April 9, 1940. A. F. VERBEEK 2,196,237

KNITTING MACHINE

Filed April 28, 1937 2 Sheets-Sheet 1

Fig. 1

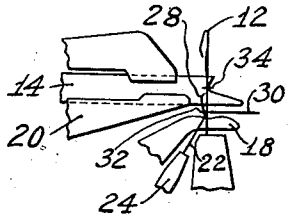


Fig. 2

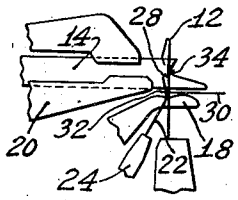


Fig. 3

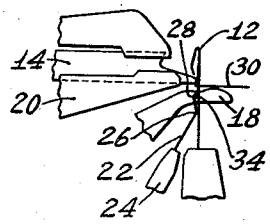


Fig. 4

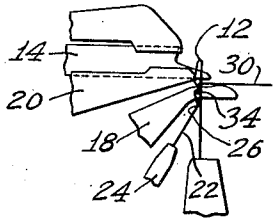


Fig. 5

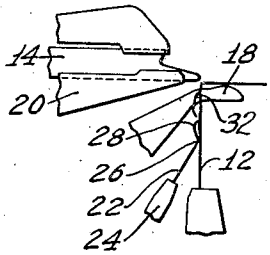


Fig. 8

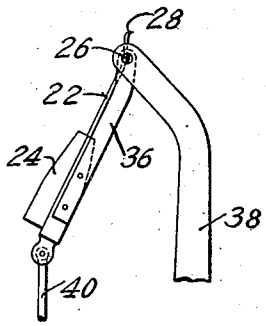


Fig. 6

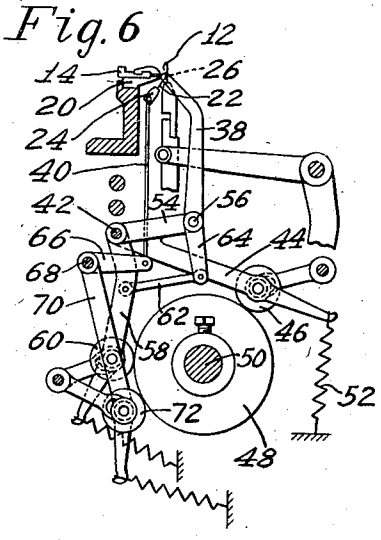


Fig. 7

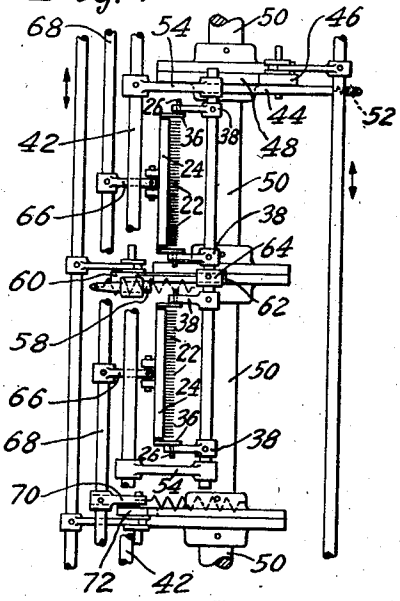
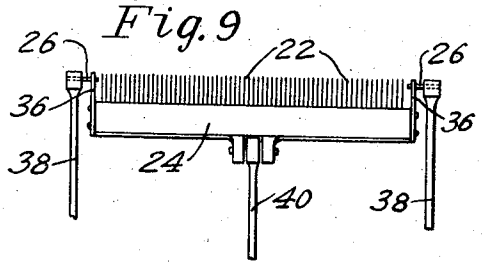


Fig. 9



Inventor

Arnold Friedrich Verbeek

by his attorneys

Fish Hildreth Carpenter & Jenney

April 9, 1940. A. F. VERBEEK 2,196,237

KNITTING MACHINE

Filed April 28, 1937 2 Sheets-Sheet 2

Fig. 10

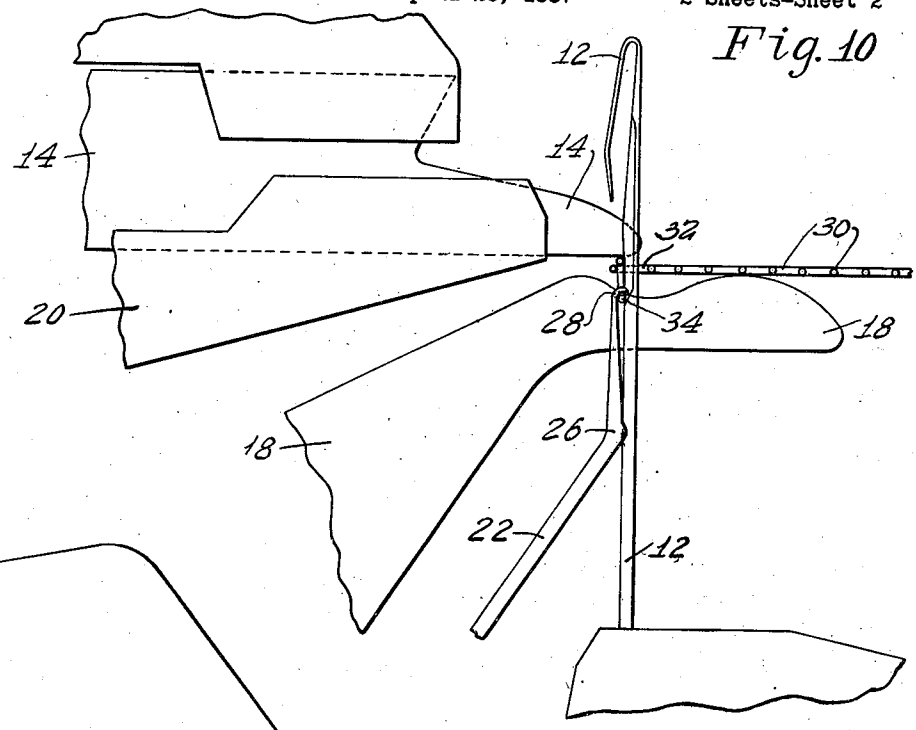
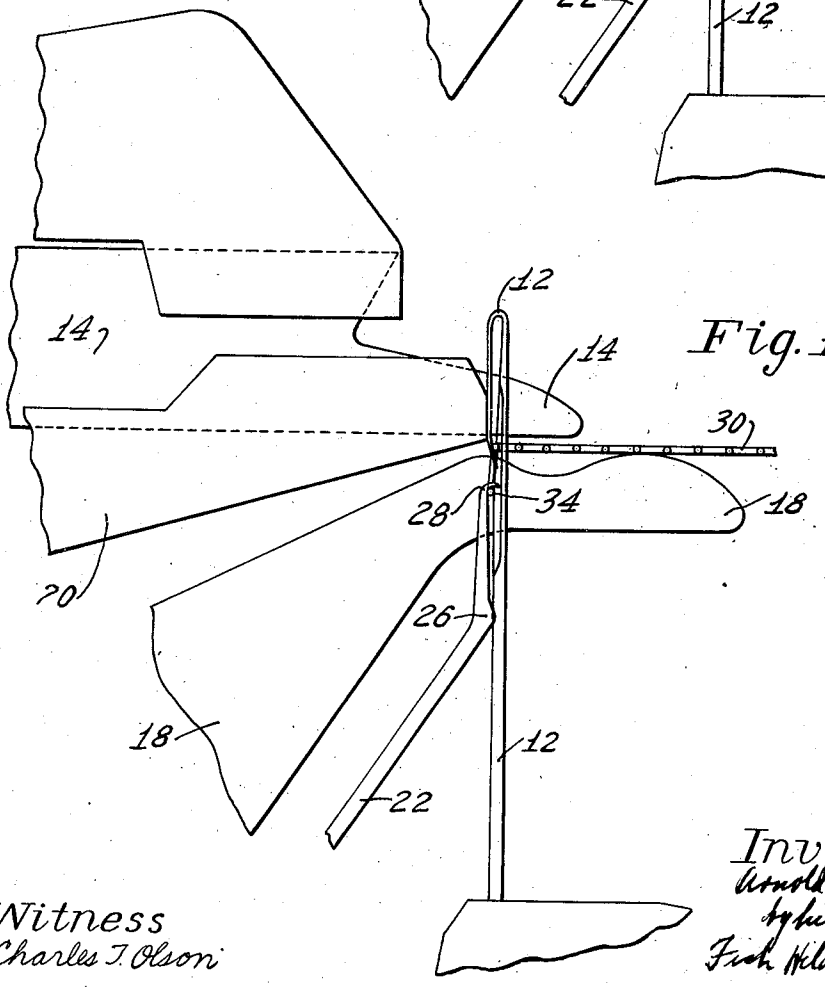


Fig. 11



Witness
Charles J. Olson

Inventor
Arnold Friedrich Verbeek
by his attorneys
Fish, Hildreth & Conyngham

Patented Apr. 9, 1940 2,196,237

UNITED STATES PATENT OFFICE

2,196,237

KNITTING MACHINE

Arnold Friedrich Verbeek, Wustenbrand, Germany, assignor to Kalio, Inc., New York, N. Y., a corporation of New York

Application April 28, 1937, Serial No. 139,349
In Germany April 29, 1936

13 Claims. (Cl. 66—96)

The present invention relates to knitting machines, and more particularly to improvements in the manufacture of non-run fabric on flat knitting machines of the general type having spring beard needles movable as a unit with relation to a press edge, and yarn measuring sinkers cooperating therewith.

The principal object of the present invention is to produce on a machine of this character a non-run fabric in which lock loops are formed in conjunction with previously formed ordinary loops of the fabric; and a secondary object of the invention is to produce such a non-run fabric without unduly stretching the ordinary loops.

With these and other objects in view as will hereinafter appear the present invention comprises the method and machine hereinafter described and particularly defined in the claims.

In the accompanying drawings Figs. 1 to 5 are diagrammatic views showing the formation of a course of lock loops; Fig. 6 is an elevation of a portion of a flat full fashioned hosiery machine; Fig. 7 is a plan view of certain of the parts shown in Fig. 6, the usual needles and their operating devices therefor; Fig. 8 is an enlarged detail view of the locking needle bar and associated supporting parts shown in Fig. 6; Fig. 9 is a front view of the locking needles, and Figs. 10 and 11 are views similar to Figs. 3 and 4, respectively, but on an enlarged scale.

According to the illustrated embodiment of the invention a non-run fabric is produced on a spring-needle flat knitting machine by sinking a course of locking yarn loops on the needles, drawing these lock loops through a previously knitted course of ordinary loops, and then casting off the lock loops while retaining the previously formed ordinary loops on the shanks of the needles in readiness for knitting a succeeding course of ordinary loops in the usual manner. The locking yarn, although not forming any part of the ordinary loop structure of the fabric, is interlocked with all the loops of a full course of fabric and thus serves to prevent runs without, however, impairing the elasticity of the fabric. To attain these results there is provided for cooperation with the needles a set of hooks, or loop retaining devices, which, because of their function of drawing one loop through another, may be designated as needles and are herein termed locking needles to distinguish from the main spring beard needles of the machine. The locking needles may be thrown out of operation to permit formation of courses of ordinary loops in the usual manner. The lock loops may be formed in any selected courses of ordinary loops, but preferably in each course of the fabric in order to produce a fabric of uniform appearance.

The parts shown in Figs. 1 to 5 inclusive include the usual elements of a flat knitting machine; namely, the spring beard needles 12, knockover bits 18 and the press edge 20. There is also provided a set of locking needles 22, arranged obliquely with respect to the spring beard needles, each locking needle being associated with a corresponding main needle 12. The locking needles for each section of the machine are mounted on a bar 24 connected with the operating devices for a series of movements to be hereinafter described in detail. Near the upper end a locking needle is bent outwardly at 26, forming a curved upper portion terminating in a pointed tip 28 adapted, under some circumstances, to enter into the groove of the corresponding main needle.

The start of a course of lock loops is shown in Fig. 1, the previously formed fabric being illustrated at 30. Each locking needle lies at this time with its tip clear of the corresponding main needle, and the last course of ordinary loops 32 surrounds both the main needles and the locking needles, as shown in Fig. 1. The portion 26 of the locking needle lies against the corresponding main needle, and the loop surrounds both needles at this point. The knitting yarn for the formation of the lock loops has been laid as indicated at 34 and the sinker loops have been formed by the forward motion of the sinkers 14. It will be noted at this time the ordinary loops 32 are not subjected to any excessive stretching since they are disposed at points where the locking needles are in contact with the main needles.

The needles are now drawn down in the normal manner, and such downward movement frictionally lowers the yarn 34 shown in Fig. 2, so that its lower bight is below the tip 28 of the locking needle, which tip is now caused to go into the regular needle eye. The sunk loops 34 are now therefore locked under the tips of the locking needles 22, and to this end the bar 24 was moved upwardly and turned outwardly to swing the tips 28 against the shanks of the main needles, and into their eyes. There is thus formed a closed eye in which the yarn of the lock loop is locked in. During the movements of the locking needles, as described above, the portion 26 of each needle lies in contact with its main needle. Furthermore, by means presently to be described, the pivotal or locking move-

ments of the locking needles are effected about the points 26 as an axis, and, therefore, the ordinary loops which surround both needles are not materially stretched during these operations.

The lock loop having been caught between needles while the ordinary loop remains around both needles, both sets of needles are moved downwardly into the position shown in Figs. 3 and 10, thus drawing the lock loop 34 down through the ordinary loop 32. By this movement the ordinary loops are cast off the locking needles by the action of the knockover bits, but such loops remain on the shanks of the main needles immediately above the tips of the locking needles. The main needles are now moved downwardly and simultaneously moved toward the press edge 20 of the machine, and the beards of the main needles are pressed shut to close over the ordinary loops 32, as shown in Figs. 4 and 11. During the cycle of lock loop formation, the spring-needle motion is altered by any suitable means to cause the pressing operation to occur at a low point dictated by the position of the loops 32 as shown in Figs. 4 and 11. The lock loops are then released from the locking needles by an outward rocking movement of the latter, and as the main needles continue their downward movement toward the position of Fig. 5, the lock loops are cast off over the beards of the main needles. The ordinary loops remain under the beards of the main needles as shown in Fig. 5. The main needles are then restored to the proper position for the start of a knitting cycle on the next course of ordinary loops in the usual manner, the locking needles being maintained in inoperative position for such an operation. After the formation of a course of ordinary loops if another course of lock loops is to be formed, the tips 28 of the locking needles which are at this time below the fabric line enter the eyes of the main needles, as these latter are rising after having cast off their regular loops. Such engagement between the needles takes place, of course, at a time when the regular needle eyes are at the fabric line. The result is that the locking needles enter the loops on the regular needle shanks, and therefore assume the position shown in Fig. 1.

The mechanisms for operating the locking needles are shown in Figs. 6 to 9, and comprise devices for movement of the locking needles in three directions; namely, a vertical movement, a horizontal movement and a pivotal movement about the axis 26.

The bars 24 for the locking needles extend over individual sections of the machine, and each bar is provided at its ends with straps 36, which are pivoted to control levers 38, the pivotal axis passing through the portions 26 of the locking needles. Vertical and horizontal movements of the locking needles are accompanied by movements of the levers 38 while pivotal movements of the needles are effected about the axis 26 by means of a rod 40 attached to the bottom of each bar.

To effect the vertical movements of the needles there is provided a shaft 42, to which is attached a cam lever 44 carrying a cam roller 46 adapted to engage a cam 48 on the cam shaft 50. The roller 46 is held in engagement with the cam by a spring 52. Also secured to the shaft 42 are a series of levers 54, one for each section of the machine. The other end of each lever 54 is pivotally connected with a shaft 56 to which the lower ends of the locking needle control levers 38 are rigidly attached. As shown in Fig. 7, the shaft 56 preferably extends over two sections of the machine. Another cam lever 58 is loosely mounted on the shaft 42 and carries a cam roller 60 adapted to engage another cam on the cam shaft. A connecting rod 62 is pivoted at one end to the lever 58 and at the other end to a depending lever 64 secured to the shaft 56. It will be seen that the movements of the cam levers 44 and 58 result in substantially vertical and horizontal bodily movements of the locking needles. The cam 48 is shown purely in a diagrammatic fashion as having a circular contour, but it will be understood that this cam, as well as the other cams for operation of the locking needles, will have the necessary contours for imparting the motions above described to the needles.

The pivotal movement of the locking needles is caused by the rod 40 which connects with a lever 66 secured to a shaft 68, to which is also secured a cam lever 70 having a cam roller 72 adapted for engagement with a suitably formed cam on the cam shaft. Motion of the rod 40 results in pivotal movement of the locking needles about the axis 26.

The cam rollers 46, 60 and 72 are displaceable in the usual manner so that when working plain loops they can be pushed to ride on disks which will hold the locking needles in an inactive position. For the formation of a course of ordinary loops the locking needles are inactive and the tips 28 are held out of engagement with their corresponding main needles. In such a case the main needles are restored to normal operation the new loops are sunk and the preceding course of fabric loops is cast off in the usual manner. When a course of lock loops is to be formed, the locking needles are called into operation so that upon upward movement of the main needles the previously formed loops 32 pass over the tips of the locking needles into the position of Fig. 1 from which the sequence of operations shown in Figs. 2 to 5 is carried out.

The locking needles may be called into operation in any suitable manner to form the lock loops in all, or any selected courses of ordinary loops but it is preferable to form the lock loops in each course in order that a fabric of uniform elasticity and appearance may be produced. Since the lock loops are cast off over the spring beard needles they appear on the top, that is, the inside of the fabric, and therefore a fabric similar in external appearance to the usual plain fabric is produced.

Although one specific embodiment of the invention has been described, it will be understood that the invention is not limited to the particular arrangement shown and described, but may be modified except as limited by the appended claims.

Having thus described the invention, I claim

1. The method of forming non-run fabric on a flat knitting machine having spring beard needles movable as a unit with relation to a press edge, yarn measuring sinkers and locking needles each having a portion thereof continuously fitted against a cooperating spring beard needle to provide a sliding point of contact between said needles about which the locking needle is pivotally movable cooperating therewith, which comprises sinking a course of lock loops against the shanks of the beard needles while the locking needles are below the yarn sinking level causing the locking needles to engage with and draw said lock loops through previous course loops on the

needles, and casting off the lock loops while retaining the previous course loops on the needles.

2. The method of forming non-run fabric on a flat knitting machine having spring beard needles movable as a unit with relation to a press edge, yarn measuring sinkers and locking needles each having a portion thereof continuously fitted against a cooperating spring beard needle to provide a sliding point of contact between said needles about which the locking needle is pivotally movable cooperating therewith, which comprises sinking a course of lock loops against the shanks of the beard needles while the locking needles are below the yarn sinking level, causing the locking needles to engage with and draw said lock loops through previous course loops on the needles, pressing the needles to retain the previous course loops under the beards thereof, and casting off the lock loops.

3. In a flat knitting machine having a series of spring beard needles movable as a unit with relation to a press edge and cooperating yarn measuring sinkers, the combination of a series of locking needles supported to move as a unit, each of said locking needles having a portion thereof continuously fitted against a cooperating spring beard needle to provide a sliding point of contact between said needles about which the locking needle is pivotally movable, means for supporting the locking needles during the yarn sinking operation against the beard needle shanks below the yarn sinking level and within the previously formed loops held upon the needle beard shanks, means for moving the locking needles relatively to the spring beard needles to cause said locking needles to engage with and draw needle kinks of sunk yarn through the previous course needle loops held on the beard needle shanks, and to position said kinks below the previous course loops to be cast off over the needle beards and loops held thereby during the subsequent pressing and knockover operations.

4. The method of forming a non-run fabric on a flat knitting machine having spring beard needles movable as a unit with relation to a press edge, yarn measuring sinkers cooperating therewith and auxiliary locking needles adapted for engagement with the spring beard needles, which comprises placing a course of ordinary fabric loops about the shanks of the spring beard needles and the locking needles, sinking a course of lock loops on the spring beard needles, pivotally moving the locking needles to close the tip portions thereof toward the spring beard needles to engage the lock loops between the locking needles and the spring beard needles, said pivotal movements of the locking needles being effected by pivotal movements of the locking needles substantially at the points of engagement thereof with the ordinary loops to avoid stretching of the loops, casting the ordinary loops off the locking needles, pressing the spring beard needles to close over the ordinary loops, and releasing the lock loops from the locking needles and casting them off the main needles.

5. The method of forming a non-run fabric on a flat knitting machine having spring beard needles movable as a unit with relation to a press edge, yarn measuring sinkers cooperating therewith and auxiliary locking needles adapted for engagement with the spring beard needles, which comprises placing a course of ordinary fabric loops about the shanks of the spring beard needles and the locking needles, sinking a course of lock loops on the spring beard needles, opening the tips of the locking needles and closing them toward the spring beard needles while effecting proper relative movements of the needles to engage the lock loops between the locking needles and the spring beard needles, the opening and closing of the locking needles being effected by pivotal movements of the locking needles substantially at the points of engagement thereof with the ordinary loops to avoid stretching of the loops, casting the ordinary loops off the locking needles to engage the shanks of the spring beard needles, pressing the spring beard needles to close over the ordinary loops, and releasing the lock loops from the locking needles and casting them off the main needles.

6. A flat knitting machine comprising spring beard main needles, locking needles associated therewith, each locking needle having a portion to engage the shank of a corresponding main needle and a tip to enter the groove of the main needle, a bar on which the locking needles are mounted, supports for the bar extending outwardly therefrom, and a pivotal mounting for the supports on an axis passing through the points of contact of the locking needles with the main needles.

7. A flat knitting machine comprising spring beard main needles, locking needles associated therewith, each locking needle having a portion to lie against the corresponding main needle and a tip to enter the groove of the main needle, means for imparting vertical and horizontal movements to the locking needles, and means for imparting pivotal movements to the locking needles about an axis passing through the points of contact thereof with the main needles.

8. A flat knitting machine comprising spring beard main needles, locking needles associated therewith and having shanks disposed obliquely with respect to the main needles, each locking needle having a curved upper portion terminating in a tip adapted to enter the groove of its corresponding main needle, the lower part of the curved portion being adapted to engage the shank of the corresponding main needle, and means for imparting pivotal movements to the locking needles about an axis passing through those portions of the locking needles which are adapted to engage the shanks of the main needles.

9. A flat knitting machine having spring beard needles movable as unit with relation to a press edge and yarn measuring sinkers cooperating therewith, in combination with locking needles, each having a portion adapted to engage the shank of its corresponding spring beard needle, and a tip adapted to enter the groove of its corresponding spring beard needles, and a means for imparting movements to the locking needles in timed relation to the knitting motion of the spring beard needles including pivotal movements substantially about an axis passing through said engaging portions to form lock loops in conjunction with previously formed ordinary loops in accordance with the following sequence of operations: placing a course of ordinary loops about the engaging portions of the shanks of both the spring beard needles and the locking needles, sinking a course of lock loops on the spring beard needles, engaging the lock loops between the locking needles and the spring beard needles, casting the ordinary loops off the locking needles, pressing the spring beard needles to close over the ordinary loops, and releasing the lock loops from the locking needles and casting them off the main needles.

10. A flat knitting machine having spring beard needles movable as unit with relation to a press edge and yarn measuring sinkers cooperating therewith, in combination with locking needles, each having a portion adapted to engage the shank of its corresponding spring beard needle and a tip adapted to enter the groove of its corresponding spring beard needle, means for imparting pivotal movements to the locking needles about an axis through the points of contact of the locking needles and the spring beard needles, and means for imparting other movements to the locking needles in timed relation to the knitting motion of the spring beard needles to form lock loops in conjunction with previously formed ordinary loops in accordance with the following sequence of operations: placing a course of ordinary loops about the shanks of both sets of needles substantially at the points of contact thereof whereby stretching of the loops during pivotal movements of the locking needles is avoided, sinking a course of loops on the spring beard needles, engaging the lock loops between the locking needles and the spring beard needles, casting the ordinary loops off the locking needles, pressing the spring beard needles to close over the ordinary loops, and releasing the lock loops from the locking needles and casting them off the main needles.

11. The method of forming a non-run fabric on a flat knitting machine having spring beard needles movable as a unit with relation to a press edge in accordance with a knitting motion, and auxiliary needles movable in timed relation to the needle motion each of said auxiliary needles having a portion thereof continuously fitted against a cooperating spring beard needle to provide a sliding point of contact between said needles about which the locking needle is pivotally movable, which comprises placing the auxiliary needles with their tip portions in the needle eyes, and moving the auxiliary needles upwardly with the beard needles from the knockover to engage the locking needles within the regular loops previously sunk against the needle shanks, positioning the locking needles below the yarn sinking level for the sinking of locking loops against the shanks of the beard needles, moving the locking needles relatively to the beard needles to engage the locking loops between the locking needles and the beard needles, casting the ordinary loops off the locking needles, pressing the spring beard needles to close over the ordinary loops, and releasing the locking loops from the locking needles and casting them off the main needles.

12. The method of forming a non-run fabric on a flat knitting machine having spring beard needles movable in accordance with a knitting motion, and beard pressing means, yarn measuring sinkers and locking needles cooperating therewith each of said locking needles having a portion thereof continuously fitted against a cooperating spring beard needle to provide a sliding point of contact between said needles about which the locking needle is pivotally movable, said locking needles being arranged to operate entirely below the yarn sinking level, which comprises placing a course of ordinary fabric loops about the shanks of the spring beard needles and the locking needles, sinking a course of locking loops against the shanks of the beard needles with the tips of the locking needles being held below the yarn sinking level and free of the needle shank, lowering said sunk course of locking loops, engaging said locking loops with the hooks of the locking needles, and drawing said locking loops through the previous course of loops on the needles.

13. The method of forming a non-run fabric on a flat knitting machine having spring beard needles movable in accordance with a knitting motion, and beard pressing means, yarn measuring sinkers and locking needles cooperating therewith each of said locking needles having a portion thereof continuously fitted against a cooperating spring beard needle to provide a sliding point of contact between said needles about which the locking needle is pivotally movable, which comprises placing a course of ordinary fabric loops about the shanks of the spring beard needles and locking needles, and supporting the locking needles at the fabric level in contact with the beard needle shanks, and with the tip portions thereof below the yarn sinking level, sinking a course of locking loops against the shanks of the spring beard needles, lowering said sunk course of locking loops and engaging the same with the tips of the locking needles, and drawing said sunk locking loops through the ordinary course of loops on the needles, and thereafter casting off the locking loops over the beards of the spring beard needles.

ARNOLD FRIEDRICH VERBEEK.