time. This introduces matching difficulties when putting the two halves together to form a complete sliding clasp fastener.

Similar circumstances are encountered in the case of sliding clasp fasteners of the type under discussion, in which the supporting fabric is in the form of a weave.

According to the present invention, a sliding clasp fastener comprises rows of interlocking members formed from plastics monofilament, each interlocking member being formed by a pair of arms and a connecting loop with an interlocking head formed on the connecting loop, the arms lying alongside each other in the longitudinal plane of the sliding clasp fastener with one arm of one member being secured to the adjacent arm of the next member by a rearward connecting loop, and the arms secured to a supporting fabric by means of textile warp threads with the connecting loop and interlocking head projecting beyond the edge of the supporting fabric, the connecting loop being so disposed that one limb of the loop lies above the other limb of the loop, when seen in a projection on the plane of the fastener and each limb extends to its respective arm such that the two arms lie alongside each other in the longitudinal plane of the fastener to directly support each other and are incorporated as a pair in a common warp-thread pocket from which project the rearward loops connecting the arms of the pairs to the respective arms of the adjacent members.

The rows of interlocking members may be formed from plastics monofilament in either helical or meander formation.

In one preferred embodiment of the invention, the warp threads are laid in a twill weave with a crossover between each adjacent pair of arms. This arrangement leads to a particularly simple and efficient load-carrying structure. Alternatively, however, the warp threads can be arranged as loop-forming threads in a weave such that each pair of arms of the members lie in a single row of loops.

Sliding clasp fasteners in accordance with the invention can be either what is known as a strip fastener, i.e. devoid of the traditional stringer tapes and therefore

adapted to sewing on a garment or the like by passing the needle straight through the rows of interlocking members, or a stringer-tape fastener. In the first case, the rearward connecting loops form the outer edges of the fastener and are preferably flattened to act as guides for a slider. Alternatively, however, the woven or plaited load-carrying fabric can be broadened to serve as a stringer tape and extend beyond the arms and the rearward connecting loops, in known manner.

The accruing advantages are to be seen in that the pitch of the sliding clasp fastener of the invention is no longer dependent on the behaviour of the supporting fabric. On the contrary, it is determined by the rows of interlocking members themselves, and is stable, because the arms of the individual interlocking members lie directly alongside each other and support each other directly without interposed textile threads. Consequently, no changes can take place in the pairs of fixing arms inside the warp-thread pockets in which they are arranged. The warp threads surrounding the pockets have a more or less compressive action, increasing the support given by one arm to the other and promoting an additional pitch-stabilising action of the rearward connecting loops. This applies even when the pairs of arms have different lengths.

A further advantage arises from the fact that the formation of abutting pairs of arms and their arrangement in individual warp-thread pockets results in substantial technical advantages in the manufacturing stage, since suitable rows of interlocking members can be made by simple means in automatic mechanical looms or plaiting machines, using needles for the plastics monofilament which function like the known needles for double stitching. In this connection, the invention also relates to a special weaving process and equipment adapted thereto. Thus in the process of the invention two plastics monofilaments are inserted simultaneously as superimposed double wefts from opposite sides into a shed formed by warp threads of a support fabric, wound in opposite directions round a single reciprocating mandrel to form two interlocked rows of interlocking members with superimposed connecting-loop limbs and fixed in position with arms lying alongside each other in the fastener plane by moving the shed of warp threads. In this case, stringer-tape weft threads can be woven into a further warp-threaded shed ahead of the plastics monofilament threads and locked in position by the warp threads after hooking with the plastics monofilament threads. The usual thermal heat treatment to fix the shape of the rows of interlocking members is preferably

5 effected on the mandrel. The device for carrying out the process consists basically and primarily of an automatic loom having  
10 weft needles on either side of a shed arranged in superimposed horizontal planes to insert or extract simultaneously double  
15 wefts of plastics monofilament threads for rows of interlocking members, a single mandrel journaled with one end in a vertically reciprocating mandrel holder and disposed  
20 centrally in the shed to hold the double wefts with superimposed connecting loop limbs, said mandrel holder being journaled in a centrally interrupted guide, and a mechanism for forming the shed by warp threads and moving said warp threads to fix the arms of the double wefts in a horizontal side-by-side position.

The invention will now be described in more detail by way of example with reference to the accompanying drawings in which:—

Figure 1 is a greatly enlarged plan view of part of a sliding clasp fastener of the invention, with the supporting fabric partly removed;

Figure 2 is a section on the line A—A of Figure 1;

Figure 3 is a front elevation, in the direction of arrow B of Figure 1;

Figure 4 corresponds to Figure 1 but shows a second embodiment of the sliding clasp fastener according to the invention;

Figure 5 is a section on the line C—C of Figure 4;

Figure 6 is a front elevation, in the direction of arrow D of Figure 4;

Figure 7 corresponds to Figure 1, but shows a third embodiment of sliding clasp fasteners according to the invention;

Figure 8 is a side elevation of equipment for producing sliding clasp fasteners in accordance with the invention;

Figure 9 is a plan view of part of the equipment shown in Figure 8;

Figure 10 is a part sectional perspective view of part of Figure 9;

Figures 11A, 11B and 11C are a side elevation, plan view and partial perspective view respectively of a second embodiment of the object of Figure 10; and

Figures 12 and 13 are a plan view and side elevation respectively of a second embodiment of equipment for producing the sliding clasp fastener of the invention.

The sliding clasp fastener shown in Figure 1 to 7 incorporates rows 1 of interlocking members made from plastics monofilament. These rows of interlocking members consist of individual interlocking members 2 having connecting loops 3 comprising overlying upper and lower limbs 4 of plastics monofilament, on which connecting heads 5 are formed, and pairs of fixing arms 6. The arms 6 lie alongside each

other in the longitudinal plane of the fastener, with each arm connected to the respective arm of an adjacent pair by rearward connecting loops 7 and are incorporated into a supporting fabric by textile warp threads 8, with the connecting loops 3 projecting beyond the warp threads 8. The sliding clasp fastener includes a slider, but this has not been shown.

In Figures 1 and 4 the interlocking heads 5 of one row engage in co-operating recesses formed between adjacent loops 3 of the other row in an engagement zone 9. From this zone 9, the overlying limbs 4 are extended into the longitudinal plane of the fastener to form the arms 6. Thus, the two arms 6 of each interlocking member are laid directly alongside each other. They directly support each other and are incorporated as an integrated pair (like a twin weft thread) in a common warp-thread pocket 10. The rearward connecting loops 7 of plastics monofilament joining the adjacent pairs of fixing arms 6 to each other project from the warp-thread pockets 10. Thus, the first effect is mutual support between the fixing arms 6 of the successive interlocking members 2 and the integration of the said fixing arms 6 by their enclosure in the warp-thread pockets 10. For this reason, the rearward connecting loops 7 function as pitch stabilisers and the arms 6 are no longer unstable. Moreover, there are no textile threads between the individual arms 6 in each pair, which could influence the pitch. The pairs of fixing arms 6 can be compressed in the warp-thread pockets 10 by shrinking the warp threads 8 and/or by thermal fixation.

In the preferred embodiment shown, the warp threads 8 are laid in a twill weave with a crossover between each adjacent pair of fixing arms 6. A similar arrangement could be obtained if the warp threads 8 were the loop-forming threads of a plaited structure. The arrangement shown in the embodiment of Figures 1 to 3 is such that the rearward connecting loops 7 of the sliding clasp fastener form the outer edges and have flats 11 to act as slider guides. This is an example of a strip fastener without stringer tapes, with the supporting fabric adapted to sewing directly to a garment of the like by passing the needle through in the vicinity of the fixing arms 6. The arrangement shown in the embodiment of Figures 4 to 7, on the other hand, is such that the support fabric is provided with a selvedge 12 projecting like a stringer tape beyond the fixing arms and the loops 7. It is essential in this case for the woven stringer tape 12 to include at least one basic textile weft thread 13. The arrangement shown in Figures 4 to 6 embodies the invention in that the said thread 13 is taken round the rows of

interlocking members and its return loops 14 pass round each individual connecting loop 3. Figure 7 makes it clear moreover that the return loops 14 of the basic weft thread 13 can also pass round the rearward connecting loops 7 between the pairs of arms 6 of each interlocking member 2. It is within the scope of the invention to provide the arms 6 with deformations 15 to reduce the resistance to bending of the finished sliding clasp fastener. The deformations 15 may consist of flats arranged substantially parallel to the plane of the fastener.

The equipment shown in Figures 8 to 13 is designed to make the sliding clasp fasteners shown in Figure 1 to 7. The fasteners are identified by the reference numeral 101 in the various Figures. The equipment consist basically and primarily of a needle loom, only shown schematically and in part, having a shedforming mechanism 102 and simultaneously functioning weft needles 105 on either side of the shed 104 formed by the warp threads 103, to insert and extract the plastics monofilaments 106 forming the rows 107 of interlocking members. A flexible mandrel 108 is journaled centrally in the shed 104, with its tip 110 furthest from the fell 109 of the shed 104 held freely in a vertically reciprocating mandrel-holder 111. As can be seen in Figure 9, the weft needles 105 are arranged in superimposed horizontal planes and can therefore cross over in the shed 104. The mandrel-holder 111 is journaled in a centrally interrupted vertical guide 112 and is reciprocated between upper and lower positions by a tappet arrangement 113, with associated arrestors 114 in the form of magnets. However, it is possible to dispense with the arrestors 114 and adopt the alternative shown in Figure 11, in which the mandrel-holder 111 is brought into its upper and lower positions by the plastics monofilaments 106 themselves. In this case the mandrel holder has rounded corners 115 ensuring smooth reciprocating movement by the plastics monofilaments 106 during insertion. Excessive pay-out of the monofilament is avoided by the provision of breadth limiters 116 on either side of the mandrel-holder 111, to limit the breadth of the outermost warp threads 103.

The equipment for producing a continuous strip fastener, shown in Figures 8 to 10, functions as follows. The two plastics monofilaments 106 paid out from supply spools 117 pass through a pair of forming rolls 118 and are then fed to the weft needles 105. The weft needles 105 insert the monofilaments 106 into the shed 104 formed by the warp threads 103, as shown in Figure 9. At once, the mandrel-holder 111 and the end 110 of the mandrel 108 freely journaled in it are sent from the

upper to the lower position or vice versa, so that when the needles 105 are retracted the monofilaments 106 are left running round the mandrel 108 in opposite directions.

Shed reversal is followed by a stroke with the slay 119. The length of the mandrel 108 is adjusted so that the interlocking members only leave it, in the vicinity of an associated fastener guide 120, after repeated locking into the warp threads 103.

It is preferable to extend the mandrel 108 to act as a coupling core of gradually decreasing cross-section leading to a thermal fixation unit (not shown), so that the fastener is fixed as it slides along the mandrel 108. This is preferably accompanied by shrinkage (e.g. 10 to 15%) of the warp threads 103, which reduces the pitch and produces a particularly close fit between the rows 107 of interlocking members. The fastener guide 120 leads into a takeoff attachment 121. This procedure produces a strip fastener 101 having rows 107 of interlocked interlocking members with connecting loops having overlapping upper and lower limbs in a projection on the plane of the fastener, which are then taken into the plane of the fastener and there incorporated in warp-thread pockets, i.e. forming a woven structure in conjunction with the warp threads 103. If the rows 107 of interlocking members are to be laid out in helical form, the mandrel 108 must be reversed both before and after inserting the plastics monofilaments 106. If however the rows 107 of interlocking members are required in meandering form, the mandrel 108 must not be reversed before inserting the monofilaments 106, but instead the vertical settings of the weft needles 105, must be interchanged after each weft insertion, so that the right-hand monofilament is alternately taken above and below the left-hand monofilament. The weft needles 105 must be manipulated accordingly.

The equipment shown in Figures 12 and 13 differs from that shown in Figures 8 to 10 in that it produces a sliding clasp fastener 101 in which the stringer tapes extend beyond the rows 107 of interlocking members. Accordingly, basic stringer-tape weft threads 123 are woven into a further warp-thread shed 122 ahead of the plastics monofilaments 106 and locked in position by the warp threads 103 after hooking with the said plastics monofilament threads 106. Correspondingly, the weft needles 105 for the monofilaments 106 are supplemented by additional weft needles 124 which simultaneously insert the basic stringer-tape weft threads 123, while a basic weft lifter 125 is provided in front of the mandrel 108 for the said hooking section.



17

WHAT WE CLAIM IS:—

1. A sliding clasp fastener comprising rows of interlocking members formed from plastics monofilament, each interlocking member being formed by a pair of arms and a connecting loop with an interlocking head formed on the connecting loop, the arms lying alongside each other in the longitudinal plane of the sliding clasp fastener with one arm of one member being secured to the adjacent arm of the next member by a rearward connecting loop, and the arms secured to a supporting fabric by means of textile warp threads, with the connecting loop and interlocking head projecting beyond the edge of the supporting fabric, the connecting loop being so disposed that one limb of the loop lies above the other limb of the loop, when seen in a projection on the plane of the fastener and each limb extends to its respective arm such that the two arms lie alongside each other in the longitudinal plane of the fastener to directly support each other and are incorporated as a pair in a common warp-thread pocket from which project the rearward loops connecting the arms of the pairs to the respective arms of the adjacent members.
2. A sliding clasp fastener as in Claim 1, wherein the warp threads are laid in a twill weave with a crossover between each adjacent pair of arms.
3. A sliding clasp fastener as in Claim 1, wherein the warp threads are loop-forming threads of a plaited structure, so laid that each pair of arms lies in one row of thread loops.
4. A sliding clasp fastener as in any of Claims 1 to 3, wherein the rearward connecting loops form the outer edges of the sliding clasp fastener and have flats to act as slider guides.
5. A sliding clasp fastener as in any of Claims 1 to 3, wherein the woven or plaited supporting fabric extends beyond the arms and the rearward connecting loops to serve as a stringer tape.
6. A sliding clasp fastener as in any of Claims 1 to 5, wherein the support fabric includes at least one basic textile weft thread, the return loops of which, associated with the rows of interlocking members, pass round each individual connecting loop.
7. A sliding clasp fastener as in any of Claims 1 to 5, wherein the woven stringer tape includes at least one basic textile weft thread, the return loops of which associated with the rows of interlocking members, pass round the rearward connecting loops between arms of adjacent interlocking members.
8. A sliding clasp fastener as in any of Claims 1 to 7, wherein the pairs of arms of

each member are compressed in the warp-thread pockets by shrinkage of the warp threads.

9. A sliding clasp fastener as in any of Claims 1 to 8, wherein the arms are provided with cross-sectional deformations along their length to reduce the resistance to bending.

10. A sliding clasp fastener as in Claim 9, wherein the cross-sectional deformations reducing the resistance to bending are flats arranged substantially parallel to the plane of the fastener.

11. A method of producing a sliding clasp fastener as in any of Claims 1 to 10, wherein two plastics monofilaments are inserted simultaneously as superimposed double wefts from opposite sides into a shed formed by warp threads of a support fabric, wound in opposite directions round a single reciprocating mandrel to form two interlocked rows of interlocking members with superimposed connecting loop limbs and fixed in position with arms lying alongside each other in the fastener plane by moving the shed of warp threads.

12. A method as in claim 11, wherein support fabric weft threads are woven into a further warp-thread shed ahead of the plastics monofilament threads and locked in position by the warp threads after hooking with the plastics monofilament threads, to produce a stringer tape as the support fabric.

13. A method as in Claim 11 or Claim 12, thermal fixation is applied to the monofilaments while still on the mandrel.

14. Equipment for carrying out the method of any of Claims 11 to 13, comprising an automatic loom having weft needles on either side of a shed arranged in superimposed horizontal planes to insert or extract simultaneously double wefts of plastics monofilament threads for rows of interlocking members, a single mandrel journaled with one end in a vertically reciprocating mandrel holder and disposed centrally in the shed to hold the double wefts with superimposed connecting loop limbs said mandrel holder being journaled in a centrally interrupted guide, and a mechanism for forming the shed by warp threads and moving said warp threads to fix the arms of the double wefts in a horizontal side-by-side position.

15. Equipment as in Claim 14, wherein the weft needles for the plastics monofilaments are supplemented by additional weft needles for the simultaneous insertion of basic stringer-tape weft threads and a basic weft lifter is disposed in front of the mandrel.

16. Equipment as in Claim 14 or Claim 15, wherein the mandrel holder is

18



6

1,527,636

6

reciprocated between upper and lower positions by a tappet arrangement with associated arrestors.

5 17. Equipment as in Claim 16, wherein the arrestors consist of magnets.

18. Equipment as in any of Claims 14 to 17, wherein said mechanism is a known thermal fixation unit for the plastics monofilament.

10 19. A sliding clasp fastener substantially as hereinbefore described with reference to Figures 1 to 3, Figures 4 to 6 or Figure 7 of the accompanying drawings.

15 20. A method of producing a sliding clasp fastener as in Claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

21. Equipment for carrying out the method of Claim 11 and substantially as

hereinbefore described with reference to Figures 8 to 10 of the accompanying drawings.

22. Equipment for carrying out the method of Claim 11 and substantially as hereinbefore described with reference to Figures 11A, 11B and 11C of the accompanying drawings.

23. Equipment for carrying out the method of Claim 11 and substantially as hereinbefore described with reference to Figures 12 and 13 of the accompanying drawings.

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