April 1, 1969 H. G. LINDNER ET AL 3,435,636

STITCH CAM AND METHOD OF KNITTING SEMIDRAWN YARN

Filed Feb. 28, 1966 Sheet 1 of 2

Fig. 1.

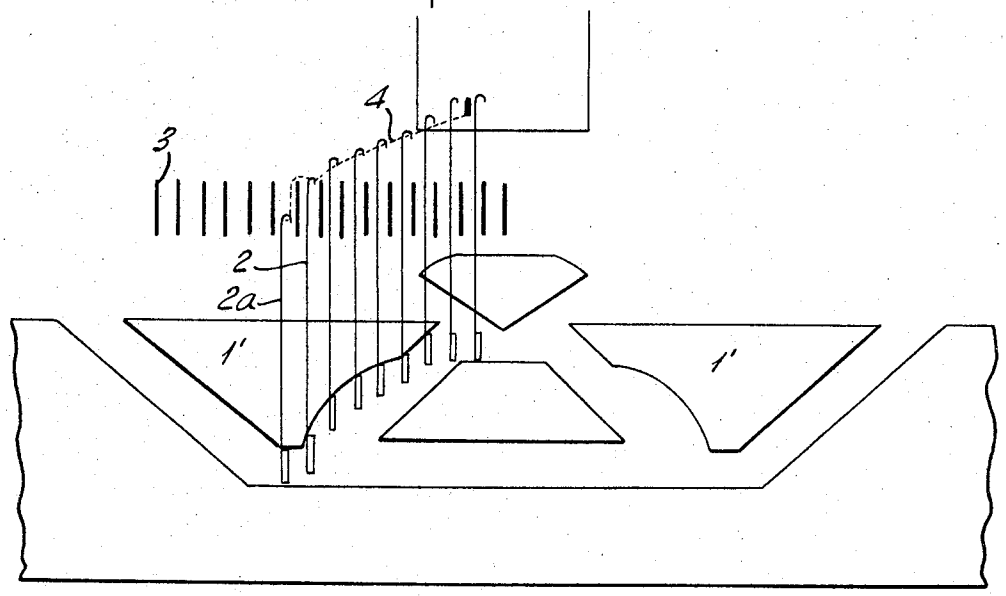
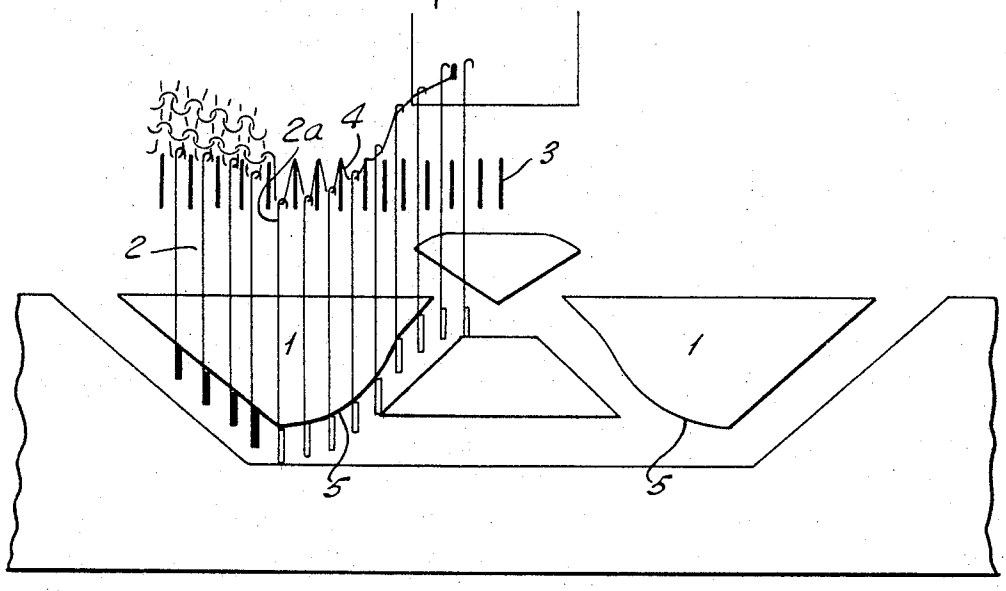


Fig. 2.



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FIG. 1A

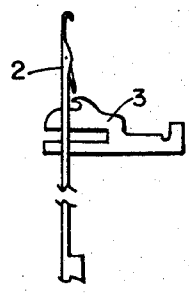


FIG. 2A

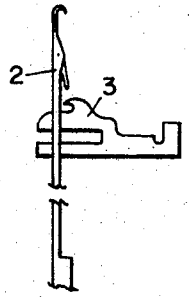
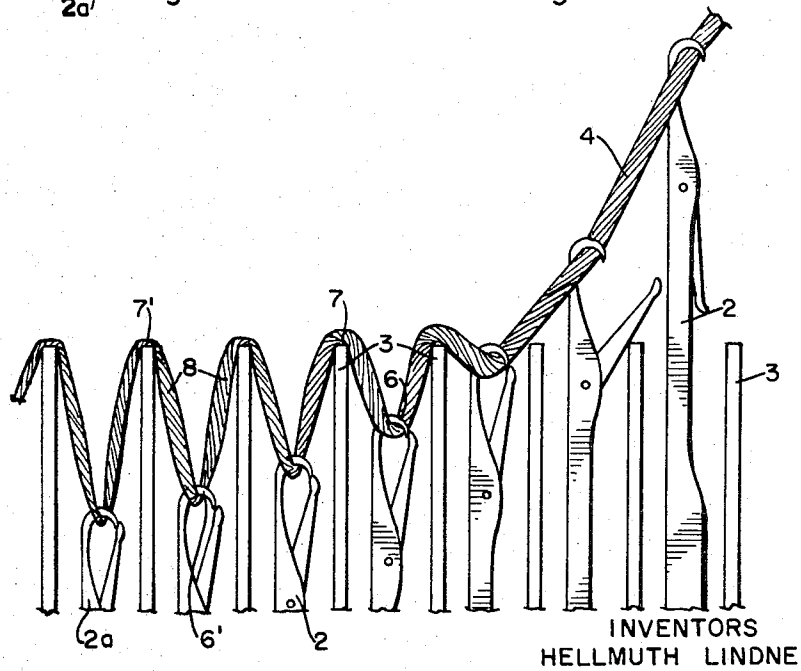


FIG. 3

FIG. 4



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3,435,636

STITCH CAM AND METHOD OF KNITTING SEMIDRAWN YARN

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U.S. Cl. 66—57 5 Claims

ABSTRACT OF THE DISCLOSURE

A knitting method and apparatus capable of being used, for example, in connection with a circular knitting machine during the knitting of an article such as a lady's stocking. Individual latch needles coact with sinkers which have upper stitch-drawing surfaces, and the lower needles butts are acted upon by the draw-down surface of a stitch cam which has its draw-down surface convexly curved and outwardly bulging while terminating at its lowermost region, corresponding to the maximum depth of the needles, in a surface portion which is almost horizontal so that a plurality of successive needles, when in the region of their maximum depth, will have their upper ends situated at a substantial distance below the upper stitch drawing surfaces of the sinkers . As a result, the yarn which extends across the upper stitch drawing surfaces of the sinkers frictionally engages these surfaces so that during the drawing of the yarn downwardly between the sinkers the yarn is automatically braked and cannot be fed further to the needles when the latter approach the region of their maximum depth. According to the invention the yarn which is fed to the needles will include a yarn which during the spinning thereof has not been fully drawn, so that the yarn is still in a condition where it can be further drawn and permanently elongated. As a result when the needles have been moved by the stitch cam of the invention to the region of their maximum depth the stopping of the yarn feed by frictional engagement of the yarn with the upper stitch drawing surfaces of the sinkers will result in further drawing of the yarn by the upper yarn-engaging ends of the needles simultaneously with loop formation, so that at least part of the length required for loop formation is brought about by permanent elongation of the yarn.

Cross reference to related application

An article which is knitted with the method and apparatus of the present invention is disclosed in copending application, Ser. No. 530,618, filed Feb. 28, 1966, entitled Knitted or Weaved Garment.

Background of the invention

The present invention relates to a knitting method and apparatus for knitting, in a knitting machine having single or multiple yarn feeds and individually movable latch needles, yarn which at least in part is composed of a yarn which has not been fully drawn. Thus, during the spinning of synthetic yarn such as nylon, for example, it is customary to draw the yarn so that it becomes permanently elongated and in fact will have its initial length increased several times. In the case of nylon, for example, it is known that the nylon yarns which issue from a spinnerette, for example, can be drawn to approximately 4–6 times their original length and then the yarn is fixed in this fully drawn condition. However, with the present invention at least part of the yarns which are treated have not been fully drawn during the spinning operations so that yarn treated with the method and apparatus of the present invention is still in a condition where it can be further drawn and permanently elongated.

There is a known method of manufacturing knit goods where a yarn, such as a fully synthetic yarn which has not yet been fully drawn, is knitted in such a way that part of the length required to form the loops is derived from the further drawing and permanent elongation of the yarn during the knitting thereof. The known method and apparatus for manufacturing goods of this latter type require a straight-bar knitting machine which does not have individual latch needles and instead requires an arrangement where all of the needles and all of the sinkers are moved in common one relative to the other in order to draw the loops and distribute the yarn among the several loops of a given course. The pressure required for this purpose exceeds that of a conventional stitch drawing pressure to form a yarn loop at a sinker which is situated between a pair of needles, since in addition to the pressure for an individual loop it is necessary to provide sufficient pressure to carry out simultaneous formation of the entire series of loops at all of the needles.

It is also known to knit, on such a straight-bar knitting machine, a pair of yarns simultaneously, where one of these yarns will yield to an extent greater than the other with the less yieldable yarn being caused to tear and break at predetermined sinkers which are provided with cutting edges which engage the yarn.

One of the disadvantages which resides in this known method and apparatus resides in the fact that alternate knitted courses of yarn which can still be further drawn and fully drawn yarn cannot be manufactured, but instead it is only possible to knit a yarn which can be further drawn simultaneously with a fully drawn yarn in the same course. Thus, with this method and apparatus special sinkers having cutting edges are required so that the yarn which is fully drawn, and therefor cannot be further elongated, will be caused to separate into a number of sections according to a predetermined pattern while the yarn which still can be further drawn is formed into a continuous series of loops for each course. The excessive pressure required for forming each course of loops from the yarn which still can be further drawn can only be achieved by way of special apparatus and structure.

In the present state of the art of knitting on circular knitting machines having individual latch needles and sinkers, each individually movable needle and sinker structure which coacts therewith is fed a length of yarn which is sufficiently great to form a complete loop before the next-following needle coacts with the next sinker structure to draw the next-following loop, so that it is conventional during normal loop formation to feed yarn of a length which is required for the full formation of the loops. Therefore, the stitch cams have at their draw-down edges an inwardly curved, concave configuration.

The known methods and apparatus are not suited for knitting yard which has not yet been fully drawn with individual latch needles and sinkers, since the present state of the knitting art does not provide the possibility of interrupting the yard feed, for example by clamping the yarn, before a length of yarn sufficient to form a complete loop has been fed, so that in this way it is possible to form at least part of a loop by further drawing and permanent elongation of the yarn.

Summary of the invention

It is accordingly a primary object of the present invention to provide a knitting machine, such as a circular knitting machine, with a structure of the present invention and to operate it according to the method of the present invention in such a way that it does indeed become possible with individual latch needles to knit with

yarn which is still in a condition wnere it can be further drawn and permanently enlongated.

It is also an object of the present invention to provide a method and apparatus which makes it possible to operate with yarns of different characteristics, so that these yarns can be combined together in a predetermined manner with the method and apparatus of the invention.

It is furthermore an object of the present invention to provide a method and apparatus which makes it possible to knit with a yarn which has not yet been fully drawn, together with additional yarn of a different character, if desired, while at the same time reducing the pressure required for drawing the yarn which is still in a condition where it can be further drawn without requiring additional structure to be added to the apparatus and while at the same time achieving a substantial acceleration in the knitting operations.

Thus, it is an object of the invention to provide individual latch needles and sinkers which are controlled during loop formation in such a way that the required length of yarn for a knitted loop is drawn by each needle individually from the yarn which is still capable of being further permanently elongated while the knitting structure is at the same time suitable for operations with different types of yarns.

In accordance with the invention the individual latch needles coact with sinkers which have upper stitch drawing surfaces while the needles are acted upon by a stitch cam which has a draw-down surface which bulges outwardly and is convexly curved, terminating at the region of its lowest point, corresponding to the maximum depth of the needles, in a slightly inclined elongated portion which is almost horizontal so that the successive needles which are in the region of the maximum depth to which they are drawn by the stitch cam have their upper ends located at successive elevations which differ from each other by only slight increments while these upper ends are all situated beneath upper stitch drawing surfaces of the sinkers. When, in accordance with the method of the invention, a yarn which still can be further drawn is fed to the needles which have this relative position with respect to the sinkers, the frictional engagement of this yearn with the upper stitch drawing surfaces of the sinkers supplies each needle initially with a length of yarn which is insufficient to form a full loop while preventing, by the frictional engagement of the yarn with the upper stitch drawing surfaces of the sinkers, further feeding of the yarn so that as the needles approach their maximum depth they can only achieve the length of the yarn required for each loop by further drawing the yarn to provide a permanent elongation thereof at the loops while the latter are formed.

By combining this method and apparatus of the invention with a multiple-feed knitting machine capable also of knitting a conventional fully drawn yarn in a conventional manner, it is possible to combine the yarn which is further drawn during the knitting thereof, according to the invention, with conventionally knit yarn in any predetermined manner.

According to a further feature of the invention, it is possible to knit simultaneously with a yarn which still can be further drawn, at the very same needles and sinkers, a yarn which has been fully drawn and which due to the frictional engagement with the upper stitch-forming surface of the sinkers cannot be fed to an extent sufficient to form a full loop without breaking of the yarn when the needles approach their maximum depth, so that in such a case, where a fully drawn yarn is in side-by-side relation with a yarn which still can be further drawn, the fully drawn yarn will necessarily tear and break haphazardly to form only parts of the loops of a given course while the yarn which can still be fully drawn will form complete continuous loops for the entire course. Thus, by providing any desired predetermined arrangement of stitch cams having an outwardly bulging draw-down surface in accordance with the invention and conventional stitch cam having conventional concave, inwardly-curved draw-down surfaces, it becomes possible to knit in any desired combination yarns which have not yet been fully drawn together with yarns which are fully drawn and which are knit in a conventional manner o rwhich are broken by being handled with the structure designed for the yarn which has not yet been fully drawn. Thus it is possible to achieve special pattern effects according to the predetermined combinations and treatments of the different types of yarns.

Brief description of the drawings

The invention is illustrated by way of example in the accompanying drawings which form part of this application and in which:

FIG. 1 is a schematic elevational illustration of part of a circular knitting machine which is conventional and which operates according to a conventional method;

FIG. 2 is a schematic elevation fragmentarily illustrating part of a circular knitting machine having the structure of the present invention and operating according to the method of the present invention, the parts of FIG. 2 being located at a different part of the knitting machine from the parts thereof shown in FIG. 1, so that with the structure of FIG. 1 it is possible to knit in a conventional manner at one part of the machine while with the structure of FIG. 2 it is possible to knit according to the present invention at another part of the machine;

FIG. 1A is a schematic side view showing a sinker and individual needle combination of FIG. 1;

FIG. 2A is a schematic side view showing a sinker and individual needle arrangement of FIG. 2;

FIG. 3 is a schematic representation of the manner in which knitting is carried out with the conventional structure of FIG. 1 in a conventional manner; and

FIG. 4 illustrates in detail the manner in which knitting is carried out according to the method of the invention with the structure of FIG. 2.

Description of preferred embodiments

Referring to FIG. 1, the conventional circular knitting machine structure schematically illustrated includes the stitch cam **1'** which is shown at the left in FIG. 1 and which has just acted with its concave, inwardly-curved draw-down edge to depress the needle **2***a* to its maximum depth to form a complete loop before the next following needle **2** draws the fully drawn, and thus the no longer stretchable, yarn **4** downwardly between the next sinkers while the yarn engages the upper stitch drawing surfaces thereof. Thus, the concave inward curvature of the draw-down surface of the stitch cam **1'** provides the operation shown in FIG. 1 which is conventional and which serves to provide for feeding to the sinkers **3** and needles **2** yarn of a length sufficient to form complete loops with the individual latch needles **2**.

At another part of the machine, which is illustrated in FIG. 2, the method and apparatus of the invention includes a stitch cam **1** which has a draw-down surface **5** which bulges outwardly and is convexly curved while having at its lowermost region, corresponding to the maximum depth of the individual latch needles **2**, an elongated portion which is only slightly inclined so as to be almost horizontal, as is apparent from FIG. 2. This drawn-down surface **5** of the stitch cam **1** of FIG. 2 will thus serve to simultaneously locate a plurality of successive individual latch needles in the region of their lowermost positions of maximum depth between successive sinkers **3** with the upper ends of these successive needles, which are simultaneously in engagement with the lowermost portion of the draw-down surface **5**, located at eelvations which differ from one to the next by only slight increment while all of these upper ends

are located at substantial distances below the upper stitch-drawing surfaces of the sinkers 3. Thus, in this case the upper yarn-engaging ends of the individual latch needles 2a will simultaneously situate loops in successive degrees of completion between the successive sinkers 3. As a result, a series of the upper stitch-drawing surfaces of the sinkers 3 are simultaneously engaged by the yarn 4 which in accordance with the method of the invention inthe case of FIG. 2 is a yarn which still has not been fully drawn during the spinning thereof so that it is still capable of being further permanently elongated. Because of the frictional pressing of the yarn 4 of FIG. 2 against a series of sinkers 3, the feeding of the yarn is automatically terminated at those needles which approach the region of their greatest depth. Thus, with the method and apparatus of the invention shown in FIG. 2 it is only possible for the individual latch needles to form complete loops by further drawing the yarn 4 at each loop so that at each loop the yarn 4 of FIG. 2 becomes further permanently elongated.

Thus, with multiple-feed machines it is possible to operate one or more parts of the machine in a conventional manner with conventional structure, as shown in FIG. 1, and to operate one or more parts of the machine with the structure and method of the invention as shown in FIG. 2, so that in this way it becomes possible to combine in any desired manner conventionally knit yarn with the yarn which is knit in accordance with the method and apparatus of the present invention.

Thus, in accordance with the selected locations of conventional stitch cams 1' and the stitch cams 1 of the invention it is possible to combine in the knitted article conventionally knit portions with the portions knit according to the method of the invention. For example, a plurality of conventional knitting structures as shown in FIG. 1 may alternate with the knitting structures of the invention shown in FIG. 2.

Furthermore, it is possible to knit with the structure of FIG. 2, simultaneously with a yarn which has not yet been fully drawn, a yarn which has indeed been fully drawn, so that this latter yarn is in side-by-side relation with the yarn which has not yet been fully drawn. The fully drawn yarn will also be prevented from being fed to the individual latch needles at a length sufficient to form complete loops because of frictional engagement of the fully drawn yarn with the upper stitch drawing surfaces of the sinkers 3 of FIG. 2. Therefore, when the needles approach their greatest depth, the fully drawn yarn will be haphazardly torn and broken at a plurality of locations, so that for a given course which is formed by continuous loops of the further drawn yarn 4 there will be portions of the course where only parts of the loops are formed by the fully drawn yarn, thus providing in a given course a haphazard arrangement of sections of fully drawn yarn distributed along the course beside the partly drawn yarn which is further drawn to form the complete loops of the entire course. In this way, special pattern effects are achieved.

Synthetic yarns, such as nylon and the like as referred to above, are particularly suitable to form the yarns, either fully drawn or partly drawn, used with the method and apparatus of the invention.

With the structure of the invention, as shown in FIG. 2, it is only necessary to provide the special stitch cams 1 having the outwardly bulging convexly curved draw-down surfaces 5. Otherwise the structure of FIG. 2 is conventional and the method of the invention differs from conventional knitting only in the fact that a yarn which has not yet been fully drawn is treated with this structure of FIG. 2. Thus, referring to FIG. 1A, it will be seen that the sinkers 3 and individual latch needles 2 are identical with the sinkers 3 and individual latch needles of FIG. 2A. These sinkers 3 and latch needles are fully conventional and are operated in an entirely conventional and well known manner, so that in accordance with the invention it is only necessary to replace the conventional stitch cams 1' shown in FIG. 1 at selected locations with the stitch cams 1 of the invention shown in FIG. 2.

The manner in which conventional yarn is knitted by coaction of the individual latch needles 2 with the sinkers 3 is shown in detail in FIG. 3 which corresponds to the operations indicated in FIG. 1. Thus, as may be seen in FIG. 3 the conventional fully drawn yarn 4' is fed to the heads 6 of the latch needles in such a way that as one latch needle 2a is drawn down to the region of its fullest depth the next latch needle is just starting to be lowered to an elevation where its upper end 6 will move beneath the upper stitch drawing surfaces of the sinkers 3, and thus the feeding structure used with the apparatus of FIGS. 1 and 3, and which is conventional, will reliably feed to each needle a length of yarn which is sufficiently great to form a complete loop.

However, referring to FIG. 4, it will be seen that the yarn 4 which can still be further drawn, since during the spinning thereof it has not been fully drawn, is acted upon by the same latch needles and sinkers 3 as those which are used in FIG. 3 but in this case the needles are acted upon by the stitch cam 1 of the invention so that a plurality of successive needles are in the region of their lowermost positions of maximum depth with the upper ends 6 of these needles situated at only slightly higher increments from one to the next while the upper ends of an entire series of needles are all simultaneously situated substantially below the upper stitch drawing surfaces of the sinkers 3. As a result, at these stitch drawing surfaces 7' and 7, indicated in FIG. 4, the yarn 4 is in such frictional engagement with the sinkers 3 that further yarn cannot be fed to the needles, and thus during the further downward movement of the needles they will pull the yarn so as to further permanently elongate it providing the yarn at each loop with side portions 8 and with a bow portion 6' interconnecting the side portions. It will be noted that during this further permanent elongation of the yarn 4 its thickness has been reduced in a non-uniform manner providing the side portions 8 of each loop with a thickness greater than the bow portion 6' of each loop.

With the stitch cam 1 of the present invention it becomes possible to eliminate undesirable factors involved in the loop formation, such as the disadvantage of being capable of achieving only a limited number of revolutions for the machine. Thus, because of the outwardly bulging convex draw-down surfaces of the stitch cams 1 of the invention, a continuous downward movement of the individual latch needles is achieved all the way down to their maximum depth so that it becomes possible in this way to increase the rotary speed of the machine.

Also, as is apparent from the above description in connection with FIG. 4 it is possible with the method and apparatus of the invention to achieve a non-uniform drawing of the yarn at each individual loop thereof so that the bow of each loop is drawn to a greater extent and has a lesser thickness than the side portions of each loop. This feature provides great advantages with respect to resistance of the yarn to tension at each knitted loop and an improvement of run-resisting properties, which is of particular importance in connection with articles such as ladies stockings.

What we claim is:

1. In a knitting machine, a plurality of independent latch needles and sinkers coacting therewith, said sinkers having upper stitch drawing surfaces, and a stitch cam having a convexly curved outwardly bulging draw-down surface for moving said needles to draw yarn stitches over the upper surfaces of said sinkers, said draw-down surface of said stitch cam having in the region of the lowest point of said cam, corresponding to the maximum depth to which said needles are moved to draw said stitches, an elongated portion which is almost horizontal for situating a plurality of successive needles at their upper yarn-engaging ends only at slightly higher incre-

ments one relative to the next with said plurality of successive needles all having their upper ends situated at a substantial distance below said upper stitch drawing surfaces of said sinkers, whereby the pressure of the yarn at said stitch drawing surfaces of said sinkers prevents further feeding of yarn to needles which are in the region of their maximum depth, so that in the case where the yarn is not in a fully drawn condition it will be further drawn by the needles so as to become permanently elongated during loop formation while in the case of a yarn which is fully drawn, the yarn will break at some point between a pair of sinkers.

2. In a method of knitting, the steps of feeding to independent latch needles of the machine and across upper stitch drawing surfaces of sinkers of the machine a yarn which during spinning has not been fully drawn so that the yarn is still capable of being permanently elongated, and depressing the needles to a depth where the frictional engagement of said yarn with said upper stitch-drawing surfaces of said sinkers will prevent further feeding of the yarn so that during loop formation the yarn is further drawn and permanently elongated by said needles.

3. In a method as recited in claim 2, the further step of simultaneously knitting a fully drawn yarn in a conventional manner and combining, in a predetermined manner, the conventionally knit fully drawn yarn with the yarn which is further drawn during the knitting thereof.

4. In a method as recited in claim 2, knitting a second, fully-drawn yarn simultaneously with said first-mentioned yarn in side-by-side relation therewith so that said second yarn will break haphazardly because it cannot yield when pulled between the sinkers while frictionally engaging said upper stitch drawing surfaces thereof, so that in a given knitted course only portions of the loops thereof will haphazardly include said second yarn.

5. In a method as recited in claim 2 and wherein said step is carried out on a circular knitting machine during knitting of a lady's stocking.

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