Jan. 13, 1942. R. E. DAVIS 2,269,757

KNITTING

Filed Dec. 22, 1939 2 Sheets-Sheet 1

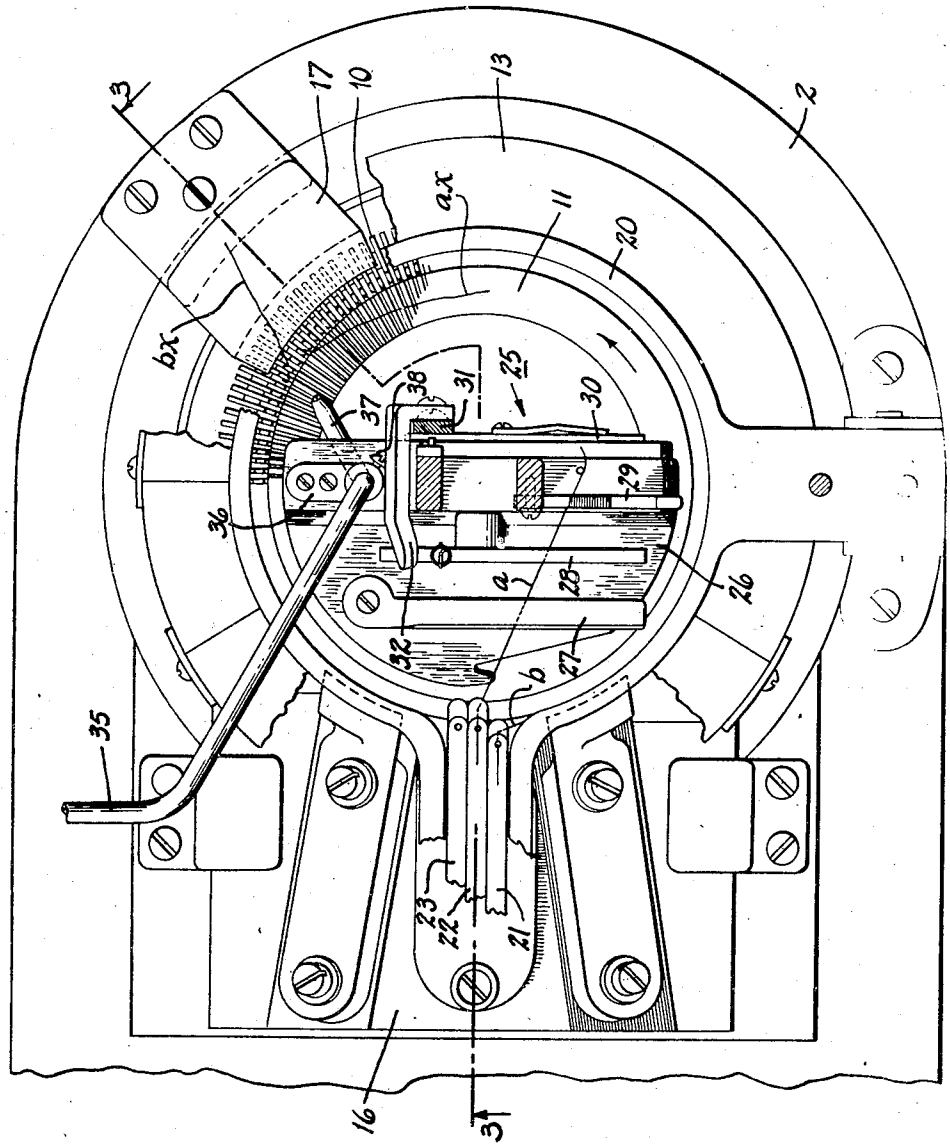


Fig 1

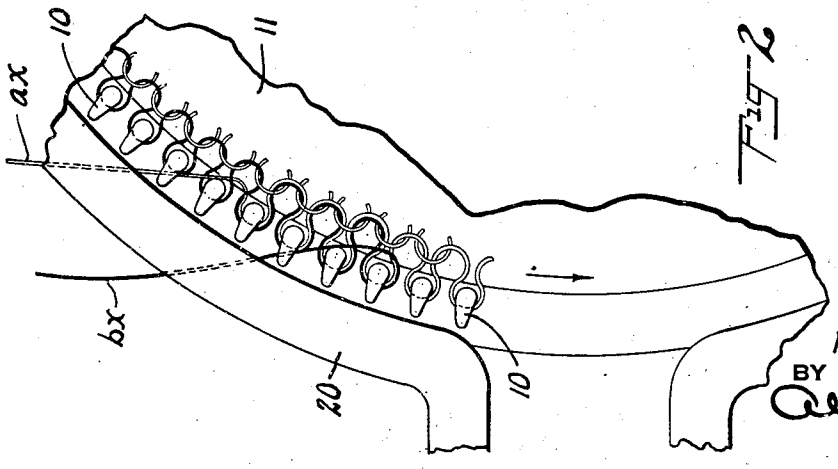


Fig 2

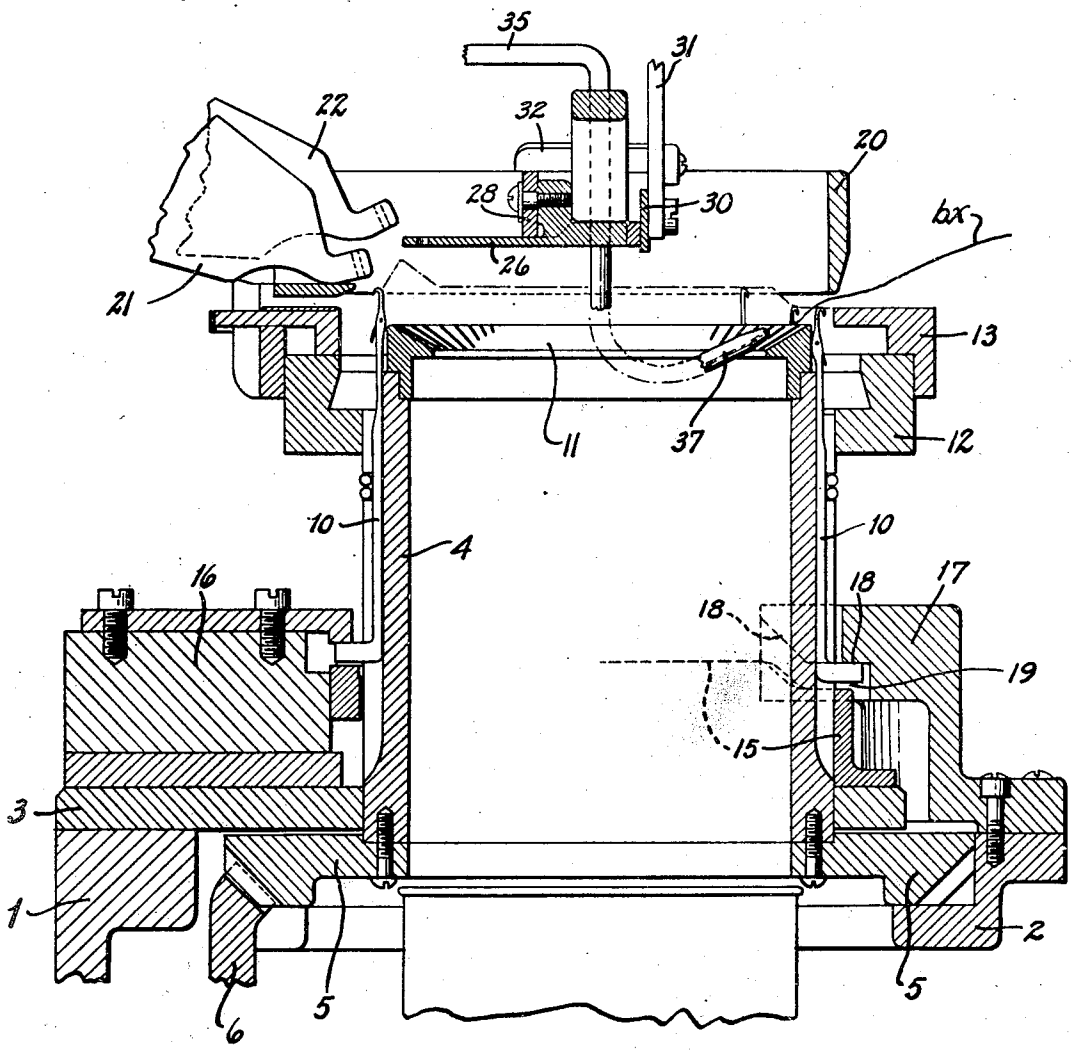
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Fig 3



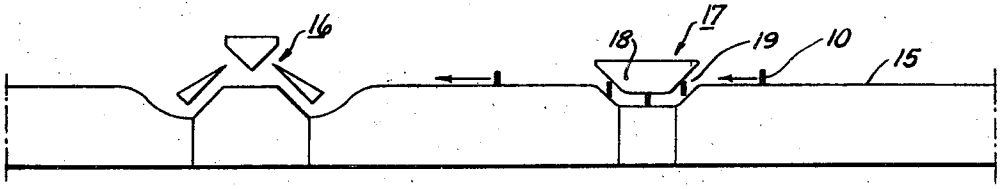


Fig 4

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2,269,757

KNITTING

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7 Claims. (Cl. 66—140)

This invention relates to knitting and more particularly to a method of incorporating in the fabric during knitting the end or ends of yarn which result at the beginning or ending of knitting of a yarn, and to apparatus for carrying out the method.

In machine knitting, the yarn customarily is fed to the needles from a feeding device, such as a feed finger, and upon completion of the knitting of that yarn, the yarn is carried into a binder or clamp and is severed by a shear action adjacent the binder. The length of yarn which spans the distance between the last needle on which the yarn was knitted and the shear action ordinarily is not incorporated in the fabric but extends as a loose end. Also, when a yarn change is effected, or at other times when knitting of a yarn is started, the length of yarn which extends from the binder to the first needle on which it is knitted ordinarily is not incorporated into the fabric, but extends as a loose end. These loose ends above referred to are unsightly, and in certain instances, as in the case of hosiery, constitute, in addition, an annoyance to the wearer of the knitted article.

These loose ends resulting at the start and finish of the knitting of a yarn have heretofore either been allowed to remain on the inside of the fabric, or have been trimmed by a manual operation which substantially increases the cost of making the knitted article.

In accordance with the present invention, the loose ends occurring at the beginning or ending of a run of yarn are incorporated into the fabric during the knitting thereof, thus eliminating any necessity for trimming. This is effected by positioning the ends during the knitting operation in such manner that they are caught by the needles and knitted into the fabric.

The invention is disclosed herein, for the purposes of illustration, in connection with one illustrative embodiment thereof, although it will be understood that the invention is not thus limited and is suitable for other applications. In order to facilitate illustration of the invention, it is described in connection with a circular, independent needle knitting machine, as for example, a machine of the Banner type.

The yarn end, which may either be the end occurring at the beginning of the knitting or the end occurring at the conclusion of the knitting, or both, is forced to the outside of the cylinder at a point removed from the feeding station or mouthpiece during the rotation of the needle cylinder, the needles at this point in the rotation of the cylinder preferably being lowered slightly to permit the end to be thrown to the outside of the cylinder without interference. The yarn end, or ends, are carried around by the cylinder and are engaged by the needles as they move through the next knitting wave and knitted into the fabric by the movement of the needles.

In certain cases, it may be desirable, after the ends have been moved to the outside of the cylinder, to urge the yarn ends inwardly against the outer needles to insure that the ends will be caught by the needles, but ordinarily, it will be found that this is not necessary as the ends will be drawn into the path of the needles without assistance.

The invention also provides novel apparatus for carrying out the method and in one illustrative form the apparatus includes a knitting machine having associated therewith means, such as an air jet, suitably directed to force the yarn end or ends to the outside of the cylinder at a point removed from the mouthpiece. Suitable means, such as a cam, preferably are provided for lowering the needles at this point in their travel to permit the yarn ends to be thrown to the outside of the cylinder.

An object of the present invention is the provision of a knitted fabric wherein no loose ends of yarn protrude from the fabric but all yarn ends are incorporated in the fabric during the knitting thereof and no trimming is required.

Another object of the invention is the provision of a method of knitting fabric or knitted articles wherein the ends of the yarn or yarns are incorporated into the fabric during the knitting operation and a neat and attractive fabric or article is provided.

Still another object of the invention is the provision of a novel machine for incorporating the yarn ends during the knitting operation and while the fabric is still on the needles, thereby eliminating the necessity for trimming.

Still another object of the invention is the provision of a method of knitting fabric wherein yarn changes are effected without producing loose ends in the finished fabric.

Various other features and advantages of the invention will be apparent from the following particular description and from an inspection of the accompanying drawings.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be

carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part hereof, in which:

Fig. 1 is a fragmentary top plan view of one form of knitting machine constructed in accordance with the invention, certain of the parts being sectioned and others broken away in order to show certain of the interior construction;

Fig. 2 is an enlarged fragmentary top plan view of a portion of the machine illustrated in Fig. 1 and showing somewhat diagrammatically the positions of yarns on which the machine is operating;

Fig. 3 is a vertical sectional view taken along the line 3—3 of Fig. 1; and

Fig. 4 is a somewhat diagrammatic development view of the needle cams of the machine shown in Figs. 1 to 3.

In the following description and in the claims, various details will be identified by specific names for convenience, but they are intended to be as generic in their application as the art will permit. Like reference characters denote like parts in the several figures of the drawings.

The invention is disclosed herein in connection with its application to a knitting machine of the Banner type, such as that disclosed in the patent to Hemphill No. 933,443, granted September 7, 1909. Since the construction generally of such a machine is well known, the machine is shown only in part, particularly to illustrate the novel features embodied in the present invention, it being understood that the parts of the machine which are not shown, may be of any usual construction.

The machine includes the usual bracket 1 (Fig. 3) supporting a table 2 on which is mounted a plate 3 serving as a bearing or guide for a needle cylinder 4. The needle cylinder 4 is carried by a bevel gear 5 meshing with a driving gear 6, which latter is driven by a suitable driven mechanism (not shown) whereby the needle cylinder can be rotated or oscillated in accordance with the fabric or article desired.

The needle cylinder 4 carries the usual latch needles 10 which ride on a needle cam 15 (Figs. 3 and 4) and are actuated to perform a knitting movement by a stitch cam 16. An auxiliary cam 17 (Fig. 4), including a cam member 18 defining with the needle cam 15 a cam track 19, is provided for the purpose of lowering or dipping the needles slightly throughout a short portion of their path of travel suitably removed from the mouthpiece of the knitting machine, for a purpose hereinafter more fully described.

The needle cylinder 4 carries at its outer end a top ring 11 (Fig. 3), and the usual sinker ring 12 and cap ring 13 also are provided. The usual sinkers (not shown) are provided and are actuated in the usual manner.

A latch ring 20, which may be of any ordinary construction, is provided and carries a plurality of feed fingers, as for example, 21, 22 and 23, adapted to feed yarns to the needles 10. In the present example, for the purpose of illustration, two yarns are illustrated as being fed, namely, a yarn *a*, which is fed by feed finger 22, and a yarn *b* which is fed by feed finger 21.

The latch ring 20 carries a binder assembly 25 including a binder plate 26, a spring guide 27, a yarn clamp 28, a yarn clamp 29, and a shear or cutter 30. The shear 30 is actuated by the usual mechanism (not shown), connected to a link 31, which in turn actuates the yarn clamp 28 through an arm 32.

Extending into the needle cylinder 4 is a tube 35 having its end or nozzle 37 terminating adjacent the path of the needles 10 and aimed outwardly of the needle cylinder 4. The tube 35 may be supported in a suitable manner and if desired, may extend through the binder plate 26 and be secured therein in any suitable manner, as by a set screw 38, threaded into the binder plate 26 or into a short sleeve 36, secured to the binder plate 26.

The operation of the machine above described is as follows:

Let it be assumed that the machine has been knitting the yarn *a* to form tubular fabric and it is desired to change yarns and substitute the yarn *b* for the yarn *a*. In the normal operation of the machine the non-knitted yarn *b* will extend from the feed finger 21 to the clamps 28 and 29 which hold the yarn when the feed finger 21 is in non-feeding position.

When the yarn change is to be made, the feed finger 21 is lowered into feeding position and the yarn *b* is positioned in the path of the needles, which engage and knit the yarn *b*, the length of yarn which extends from the feed finger 21 to the shear 30 and held by the yarn clamps 28 and 29 being pulled out of the clamps. This length or end *bx* trails behind the first needle on which this yarn is knitted.

Shortly after the feed finger 21 is lowered, the feed finger 22 is elevated to carry the yarn *a* out of the path of the needles and into the yarn clamps 28 and 29 and shear 30, whereafter the shear is actuated to sever the yarn. The length of yarn *a* which extends from the shear to the last knitted needle constitutes an end *ax* which trails behind the last needle on which this yarn is knitted. The position and condition of the machines and yarns at this point in the operation is illustrated in Figs. 1, 2 and 3 of the drawings.

The ends *bx* and *ax* normally are carried around by the needle cylinder on the inside thereof and ordinarily would not be positioned to be knitted by the needles, and hence, when the fabric came off the machine, these ends would extend from the inner face of the fabric. However, in accordance with the present invention, the ends *bx* and *ax* are forced to the outside of the cylinder and are caught by and knitted by the needles as they pass the knitting station.

Air under pressure is supplied to the tube 35 and is ejected at the end or nozzle 37 in a direction such that it blows the ends *bx* and *ax* upwardly and outwardly from the cylinder through the space between the top of the cap ring 13 and the bottom of the latch ring 20.

In order to facilitate passage of the yarn ends *ax* and *bx* out of the cylinder, the needles 10 preferably are lowered at this portion of their travel by the cam 17. The needles preferably are lowered only to the level of the cap ring, and in any case, are not lowered sufficiently to shed their stitches.

When the yarn end *bx* is forced to the exterior of the cylinder, as illustrated particularly in Figs. 1 and 2, and the needles are again raised to normal level, the yarn *bx* passes between two adjacent needles at or adjacent the first needle on which it was knitted and trails behind these needles. In an analogous manner, the yarn *ax* extends between two needles and trails behind the last knitting needle or a neighboring needle.

The yarn ends thus are carried around by the

rotation of the needle cylinder to the mouthpiece or knitting station and, when the needles are carried through the knitting wave and engage and knit the yarn *b*, the yarn ends *bx* and *ax* are drawn into position to also be engaged by the needles and to be knit thereby, along with the feed yarn *b*, the ends thus being knitted into the fabric.

In certain cases, it may be found desirable to force the yarn ends *bx* and *ax* in toward the needles as the needles approach the mouthpiece and in this event, an air jet (not shown) may be provided exteriorly of the cylinder and aimed in a direction to force the yarn ends in toward the needles. However, it has been found that this is usually not necessary as the movement of the needles will usually carry the yarn into engagement with the needles so that they are knitted by the needles at the knitting station.

Various modifications may be made without departing from the scope of the invention and the invention is capable of adaptation to machines of other types than the machine herein disclosed.

For example, instead of employing an air jet for forcing the yarn ends to the exterior of the cylinder, I may employ suction means on the exterior of the cylinder adjacent a portion of the needle path removed from the knitting station. Thus suction means is so positioned and of such suction strength as to draw the yarn ends outwardly of the cylinder in a manner analogous to that in which the yarn ends are forced outwardly by the air jet above described. The needles may be lowered adjacent the suction means in a manner similar to that above described in order to facilitate passage of the yarn ends out of the cylinder.

In another embodiment, there may be provided a brush wheel located adjacent or in the path of the needles and rotated by the movement of the needles to urge the yarn ends out of the cylinder. In a like manner a brush wheel may be employed for urging the yarn ends against the needles as the latter approach the mouthpiece in order to insure that the ends will be caught and knitted by the needles.

The invention provides a fabric which to the casual observer does not differ in appearance from fabric formed in the usual manner and which fabric is fully as neat and attractive in appearance as fabric in which the yarn ends have been trimmed. It will be understood that the leading or beginning end of the yarn is knitted with that yarn in the second course and the trailing end of the first yarn is knitted along with the second course of the second yarn and both are sufficiently close to their principal courses and in most cases they are barely noticeable. In many fabrics, such as terry fabrics, for example, the yarn ends are substantially concealed by the terry loops or other features of the fabric even to a greater extent than in plain non-terry or undecorated fabric.

The present invention has a wide use in knitting, as will be apparent to those skilled in the art, and it is particularly advantageous in connection with the knitting of various fabrics and articles, wherein yarn changes are made for such purposes as providing horizontal stripes of different colors or horizontal sections of different materials or patterns. The fabric or article when it leaves the needles has no loose ends extending therefrom, and hence, no trimming is necessary.

While certain novel features of the invention have been disclosed herein, and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

What is claimed is:

1. In a knitting machine, in combination, a needle cylinder having a series of needles, means for actuating said needles, means including feed fingers for feeding yarns to said needles, a central yarn clamp and shear device, means actuating said feeding means to feed a first yarn to said needles, and thereafter feed a second yarn to said needles and discontinue the feeding of said first yarn, means actuating said clamp and shear to clamp and cut said first yarn, and pneumatic means to move into the path of said needles the end of said first yarn extending between the last needle on which knit and said clamp and shear device, and the end of said second yarn extending between the first needle on which knit and said clamp and shear device, whereby said ends are knit by said needles during the regular operation thereof.

2. In a circular knitting machine of the type having a movable needle cylinder, and at least one knitting station, in combination, means for knitting a plurality of yarns successively, means for making a yarn change from a first to a second yarn, means for cutting the first yarn, and means for causing the ends of said yarns to be knitted into the fabric, said last means including means for lowering the needles at a point removed from a knitting station, and means for throwing the ends of the first and second yarns to the outside of said needle cylinder at the point where said needles are lowered.

3. In a circular knitting machine, the combination with a movable needle cylinder having a series of needles, a knitting station, means for feeding a plurality of yarns to said needles selectively, of means for causing the ends of said yarns to be knitted into the fabric, said last means including means for lowering the needles as they pass a portion of their path removed from the knitting station, and means for moving cut ends of knitted yarn to the outside of the needle cylinder at said portion of the needle path.

4. In a circular knitting machine of the type having a movable needle cylinder, and a knitting station, means for knitting a plurality of yarns successively, means for making a yarn change from a first to a second yarn, means inwardly of said needle cylinder for cutting the first yarn, and means including an air jet for throwing the ends of the first and second yarns to the outside of said needle cylinder at a point removed from said knitting station, whereby said ends are knitted into the fabric.

5. In the method of knitting fabric on a plain circular knitting machine having a shear device inwardly of the needle cylinder, the steps which comprise knitting a first yarn to form one or more courses, effecting a yarn change from said first yarn to a second yarn, cutting the first yarn inwardly of the needle cylinder, moving the ends of the cut yarns to the outside of the needle cylinder and causing both the first and second yarn ends to knit into the fabric during the knitting of the second yarn in plating relation therewith.

6. In the method of operating a plain knitting machine having a yarn cutting device inwardly of the needle cylinder, the steps which comprise knitting a yarn, cutting said yarn inwardly of said needle cylinder, moving to the outside of said cylinder the end of said yarn which extends from the last needle on which it is knit, lowering the needles to provide space for said end to pass out of said cylinder before approaching the knitting point, and causing said end to be knit into the fabric.

7. In a circular knitting machine, the combination with a movable needle cylinder having a series of needles, a knitting station, means for feeding a plurality of yarns to said needles selectively, means for severing said yarns, means for lowering the needles as they pass a portion of their path removed from the knitting station, means for causing a current of air passing from the inside to the outside of said needle cylinder for throwing the free ends of said yarns into the path of said needles whereby said free ends are knitted into the fabric.

ROBERT E. DAVIS.