1206494

PATENT SPECIFICATION (11) 1206494

DRAWINGS ATTACHED

(21) Application No. 46954/68 (22) Filed 3 Oct. 1968
(31) Convention Application No. P 16 10 385.8
(32) Filed 8 Nov. 1967 in
(33) Germany (DT)
(45) Complete Specification published 23 Sept. 1970
(51) International Classification D 02 g 3/26
(52) Index at acceptance
D1F 41A
B5A 1R38 1R71
D1W 1 3

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(54) IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF COILED INTERLOCKING ELEMENTS FOR SLIDING CLASP FASTENERS AND APPARATUS THEREFOR

(71) We, OPTI-HOLDING AG., a Company organised under the laws of Switzerland, of Burgstrasse 24, 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 the manufacture of coiled interlocking elements for sliding clasp fasteners and apparatus therefor.

It is known to coil a continuous filament of plastics material on a stationary mandrel, the filament being drawn from a bobbin fixed in position but free to rotate about its own axis, and a power-driven filament guide unit being revolved about the mandrel to effect the coiling. Since only a single strand of filament can be coiled on the mandrel the necessary pair of rows of interlocking elements required for a fastener must subsequently be produced by meshing and connecting together two coils so produced. Therefore, although the coiling can be done at high speed, the subsequent registering by elements such as gears or conveyor worms of the two rows of interlocking elements can only be done at restricted speed, besides which the need for such elements makes the machine more complicated and liable to breakdown.

It is evident that if two strands of filament, instead of one, were coiled on the one mandrel, with the turns of one alternating with those of the other, the two coils would be so interlinked that they could not be separated without difficulty, in fact only by the awkard operation of unscrewing one lengthways from the other. It will be equally evident that this does not enable in one coiling operation, two rows of interlocking elements to be produced in a manner that enables them to emerge in the meshed condition required in the fastener.

To produce the two rows in such condition, it is known to coil two strands of filament simultaneously on the one mandrel, and to form them as meshed rows by winding the strands round the mandrel in opposite directions. This makes it necessary for the two filament bobbins to revolve about the mandrel, besides which the mandrel must be overhung, which is again disadvantageous. Large-capacity bobbins cannot be used because they set up out-of-balance forces by their revolution. The limitation to relatively small bobbins necessitates frequent stoppages for bobbin-changing, so that the operation has a low output rate and correspondingly low efficiency.

The object of the invention is to enable two rows of interlocking elements to be coiled on a single mandrel, without any revolving of filament bobbins about the mandrel, with the two rows capable of being separated one from the other and in condition to be passed, continuously with the coiling operation, for further processing into the meshed condition required of them in the actual fasteners.

According to the present invention, apparatus for the simultaneous coiling of two filament strands comprises a stationary mandrel, a rotatable support surrounding the mandrel, a guide bush mounted on the support to revolve planetwise about the axis of the mandrel, the bush having two filament guide holes, means for preventing the bush from rotating about its own axis as it revolves about the mandrel, means for leading two filament strands individually from external bobbins to the respective guide holes, and means for rotating the support about the mandrel.

The expressions "revolve" and "revolution"

[Price 5s. 0d. (25p)]

are used to denote planetary motion of the support about the mandrel and the expressions "rotate" and "rotation" motion (or its absence) with respect to the bush axis.

Simple means of preventing rotation of the bush becomes available if the apparatus has at least two mandrels mounted with their axes parallel, when the respective filament guide bushes can be connected rigidly together by a connecting rod, so that none of them can rotate. Alternatively, the filament guide bush can be attached to a universal joint arrangement to prevent it from rotating as it revolves. Simple means are also available for preventing the mandrel from rotating in its location inside the revolvable bush, viz., by connecting the mandrel to the bush by a planetary gear arrangement. Since the bush is prevented from rotating about its own axis, so also is the mandrel prevented from rotating about its axis.

Thus, with the guide bush mounted in a rotary support that is provided with a sprocket to enable it to be driven by a chain, or with a gear that meshes with a driving pinion. Then, the filament guide bush and the mandrel can each be provided with a rearwardly located gear, with an intermediate gear to transmit motion from one to the other, to form the planetary gear arrangement above indicated.

The various elements of the apparatus must be suitably dimensioned one relative to another. This requirement applies to the mandrel perimeter, the radial distance between the filament guide bush and the mandrel, and the distance between the two filament guide holes in the bush. In general, it is advantageous (but not absolutely essential) for the distance between the two filament guide holes centres to be exactly equal to the length of filament required for one complete turn round the mandrel. When this is so, the two strands of filament will wind tightly on the mandrel, twisting so that they cross over twice in each revolution. The effect of these crossovers is that the pairs of rows of interlocking elements at once take up a position from which they can easily be brought to meshed position.

The mandrel may have a round, elliptical, or flattened rectangular cross-section. If a flattened mandrel is used the crossover points of the two filaments should preferably lie on its broad faces.

As already indicated, it is not strictly necessary to adhere to the dimensioning just described. If the distance between the filament guide hole centres exceeds the length of filament per turn round the mandrel, a filament restrainer may be provided between the coiling mechanism and the filament supply, as for example an eccentric to maintain equal tension in both the strands of filament and to return the excess length back to the filament guide bush as it travels on.

The cross-section of the plastics monofilaments used to provide the strands to be coiled can take a wide variety of forms. If for example the cross-section of the filament is elliptical, crescent, cusp-shaped or even simply rectangular, no separate means need be provided to form the interlocking heads on the filaments, since the revolutions of the filament guide bush, inhibited from simultaneous rotation about its own axis, put a twist in each filament, which causes the pair of simultaneously produced rows of coiled interlocking elements to mesh together. If however the filaments have a round cross-section, separate forming means to make the interlocking heads may be necessary. Thus, with the filament guide holes parallel to the bush axis, transverse forming abutments may be provided within the bush, to coperate with one or more forming rolls to form the interlocking heads, as by kinking, as the bush revolves.

As the coiling of the rows of interlocking elements proceeds on the mandrel, they are progressively propelled off the end of the mandrel. To assist this propulsion, and also to cotrol the coiling of the filaments, the inner end of the mandrel is preferably provided with oblique edges or a conical surface leading to the length on which the coiling takes place.

Because the guide bush does not itself rotate, the two strands of filament must necessarily cross over twice per revolution of the bush about the mandrel axis. By reason of these crossovers, the two simultaneously produced rows of interlocking elements can be separated laterally immediately they leave the end of the mandrel. The equipment can indeed be provided with means whereby the crossovers are mutually displaced to bring the two rows of elements into ready-meshed and interlocked condition. This is achieved by using a plurality of forming rolls per filament guide bush, one set of rolls to form the interlocking heads and the other set to form a rear loop for each turn of the coil. The rear loop can be given any particular orientation, trial and error readily determining the optimum. If the apparatus is constructed so that only the interlocking heads are formed on the successive turns of interlocking elements of the rows, the crossovers can be re-shaped by combining with the features already described a set of shaping rolls on the mandrel or on a mount in line with or actually extending like a core from the mandrel which rolls shape the individual turns and urge the pair of simultaneously produced rows of correctly shaped interlocking elements into the interlocked position. A heater can be fitted in front of the shaping rolls.

By means of the invention, it becomes possible to coil pairs of interlinked rows of interlocking elements on one mandrel, from plastics monofilaments supplied from bobbins that do not partake of the coiling revolutions; and, continuously with the coiling, either mesh them together or separate them one from the

other. Without revolving bobbins or rotating mandrel, a high output can be obtained and close manufacturing tolerances can be maintained without difficulty.

The invention will now be further described with reference to an embodiment shown, purely by way of example, in the accompanying drawings, in which:—

Figure 1 is a plan view of a complete machine including two coiling devices for producing side-by-side two pairs of rows of interlocking elements for sliding clasp fasteners;

Figure 2 is a side elevation of the machine of Figure 1;

Figure 3 is a plan view, on a larger scale, of the two coiling devices of the machine of Figure 1;

Figure 4 is a view of the coiling devices of Figure 3, looking in the direction of the arrow A;

Figure 5 is a side-view (reversed as compared with Figure 1) of the coiling devices of Figure 3, looking in the direction of the arrow B;

Figure 6 is a view of the coiling devices of Figure 3, looking in the direction of the arrow C;

Figure 7 is a diagrammatic front elevation, on a still larger scale than Figures 3 to 6, of one of the coiling devices, to indicate the kinematic relationships;

Figure 8 is a section, taken on the line D—D of Figure 7, to a still larger scale, showing two filaments as coiled on the mandrel of the device;

Figure 9 shows a short length of the two intertwined rows of interlocking elements after removal from the mandrel, but still with crossovers in the turns;

Figure 10 shows the rows of interlocking elements of Figure 9, in the interlocking position, the turns having been re-shaped; and

Figure 11 shows, in plan view, alternative means for preventing rotation of a revolving guide bush in a coiling device.

The machine shown in Figures 1 and 2 includes two coiling devices 1, each for forming two rows of interlocking elements for a sliding clasp fastener by coiling a pair of plastics monofilaments 6. The devices 1 are mounted on a machine frame 2, provided with driving means 3. Bobbins 5 for supplying the monofilaments 6 are mounted in fixed position but are free to rotate about their own axes. In each coiling device 1 is a power-driven filament guide unit 7 which revolves about a non-rotating mandrel 4 on which the two filaments 6 are coiled. Beyond the mandrel is a series of heaters 8 in alternation with shaping rolls 9, and finally a cooler 10, for each of the two pairs of rows of interlocking elements formed from the filaments 6 into finished rows of interlocking elements ready for further processing, by forming and optionally thermal setting. Between the bobbins 5 and the coiling devices filament tensioning and guiding devices are provided. There may also be heating means to condition the filaments before they reach the coiling devices.

As shown more particularly in Figures 3 to 7, the mandrel 4 of each coiling device is surrounded by a rotary support 11, which carries a filament guide bush 12 spaced from and parallel to the mandrel. The bush 12 is provided with two parallel guide holes 13, 14 for the two filaments 6. The bush 12 is carried bodily round the mandrel 4 by the support 11 as it revolves about the mandrel 4 but is restricted as regards rotation about its own axis. As shown by Figures 3 and 6, the supports 11 of the two coiling devices have their respective guide bushes 12 connected rigidly together by a connecting rod 15, so that each bush is completely restricted against rotation about its own axis. Alternatively, the restriction of rotation of an individual bush 12 could be prevented as shown in Figure 11 by attaching it to one end of a universal joint arrangement 16, the other end of which is prevented from rotating. As Figure 6 shows, two sprockets 18 are driven by a common chain 19, for the simultaneous revolution of the two supports 11 in the same direction. An idler gear 17 carried by each support 11 engages gears 20 and 21 secured respectively to the rear ends of the mandrel 4 and the bush 12. Since the bush 12 cannot rotate about its own axis, so also is the mandrel 4 prevented from rotating about its axis. The mandrel 4, with operative end of rectangular section as shown in Figure 7, always remains orientated as shown in that Figure, and the bush 12 also maintains its orientation, as also shown in that Figure, throughout its revolution about the axis of the mandrel.

The two plastics monofilaments 6 of round cross-section are led to the respective filament guide holes 13 and 14 in the bush 12. In passing along the bush 12, the two strands 6 are exposed, to be engaged by a forming roll (Figures 3 and 5) for interlocking heads 22 (Figure 8) to be formed as the bush 12 revolves. Since the bush 12 does not rotate, each revolution about the axis of the mandrel causes one of the two filament guide holes 13 and 14 to be first outermost and then innermost, with the other occupying the reverse positions, during their mutually distinct eccentric circular paths, as shown by Figure 7. The distance between the centres of the two holes 13 and 14, i.e., the eccentricity of the two circular paths, corresponds to the length of filament needed to make one turn in the row of interlocking elements, viz., the length between consecutive heads 22. The length can be larger, but if so it is necessary to include additional tensioners between the bobbins 5 and the coiling devices.

Figure 8 shows the filaments leaving the holes 13 and 14 and passing to the begining of the mandrel 4, and also shows that on the

way they receive a twist. Before reaching the operative end of the mandrel, each such length 24 or 25 of filament in turn encounters one of two oblique edges 23, which lead to the edges of the operative end. Each is therefore automatically pushed forwards in turn. As they advance, parts of the lengths 24 and 25 cross obliquely over parts of the other, but at opposite sides of the mandrel. The result is, that when the two coils are pushed from the mandrel, they appear as in Figure 9, in which the "uppermost" coil has been cross-hatched to emphasise that it can be separated from the other.

The oblique portions can then be re-shaped, as by shaping rolls provided on the mandrel 4 or on a mount in line with or actually extending like a core from the mandrel 4, to produce the condition shown in Figure 10.

The two interlocked rows 24 and 25 of elements, now correctly meshed together, can be pulled apart laterally until the interlocking heads interengage, when the two rows are in condition for further processing, e.g., securing to the stringer tapes of the fastener. In Figures 1 and 2, the shaping rolls 9 are each preceded by a heater 8, and finally followed by the cooler 10. It is however possible to dispense with the shaping rolls, provided the interlocking heads and rear loops have already been formed.

WHAT WE CLAIM IS:—

1. Apparatus for coiling two filament strands into rows of interlocking elements for sliding clasp fasteners comprising a stationary mandrel, a rotatable support surrounding the mandrel, a guide bush mounted on the support to revolve planet-wise about the axis of the mandrel, the bush having two filament guide holes, means for preventing the bush from rotating about its own axis as it revolves about the mandrel, means for leading two filament strands individually from external bobbins to the respective guide holes, and means for rotating the support about the mandrel.

2. Apparatus as in Claim 1, wherein the mandrel is prevented from rotating by planetary gears connecting it to the filament guide bush.

3. Apparatus as in Claim 2, wherein the rear ends of the bush and the mandrel are each provided with a gear, the gears being connected by an idler gear carried by the support.

4. Apparatus as in any one of Claims 1 to 3, wherein two mandrels are mounted with their axes parallel in the one machine bed and their respective filament guide bushes are connected rigidly together by a connecting rod so that neither can rotate.

5. Apparatus as in any one or Claims 1 to 3, wherein an individual filament guide bush is attached to a universal joint arrangement to prevent it from rotating as it revolves.

6. Apparatus as in any one of Claims 1 to 5, wherein the filament guide holes are substantially parallel to the axis of the bush, and roller forming means associated with the bush is provided to form interlocking heads on the filaments as the bush revolves.

7. Apparatus as in any one of Claims 1 to 6, wherein the mandrel is provided with a conical surface or oblique edges leading to the portion of the mandrel on which the coiling takes place.

8. Apparatus as in any one of Claims 1 to 7, comprising also shaping rolls to reshape and position the turns of the two coils formed on the mandrel.

9. Apparatus for coiling filaments into two rows of interlocking elements for sliding clasp fasteners, substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 2nd day of October, 1968.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1970.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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