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(54) MAKING SLIDING CLASP FASTENERS

(71) We, WILLIAM PRYM-WERKE K.G., a German company of 519 Stolberg/Rhld., Zweifaller Str. 5-7, Germany, 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:—

The invention relates to improvements or modifications in the invention described and claimed in our co-pending Patent Specification No. 1,341,266 and is based on the problem of further simplifying the method of producing a sliding clasp fastener by weaving.

According to the invention, there is provided an apparatus for manufacturing sliding clasp fasteners having coupling links woven into the edge of a supporting tape, the apparatus comprising means for imparting a shedding movement to a plurality of warp threads while feeding the warp threads towards a fell, means for laying a weft thread between the warp threads by moving the weft threads in one or more predetermined planes, and means for incorporating into the tape during weaving a warp thread of plastics material including a rotatable disc rotor having an aperture therethrough eccentrically positioned for passage of the thread of plastics material, a loop-forming mandrel having one end supported substantially on the axis of rotation of the rotor and being of sufficient length to extend to the fell, the rotor being arranged so that as the plastics thread passes through the rotor aperture the thread is fed in a circular motion to the fell about the

mandrel and is formed thereby into loops projecting from the tape, and means for rotating the disc rotor so that the circular movement of the plastics thread about the mandrel is synchronised with the shedding motion of the other warp threads and so that it describes at least a substantial part of the outer surface of a cone which is disposed about the mandrel and has its apex in the fell and its base defined by the path of the rotor aperture, the arrangement being such that the projection onto the plane of shedding movement of the limits of the circular motion of the plastics thread from the fell to the path of the rotor aperture overlaps the limits of the shedding movement of the warp threads adjacent the fell.

Also according to the invention, there is provided a method of manufacturing a sliding clasp fastener which comprises weaving a supporting tape by imparting a shedding movement to a plurality of warp threads while feeding the warp threads towards a fell and laying a weft thread between the warp threads by moving the weft thread in one or more predetermined planes, and incorporating into the tape during weaving a warp thread of synthetic plastics material, which thread passes through an aperture eccentrically positioned in a rotating disc rotor so that the thread is fed in a circular movement to the fell about a mandrel and is formed thereby into loops projecting from the tape, the circular movement of the plastics thread about the mandrel being synchronised with shedding movement of the other warp threads; wherein the plastics thread is guided so that it describes at least a sub-

stantial part of the outer surface of a cone, which cone is disposed about the mandrel and has its apex in the fell; wherein the base of the cone is defined by the path of the aperture in the rotor; and wherein the projection onto the plane of the shedding movement of the limits of the circular motion of the plastics thread from the fell to the path of the rotor aperture overlaps the limits of the shedding movement of the warp threads adjacent the fell.

With the rotation of the plastics warp thread about the mandrel, the working movements are performed simultaneously. The plastics warp thread as it moves around the said one end portion of the mandrel, is moved up and down through the weaving plane in accordance with the travel of the weft laying means, so that the warp thread can be woven into the supporting tape. Also, the plastics thread, during this rotation, is at the same time wound around the mandrel, so that the loops are formed. The plastics thread moving around the loop-forming mandrel describes a cone about the mandrel. The diameter of the base circle of the cone determines the extent of shedding movement of the plastics thread and is preferably in a plane parallel to the plane of shedding movement of the warp threads. With the base circle in such a plane, the remaining warp threads of the weave do not hamper the rotation of the plastics thread.

In order to produce the shedding movement of the plastics thread during shed formation it is desirable, even in those cases where the base circle of the cone is very close to the fell, to have the plastics thread describe an oblique cone having a considerable base circle. The cone axis then encloses an acute angle with the plane of the base circle.

The mandrel can be rotatably mounted on the shed-forming rotor, so that the mandrel is not entrained with the rotor as it rotates. The loop-forming mandrel need not take part in shed formation and remains constantly on one side of the weaving plane so that it does not cross the weft thread or protrude unnecessarily into the working path of the weft laying means, e.g. a weft insertion needle.

In order to produce rotary movement of the plastics thread, the eccentricity of the thread-guiding aperture with respect to the axis of rotation of the rotor is advantageously as large as possible. So that the size of the rotor does not make it difficult to locate the rotor in the apparatus, the rotor can be constructed as a circular disc, its axis of rotation being located substantially at right-angles to the plane of shedding movement of the warp threads. The circular rotor is preferably in the form of a circular disc having peripheral teeth meshed with

the teeth of a drive gear.

For the purpose of more rigid tying-in or more extensive working-in of the loops of the plastics warp thread, it is advantageous to use a stiffening thread in the interior of the loops. For this purpose, a stiffening thread, which is intended to form what will subsequently be a stiffener for the links, and the mandrel have the plastics thread looped around them in the region of the fell. At the same time, the stiffening thread can be fed from upstream of the fell and rotor by a compensating arrangement so that any rotation in the opposite direction to the looping of the stiffening thread about the mandrel can be eliminated.

In one embodiment the rotor contains a non-rotating insert which carries the mandrel and which is provided with a thread guide for the stiffening thread which later on serves as a stiffener for the row of coupling links. This insert is expediently located in the centre of the rotor. A compensating arrangement is located upstream of the rotor and has a revolving thread guide means which runs in synchronism with the rotation of the rotor. Such a thread guide means may comprise a thread take-off member which is rotatable coaxially with the stiffening thread supply spool and rigidly connected to a hollow shaft which is connected for motion with the drive for the rotor. The plastics thread is guided through the interior of the hollow shaft. The reverse arrangement could also be used, the take-off member being located co-axially with respect to the supply spool of plastics thread, while the stiffening thread is guided through the cavity in the shaft, its supply spool being located farther back with respect thereto.

So that the stiffening thread can be picked up by the weft together with the plastics thread and can be tied into the fabric, a thread guide means can be included between the fell and the insert, the said means performing a stroke in cadence with the weaving, so that the thread is transferred from its usual position in, for example, the lower position, where the loop-forming mandrel is also located, beyond the weaving plane and into the upper position. The guide means can be a push-member which is moved up and down rhythmically in a plane parallel to the plane of the movement of the warp thread. In this case, it is possible to provide on the end of the push member a groove in which the stiffening thread sits.

Instead of a thread guide means for the stiffening thread, it is also possible to make the weaving plane itself which is determined by the path of travel of the weft thread laying means, adjustable in height, in such a way that the stiffening thread, which is no longer involved in shed-forming

movement, is alternately above and below the particular position of the horizontal weft insertion plane. To this end, the thread passage in the central insert of the rotor is located at a sufficient distance from the point of attachment of the mandrel, so that there is sufficient space for the weft thread laying means to pass between the stiffening thread and the mandrel.

A further way in which the weft can take up only the stiffening thread and not the mandrel, in the manner desired, involves locating the point of exit of the thread guide for the stiffening thread eccentrically with respect to the axis of the insert so that between the mandrel which is in the axial zone of the insert, and the stiffening thread, there is a sufficient space for passage of the weft thread laying means. The insert is driven oscillatingly as the weaving is performed. By this oscillating movement of the insert, the thread guiding arrangement in the insert occupies various heights with respect to the weaving plane, so that the stiffening thread is moved from one extreme position with the group of warp threads of one part of the shed, through the horizontal weft insertion plane, into an extreme position in which it is located with the warp threads of the other part of the shed. The mandrel is mounted in and for rotation with respect to the central insert.

The rotor which winds the plastics thread around the mandrel preferably rotates only in one direction so that a helical row of loops is formed. However, it is also possible to produce courses of loops having a different form of winding, e.g. in the form of a meander, if the direction of rotation the rotor is rhythmically altered. This is effected by controlling the rotation of the rotor and it is possible to achieve a variety of forms of loops.

Immediately downstream of the fell, a guide system can be used to enclose the row of loops and to feed the loops to means for forming coupling heads on the loops, thereby producing coupling links. Heat may be brought to bear upon the row of loops in order to facilitate the shaping process. Heat may be exerted in the guide region in any desired manner, e.g. by heating said means or by ultra-sonics or by high-frequency energy which acts on the row of loops. In consequence, the cross-section of the completed row of coupling links can be changed.

Preferred and illustrative embodiments of the invention will now be particularly described with reference to the accompanying drawings, in which:

Fig. 1 shows, partly in section, a side view of those parts of a loom which are most essential to an understanding of the invention;

Fig. 2 is a plan view, partly in section, showing an enlargement of part of the loom of Fig. 1, but with the parts which are adapted for rotary movement in a different position;

Fig. 3 is a side view corresponding to Fig. 1 showing a second embodiment of the invention;

Fig. 4 is a sectional plan view of the loom of Fig. 3, taken along the line IV—IV of Fig. 3;

Fig. 5 shows a further embodiment of the apparatus according to the invention, most of the components of the loom having been omitted;

Fig. 6a and 7a are side views of the fabric in the region of the weaving zone, in two different operational positions of the different threads; and Fig. 6b and 7b are the corresponding plan views of the fabric in the two aforementioned working positions.

For producing a sliding clasp fastener strip using the apparatus according to Figs. 1 and 2, warp threads 11 and a weft thread 12 are used. In order to form a row of woven loops 14, a warp thread 15 is used. This is a strand of synthetic plastics material. In a manner still to be described in greater detail, this strand is guided around a mandrel 16 to form the row of loops.

In the present case, a weft needle 17, which is shown in cross-section in Fig. 1 and in plan view in Fig. 2, is used to insert the weft. Using this needle, the weft thread 12 is laid as a weft thread loop. The warp threads 11 and the thread 15 are spaced apart to form a shed 18 for passage of the weft. Passage of the weft through the shed 18 occurs in the weaving plane WE shown in chain-dotted lines in Fig. 1. This plane is determined by the line of movement of the weft needle 17 and a comb 30, with which the laid-in weft threads are finally beaten-up in the weaving zone 57 to form the completed woven fabric.

The warp threads 11 of the strip are shedded by thread-guiding arrangements, in the present case conventional healds 24 and heald shafts 22 and 23, through the weaving plane WE and movable alternately into an upper position 19 and a lower position 20. The number of healds and shafts used is governed by the type of fabric design desired. The linkage which serves to move the shafts and the shaft controlling means may be of conventional construction. The warp threads 11 are drawn into the healds 24 on the shafts 22 and 23 according to the pattern of weaving desired. The warp threads are shedded by the healds in sheets 11' and 11'', so that a sufficient angle of spread is produced for the needle 17 to pass through the shed 18.

The loop-forming mandrel 16 extends at an angle to the weaving plane WE, in order

not to obstruct the weft needle 17; and in fact it remains constantly in the region of the lower sheet of threads 11' and extends through the lower portion of the shed. The mandrel 16 does not move with the warp threads 11 and therefore does not change its position below the weaving plane WE. The end of the mandrel 16 located in the region of the fell 57 is tied into the loops formed by the thread 15 and extends for a distance along the marginal area of the fabric. The loops are progressively pulled off the free end 33 of the mandrel as the woven fabric moves away from the fell. The opposite end 31 of the mandrel, as viewed in Fig. 1, is located adjacent one of the boundaries of the shed 18, formed by the warp threads and is rotatably journaled in a mandrel holder 32.

The mandrel holder 32 comprises an annular bearing housing 46 and a rotor 47, which has the shape of a flat, circular disc-shaped wheel. The radius of the rotor is substantially equal to the height of the shed adjacent the end 31 of the mandrel. The housing 46 comprises a mounting plate 48 which is mounted on the frame of the loom by means of one or a plurality of fixed supports 50. In order to form a groove in which the rotor 47 can rotate, a ring 49 is mounted on the plate 48. The rotor 47 is located for rotation in a plane B which is fixed with respect to the weaving plane WE. The plane B, which is shown in chain dotted lines in Fig. 2, extends approximately parallel with the plane of the shedding movement 11', 11" of the warp threads 11. The rotor 47 has peripheral teeth 51 which mesh with a gearwheel 52. The gearwheel 52 is driven by a shaft 53. If the loom has a plurality of adjacent working stations for weaving several sliding clasp fasteners simultaneously then each of these working stations can be constructed in the manner shown and driven by a single shaft 53.

As can be seen in Fig. 2, the attachment end 31 of the mandrel 16 is located in the region of the axis of rotation 77 of the rotor 47. This axis is shown by chain-dotted lines in Fig. 2. The mandrel is bent adjacent the attachment end 31 and towards the rotor 47. The rotary axis 77 of the rotor 47 extends at right-angles to the plane B.

Apart from retaining the attachment end of the mandrel 16, the rotor 47 also fulfils the further function of shedding the thread 15. The rotor 47 has an aperture 56 which serves to guide the deformable thread 15. This aperture 56 is located at one end of a spoke extending diametrically of the rotor and separating two recesses 27 and 28 in the rotor 47. The recesses are provided as a means of saving weight. The shaft 53 drives the gear-wheel 52 in the direction of the arrow 54, causing the rotor 47 to rotate in

the direction of the arrow 43. Thus, thread-guiding aperture 56 passes around the axis of rotation 77 in the direction of the arrow 43. Thus, the thread 15 is shedded over a vertical distance which is only slightly less than the diameter of the rotor.

In the position shown in Fig. 1, the thread 15 is in its extreme upper position. Half a rotation later, the aperture is in the position 56' which is shown in broken lines, so that the thread 15 assumes its extreme low position to form the lower part of the shed. As can be seen, during rotation of the rotor 47, the thread 15 is located alternately above and below the weaving plane WE, so that the weft thread inserted by the needle 17 in the weaving plane can secure the thread 15.

During this rotation of the rotor 47, that part 15' of the thread between the fell 57 and the aperture 56 describes an oblique circular cone 41 shown in chain-dotted lines, of which the cone axis A is also shown in chain-dotted lines in Fig. 2. The axis A passes through the position at which the rotor axis 77 cuts the plane B and the location of the last-formed loop turn 21 at the fell 57. The base circle of the cone lies in the plane B where the circular path of rotation of the thread-guiding aperture 56 is located. This base circle encloses an acute angle α with the cone axis A, and this angle, and thus the gap between the rotor 47 and the other warp threads 11 of the supporting strip, is kept as small as possible in order to save space. Alternative positions of the part 15' of the thread are shown in the drawings by thin chain-dotted lines for different angles of rotation of the rotor 47. Fig. 2 shows the direction of rotation 43, indicated by the arrow, of the thread part 15' during generation of the circular cone 41.

Although the mandrel 16, as can be seen particularly in Fig. 2, may diverge from the path of the cone axis A, it does not hamper the encircling movement of the warp thread 15 about the mandrel because the main part of the mandrel is within the cone which is generated. Thus, for each revolution of the rotor a loop is formed in the region of the weaving zone 57. The loop is woven in by the weft 12 and beaten up at the fell 57 by the comb 30 which is shown with part of its upper portion broken away, the said beating up taking place as the comb 30 is pivoted to and fro in the direction of the double-headed arrow 58. A more detailed description of the manner in which the weaving is effected will later be given with reference to Figs. 6a to 7b. The additional thread 60 which is shown in those drawings should be disregarded for the purpose of understanding Figs. 1 and 2.

In the embodiment shown in Figs. 3 and 4, the same reference numerals are used as in the previous embodiment insofar as the

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Corresponding component parts are involved. One essential difference is that there is, in the centre of the rotor 47, an insert 55 which does not rotate during rotation of the rotor 47. In this embodiment the mandrel holder 32 guides a stiffening thread 60 which produces a stiffening for the row of loops 14, the thread 60 being woven in by the weft thread 12 of the fabric in the marginal area of the strip.

The insert 55 not only carries the attachment end 31 of the mandrel, but also has an aperture 59 through which the thread 60 passes from one side of the rotor 47 to the other, where the mandrel is also situated. At one end, the insert 55 has a flange-like head which bears on the surface of the rotor when the shaft end of the insert is passed through a central hole in the rotor 47, as shown in Fig. 4. The shaft end of the insert 55 protrudes from the opposite side of the rotor to the head and is retained by a spring clip or the like. The head of the insert 55 is conical and has a radially extending groove 61 which is connected to an axial bore. The attachment end 31 of the mandrel is fitted, in the manner shown in Fig. 4, into the bore and passes through the groove 61. To prevent damage to thread 60, the edges of the hole 59 are rounded.

Because the mandrel 16 extends inside the groove 61 and the thread 60 extends along the flattened end face of the head of the insert 55, the mandrel and thread are located at some distance from but alongside each other in this zone, although they abut at the fell 57. A space is provided to accommodate a thread guide element in the form of a push member 62 which has a notch 64 located at its head end. The thread 60 is received by the notch when the push rod 62 is moved in the direction of the arrow 63 in Fig. 3 from the ineffective position shown in solid lines to the effective position 62' which is shown in chain-dotted lines. Usually, the thread 60 is located in a lower position 20'' with respect to the weaving plane WE while the push rod 62, located in its ineffective position, is far outside the spreading movement of the warp threads so that it cannot interfere with the formation of the shed. According to the desired design in which the weft thread is to be used, the thread 60 may be passed through the weaving plane WE using the push rod 62 which is moved into the position 62' shown in Fig. 3.

In Figs. 6a to 7b, the method according to the invention is illustrated in greater detail with reference to two consecutive working positions of the threads. For each working position, one plan view and one side view are shown, one beside the other.

In the stage shown in Figs. 6a and 6b, the thread 15 is in its upper position 19', which

is completed after the rotor 47 has rotated through half a revolution from the position shown in solid lines in Fig. 3. The aperture 56 is in the position 56' (Fig. 3) shown by the broken line and the thread which has been guided through it is in the position shown by chain-dotted lines. The healds 24 spread the warp threads to form two warp thread sheets 11' and 11'' in the upper sheet position 19 and lower sheet position 20, respectively. The push rod 62 lifts the thread 60 in the direction of the double-headed arrow 63 to the chain-dotted position 62' (Fig. 6a). The mandrel 16 is in the region of the group 11' of warp threads which are in the lower sheet position 20. Now, using weft insertion needle 17, the weft thread is laid in to form a loop 34 as shown in Fig. 6b. The weft thread is laid in from the marginal zone of the fabric which carries the row of loops and passes through the warp threads as a loop thread. A stitch-forming loop 36 of the weft thread 12 is pulled through a preceding weft thread loop so that a row of stitches in the form of knitted loops extends along the edge 35 of the fabric.

Figs. 7a and 7b show the next stage of the weaving process. The subsequent weft thread loop 34' is inserted. The mandrel 16 remains on the same side of the weaving plane WE as the warp thread 11'. To reach this stage, the rotor 47 has been moved on through half a revolution, so that the thread 15 has moved into the position shown in solid lines in Fig. 3. The warp thread 15 is now in the lower sheet position 20', see Fig. 7a. The lower portion 20' of the sheet is larger with respect to the weaving plane WE than the upper portion 19' in Fig. 6a, since the rotor 47 is offset with respect to the weaving plane. The rotor 47 rotates around the attachment end 31 of the mandrel 16, so that the two positions of the thread 15 shown in Figs. 6a and 7a describe approximately the same angle with the mandrel 16. The mandrel remains in the lower position 20 of the warp threads 11'. During the rotary movement between the Fig. 6 and Fig. 7 positions of the thread 15, the portion of thread 15 between the fell 57 and the aperture 56 describes one half of the cone 41 (explained in greater detail in connection with Fig. 2) which is located to one side of the warp threads 11. With this movement of the thread 15 on the left-hand side in the plan view of Figs. 6b and 7b, the loop designated 45 has formed itself around the mandrel 16. The push rod 62 is not supporting the thread 60, so the rod has moved into its position as shown in full lines in Fig. 3, extending between the aperture 59 in the insert 55 and the fell, so that the thread 60 forms a lower shed 20'' with respect to the weaving plane WE.

When the loop 34' is laid, the weft needle

17 moves into the open shed 18 and passes over the thread 60, as can be seen from the weft thread loop 34' in Fig. 7b, and over the link-forming warp thread 15 so that both threads are woven into the fabric. The protruding stitch-forming loop 36' of the weft thread is passed through the preceding stitch-forming loop 36 at the free edge 35 of the fabric.

10 With the further rotation of the rotor 47 in the direction of the arrow 43 in Fig. 3, the thread 15 in turn moves into the position shown by chain-dotted lines in Fig. 3, the various threads resuming the positions shown in Figs. 6a and 6b, so that the working cycle is concluded and the next cycle can commence. During this further movement of the rotor 47, the part of the thread 15 which is stretched between the fell 57 and the aperture 56 describes the second half of the cone 41. In doing so, thread 15 encircles not only the mandrel but also the thread 60 which extends alongside it and which serves as a stiffening for the loops.

25 It is possible for the row of loops 14 to have those parts of their turns which are secured by the woven fabric covered by auxiliary warp threads 37. These threads can be guided in the marginal zone 38 which is adjacent to the actual supporting strip part 25. The auxiliary warp threads 37, in contrast to the warp thread 11 of the supporting strip part 25, act in the manner of a hollow fabric design, co-operating with the weft thread 12 so that a receiving channel is formed in the fabric, which channel is open towards the warp thread 15. The rear parts 39 of the links in the warp thread 15, together with the thread 60, can be drawn by the weft loops 34, 34' into this channel and thus be covered. In the interest of clarity, the position of the completed row of loops and of the auxiliary warp threads 37 in Figs. 6b and 7b are shown as being located alongside one another, and furthermore, only two warp threads 37 are shown. The threads 37 produce the upper wall of a hollow channel in the marginal zone 38, which wall is just visible in Figs. 6b and 7b.

50 It will be appreciated that further auxiliary warp threads operating as mirror-opposites to the threads 37 are provided to complete the channel, and that the number of auxiliary warp threads can naturally be greater than two. The rear parts 39 of the loops in the warp thread 15 can be drawn into the fabric as far as the transition between the marginal zone 38 shown in the drawing and the supporting strip part 25.

60 Thus, it is possible to produce a sliding clasp fastener having a row of links which is substantially covered by the woven fabric of the supporting strip. Masking by the auxiliary warp threads could naturally also be provided on one side only, which could

be easily achieved by a suitable design of weave.

In the diagrammatically shown weave structure in Figs. 6a to 7b, the thicknesses of the threads and the thread density do not coincide with reality; instead, for greater clarity of the thread pattern, the illustration has been made to an enlarged scale.

Upon rotation of the rotor 47 the loops are formed around the mandrel 16 and the thread 60 in the region of the fell 57. However, in the feeding zone of the threads there is generally an oppositely-directed looping of the thread 15 around the thread 60. This is compensated by the compensating arrangement 40 shown in the right-hand part of Fig. 3. By suitable location of a storage bobbin for the thread 60 in the interior of the cone which, during the weaving process, is described by the thread 15, it would in principle be possible to dispense with a compensating arrangement, because undesired looping could not occur in the thread feeding zone. For reasons of space, however, it is often necessary to choose a less favourable arrangement of the storage bobbin, at some distance from the motor 47, as shown in Fig. 3.

The supply bobbin 67 for the thread 60 is, viewed in the direction of feed of the fabric, still located upstream of the heald shafts 22 and 23. The axis of rotation of the supply bobbin 67 is located approximately in the direction of travel of the thread 15 and is fitted onto a hollow shaft 69 rotating in the direction of the arrow 68. The bore 78 of the shaft serves as a passage for the warp thread 15, which is pulled off a supply bobbin located still farther upstream. Rigidly connected to the hollow shaft 69 is an unreeling bracket 70 which, as the shaft 69 rotates, rotates around the bobbin in the direction of the arrow 71 in Fig. 3, and in synchronism with rotor rotation. The driving gear is not shown.

In the unreeling bracket is a hole 72 through which the thread 60 is guided and with which the thread pay-out point on the supply bobbin 67 is determined. The thread 60 passes through an eyelet 73 which maintains the thread 60 under tension by means a tensioning element 66, for example, a coil spring. As the hollow shaft 69 and the unreeling bracket 70 rotate, the supply bobbin 67 is carried along with them, as is additionally assured by a bobbin brake 76 provided on the unreeling bracket. This does not prevent the supply bobbin being able to rotate with respect to the unreeling bracket 70. The aforesaid tensioning arrangement 66 equalises any irregularities in rotation of the rotating arrangement 40, and also any necessary variations in length in that part of the thread 60 which leads to

the fell 57 and which arise from the thread 60 being lifted by the push rod into the position 62'.

Rotation of the unreeling bracket 70 is synchronised with the rotation 43 of the rotor, as shown in Fig. 3. If the rotor 47 has its aperture 56 in the position shown in solid lines, where the thread 15 is just in its lower sheet position, then the unreeling bracket assumes the upper position 70 shown by solid lines. Thus the thread pay-out point 72 for the thread 60 is at the top. If the rotor 47 moves on by half a rotation 43, then the thread-guiding aperture 56 passes into its diametrically-opposed position 56' shown by chain-dotted lines, so that the thread 15 assumes the upper sheet position shown by the chain-dotted lines. By virtue of the rotation of the hollow shaft 69, which is matched to rotation of the rotor, the unreeling bracket 70 moves at the same time into the diametrically-opposed position 70' indicated by the dash-dotted lines, so that the thread pay-out point moves to the position 72' shown in the drawings, so that the accompanying thread now follows the pattern indicated by the chain-dotted lines. It is thus evident that through this compensating arrangement 40, the thread 60, in the feeding zone, follows the rotating movement of the warp thread 15 in this zone. Upon this rotation in the feed zone, the thread 60 follows the movements of the thread 15 at the same angular velocity, a reciprocal inter-twisting of these threads in the feed zone thus being prevented.

Instead of the described arrangement of supply bobbins of thread 15 and of thread 60, it would also be possible to reverse the location of the bobbins because compensation of undesired looping in the region of the feed zone depends solely upon a relative rotation between these two threads.

In the embodiment shown in Fig. 5, a modified construction of rotor 47 is shown. For designating the appropriate parts, the same reference numerals have been used as previously and to this extent the previous explanations apply.

One difference resides in the larger diameter construction of the insert 55 in the rotor. The thread passage 59 for the thread 60 can now be sufficiently far removed from the attachment end 31 of the mandrel 16 in the insert 55, so that a wider shedding angle is achieved which provides adequate intermediate space for the travel of a weft thread insertion needle 17. With regard to the weaving plane WE I which is shown in Fig. 5, the thread 60 is in an upper position, while the mandrel 16 which is stationary during weaving, is in the plane of the warp thread 11' of the lower warp sheet. In this construction also, the insert 55 remains stationary during rotation of the rotor disc 47.

The weft needle can be raised into the position 17', which results in a new weaving plane WE II being formed, this being displaced in height with respect to plane WE I. The thread 60 forms a lower shed with respect to the raised weaving plane WEI II. The warp threads of the fabric perform a sufficiently great shedding stroke that the position of the weaving plane does not affect the weaving process.

In the embodiment shown in Fig. 5, the insert 55 may oscillate as shown by the chain-dotted arrow 74. In this case, the weft needle 17 need only operate in a fixed weaving plane WE I. The insert 55 oscillates through a sufficiently large angle that the thread 60 moves out of its position shown in the drawing, above the weaving plane WE I, where it forms an upper shed therewith, into a lower position which is located beneath the weaving plane WE I, approximately in the plane of the warp 11'. To form such a lower shed, the insert 55 according to Fig. 5, need only perform a pivoting movement of slightly more than 90°.

In all the embodiments described, the rotary movement of the rotor 47 need not take place in only one direction; instead, the rotor could also be oscillated. Thus, instead of producing a row of loops with helical turns, it would be possible to produce turns of any other desired type, e.g. turns of a meander. This can easily be achieved by an alternating drive or by suitable couplings.

Immediately after the fell 57, there is a guide 75 for the row of loops. Heat can be applied to shape the coupling part of the loops to form a completed row of coupling links.

The described rotatably driven rotor 47 is of general importance because it can be used not only for the weaving of the row of loops to make sliding clasp fasteners, but can be used for any weaving operation where it is desirable to spread warp threads apart to allow passage of weft threads. Thus for the shedding movement of the warp thread 11 of the woven supporting strips, corresponding rotors could be used instead of the healds shown. In addition, such rotors could be used for shedding warp threads for manufacturing any other woven fabrics, such as woven strips. In these cases, the rotor could be located almost parallel with the plane of movement of the warp threads, according to the illustration shown in Fig. 1. The axis of rotation will be located in the middle between the two extreme positions of the shed-forming arrangement. Furthermore, in these cases, since no mandrel needs to be held, the eccentricity of the thread-guiding aperture 56 can be so selected with reference to the rotor axis 77, that this latter corresponds to approximately half the height of lift of the warp threads.

Viewed in the illustration according to Fig. 1, this means that the thread-guiding aperture 56 for movement of an ordinary warp thread, is moved from the sheet position 11' into the oppositely-disposed sheet position 11' once the rotor has made half a turn. In these cases, for the weaving lifting movement of the warp threads, quite a number of parallel and adjacently-disposed rotors are used which are driven jointly in groups according to the fabric design required. By individual control of the rotors, any desired fabric design can be achieved. For reasons of space, numerous rotors could also be located in a staggered arrangement upstream of the weaving point, for shed formation. In order to form a clean shed, with increasing remoteness of the position of the rotor from the weaving point, provision can be made for increased eccentricity of the thread-guiding aperture with respect to the rotor axis. For this, apertures of different eccentricities could be located in the rotor. Finally, it would also be possible to provide a rotor with several apertures for shedding various warp threads; e.g. the rotor could be provided with in each case one aperture for guiding one warp thread, these apertures being at diametrically-opposed locations. In the last-mentioned case, one warp thread is in the upper sheet position while the other warp thread is in the lower sheet position. After half a rotation of the rotor, the warp threads are located in reversed positions.

WHAT WE CLAIM IS:—

1. A method of manufacturing a sliding clasp fastener which comprises weaving a supporting tape by imparting a shedding movement to a plurality of warp threads while feeding the warp threads towards a fell and laying a weft thread between the warp threads by moving the weft thread in one or more predetermined planes, and incorporating into the tape during weaving a warp thread of synthetic plastics material, which thread passes through an aperture eccentrically positioned in a rotating disc rotor so that the thread is fed in a circular movement to the fell about a mandrel and is formed thereby into loops projecting from the tape, the circular movement of the plastics thread about the mandrel being synchronised with shedding movement of the other warp threads; wherein the plastics thread is guided so that it describes at least a substantial part of the outer surface of a cone, which cone is disposed about the mandrel and has its apex in the fell; wherein the base of the cone is defined by the path of the aperture in the rotor; and wherein the projection onto the plane of the shedding movement of the limits of the circular motion of the plastics thread from the fell to the path of the rotor aperture overlaps the

limits of the shedding movement of the warp threads adjacent the fell.

2. A method according to claim 1, wherein a weft thread is laid between the warp threads by a weft needle.

3. A method according to either preceding claim, wherein the plastics thread is rotated around the mandrel, and describes a complete oblique cone about the mandrel, the base of the cone being substantially parallel to the plane of shedding movement of the warp threads.

4. A method according to any preceding claim wherein a stiffening thread is fed to the fell and the plastics warp thread is wound there-about, downstream of the supported end of the mandrel, and wherein the plastics warp thread and stiffening thread are rotated one about the other upstream of the supported end of the mandrel.

5. A method substantially as herein described with reference to Figures 6a, 6b, 7a and 7b of the accompanying drawings.

6. An apparatus for manufacturing sliding clasp fasteners having coupling links woven into the edge of a supporting tape, the apparatus comprising means for imparting a shedding movement to a plurality of warp threads while feeding the warp threads towards a fell, means for laying a weft thread between the warp threads by moving the weft threads in one or more predetermined planes, and means for incorporating into the tape during weaving a warp thread of plastics material including a rotatable disc rotor having an aperture therethrough eccentrically positioned for passage of the thread of plastics material, a loop-forming mandrel having one end supported substantially on the axis of rotation of the rotor and being of sufficient length to extend to the fell, the rotor being arranged so that as the plastics thread passes through the rotor aperture the thread is fed in a circular motion to the fell about the mandrel and is formed thereby into loops projecting from the tape, and means for rotating the disc rotor so that the circular movement of the plastics thread about the mandrel is synchronised with the shedding motion of the other warp threads and so that it describes at least a substantial part of the outer surface of a cone which is disposed about the mandrel and has its apex in the fell and its base defined by the path of the rotor aperture, the arrangement being such that the projection onto the plane of shedding movement of the limits of the circular motion of the plastics thread from the fell to the path of the rotor aperture overlaps the limits of the shedding movement of the warp threads adjacent the fell.

7. An apparatus according to claim 6, wherein the axis of rotation of the rotor is

Viewed in the illustration according to Fig. 1, this means that the thread-guiding aperture 56 for movement of an ordinary warp thread, is moved from the sheet position 11' into the oppositely-disposed sheet position 11' once the rotor has made half a turn. In these cases, for the weaving lifting movement of the warp threads, quite a number of parallel and adjacently-disposed rotors are used which are driven jointly in groups according to the fabric design required. By individual control of the rotors, any desired fabric design can be achieved. For reasons of space, numerous rotors could also be located in a staggered arrangement upstream of the weaving point, for shed formation. In order to form a clean shed, with increasing remoteness of the position of the rotor from the weaving point, provision can be made for increased eccentricity of the thread-guiding aperture with respect to the rotor axis. For this, apertures of different eccentricities could be located in the rotor. Finally, it would also be possible to provide a rotor with several apertures for shedding various warp threads; e.g. the rotor could be provided with in each case one aperture for guiding one warp thread, these apertures being at diametrically-opposed locations. In the last-mentioned case, one warp thread is in the upper sheet position while the other warp thread is in the lower sheet position. After half a rotation of the rotor, the warp threads are located in reversed positions.

WHAT WE CLAIM IS:—

1. A method of manufacturing a sliding clasp fastener which comprises weaving a supporting tape by imparting a shedding movement to a plurality of warp threads while feeding the warp threads towards a fell and laying a weft thread between the warp threads by moving the weft thread in one or more predetermined planes, and incorporating into the tape during weaving a warp thread of synthetic plastics material, which thread passes through an aperture eccentrically positioned in a rotating disc rotor so that the thread is fed in a circular movement to the fell about a mandrel and is formed thereby into loops projecting from the tape, the circular movement of the plastics thread about the mandrel being synchronised with shedding movement of the other warp threads; wherein the plastics thread is guided so that it describes at least a substantial part of the outer surface of a cone, which cone is disposed about the mandrel and has its apex in the fell; wherein the base of the cone is defined by the path of the aperture in the rotor; and wherein the projection onto the plane of the shedding movement of the limits of the circular motion of the plastics thread from the fell to the path of the rotor aperture overlaps the

limits of the shedding movement of the warp threads adjacent the fell.

2. A method according to claim 1, wherein a weft thread is laid between the warp threads by a weft needle.

3. A method according to either preceding claim, wherein the plastics thread is rotated around the mandrel, and describes a complete oblique cone about the mandrel, the base of the cone being substantially parallel to the plane of shedding movement of the warp threads.

4. A method according to any preceding claim wherein a stiffening thread is fed to the fell and the plastics warp thread is wound thereabout, downstream of the supported end of the mandrel, and wherein the plastics warp thread and stiffening thread are rotated one about the other upstream of the supported end of the mandrel.

5. A method substantially as herein described with reference to Figures 6a, 6b, 7a and 7b of the accompanying drawings.

6. An apparatus for manufacturing sliding clasp fasteners having coupling links woven into the edge of a supporting tape, the apparatus comprising means for imparting a shedding movement to a plurality of warp threads while feeding the warp threads towards a fell, means for laying a weft thread between the warp threads by moving the weft threads in one or more predetermined planes, and means for incorporating into the tape during weaving a warp thread of plastics material including a rotatable disc rotor having an aperture therethrough eccentrically positioned for passage of the thread of plastics material, a loop-forming mandrel having one end supported substantially on the axis of rotation of the rotor and being of sufficient length to extend to the fell, the rotor being arranged so that as the plastics thread passes through the rotor aperture the thread is fed in a circular motion to the fell about the mandrel and is formed thereby into loops projecting from the tape, and means for rotating the disc rotor so that the circular movement of the plastics thread about the mandrel is synchronised with the shedding motion of the other warp threads and so that it describes at least a substantial part of the outer surface of a cone which is disposed about the mandrel and has its apex in the fell and its base defined by the path of the rotor aperture, the arrangement being such that the projection onto the plane of shedding movement of the limits of the circular motion of the plastics thread from the fell to the path of the rotor aperture overlaps the limits of the shedding movement of the warp threads adjacent the fell.

7. An apparatus according to claim 6, wherein the axis of rotation of the rotor is



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- substantially at right angles to the plane of shedding movement of the warp threads.
8. An apparatus according to claim 6 or 7, wherein the rotor is in the form of a circular disc having peripheral teeth meshed with the teeth of a drive gear.
9. An apparatus according to any one of claims 6 to 8, wherein the rotor has an insert in which the supported end of the mandrel is journaled, the insert including an aperture through which a stiffening thread for the loops is fed to the fell.
10. An apparatus according to claim 9, including a rotatable guide means for rotating either the plastics thread or the stiffening thread about the other upstream of the rotor.
11. An apparatus according to claim 10, in which the said guide means is synchronised for rotation with the rotor.
12. An apparatus according to claim 10 or 11, in which the said guide means comprises a bracket rotatable about a supply bobbin to withdraw the plastics thread or stiffening thread from the bobbin, said bracket being connected to a hollow shaft through which the other thread can pass.
13. An apparatus according to any one of claims 9 to 12, including thread-guide means connected to raise and lower the stiffening thread synchronously with the shedding movement of the plastics thread.
14. An apparatus according to any one of claims 6 to 13, including a weft insertion needle to lay the weft thread between the warp threads.
15. An apparatus according to claim 14, wherein the weft needle is controlled to lay alternate loops of weft thread respective of upper and lower weaving planes.
16. An apparatus according to any one of claims 6, 7 or 8, or claim 14 when dependent thereon, including an insert rotatable coaxially with the rotor and having therein an aperture eccentric with respect to said axis to feed a stiffening thread for the loops to the fell.
17. An apparatus according to any one of claims 7 to 16, including means for forming a coupling head on each loop.
18. An apparatus substantially as herein described with reference to Figures 1 and 2, 3 and 4, or 5.
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