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(54) Process for knitting tubular articles in a single-cylinder circular knitting machine, namely for the manufacturing of stockings

(57) Process for knitting a thread (F) for forming a tubular article in a single-cylinder circular knitting machine, namely for the manufacturing of stockings. The machine comprises a plurality of needles (1) co-operating with a plurality of sinkers (2), slidably inserted between the needles (1). According to the process, for each feed of the thread (F), backward and forward displacements of a respective sinker (2) occur in correspondence to the top stroke-end position of a corresponding needle (1), whereby a new stitch (M1) is formed on the upper edge (2b) of the tip (2a) of the sinker (2) and engages with an old stitch (M2), formed in the previous feed, disengaged from the upper edge (2b) as a consequence of said backward displacement and stretched, as a consequence of said forward displacement, between the tip (2a and the needle (1). When needle (1) returns to said starting position the old stitch (M2) is stretched by the tip (2b) and the new stitch (M1).

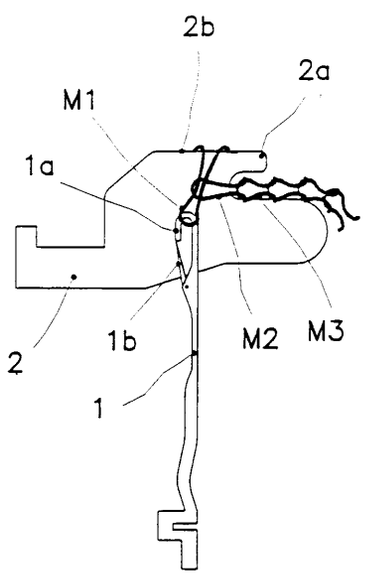

Fig. 12

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Description

[0001] The present invention relates to the textile industry field, and more particularly it refers to a process for knitting tubular articles in a single-cylinder circular knitting machine, namely but not exclusively for the manufacturing of stockings.

[0002] As known, the manufacturing of stockings requires the knitting of tubular articles, usually by means of circular, so-called single cylinder, knitting machines, in which a number of needles slide in axial slots formed in a revolving cylinder. The needles have respective end hooks and movable levers, as known to an expert in the field, and are driven by a fixed, cam-shaped tubular member, coaxial to the cylinder. Substantially horizontal flat elements, known to a person skilled in the art too and commonly referred to as "sinkers", are inserted between the needles and driven by a ring external to the cylinder. The sinkers co-operate with the needles, to create the loops forming the stitches.

[0003] The zone in which the thread is fed, and in correspondence of which the needles are operated to form the stitches, is commonly known as "feed". A machine can have one, two or more feeds, the number of which corresponds to the number of ranks, i. e. horizontal successions of stitches, formed in a single revolution of the cylinder. Besides, suction means are provided to establish a depression in the bore of the cylinder, in order to assist the formation and the discharge of the stitches. The suction means are also used to extract the tubular article from the machine at the end of the operating cycle and to collect the thread cuts produced during the same cycle. They can comprise a single fan for each machine or consist of a centralised system (in large knitting departments).

[0004] In further detail, figures 1 to 6 schematically show how each stitch is formed, according to the prior art, by a needle 1 and a respective sinker 2, followed as they pass through a single feed. A number of fundamental steps can be distinguished. In a first of them (figure 1) needle 1 is slightly lifted, with respect to the bottom stroke-end position, keeping a stitch M2, which belongs to the rank formed in the previous feed, stretched between its hook 1a, the groove defined by tip 2a of sinker 2 and that of the consecutive sinker, not shown, placed upstream needle 1. In the following step (figure 2), needle 1 goes up, while sinker 2 remains engaged with the already formed fabric, in order to hold it down and to prevent it from following needle 1 itself in its movement. Lever 1b of needle 1 is held by the needle loop of already formed stitch M2.

[0005] In a third step (figure 3), needle 1 reaches the top stroke-end position, so that it can engage with thread F, by means of hook 1a, as old stitch M2 passes from unlocked lever 1b to the shank of needle 1. Then, needle 1 starts to go down (figure 4), as sinker 2 moves backward to clear the zone where thread F, through which a new stitch is to be formed, has to be brought down. In this step old stitch M2, stretched only by the depression in the cylinder bore, finds a support on sinker 2, gets under lever 1b and starts to lock it.

[0006] In the final step (figures 5 and 6) old stitch M2 is discharged and a new one M1, held by hook 1a of needle 1, is formed. As needle 1 reaches the bottom stroke-end position, old stitch M2 is released by needle 1 and discharged, owing to the mentioned depression, towards the bore of the cylinder. Sinker 2 moves forward to engage back with the fabric, stretching new stitch M1 in co-operation with hook 1a and reproducing the initial situation.

[0007] It will be easily appreciated from the foregoing that the size of each stitch, when formed, is precisely and forcibly a function of a structural parameter of the machine, i.e. the mutual placement of needle 1 and sinker 2. On the contrary, in the following feed the size of the same stitch, when engaging with a new stitch of the following rank, is due only to the stretching caused by the depression in the cylinder bore, as above described with reference to stitch M2.

[0008] As a consequence, the length of the stitches over successive ranks is kept homogeneous only if the cylinder depression is strictly uniform, whereby the single suction device, or the centralised suction system to which a number of machines are connected, needs an extremely precise adjustment. The adjustment procedure is usually troublesome, and even very careful check and maintenance of the suction system, with consequent high costs, can not avoid the manufacturing of low-quality articles, and sometimes defective ones. This because even the smallest variation of the depression, as well as unpredictable eddies and local turbulences in the air flow, can affect the length of the stitch in the discharge step. Then, the prior art process involves a serious problem of dimensional uniformity throughout the stitches of successive ranks.

[0009] On the basis of the above explained general problem, the known process also involves a more specific drawback, which is raised in the manufacturing of tubular articles formed by nylon/elastomer alternate ranks, widely employed in the stocking production field. In fact, during the discharge step, the free elastomer stitches tend to elastically pull the stitches of the already formed nylon rank closer to the stitches, in nylon as well, which are being formed by the needles.

[0010] Light nylons, that is to say nylons with a low denier value (weight in grams of 9000 m of thread), or threads formed by micro-filaments (the denier value of a single filament being lower than or equal to 1), can not actually resist to the pulling action of the elastomer. Consequently, zones in which the amount of thread is excessive are formed, this resulting in a defective stocking. Manufacturers are then forced to use nylons with a high denier value, much more expensive, or with thicker filaments, much less valuable, which have a structural strength sufficient to resist to the traction exerted by the elastomer. Analogous problems also occur in other knit-

ting techniques which make use of different kinds of threads, for instance those known in the field as "vanise" or "3D".

[0011] The main object of the present invention is to provide a process for knitting tubular articles in a single-cylinder circular knitting machine, namely but not exclusively for the manufacturing of stockings, which allows the accomplishment of a dimensional uniformity much higher than that obtainable with the known process, the function of stretching the formed stitches, when they are discharged from the needles and engage with respective stitches of the following rank, being not carried out by the suction system.

[0012] A particular object of the invention is to provide a process of the above mentioned type which allows the use, in the manufacturing of nylon/elastomer alternate ranks tubular articles, of low denier value nylon without affecting the quality of the product and, more specifically, the uniform distribution of the thread.

[0013] The above objects are achieved by the process according to the present invention, the essential features of which are defined in appended claim 1.

[0014] The features and advantages of the process according to the present invention will be made clearer thanks to the following description of exemplifying and not limiting embodiments thereof, with reference to the following drawings wherein:

- Figures 1 to 6 schematically show the process by which stitches are formed, according to the prior art;
- Figures 7 to 12 schematically show the process by which stitches are formed, according to the present invention.

[0015] With reference to figures 7 to 12, the process according to the invention is schematically represented in an analogous manner to that of figures 1 to 6, referred to the prior art process. The new process is carried out by a conventional single-cylinder circular knitting machine, a brief description thereof being given in the introductory part. In figures 7 to 12, elements that are equal or substantially corresponding to those of figures 1 to 6 are indicated with the same reference numerals.

[0016] A single stitch is formed in the following way. In the starting configuration of figure 7 a stitch M2 of the rank formed in the previous feed, with respect to that under consideration, is extended, and so stretched, between hook 1a of needle 1, upper edge 2b of sinker 2 and the upper edge of the consecutive sinker, not shown, placed upstream needle 1. Both sinkers are in a position of maximum forward displacement. Needle 1, which is lifting, is in a slightly higher position than the bottom stroke-end one, allowing the stitch to loosen. Besides, it will be appreciated that a corresponding stitch M3 of the rank formed in the second previous feed is stretched between stitch M2, the groove defined by tip 2a of sinker 2 and that defined by the consecutive sinker.

[0017] As shown in figure 8, needle 1 keeps on lifting so as to engage with thread F, with which a new stitch is to be formed. Sinker 2 is still, and stitch M2, sliding with its needle loop with respect to the shank of needle 1, holds lever 1b thereof. In figure 9 needle 1 has reached the top stroke-end position and, as old stitch M2 passes from lever 1b unlocked to the shank of needle 1b, sinker 2 moves backward (figure 10). In this way stitch M2 is disengaged by upper edge 2b of tip 2a of sinker 2, as stitch M3, released, is discharged towards the bore of the cylinder.

[0018] While needle 1 starts going down, having engaged with thread F by means of hook 1a, sinker 2 moves forward to the starting position, engaging with stitch M2. As needle 1 goes down, stitch M2 progressively turns lever 1b and a new stitch M1 is formed on upper edge 2b of tip 2a of sinker 2. New stitch M1 engages with old stitch M2, which is stretched by tip 2a and needle 1, as shown in figure 11. In particular, in such figure needle 1 has already reached the bottom stroke-end position and has released old stitch M2, which extends between tip 2a and new stitch M1.

[0019] Finally, in figure 12 needle 1, having overcome the bottom stroke-end position, is slightly lifted, in a configuration that exactly corresponds to that of figure 7, and then it is ready to repeat exactly the above described cycle, in the following feed. In this regard, It will be noted that the disengagement between new stitch M1 and tip 2a of sinker 2 is not completed in the same feed in which stitch M1 itself is formed, as in the known process, but in the following one.

[0020] In the process according to the invention, when new stitch M1 is formed, this is not the only stitch to be mechanically stretched by needle 1 and sinker 2. As a matter of fact, in this very important step, corresponding to the configuration shown in figure 11, the mechanical co-operation between needle 1 and sinker 2 stretches old stitch M2 too. It will be easily appreciated that a much better dimensional uniformity over the stitches can be accomplished, with respect to the conventional stretching by means of the suction system. In fact, the shape and size of the stitches can be actually controlled as a function of structural parameters of the machine and not of the regularity of the depression in the cylinder bore.

[0021] Frequent check and adjustment operations on the suction system are not necessary, with the related savings, and the quality of the product is much less affected by random factors like those controlling the phenomena of turbulence in the air flow.

[0022] Besides, thanks to the new process, when nylon/elastomer alternate ranks tubular articles are manufactured, each elastomer rank is mechanically stretched during the engagement with the following nylon rank and is not free to elastically pull the downstream, already formed nylon rank. Then, low denier value nylon can be used in order to produce high quality tubular articles. Furthermore, the extension of the elastomer, due to the stretching, can permit significant savings in the overall amount of elastomer in the tubular

article. It has to be pointed out in this regard that each article can require kilometres of thread, and so even a small reduction of the size of each stitch means a valuable saving.

[0023] Finally, the accomplishment of a more uniform stretching of the engaged stitches can be highly advantageous also in "vanise" or "3D" knitting techniques, resulting in a reduction of wastes and in the possibility of producing cheaper articles. In a more general point of view, it is important to stress that the new process can stir the development of new products, until now possible just in theory and never actually realised due to problems related to the size uniformity of the stitches and/or to production costs.

[0024] The process according to the invention can be accomplished in a conventional machine, in which only the synchronisation between the movement of the sinkers and the needles has to be differently adjusted. In fact, while in the prior art process each sinker moves backward when the corresponding needle is close to its bottom stroke-end position, in the new process the displacement necessarily occurs in correspondence to the top stroke-end position of the needle itself. Advantageously, if the machine allows a quick adjustment of the timing and of the extent of the displacement of the sinkers, the process according to the prior art can be shifted to that according to the invention, and vice versa, even when manufacturing a single tubular article; moreover, stitch M2 formed in the previous feed can be stretched to a greater or smaller extent. Said quick adjustment, useful in general in the known process too, is particularly advantageous in the new process, according to which old stitch M2 is mechanically stretched as new stitch M1 is formed.

[0025] Sinkers having longer upper edges than common ones can assist a better accomplishment of the new process, as can be understood from the comparison between figures from 7 to 12 and those from 1 to 6. In this way a wider space is made available for forming the stitches. A second tip can also be provided in the sinkers, so as to prevent the formed stitch from going up with the needle when it accomplishes its cycle in the following feed.

[0026] Other variations and/or modifications can be brought to the process for knitting tubular articles in a single-cylinder circular knitting machine, namely for the manufacturing of stockings according to the present invention, without departing from the scope of the invention itself as defined in the appended claims.

Claims

1. Process for knitting a thread (F) for forming a tubular article in a single-cylinder circular knitting machine, namely for the manufacturing of stockings, said machine comprising a plurality of needles (1), each provided with an end hook (1a) and a movable lever (1b), axially slidable over a rotating cylinder and cooperating with a plurality of sinkers (2), provided with respective tips (2a) and slidably inserted between said needles (1), orthogonally thereto, said sinkers (2) and said needles (1) being operated in correspondence to at least one feed of said thread to said cylinder, said process comprising for each new stitch (M1) to be formed in said feed the following steps: lifting of a respective of said needles (1) from a starting position, close to a bottom stroke-end one, in which an old stitch (M2) of said thread, formed in the previous feed, is stretched between the same needle (1) and the two sinkers (2) adjacent thereto, the unlocking of said lever (1b) by said old stitch (M2) being associated to said lifting; engagement of said needle (1), in correspondence to its top stroke-end position, with said thread (F) by means of said hook (1a); descent of said needle (1) towards said bottom stroke-end position, with consequent formation of said new stitch (M1) by inserting said thread (F) in said old stitch (M2) with the assistance of the locking of said lever (1b), and release of said old stitch (M2) by the same needle (1); and lifting back of said needle (1) to said starting position, said steps being associated to backward and forward successive displacements of one of said sinkers (2) adjacent to said needle (1), so as to permit the release of said old stitch (M2) from said needle (1) and its consequent discharge towards the bore of said cylinder, said process being characterised in that said backward and forward displacements of said sinker (2) occur in correspondence to said top stroke-end position of said needle (1), whereby said new stitch (M1) is formed on the upper edge (2b) of said tip (2a) of said sinker (2) and engages with said old stitch (M2), which, disengaged from said upper edge (2b) as a consequence of said backward displacement, is stretched, as a consequence of said forward displacement, between said tip (2a) and said needle (1), said old stitch (M2) being stretched by said tip (2a) and said new stitch (M1) when said needle (1) is back to its starting position.

2. Process according to claim 1, wherein said backward and forward displacements of said sinker (2) are completed before that said needle (1) has begun its descent.

3. Process according to any of the previous claims, wherein said sinkers (2) have respective further tips to prevent said old stitch (M2) from going up with the respective needle (1).

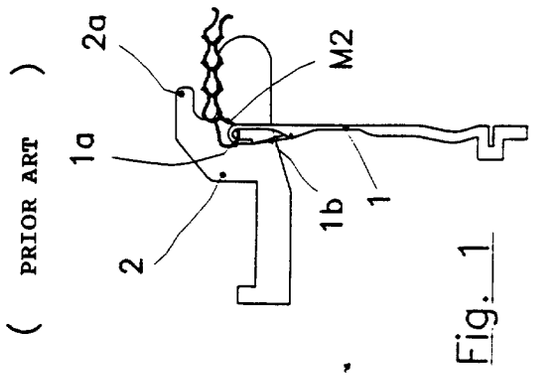

Fig. 1

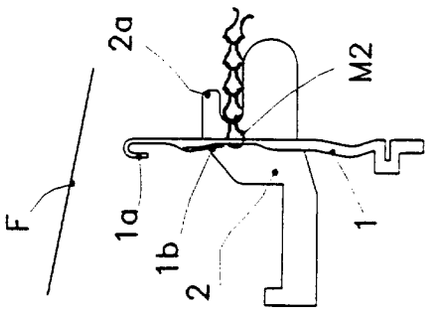

Fig. 2

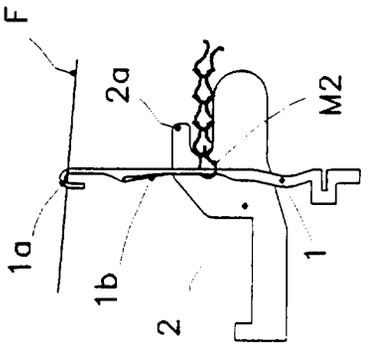

Fig. 3

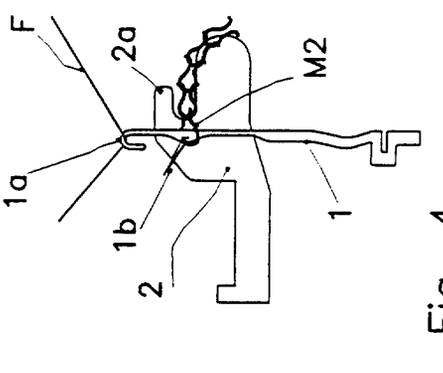

Fig. 4

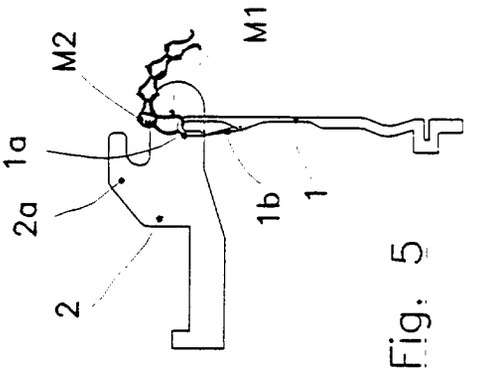

Fig. 5

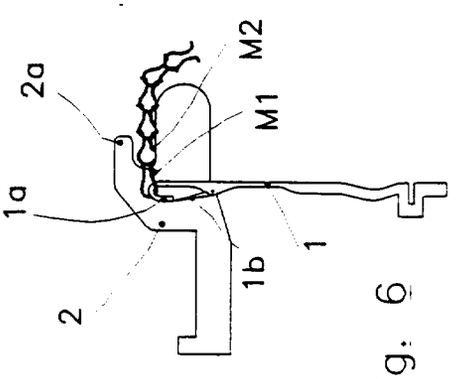

Fig. 6

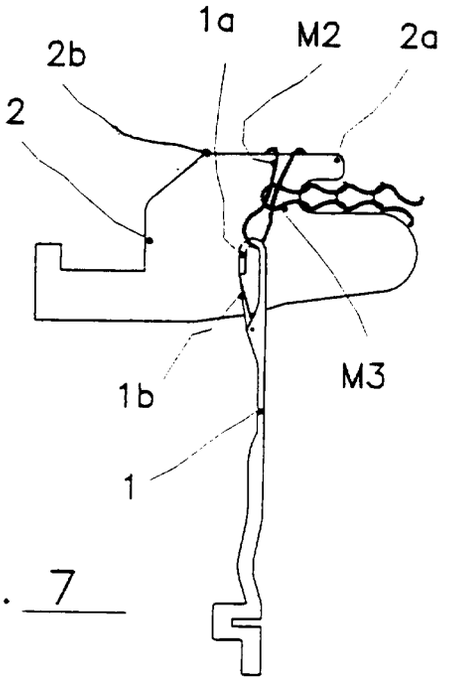

Fig. 7

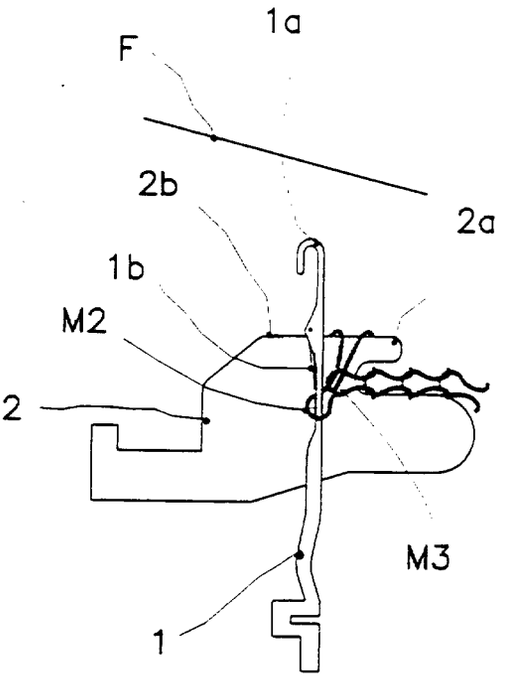

Fig. 8

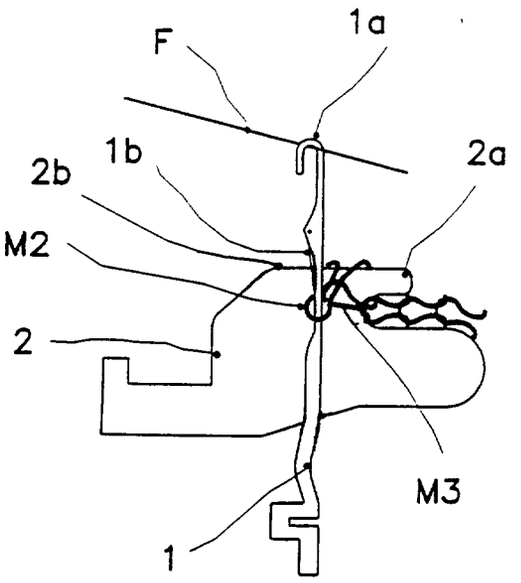

Fig. 9

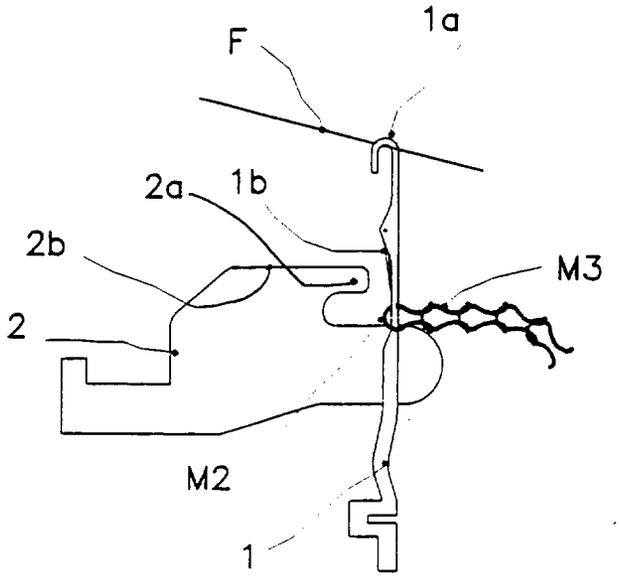

Fig. 10

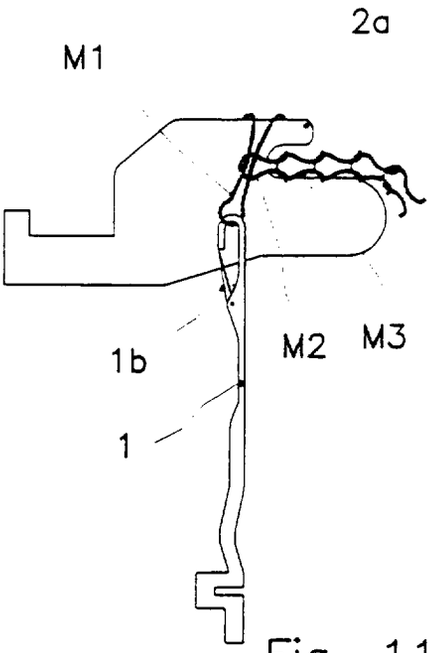

Fig. 11

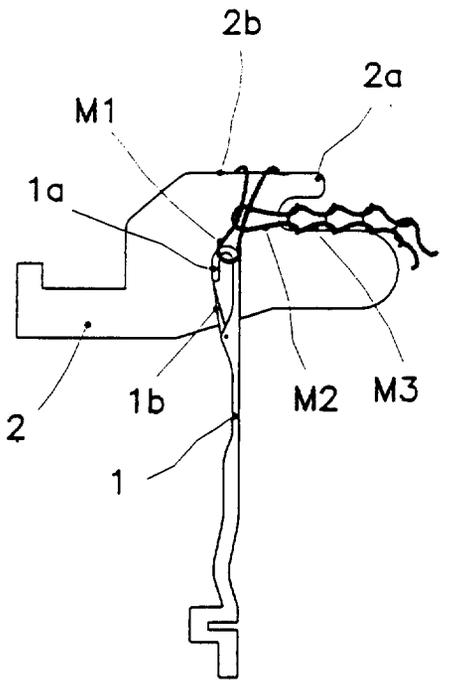

Fig. 12