

[54] **DEVICE FOR AND METHOD OF MAKING A KNITTED BAND HAVING A SPIRAL ZIPPER INCORPORATED THEREIN**
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[58] Field of Search 66/86, 195

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[57] **ABSTRACT**
The present invention relates to a device for and method making a knitted band having on one of its edges a zipper spiral for the purpose of forming one of the halves of a zipper.
6 Claims, 15 Drawing Figures

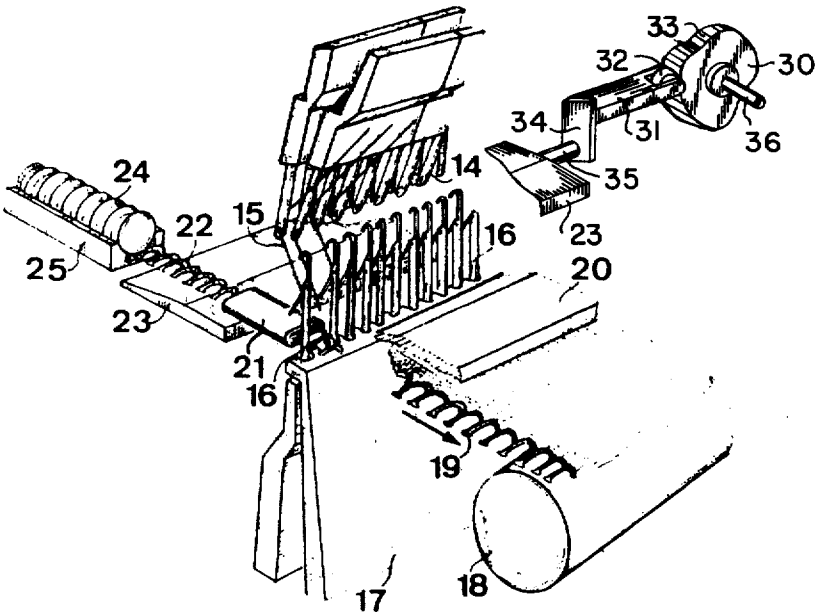


FIG. 1

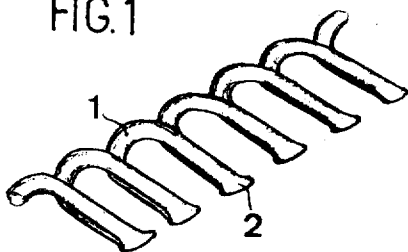


FIG. 2

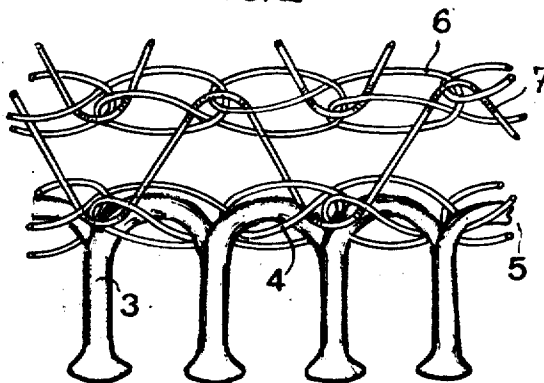


FIG. 4

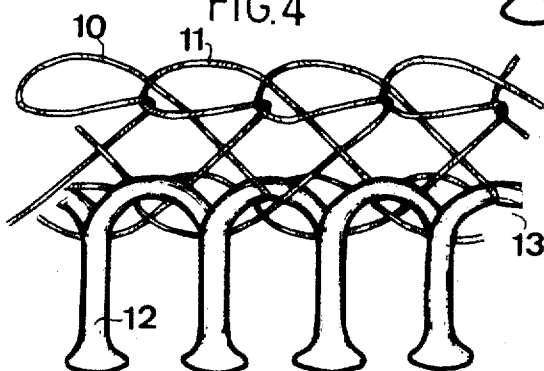


FIG. 3

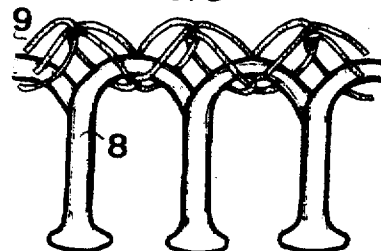
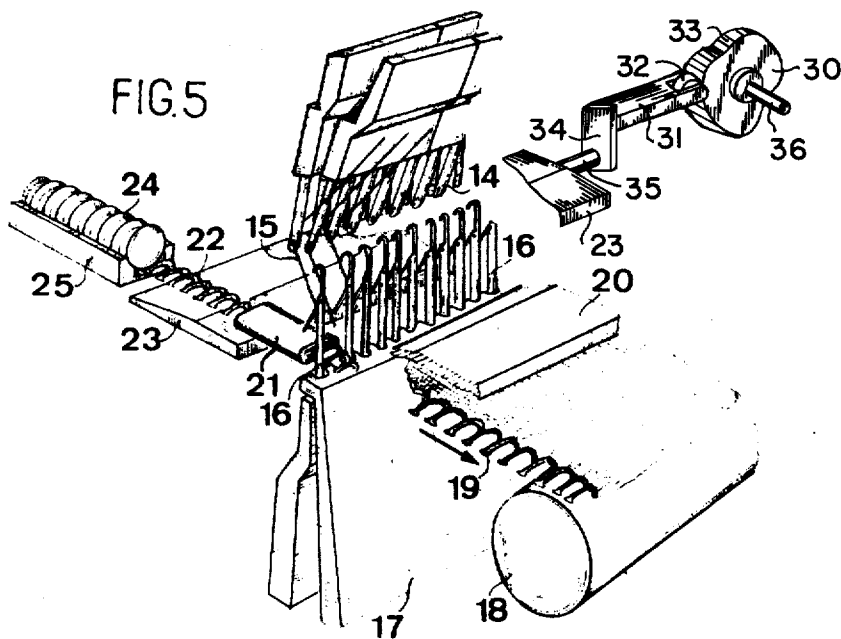
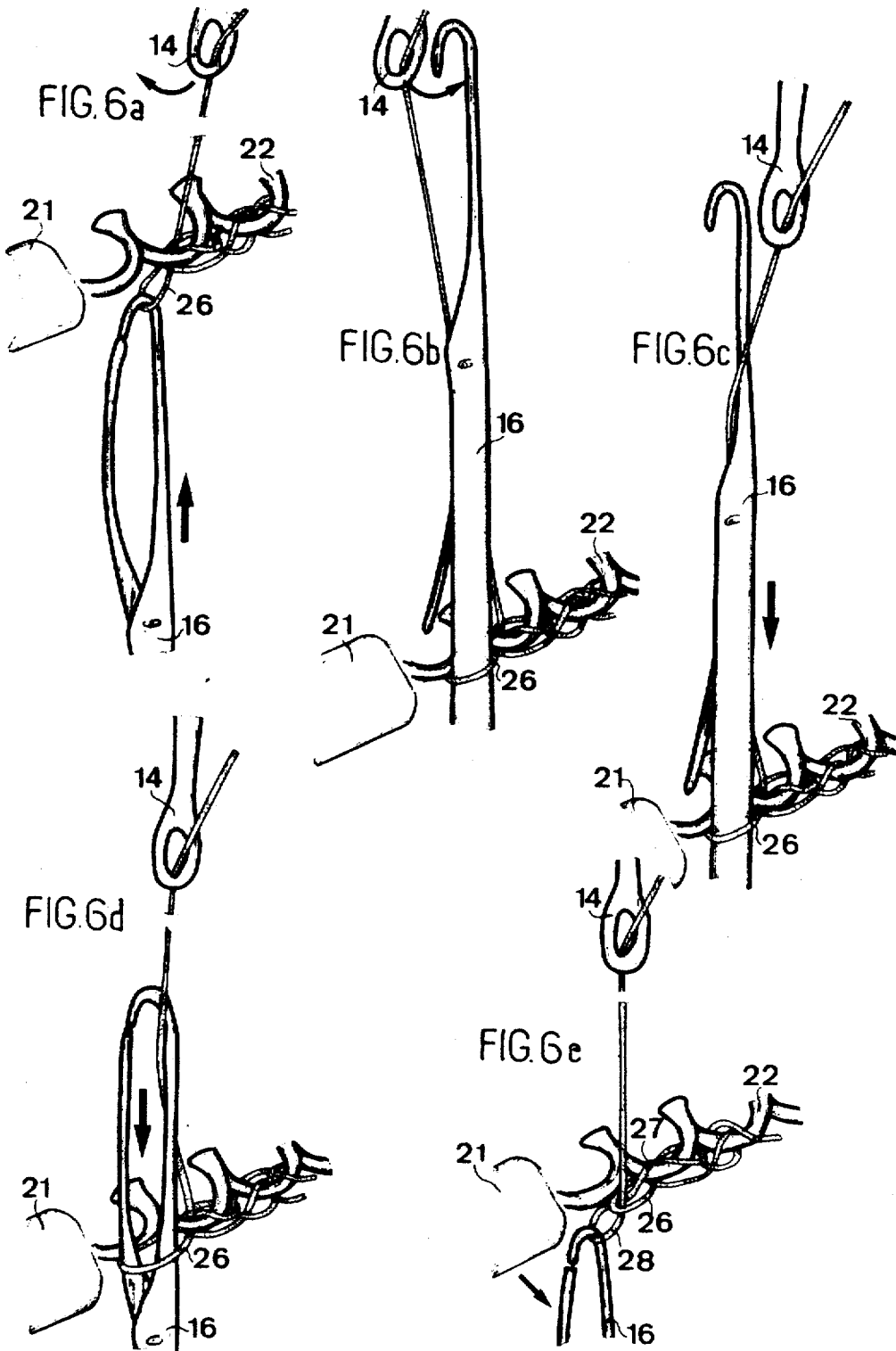
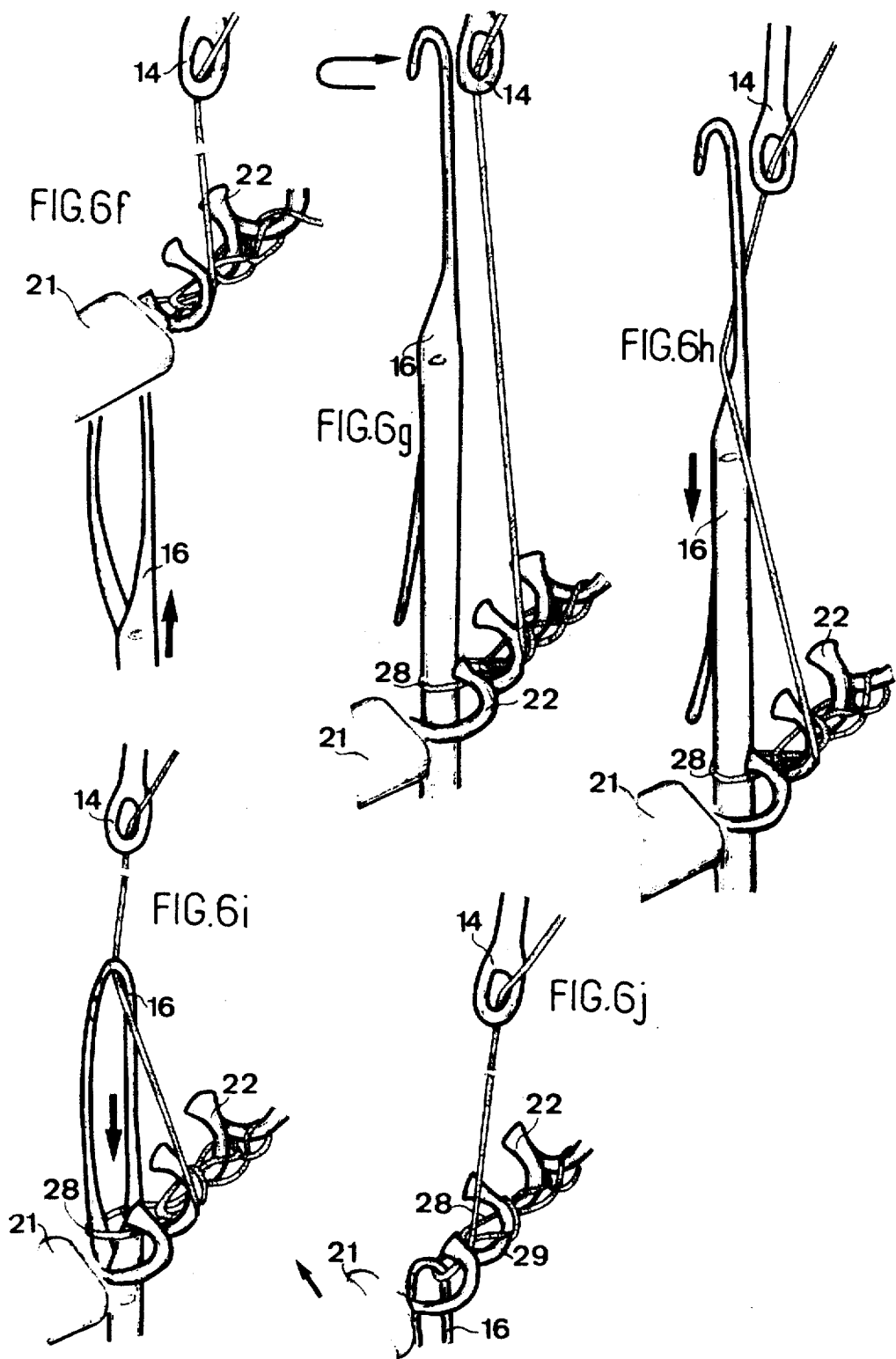


FIG. 5







DEVICE FOR AND METHOD OF MAKING A KNITTED BAND HAVING A SPIRAL ZIPPER INCORPORATED THEREIN

BACKGROUND OF THE INVENTION

There exist essentially two types of zippers, one in which the closure spiral is arranged on the edge of a woven tape, and the other in which the closure spiral is arranged on the edge of a knitted band. It will be recalled that the techniques of weaving and knitting are radically different; the first, employed on weaving looms, consists of intercrossing longitudinal warp threads and transverse weft threads so as to form a fabric, while the second, employed on warp knitting machines, consists of carrying-out columns of stitches coupled to each other, either by the threads which form the stitches or by additional weft threads, or by an association of threads having both functions.

The method generally employed in manufacturing both woven tape provided with a zipper spiral and knitted bands provided in like manner with a spiral, consists of previously manufacturing the woven tape on a weaving loom or the knitted band on a warp knitting machine, and then sewing the closure spiral on one edge of this tape or this band.

This seaming operation is extremely delicate and presents numerous problems which manufacturers have made efforts to resolve by associating more or less complicated devices with the sewing machines, which makes very careful adjustments necessary. The reasons for these difficulties arise from the fact that the junction between the spiral and the tape or band is effected by means of a seam made subsequently with an added seaming thread totally distinct from the threads which form the tape or band. On the one hand, it is difficult to adjust the tensions of the tape or the band and of the spiral in order that the pitch of the latter remains constant over its whole length; on the other hand, deformations, sometimes non-reversible, to which the seaming thread and the tape or the band are inevitably subjected, are different and may give rise to twisting and sagging, which give the finished tape or band a poor appearance and result in difficulties of use due to irregularity of the pitch of the spiral.

Thus, for example, in order to try to produce a presentable product, manufactures are compelled, at the time of seaming, to compensate for the shrinking which the product will undergo during the course of dyeing operations by producing reverse deformations inside the product. The difficulties which may be caused by such an operation can readily be understood; in the event of a bad regulation, the final result is to obtain a product having very imperfect flatness.

In addition, it is clear that this process of manufacturing in two stages (production of the tape or band followed by seaming) increases the production cost of the products obtained due to the accumulation of time necessary for each stage, to the immobilization of two types of machines (knitting and sewing machine) and to the necessity of transferring the bare band or tape manufactured on the first type of machine to the second type.

In order to eliminate the above-mentioned disadvantages, efforts have been made to develop a method of manufacturing woven tape provided on one edge with loops for a zipper. This method of weaving consists of adding to the two layers of warp threads an auxiliary

layer of selvage which follows the movement of one of the main layers, and of inserting between this main layer and the auxiliary layer an auxiliary thread which extends beyond one edge of the tape to form projecting loops, the amplitude of which are regulated by providing, parallel to the edge of the tape, a needle about which the loops are formed. This auxiliary thread is made of a deformable material, so that the method can be completed by deforming the tops of the loops, in particular by flattening under heat, in order to give the projecting loops the required shape which will enable them to play the part of a hooking member in the interior of the zipper.

This method, applicable on a converted weaving loom, is no longer industrially used at the present time for various reason, one being that it compels the user to carry-out very considerable and expensive conversions of standard weaving looms. Such conversions include, adding equipment to the loom which will connect the closure spiral to the projecting edge loops, and adapting the mechanisms of these weaving looms which, from the very nature of their kinematics, lend themselves very badly to the type of work necessary in order to produce the loops projecting from the edge of the tape.

In addition, the weaving looms referred to above are slow looms having a productivity very much lower than that of knitting machines.

As the above-described solution does not give satisfaction, manufactures have carried out tests on warp knitting machines in order to try to insert directly, during the knitting of the band, the spiral of the zipper which is to this end brought close to one edge of the working zone in which the knitting is carried out.

The method adopted by these manufacturers consists of leading the zipper spiral to the edge of the working zone in a direction substantially parallel to that of the knitting needles, in order that this spiral may be placed between two needles which are separated by a sufficient distance to permit the passage of the spiral and its guide. On one side the spiral, a thread is worked in a stitch on the two above-mentioned needles, while on the other side, a weft thread is guided so as to hook the stitches thus formed in such a manner that the spiral is maintained between a weft thread which forms a layer on one side of the spiral and a thread worked in stitches which forms a layer on the other side of the spiral and is attached to the first thread. In order to facilitate the work of these threads, the spiral may be subjected to an oscillating movement (swinging movement) in the central plane between the needles, which plane is parallel to the common direction of the needles and perpendicular to the front of them.

However, it proved that this method had serious drawbacks which are of two types and which in practice gave the method a character non-usable industrially. One such drawback is that due to the necessary distance between the two needles on which the stitch thread mentioned above is worked, the space defined between the two layers referred to above has a size considerably larger than the diameter of the filament which forms the spiral. The spiral is thus held fairly loosely, which constitutes an extremely serious defect in a product of this type. The other drawback is that in the case where the spiral is given an oscillating movement, the above method results in delicate, fragile and unreliable

mechanisms which are incompatible with the high speed at which knitting machines work.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to knitted bands, manufactured by making longitudinal columns of stitches connected to each other either by the threads which form the stitches or by additional weft threads, or by an association of threads which have the two functions. It offers a method free from the above-mentioned disadvantages of other methods, thereby permitting the manufacture of a knitted band on one edge of which a spiral of a zipper is incorporated at the actual time of knitting.

To this end, this method consists of guiding towards a working zone extending over the width of the band, the threads required for knitting the band and the spiral of the zipper, the latter being guided in such manner as to come into proximity of one edge of the working zone with its hooking means being turned towards the outside of the zone. A pre-determined, cycle of formation of stitches, according to known methods, is then worked so as to use the above-mentioned threads for the purpose of forming a piece of knitting constituted by columns of stitches connected to each other.

According to the invention, the spiral is given, on the edge of the band at the level of the working zone, a substantially rectilinear cyclic to-and-fro motion having a transverse direction with respect to the band formed. This causes the spiral to pass transversely through at least one column of stitches being formed on the edge of the band. This cyclic movement of the spiral is combined with a longitudinal forward movement of the spiral which in turn is regulated in relation to the formation cycle of the stitches. In this manner, each turn of the spiral becomes inserted in at least one stitch of at least one column of stitches on the knitted band's edge.

As will be observed later, a method of this kind lends itself exceptionally well to execution on warp knitting machines after certain very minor and inexpensive modifications thereto, the looms being of the hook type or "Rachel" type.

As the knitted band so formed does not necessitate any seam, the present device and method thus eliminates the above-described disadvantages of the conventional methods and devices which consist of putting the spiral into position by seaming subsequent to formation of the band. In addition, since the invention utilizes knitting techniques and since the spiral is wholly formed at the movement when it is worked with the threads, the present method is freed from all the disadvantages of the weaving method referred to above.

Furthermore, this method is also freed from the drawbacks of the knitting method previously referred to. In fact, the zipper spiral, guided transversely with respect to the knitted band so as to pass through at least one column of stitches during band formation, is maintained by the actual loops of such columns which are formed around the spiral and grip it very tightly. This characteristic feature will be further described below.

In addition, as will also be seen later, the modifications to be made to known warp knitting machines in order to carry this method into effect are of a minor nature and the simple and durable mechanisms added thereto are perfectly compatible with the high speeds at which these knitting machines work.

In the present method, the spiral is preferably guided towards the working zone of the knitting machine in a direction which is approximately orthogonal to the mean intake plane of the threads necessary for the knitting, the threads being guided in a layer towards the working zone. Due to the definite separation of the threads' intake trajectories, this arrangement prevents the threads and the zipper spiral from being hooked upstream of the working zone. In addition, it facilitates the utilization of the subject method on warp knitting machines looms, since the space located in front of the needles (upstream of the working zone) is unoccupied in these machines. Distribution and guiding means for the spiral may thus be arranged immediately in front of the needles. In this way, deformation of the spiral between the distribution and guiding means and the front of the needles will be very small, while the spiral's positioning by the guiding means will be extremely accurate thereby contributing to excellent uniformity of insertion of the spiral.

According to another characteristic feature of the present method, the band produced with an incorporated zipper spiral is guided at its outlet from the working zone in a direction very approximately orthogonal to the mean intake plane of the threads required for knitting. This arrangement results in a tighter grip of the stitches around the spiral as well as reducing the angular deformations of the spiral.

According to an alternative form of the subject method, it is possible to simultaneously make two or more bands, each band provided with a zipper spiral on its edge. In this alternative embodiment, there are employed one or more pairs of spirals with each pair hooked together by their hooking means. The spirals thus associated in pairs are interconnected one in the other in the same way as the spirals of a zipper in the closed position.

The corresponding spirals of the various pairs are freed and removed from each other and are each guided towards separate working zones in which the above-mentioned method is utilized. At the outlet of these zones, the bands with homologous spirals are joined together and fixed by hooking of their spirals. In the case where several pairs of bands are manufactured simultaneously, auxiliary threads are provided between pairs of bands so as to bind together facing edges of the adjacent bands at the moment of knitting.

It is also possible to fix together the pairs of bands by producing a bottom of so-called single knitting between these pairs of bands. A lateral tension on these pairs is then sufficient to cause them to separate, and there is thus produced an undivided layer of bands with incorporated spirals on which from many points of view (handling, etc.), it is much more practical to effect finishing operations (dyeing, drying, dressing, etc.).

The invention also relates to a rectilinear warp knitting machine modified so as to permit the utilization of the subject method. In a conventional manner, this knitting machine comprises means for distributing threads, needles subjected to an alternating movement to enable them to form the stitches on the stitch threads, guiding means such as thread guiding tubes actuated so as to guide the threads towards a working zone in front of the needles, tensioning means for the knitting produced located at the outlet of the working zone, a trick plate intended to carry out the clearing of the stitches, and driving means associated with trans-

mission means intended to give the appropriate movements to the various members of the machine.

This machine is further equipped with means for distributing at least one zipper spiral and with a member for guiding the spiral to the working zone, this member being located in proximity to the working zone. According to the invention, the spiral guiding member is driven in a cyclic, substantially rectilinear to-and-fro movement independent of the movements of the thread-guiding members, causing the spiral to pass transversely in front of and to each side of at least one needle, said needle or needles being arranged at the selvage of the working zone for the purpose of forming at least one column of stitches located at the edge of the knitted band. Such needle or needles are separated from the other needles by a distance at least equal to the transverse dimension (width) of the above-mentioned zipper spiral, so that during the course of the spiral's movement it is able to be engaged in this space between such separated needle or needles and the remaining needles.

The knitting machine may also be of the Rachel type in which the needles and the thread-guiding member are arranged approximately face to face in the same vertical plane. A machine of this kind modified in order to utilize the method according to the invention is shown in FIGS. 5 and 6a, 6b, 6c, 6d, 6e, 6f, 6g, 6h, 6i, 6j of the accompanying drawings. These drawings will be described later.

In addition, the invention covers a knitted band having turns and on one of its edges with a spiral of a zipper provided conventional hooking means and characterized in that each turn of the spiral is inserted in at least one stitch of at least one column of stitches located on the edge of the band, the turns being maintained therein by these stitches which form loops around the turns.

Finally, the invention extends to a layer of knitted bands of the type referred to above, characterized in that each band of the said layer is coupled by its longitudinal, spiral-free edge to the longitudinal, spiral-free edge of an adjacent band, and is fixed by its incorporated spiral to the spiral of the other adjacent band.

Other characteristic features and advantages of the invention will become apparent from the description which follows below with reference to the accompanying drawings, the description and drawings being given only by way of example and not to be limitative in any sense.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in perspective of a portion of spiral of a conventional zipper;

FIGS. 2, 3 and 4 are diagrams showing the edge of three knitted bands according to the invention;

FIG. 5 is a simplified perspective view of the working parts of a straight warp knitting machine of the Rachel type modified in accordance with the present invention;

FIGS. 6a, 6b, 6c, 6d, 6e, 6f, 6g, 6h, 6i and 6j are partial diagrams of the loom shown in FIG. 5 during the course of working, these being intended to facilitate the understanding of the method the present invention, the process of which has been divided into ten successive stages.

DETAILED DESCRIPTION OF THE INVENTION

The zipper spirals utilized in the examples shown are of the same type as those shown diagrammatically in FIG. 1. They are of synthetic material, in particular of nylon, and comprise flattened turns each made up of a coupling zone 1 and on the opposite side by hooking heads such as 2. The pitch of the spiral is equal to the longitudinal dimension of a turn, while the transverse dimension of these latter (distance between zone 1 and hooking head 2) will be referred to as the width of the spiral.

FIG. 2 shows the edge of a knitted band according to the invention, in which each turn of a zipper spiral 3 of the type described above is inserted in a stitch such as 4 of a column of stitches 5 formed by a single stitch thread worked in chain-stitch. This column of stitches 5 is connected to the column of adjacent stitches 6 of the band by a weft thread 7. It is seen that the spiral 3 is incorporated in the stitches of the knitted band in the absence of any thread foreign to the latter. For the knitted band shown in FIG. 2, the pitch of the spiral is equal to the pitch of the stitches.

In FIG. 3, there has been shown the edge of a knitted band in which each turn of a zipper spiral 8 is inserted in two stitches of an edge of chain-stitch 9. In this case, the pitch of the stitches is equal to one-half the pitch of the spiral. It is quite clear that it would be possible in the same way to insert each turn of a spiral in a greater number n of stitches of a chain-stitch, the pitch of the stitches relative to the pitch of the spiral being then equal to $1/n$.

In FIG. 4 there has been shown the edge of a knitted band in which each column of stitches is formed by two different threads 10 and 11. In this example, each turn of a spiral 12 is inserted in a stitch of the column of edge stitches 13 formed by the threads 10 and 11. In this case, the pitch of the spiral is equal to the pitch of the stitch, and the threads of stitches play the part of weft threads between two adjacent columns of stitches.

From these examples, it is easy to design more complex structures, in particular a texture in which each turn of the closure spiral is inserted in several stitches of several columns of stitches located on the edge of the band, each column being formed as required by several stitch threads.

The modified Rachel knitting machine shown in FIG. 5, makes it possible during knitting of the band to incorporate closure spirals directly on the edge of the knitted bands. In order to clarify the present invention, FIG. 5, does not show source of the various standard and well known parts which make up Rachel knitting machines, such as transmission means, distribution beams for the threads, dividing comb, frame, etc. As shown in FIG. 5, thread distribution means 14, such as guide the threads 15 to a working zone. These guide needles are subjected to the usual cyclic movements, well known in the art, which differ for a given cycle depending on whether the guide needles considered guide a thread which forms the stitch or guide a weft thread.

Facing the guide needles are standard latch needles 16, intended to form the stitches which are then retained by the teeth of a conventional trick plate 17. Behind the latch needles is located a tensioning roller 18 intended to guide the formed band 19 at its outlet from the working zone.

It should be noted that the position of tension roller 18 is not modified, but its direction of rotation is reversed with respect to the usual direction of rotation. Therefore, the band formed is guided at its outlet in a substantially horizontal plane by making contact with the generator lines located at the edge of the roller, instead of being guided in a plane very close to that of the latch needles and wound underneath the roller as is the case in standard Rachel looms. The direction of rotation of the roller, then, is the same as the movement of the formed band. Furthermore, a holding bar 20 is provided above the band in order to prevent upward movements of the band caused by the movements of the needles.

A guide tube 21 is arranged facing the needles 16 close to the latch needle located at the edge or selvage of the working zone. Guide tube 21 is given a cyclic, rectilinear to-and-fro movement causing it to pass in front and to each side of this edge latch needle. Guide-tube 21 has an oblong section having a size slightly greater than that of zipper spiral 22 which tube 21 is intended to guide. The spiral 22 guided by tube 21 passes through the tube and emerges therefrom close to the edge needle 16. This edge needle is separated from the other latch needles by a distance slightly greater than the width of spiral 22 in order that the spiral may be engaged, at the outlet of tube 21, in the space provided between the edge needle and the other needles without risk of being hooked.

In the example shown in FIG. 5, the guide-tube 21 has been fixed on the ironwork 23 of the moving comb (not shown) which is generally provided on Rachel knitting machines and which has become useless in view of the presence of the tensioning roller 18 and holding bar 20 provided at the outlet of the working zone. It can thus be seen that the modifications made to the loom are of a minor nature.

Any known mechanical means may be utilized in the present invention to impart the aforementioned transverse movement to the guide tube 21, such as a cam with connecting linkage similar to that disclosed in U.S. Pat. No. 3,657,904. By example only and as illustrated in FIG. 5, the cyclic, to-and-fro movement of guide tube 21, which as mentioned above is fixed to ironwork 23, may be obtained from the mechanical device (not shown) normally utilized in this type of knitting machine to actuate the guide needles 14. As illustrated, a rotatable cam 30 drives a push-rod 31 which is provided at one end with a roller 32, roller 32 being maintained against the cam surface 33 of cam 30 by a return spring (not shown). Push rod 31 is connected to ironwork 23 by bracket 34 and rod 35. As cam 30 is rotated by drive shaft 36, which is connected to the aforementioned mechanical device for actuating the guide needles 14, push-rod 31 is moved back and forth which in turn moves ironwork 23 in a cyclic, transverse fashion. As guide tube 21 is affixed to ironwork 23, this movement of the ironwork causes the guide tube 21 to move in the above-described cyclic, to-and-fro manner.

The forward movement of spiral 22 is regulated by means of a very simple device constituted by a threaded shaft 24 mounted in grooved plate 25, the surface of the groove and the threads of shaft 24 forming and defining a longitudinal passage in which spiral 22 is housed. The pitch of the threads is made equal to the pitch of the spiral in order that each turn of the spiral

falls flat in a natural manner in the various transverse channels formed by the threads of shaft 24.

This shaft is driven by an appropriate transmission coupled to the knitting machine driving means, at an angular speed of one shaft revolution to n cycles of the knitting machine (n whole), a cycle of the knitting machine loom corresponding to the formation of a stitch on a given needle. For example, if this number is equal to 1, spiral 22 will advance by one turn per stitch formed on the edge needle, resulting in each turn of the spiral being inserted in a single stitch of the chain-stitch formed on the edge of the knitted band. If n is equal to 2, as has been assumed in the subsequent figures, each turn of spiral 22 will be inserted in two stitches of the edge chain-stitch.

Before describing the various working stages shown in FIG. 6, it must be noted that the upstream of the spiral 22, guided by the tube 21, reaches the working zone in a horizontal direction substantially in alignment with the downstream portion of this spiral which having been incorporated in the edge of the knitted band, leaves the working zone. The deformations of this spiral have therefore a very small amplitude. In addition, it can be seen that the threads 15 guided by the guide needles 14 at the inlet of the working zone follow a path substantially directed from the top downwards, while the spiral follows a horizontal path. It will be understood that this arrangement eliminates any risk of accidental hooking between the threads and the spiral on the upstream side of the working zone.

It has been assumed in FIG. 6a that, at the beginning of the cycle, the edge needle 16 located at the selvage of the working zone was in the bottom position and that the guide-tube 21 and as well as spiral 22 were located to the left of this edge needle. During the course of its movement, the needle is then caused to move upwards to the right of the spiral so as to come into the position shown in FIG. 6b, its latch having been opened by the loop 26 of the thread formed around the body of the needle. The guide needle 14 is positioned for the throw.

At the next stage (FIG. 6c) the throw is made and the latch needle prepares to move down again.

FIG. 6d shows this needle in mid-travel as it moves downwards. The loop 26 closes the latch by sliding over the needle body.

At the next stage (FIG. 6e) the needle is again located at its bottom position, known as the doffing position, and the loop shown by the reference 26 has formed a stitch which maintains the coupling zone of a turn at a point 27. A new loop 28 has become formed in the hook of the needle.

During the course of the next stage, the guide-tube 21 is given a transverse movement towards the right which brings it to the right of the needle, as shown in FIG. 6f, the needle prepared to move up on the left of the guide-tube and the spiral.

During the course of its upward movement (FIG. 6g) the newly-formed loop 28 has, as previously for the loop 26, opened the latch of the needle with a fresh throw about to be made.

Once the throw has been made (FIG. 6h), the needle again moves down (FIG. 6i) and in the bottom position (FIG. 6j) effects the formation of a stitch derived from the loop 28, this stitch holding the spiral at a point 29. At this point, one cycle has been completed.

During the course of this cycle, the spiral has advanced by one pitch, that is to say by the length of one

turn, while, as has been seen, the needle has formed two stitches which hold one turn of the spiral. There is thus obtained a band of the type shown in FIG. 3, in which each turn of the zipper spiral is inserted in two stitches of the border chain-stitch.

By analogy, it is easy to envisage cycles corresponding to other textures. Similarly, instead of providing a single edge needle which works with the spiral, it is possible to provide several of these, so that the turns of this spiral may be inserted in several columns of stitches located on the edge of the band.

As the invention has been explained and its advantage clearly shown in the detailed examples, the applicant reserve to themselves its exclusive rights during the entire period of the patent, without any limitation other than that of the terms of the appended claims.

What is claimed is:

1. A method of making a knitted band having a zipper spiral securely incorporated into a longitudinal edge thereof, said zipper spiral having a plurality of turns with a plurality of hooking means extending outwardly therefrom, said method comprising the steps of: warp-knitting said band with stitch threads and weft threads in longitudinal columns of stitches interconnected with each other, said stitch threads and weft threads being guided as a layer to said band during the knitting thereof;

placing said zipper spiral adjacent the longitudinal exterior edge of said band during the knitting of said band with said hooking means being directed away therefrom, the longitudinal axis of said zipper spiral being essentially perpendicular to the plane of said layer of stitch and weft threads and essentially aligned with the plane of said bend;

passing said zipper spiral through a guide tube positioned immediately forward of and axially perpendicular to said layer of threads;

moving said zipper spiral longitudinally through said guide tube during the knitting of said band in accordance with the formation cycle of said stitches; and

simultaneously passing each of said turns transversely through at least one column of stitches being formed on the longitudinal exterior edge of said band by moving said guide tube in a uniform, essentially rectilinear cyclic manner perpendicular to its longitudinal axis and parallel with the plane of said band, said guide tube moving said zipper spiral in a direction transverse to and in the same plane with the band being formed so as to pass at least one of said threads on both sides of each turn of said zipper spiral to secure each turn in at least one stitch of said bend at its longitudinal exterior edge.

2. A method of simultaneously making a pair of knitted bands with each band of said pair having a zipper spiral securely incorporated into a longitudinal edge thereof, each of said zipper spirals having a plurality of turns with a plurality of hooking means extending outwardly therefrom, said zipper spirals being hooked together so as to join said pair of knitted bands, said method comprising the steps of:

hooking said zipper spirals together to form a zipper; simultaneously warp-knitting each of said bands with stitch threads and weft threads in longitudinal columns of stitches interconnected with each other, said stitch threads and weft threads being guided as parallel layers to said bands during the knitting

thereof, said bands being positioned and knitted adjacent each other;

placing said zipper between the longitudinal adjacent edges of said bands during the knitting of said bands, said zipper spirals being separated during the formation of said bands with their longitudinal axes being essentially perpendicular to the planes of said layers of stitch and weft threads and essentially aligned with the planes of said bands;

passing said zipper spirals through guide tubes each of which is positioned immediately forward of and axially perpendicular to one of said layers of threads;

moving said separated zipper spirals longitudinally through said guide tubes during the knitting of said bands in accordance with the formation cycle of said stitches;

simultaneously passing each of said turns of each zipper spiral transversely through at least one column of stitches being formed on the longitudinal edge of the band adjacent to said spiral by moving said guide tubes in a uniform, essentially rectilinear cyclic manner perpendicular to their longitudinal axes and parallel with the planes of said bands, said guide tubes moving said zipper spirals in a direction transverse to and in the same plane with the band being formed adjacent thereto so as to pass at least one of said threads on both sides of each turn of each zipper spiral to secure each turn of each spiral in at least one stitch of the longitudinal edge of the band being formed adjacent to that spiral; and

joining together said pair of knitted bands by hooking together the zipper spirals incorporated therein.

3. A rectilinear warp-knitting machine for forming a knitted band having a zipper spiral securely incorporated into a longitudinal edge thereof, said zipper spiral having a plurality of turns with a plurality of hooking means extending outwardly therefrom and said knitting machine having a working zone wherein said band is formed, comprising:

a plurality of thread guiding members for guiding threads in a layer to said working zone;

a plurality of essentially parallel latch needles arranged face-to-face with said thread guiding members in essentially parallel vertical planes, said needles moving in an alternating fashion to form the stitches of said band with at least one of said needles being separated from the remaining needles at the selvage of said working zone by a distance approximately equal to the transverse dimension of said zipper spiral, said separated needle forming at least one column of stitches located on the longitudinal edge of said knitted band;

means located upstream of said working zone for distributing and imparting a forward movement to said zipper spiral, said zipper spiral moving essentially perpendicular to the plane of said latch needles and parallel with the plane of said band;

a tubular guiding member through which said zipper spiral passes located between said spiral distributing means and said working zone proximate to said working zone and axially perpendicular to the plane of said needles, said tubular guiding member being disposed to move independently of said thread guiding members in an essentially uniform, rectilinear cyclic manner perpendicular to its longitudinal axis and parallel with the plane of said band

so as to pass transversely in front of and to each side of said separated needle, said tubular guiding member repeatedly moving said zipper spiral to alternate sides of said separated needle in a direction transverse to and in the same plane with the band being formed so as to pass at least one of said threads on both sides of each turn of said zipper spiral to secure each turn in at least one stitch of said band at its longitudinal exterior edge; and

tensioning means located at the outlet of said working zone for guiding said knitted band having said zipper spiral incorporated therein.

4. The method according to claim 2, wherein a plurality of said pairs of knitted bands positioned laterally to one another are simultaneously formed, said pairs being joined together at their adjacent, spiral-free longitudinal edges with auxiliary threads during the knit-

ting of said bands.

5. A knitting machine according to claim 3, wherein a horizontal holding bar parallel to the plane of said needles is located at the outlet of said working zone above said knitted band to prevent upward movements of said band caused by the movement of said needles, and wherein said tensioning means comprises a roller disposed to rotate in the same direction as the movement of said zipper spiral and said knitted band.

6. A knitting machine according to claim 3, wherein said spiral distributing means comprises a threaded shaft seated in a grooved plate, the threads of said shaft having a pitch approximately equal to that of said zipper spiral, said zipper spiral being housed in the continuous passageway defined by said threads and the surface of the groove in said plate.

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