Jan. 7, 1930. R. G. JENNINGS 1,742,255

CIRCULAR KNITTING MACHINE

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Fig. 1.

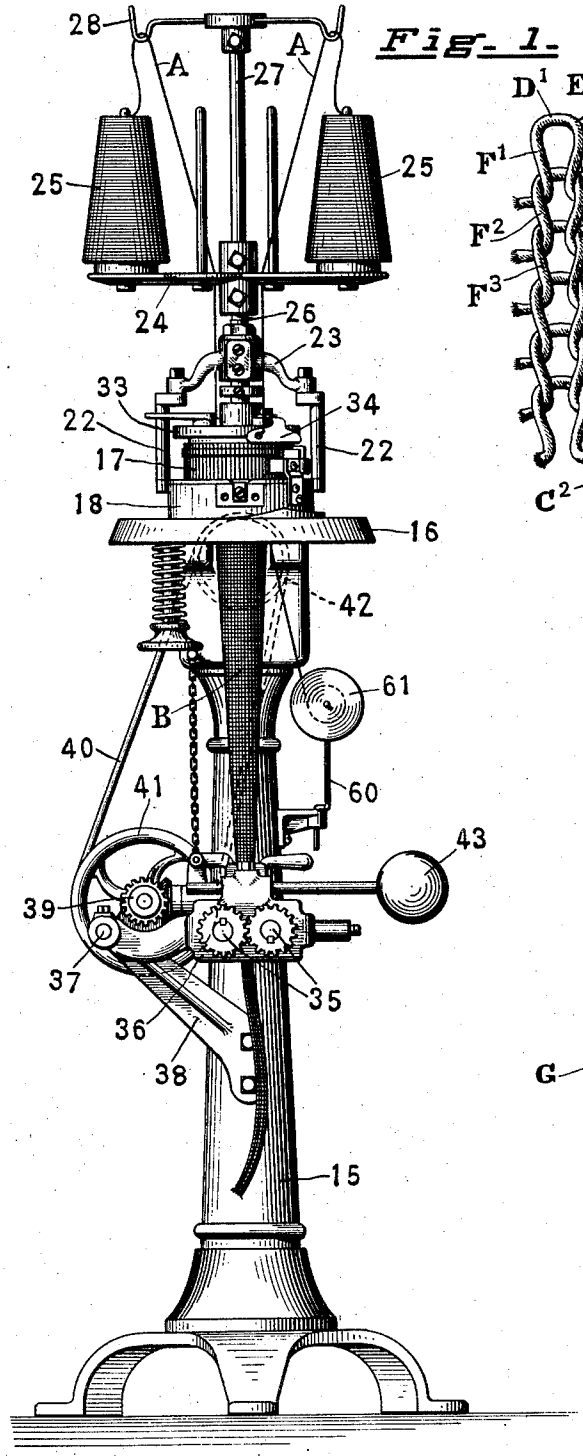


Fig. 6.

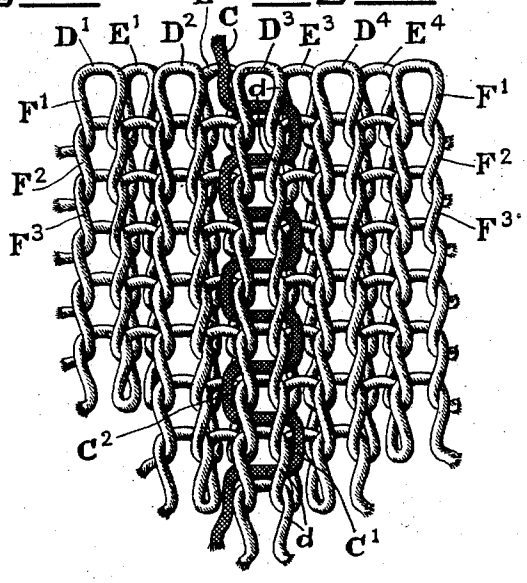
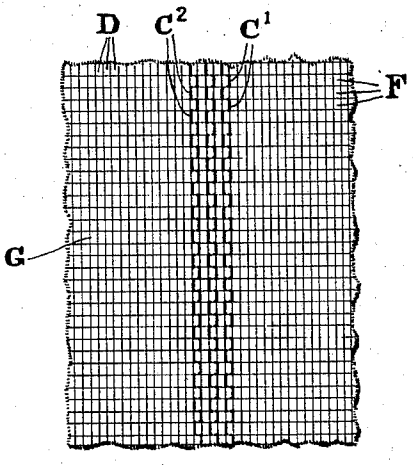


Fig. 7.



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Fig. 2.

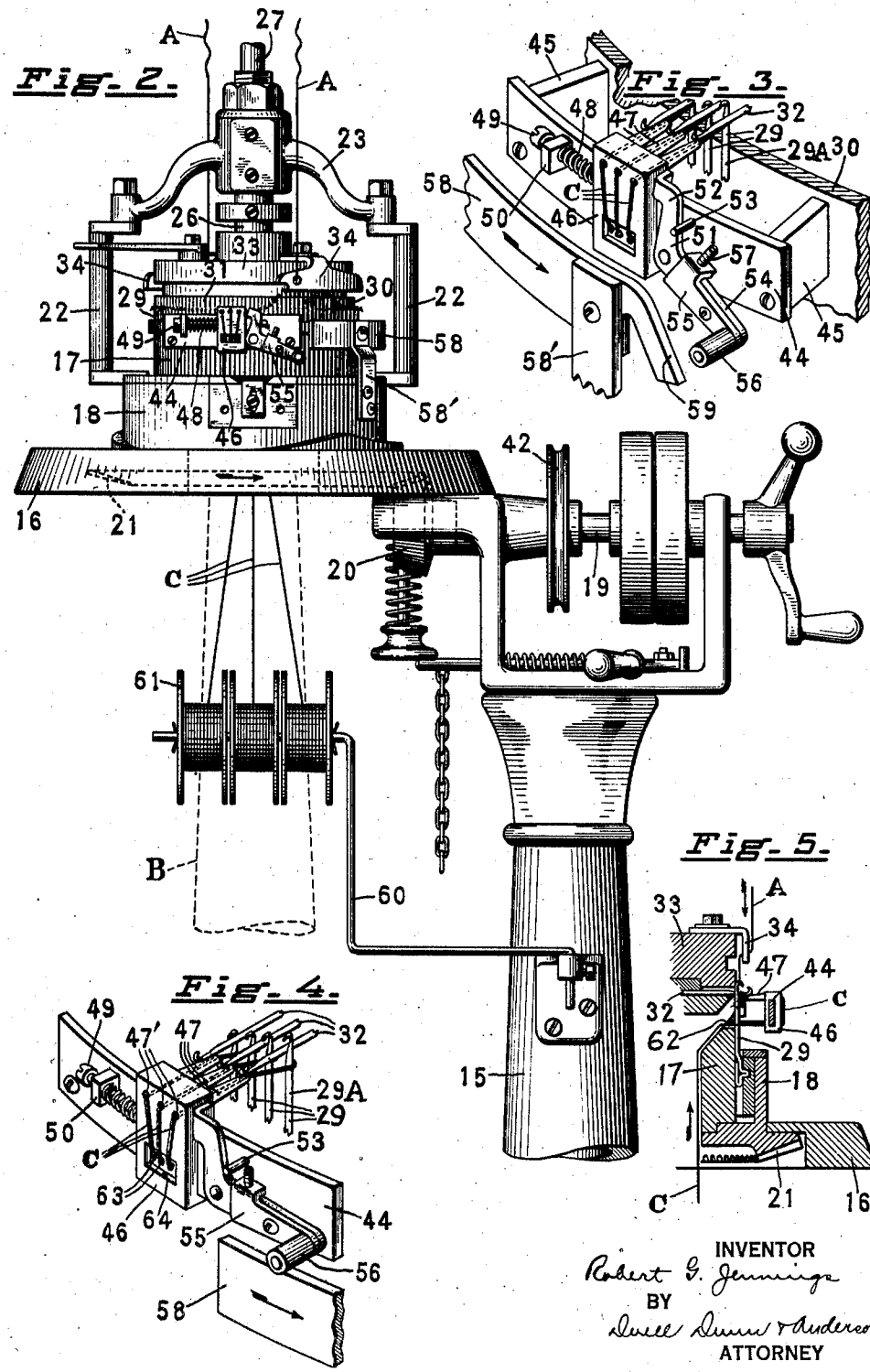


Fig. 3.

Fig. 4.

Fig. 5.

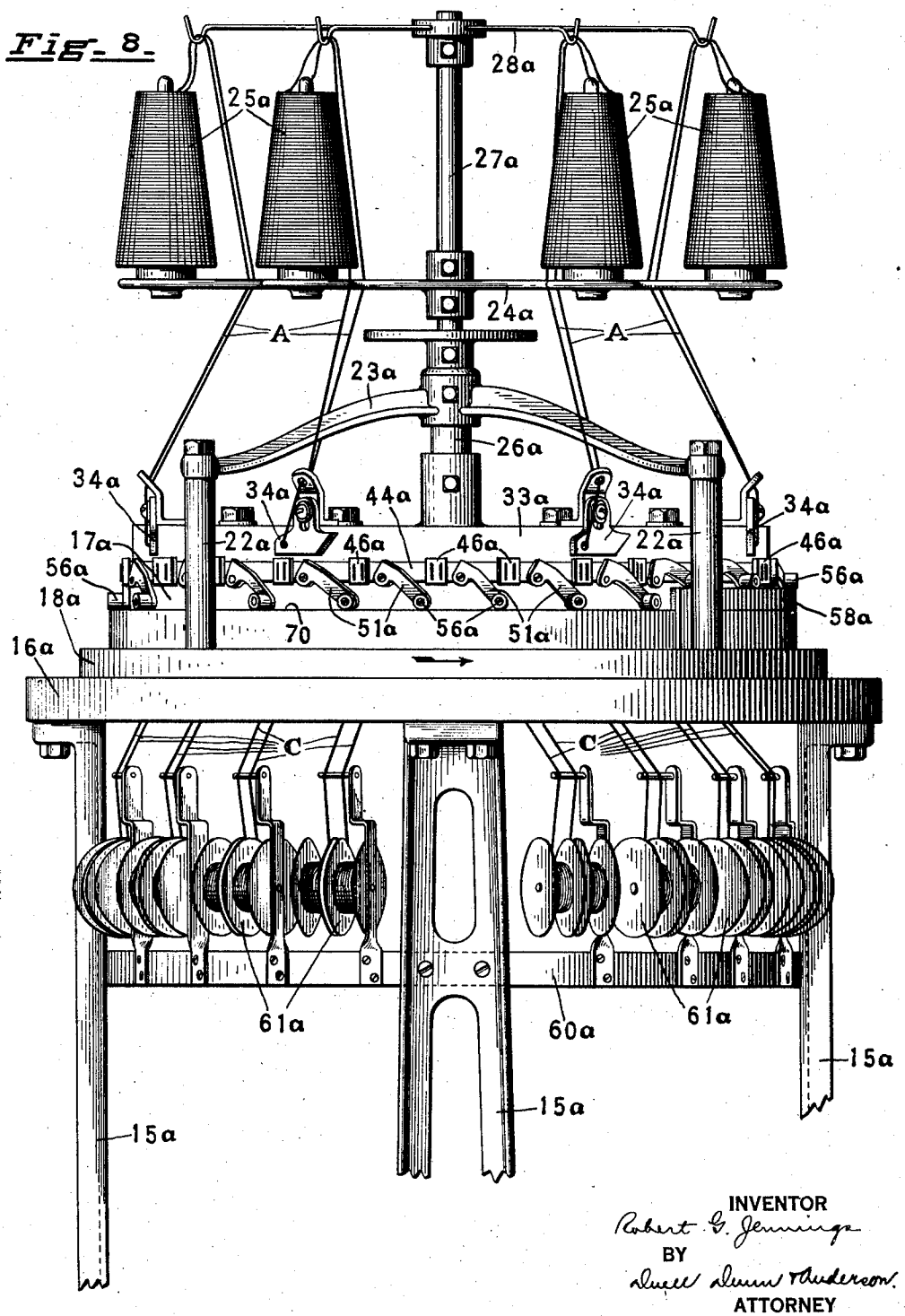
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CIRCULAR KNITTING MACHINE

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Fig. 8.



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Fig. 10.

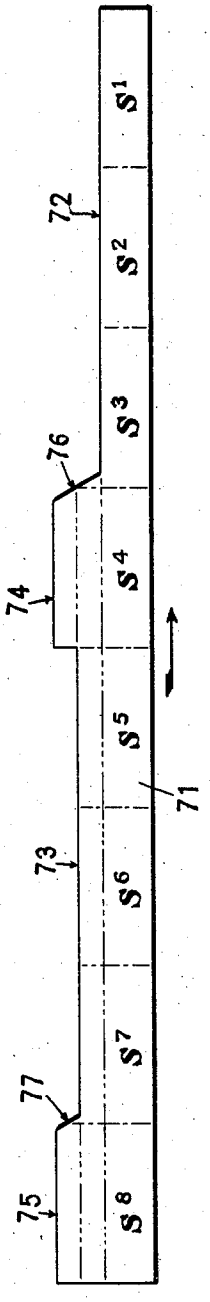


Fig. 12.

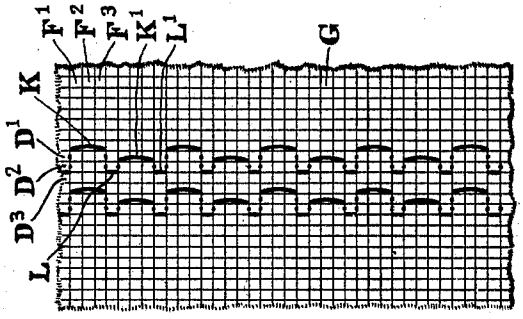


Fig. 11.

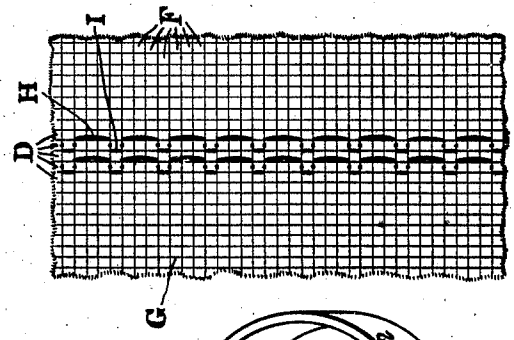
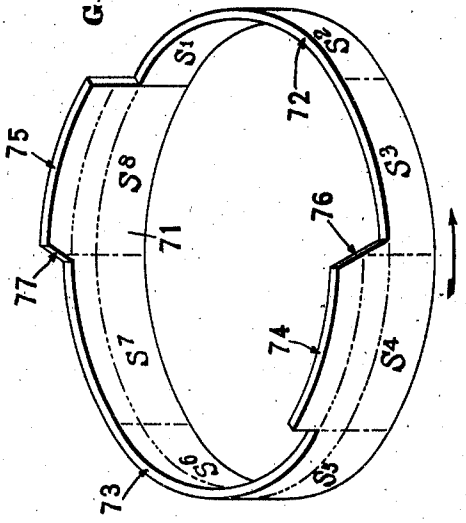


Fig. 9.



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1,742,255

UNITED STATES PATENT OFFICE

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CIRCULAR-KNITTING MACHINE

Application filed October 26, 1926. Serial No. 144,672.

This invention relates to improvements in textile machinery, and more particularly in some of its details it relates to improvements in circular and other knitting machines whereby an improved and unique fabric may be produced. Furthermore, the invention relates to improvements in methods of making textile fabrics.

It is a general object of the invention to provide a machine of the class mentioned of improved construction and arrangement, and which is capable of producing a fabric having improved and advantageous features, including unique decorative effects and improvements in strength and wearing qualities.

A further object is to provide an improved machine of the class mentioned which, while being simple and inexpensive in construction and conforming to standard practice in the art, is capable of making an improved textile fabric having unique decorative patterns thereon.

Another object of the invention is to provide a machine of the class mentioned having an improved, simple and inexpensive mechanism for forming knit fabrics with stripes running longitudinally thereof so as to provide not only decorative effects, but to strengthen the fabric and improve its wearing qualities.

Still another object is to provide a simple and practical arrangement in machine of the class mentioned for applying longitudinal stripes or similar decorative effects to knitted fabrics during the process of formation thereof.

Another object is to provide, in knitting machine of the class mentioned, an improved and simple arrangement for leading one or a plurality of threads into position to be entwined with the fabric thread as formed into stitches by the machine needles.

Another object is to provide an improved arrangement for leading an additional or embroidery thread into position to be entwined with the fabric thread during formation of the fabric, and for avoiding interference by said embroidery thread with the operation of the regular knitting elements of the machine.

A further object of the invention is to provide an improved method of making a textile fabric which is simple in nature and provides a fabric of superior strength and wearing qualities, also imparting a unique decorative effect.

Other objects will be in part pointed out in the following detailed description of certain illustrative but preferred embodiments of the invention, and will be in part obvious in connection therewith.

The invention accordingly comprises the several steps and the relation and order of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combinations of elements and arrangement of parts which are adapted to effect such steps, all as exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a more complete understanding of the nature and objects of the invention, reference is had to the accompanying detailed description of certain preferred embodiments of the invention and to the accompanying drawings, in which

Figure 1 is a side elevation of a circular rib knitting machine equipped with the invention.

Fig. 2 is an enlarged fragmentary side elevation looking toward the right side of Fig. 1.

Fig. 3 is an enlarged fragmentary perspective view showing details of operative parts of the invention.

Fig. 4 is a view similar to Fig. 3, but showing the parts in a different position.

Fig. 5 is a fragmentary sectional view through the needle cylinder showing the arrangement for guiding the decorative or embroidery threads into operative position.

Fig. 6 is an elevation of a fragment of knit fabric as formed by the improved machine, the threads being shown as enlarged and pulled apart longitudinally and transversely in order to clearly disclose the stitch construction and the intertwining of the decorative thread.

Fig. 7 is a fragment of the fabric constructed with the improved machine and

showing one form of the general improved decorative effect.

Fig. 8 is an enlarged elevational view similar to that of Fig. 2, but showing a modified form of the improved mechanism.

Fig. 9 is a partially diagrammatic view of a modified form cam for varying the decorative effect applied to the knit fabric.

Fig. 10 is a diagrammatic view showing a development of the cam of Fig. 9.

Fig. 11 is a diagrammatic elevation of a fragment of fabric similar to that of Fig. 7 but showing generally the decorative effect of the balloon stitch, and

Fig. 12 is a view similar to that of Fig. 11, but showing a variation of the balloon stitch as produced by the form of cam shown in Figs. 9 and 10.

Referring to the drawing for a complete detailed disclosure of the embodiments of the invention there shown, and first to the embodiment shown in Figs. 1 to 5, inclusive, a frame member 15 of any preferred known construction may be provided, and mounted thereon at the upper part thereof is a horizontal supporting or base plate 16 carrying the needle cylinder 17 in upright stationary position thereon. A vertical cam cylinder 18 surrounds the lower end of the stationary needle cylinder 17, being rotatably mounted in suitable bearings in the base plate 16 and connected for rotation in a horizontal plane by a driving shaft 19 through a pinion 20 and a circular rack 21 connected to the underside of the cam cylinder. Supporting standards 22 are rigidly attached to the cam cylinder 18 and carry a supporting spider or arch 23 which, in turn, carries a surmounting bracket support 24 for the cops 25 of thread or yarn used for knitting the fabric. The rotary central spindle 26 extends vertically down from the arch 23 and is attached through said arch for unitary rotation with the cam cylinder 18. A spindle extension 27 rises above the bracket 24 carrying a guide bar 28 for guiding the thread A from the cops into position for cooperation with the knitting mechanism.

The peripheral surface of the needle cylinder 17 is provided with a series of vertically disposed circumferentially spaced grooves for guiding and supporting in vertical position, a series of reciprocatory cylinder needles 29, said series of needles extending entirely around the needle cylinder.

A disk 30 forming a horizontal needle dial surmounts the needle cylinder 17, being arranged at right angles to the central spindle 26. This needle dial provides an upper supporting surface with a series of radially disposed grooves 31 for guiding and supporting the dial needles 32 for longitudinal reciprocatory movement, there being as many dial needles as cylinder needles, and the cylinder needles and dial needles being arranged in staggered position relatively to each other. A circular plate 33 is rigidly secured to the rotary spindle 26 for rotation therewith, and is provided on its lower face with a cam to provide a dial cam plate for reciprocating the dial needles 32. Thread guide plates 34 are attached to the rotary dial cam plate 33 and provided with apertures through which the thread A passes and is delivered thereby into proper position for cooperation with the needles. As understood by those skilled in the art, the number of thread guide plates 34 may vary and the cam cylinder and dial cam plate are constructed to effect reciprocatory movement of the cylinder dial needles in proper sequence and in proper order to loop the thread and thus form stitches. For illustrative purposes a tubular thread machine of the circular type is shown, which knits a tubular ribbed fabric.

For the purpose of taking up the fabric as knit and for maintaining a constant and substantially uniform tension thereon, as desirable in this form of knitting machine, a take-up device is provided as shown in Fig. 1. This take-up device may be of any preferred known form, that shown being of the type described in Patent No. 421,147, issued February 11, 1890, and including a pair of gripping rolls for gripping the tubular knit fabric which is shown at B in the drawing. These gripping rolls are mounted upon adjacent parallel rotary shafts 35 mounted upon a swinging frame 36 pivotally mounted at 37 upon a bracket 38 carried by the machine so as to be swingable in a vertical plane. The rolls are driven through a train of gearing 39 upon the swinging frame 36 by a belt 40 engaging a pulley 41 connected with the gear train and with a pulley 42 on the drive shaft 19. A weight 43 is carried by the swinging frame so as to exert the desired downward pull upon the tubular fabric B. As fully explained in the above mentioned patent, this take-up arrangement is operated by the belt 40 to actuate the gripping rolls which run upwardly on the fabric tube B to swing the swinging frame 36 upwardly on its pivot, thus raising the pulley 41 until the belt 40 is sufficiently loosened to cause slipping thereof, thus terminating operation of the rolls. The rolls are started again as the knitting progresses, the swinging frame then moving downwardly with the fabric tube until belt tension is again increased to a sufficient degree to cause operation of the gripping rolls. Tension upon the tubular fabric is thus maintained substantially constant.

The construction above referred to will be understood by those skilled in the art without further detailed disclosure, since it is standard in the art of knitting and is disclosed, for example, in Patent 421,147, mentioned above. This construction forms a part

of the present invention only in combination with other elements and arrangements as described with particularity and in detail below.

It will also be understood by those skilled in the art that the machine described is operative to form the tubular knit fabric B, the cylinder needles being longitudinally reciprocated vertically in their guides by operation of the cam cylinder 18, and the dial needles being longitudinally reciprocated horizontally by operation of the dial cam plate 33, the thread A being fed to the needles and guided into correct position to be engaged thereby by means of the thread guide plates 34. In the form of machine shown the needles are of the latch type; that is, each needle is provided with a latch member pivoted thereto so as to swing into position for co-operation with the hooked end of the needle to form a closed eye, or to swing away from said hooked end to open the eye. It will also be understood that the needles are operated in proper sequence with reference to each other, and to movement of the thread-guiding plates 34, to form the thread into longitudinal rows of interlooping stitches to form the wales of the fabric, and transverse rows interlooping stiches to form the stitch courses of the fabric.

As best shown in Figs. 2, 3 and 4, a supporting and guiding plate or bracket 44 is supported upon the outside of the needle cylinder 17 by means of supporting studs 45 secured to the outer surface of the cylinder and lying between adjacent cylinder needles. This supporting bracket is positioned outside of the cylinder needles and is curved concentrically with the cylinder surface, carrying a block 46 mounted for sliding movement along the length of the bracket. For the purpose of slidably supporting the block 46 it may be provided on its inner face with transverse upper and lower grooves adapted to fit respectively over the upper and lower edges of the bracket plate 44, whereby the block may be slid into operative position over either end of the bracket plate. The block 46 carries one or more inwardly extending thread-guiding members which are shown in the form of tubes or nozzles 47 having longitudinal apertures 47′ extending therethrough for conducting the threads into position, and positioned with their inner ends in proximity to the cylinder needles. Three of these thread-guiding nozzles are shown in the drawing positioned side by side transversely of the supporting block 46, but it will be understood that a greater or lesser number of nozzles may be utilized.

The inner ends of the guiding nozzles are in alignment with the respectively adjacent spaces between the cylinder needles when the nozzle block is in either right-hand or left-hand operative position, and said ends preferably extend inwardly slightly beyond the outer faces of the cylinder needles so as to guide the thread closely into position with reference to the stitches being formed by the needles, and to support such threads in position to insure entwinement with the stitches as the latter are being formed. The nozzles are vertically positioned slightly above the upper ends of the cylinder needles when the latter are in their lowermost position, so that lateral movement of the nozzles may be effected when said needles are lowered without being obstructed by said needles.

A spring 48 is mounted upon a rod 49 slidably mounted in an aperture in a stud 50 attached to the face of the bracket plate 44. The end of this rod is threaded or otherwise secured to the adjacent face of the supporting block 46, and the spring 48 is stressed under compression between the stud 50 and the block 46 so as to urge the latter into its right-hand operative position. The screw rod 49 is thus adjustable in length and the head of the rod contacts with the stud 50 to adjustably limit the movement of the nozzle block to the right, whereby said block may be adjusted to correctly position it in one extreme position.

An operating bell crank lever 51 is pivotally connected at its angle to the bracket plate 44, and is positioned on the opposite side of the nozzle block from the spring 48. The lever arm 52 of the bell crank lever is provided with a contact foot for engagement with the adjacent face of the nozzle block and a stop 53 is mounted upon the plate 44 in position to limit movement of the lever arm 52 in a direction away from the nozzle block so as to maintain the bell crank lever in correct position for cooperation with its operating cam. To the lever arm 54 of the bell crank lever is pivoted an adjustable bar 55 carrying at its outer end an operating pin or roller 56, and at its inner end an adjusting screw 57 arranged to contact with the arm 54 so as to adjust the bar 55 on its pivot. By this means the movement of the nozzles and nozzle block to the left occasioned by action of the bell crank lever, may be adjusted.

A cam plate 58 is mounted upon the cam cylinder 18 by means of standards 58, and is positioned outside of the outer surface of the needle cylinder 17 and concentrically curved therewith. This cam plate is provided at this forward end with a downwardly inclined cam surface 59 positioned to encounter the operating roller 56 of the bell crank lever as the cam plate 58 rotates with the cam cylinder in the direction indicated by the arrows in Figs. 3 and 4. Since the bracket plate 44 is stationary, this action results in moving the bell crank lever on its pivot in such a manner as to slide the nozzle block 46 to the left along the bracket 44, the extent of this movement and the final position of the nozzles being adjustable by means of the adjusting screw 57, so as to correctly position the threads with

reference to the needles when the nozzles are to the left.

In the form of machine shown in Figs. 1 to 5 the cam bar 58 extends for about 180 degrees of the circumference of the cam cylinder and of the needle cylinder, this being about the same as the angular distance between the thread-guide plates 34 from center to center thereof. It will be seen, therefore, that the thread-guiding nozzles 47 remain at the right for approximately one-half revolution of the cam cylinder and at the left for the remainder of the revolution.

A bracket 60 is suitably supported on the machine and carries one or a plurality of spools 61 for supplying the additional or embroidery thread C. As shown in Fig. 5, this thread C is carried upwardly within the cam cylinder 18 and the needle cylinder 17 and passes outwardly through apertures 62 in the walls of the needle cylinder and through apertures 63 in the bracket plate 44. An opening 64 is provided in the nozzle block for the passage of the threads C which pass thence upwardly to the nozzle apertures 47′. The threads C when thus disposed are protected from injury by contact with external objects or with operating parts of the machine, and interference with operation of the machine is effectively avoided.

A detailed description of one form of the invention having been above set forth, the complete operation thereof to produce a fabric having improved strength and wearing qualities and improved decorative effects, will now be understood by those skilled in the art, and for clearness and emphasis may be described as follows:

The machine is threaded in the usual manner, with the usual knitting threads A, and the additional threads C are positioned as above described and shown in the drawing, the ends thereof emerging from the ends of the nozzles 47 and being attached in any desired manner to the fabric being formed. As the fabric is formed by operation of the machine, the threads C are fed forwardly by the downward movement of the tubular fabric B as formed.

When the right-hand nozzle 47 is positioned at the right, that is, when the operating bell crank lever 51 is out of engagement with the cam 58 as shown in Fig. 3, the corresponding thread C is positioned just at the right of the path of longitudinal reciprocation of the adjustment cylinder needle designated in Fig. 3 as 29^A. Since the thread C is held in this position for one-half revolution of the cam cylinder 18, the cylinder needles will be operated to loop the thread A to form a stitch. Hence a stitch will be formed while the nozzle remains in its right-hand position. It will be understood that in machines of this type the needles are operated to form a stitch during an angular movement of the cam cylinder approximately equal to the angular distance between centers of the thread-guiding plates 34, so that in the modifications shown in the drawings, the stitch will be formed with the nozzle block positioned to the right, and the next successive stitch in the same wale will be formed when the nozzle block is positioned at the left. When the inclined part 59 of the cam 58 encounters the roller 56, the nozzle block is shifted to the left, as shown in Fig. 4, carrying the thread C of the right-hand nozzle to the left of the path of the needle 29^A so that said needle moves upwardly in its path at the right of the thread C and the second stitch in the same wale is formed. It being remembered that the thread C is attached to the fabric, and that shifting of the nozzle block occurs in either direction when the cylinder needles are in their lowermost position, it will be seen that the movement of the nozzle will carry the thread C transversely across the path of the needle and transversely over the threads of the stitch which is at that moment looped through the hooked end of the needle. Then when the needle moves upwardly, it passes at the opposite side of the thread C from that of its next preceding movement. The next succeeding stitch loop is then formed and looped through that last mentioned as the needle passes down again to its lowermost position. The nozzle shifts again at this point carrying the thread C back across the partially formed stitch the same as before but in the opposite direction. This operation of interlooping or entwining the thread C with the stitches of a wale will be made clearer upon reference to the magnified view of the fabric shown in Fig. 6.

As each stitch is formed the fabric B is moved forwardly the length of one stitch by the take-up device, thus feeding the thread C forwardly slightly. The adjacent guiding nozzles are positioned similarly to the right nozzle with reference to the respective adjacent cylinder needles, and the effect is the same as described with reference to said right nozzle. The result is that each of the threads C is entwined transversely back and forth in reverse loops through the longitudinal series of stitches forming a wale of the fabric, the effect of which is to provide a stripe running longitudinally of the fabric, as well as to reinforce and strengthen the fabric. The thread C may be of a color to contrast with that of the regular fabric thread A, so as to form a distinct stripe.

In the form of machine above described the thread-guiding nozzles are shifted back and forth a distance equal to the width of one wale; that is, the cam 58 is proportioned to move the nozzle block 46 a distance equal to the width of a single wale. Also it should be observed that the cam 58 is arranged so that shifting of the nozzle block in either direction takes place when the cylinder needles

are depressed so that the nozzles clear the upper ends of the needles.

The manner of entwining a thread C with one of the fabric wales, as above described, will be clearer upon reference to Fig. 6, which shows a fragment of a fabric constructed as described, the stitches being shown as enlarged and stretched apart both longitudinally and transversely in order to reveal the structure more clearly. This is a ribbed fabric such as knit by the form of machine disclosed; that is, a machine having a set of cylinder needles forming the outer ribs, and a set of dial needles forming the inner ribs. The outer ribs are shown in Fig. 6 as extending from top to bottom of the fabric fragment and are formed by the stitches interlooping in longitudinal sequence to provide the ribs or wales indicated at D^1, D^2 and D^3, etc. The inner ribs or wales are simply indicated at E^1, E^2, E^3, etc. The transverse courses of stitches are indicated at F^1, F^2, F^3, etc. From this view it will be clear how the successive outer stitch loops *d* of the wale D^3 are carried upwardly by the needles over the adjacent transversely disposed stretches of the thread C, first when the thread-guiding nozzle is disposed at the right of the wale and then to the right thereof.

From the above description of the operation of the machine it will be seen that each of the threads C will be looped back and forth through the stitches of a wale in reversely disposed loops indicated in Fig. 6 as C^1, C^2, these loops being formed and arranged with reference to the fabric stitches of the wale D^3, substantially as shown. One thread C may thus be entwined with each of the outer wales or they may be spaced as desired to vary the stripe pattern, or arranged in groups of two or more in adjacent wales with intervening spaces free from the threads C.

The general effect of a triple thread stripe, such as applied to a fabric by means of a group of three nozzles as shown, is indicated by the diagrammatic representation of Fig. 7 showing a fragment G of fabric. In this view the reverse loops of the threads are indicated at C^1 and C^2. The longitudinal wales are designated by the spaces D between adjacent longitudinal lines, and the transverse courses of stitches are indicated by the spaces between the adjacent transverse lines. It will be seen that in the form of machine disclosed the reverse loops C^1 and C^2 will be of equal length and each equal to the length of a fabric stitch due to the fact that the cam 58 is proportioned to shift the nozzle block 46 at the formation of each course of stitches.

The form of the invention shown in Fig. 8 is similar generally to that above set forth, and the form of knitting machine to which this form is applied is also similar to the knitting machine above described. It should be observed, however, that the type of machine disclosed in Fig. 8 is of a larger size than the other, and is adapted for knitting a larger size tubing. Parts of the machine disclosed in Fig. 8 corresponding to similar parts of the previous embodiment are designated by the same reference numerals, respectively, with the addition of the index *a*. It will, therefore, be unnecessary to describe at length this form of knitting machine as the general construction and operation thereof will be understood by those skilled in the art. However, it will be observed that there are eight cop supports 25^a, and eight fabric threads A leading therefrom, respectively, to a corresponding number of thread guiding plates 34^a attached to the dial cam plate 33^a.

In this form the bracket plate 44^a, for supporting the nozzle supporting blocks 46^a, extends entirely around the needle cylinder 17^a, and it may be supported upon said needle cylinder as described above. The bracket plate 44^a may be constructed in a plurality of sections or it may extend continuously around the needle cylinder. Also there are a number of the nozzle blocks 46^a supported for lateral sliding movement upon the bracket plate 44^a. The nozzle block operating levers 51^a are pivoted as before to the bracket support, and mounted thereon are rollers 56^a adapted for cooperation with and operation by the operating cam 58^a which is mounted upon and rotates with the cam cylinder 18^a. In the present case the levers are held in position for cooperation with the cam 58^a by a horizontal cam surface 70 positioned for contact with the operating rollers 56^a. When the rollers are in contact with the cam surface 70 the respective levers are maintained in position for engagement and cooperation with the inclined part of the cam 58^a when it comes into operative position, and the corresponding nozzle blocks 46^a are maintained by their springs in their right-hand operative positions.

The additional or decorative threads C are shown as being distributed around the needle cylinder so as to form a plurality of spaced two-thread stripes. The decorative threads are supported by a plurality of spools 61^a carried by the bracket bar 60^a attached to the frame 15^a of the knitting machine. The spools 61^a are disposed circumferentially of the machine on the bracket bar 60^a for proper distribution of the decorative threads.

The thread-guiding plates 34^a, as in the form of machine previously described, are equally spaced circumferentially upon the rotary dial cam plate 33^a and secured thereto. In the present case, however, there are eight of these thread-guiding plates, and therefore their angular spacing from center to center will be about 45°.

In the form of machine shown in Fig. 8 there are two of the cams 58^a spaced apart 180° each extending circumferentially about 45°; that is, the circumferential extent of

these cams is about equal to the angular distance between adjacent thread-guiding plates 34^a. There are, therefore, two of the horizontal cam surfaces 70 separated at both ends thereof by the cams 58^a. The cam surfaces 70 are consequently equally spaced, each being about 135° in circumferential extent, or about equal to the angular space occupied by three of the spaces between adjacent thread-guiding plates 34^a. The nozzle block operating levers 56^a will therefore remain lowered, and the corresponding nozzle blocks will remain in their right-hand operative position during formation of three successive stitches in each wale; that is, three courses of stitches will be formed with the guiding nozzles positioned to guide the decorative threads C to the right side of the respective wales, and consequently during this period there will be no entwining of the decorative thread with the fabric stitches.

The effect of this operation is to apply a unique decorative effect to the fabric as represented in Fig. 11 in which a fragment G of fabric is depicted diagrammatically, as explained above in connection with Fig. 7. As shown in Fig. 11, this method of applying the threads C results in formation of the balloon stitch H, which is particularly effective in lending a unique and attractive appearance to the fabric. It will be clear from Fig. 11 that the balloon stitches H jump or extend in continuous free stretches over three adjacent courses F of stitches. The oppositely disposed loops 1 of the thread C, corresponding to the loops C^2 of Fig. 6, extend over the length of but one of the courses F, thus forming a short stitch which is inconspicuous as compared with the long balloon stitches H. These balloon stitches, therefore, accomplish the major part of the decorative effect as applied to the fabric.

The ballooning, or lateral curving away from the wales, of the long stitches H is caused largely by the tension imposed constantly upon the fabric tube B by operation of the take-up device as set forth above. Due to this tensioning the tube B is stretched longitudinally while the threads C are not tensioned to any considerable extent as they pass from the spools 61^a. There may be some tensioning of the thread C, but it is slight as compared to the tensioning of the fabric tube B. The result of these conditions, when the longitudinal tension upon the fabric tube is relieved, is that the fabric shrinks in longitudinal extent to a greater degree than the longitudinal shrinkage of the long decorative stitches, causing the latter to bulge laterally away from the wales to which they are attached. It will be obvious that the degree of ballooning of the stitches may be varied by varying the tension of the decorative thread C. It will be clear also that the grouping or spacing of the stripes may be varied as above mentioned to change the pattern or form of stripe applied to the fabric.

For the purpose of further varying the decorative figure applied to the fabric, another modification of the invention is disclosed diagrammatically in Fig. 9, depicting a nozzle block operating cam, and in Fig. 10 showing a plane development thereof. This form of cam may be applied to a type of knitting machine such as shown in Fig. 8, and above described. This cam 71 has a cam face 72, a cam face 73 spaced therefrom, and two cam faces 74 and 75, positioned between and separating the other two cam faces. For facilitating disclosure, the cam is shown as divided into a plurality of circumferentially disposed zones or spaces S^1 to S^8, inclusive, separated by vertical dot-and-dash lines, and each representing a cam arc of 45°. Each of the cam faces 72, 73, 74, 75, is positioned and adapted for contact with the cam rollers 56^a of the operating levers, as shown in Fig. 8, and to cooperate therewith to operate the nozzle blocks 46^a.

The cam face 72 is positioned at a low level, the cam face 73 at an intermediate level, and the cam faces 74 and 75 are both at the same high level above the other cam faces. Also the cam faces 72 and 73 are substantially 135° in extent, while cam faces 74 and 75 are substantially 45° in extent. An inclined cam face 76 is interposed between the faces 72 and 74, corresponding to the inclined cam face 59 disclosed in Fig. 3, for cooperation with the lever operating rolls, while an inclined cam face 77 is interposed between faces 73 and 75 for a similar purpose.

It will now be clear in view of the disclosure given above in connection with Fig. 8, that when cam 79 rotates in the direction indicated by the arrows in Figs. 9 and 10, the cam face 72 cooperates to position the thread C in a certain position relative to the wales during the formation of three successive courses of fabric stitches. The threads C are similarly disposed in another position relatively to the wales by the cam face 74 or 75 during the formation of a single fabric stitch or course, and by the cam face 73 in still another relative position during the formation of three successive fabric courses. The different positioning of the decorative thread C with relation to the wales is due to the different levels of the cam faces of the cam 71 which cooperates to shift the nozzle blocks into different horizontal positions.

This action of the form of cam shown in Figs. 9 and 10 to vary the decorative pattern is shown diagrammatically in Fig. 12 depicting a fragment G of the fabric thus formed. The successive courses of stitches are indicated at F^1, F^2, etc., and the successive adjacent wales are indicated at D^1, D^2, etc., it being understood that the courses are represented by the spaces between adjacent

parallel horizontal lines, while the wales are similarly represented by the spaces between adjacent parallel vertical lines. When the cam face 72 controls the position of the thread-guiding nozzles, the decorative thread is positioned at the left of the wale D′ to form a decorative stitch K. Since the cam face 72 is 135° in extent, or about equal to the rotative movement of the needle operating cam of the machine during the formation of three courses of stitches, as described above in connection with Fig. 8, it is obvious that the stitch K is a long stitch extending over three courses of the knit fabric. Furthermore, in view of the above exposition in connection with Fig. 11, it is obvious that the stitch K is of the balloon type.

The thread-guiding nozzles are next operated by action of the inclined cam face 76 and cam face 74, thus guiding the thread C to the left of the wale D^3, which is the second to the left of the wale D′. Due to the high elevation of the cam face 74, the decorative thread is shifted, not the width of a single wale as described in connection with the previous embodiment, but the width of two adjacent wales. A stitch L is therefore formed of the thread C, which is looped at the left side of the wale D^3, the stitch L being a short stitch due to the limited extent of the cam face 74. At the next step of operation of the cam 71 the decorative thread is controlled to an intermediate position due to the action of the intermediate cam surface 73, the effect being that a stitch is formed at the right side of wale D^3, being a long balloon stitch caused by operation of the long cam face 73. At the next step of operation the cam face 75 comes into action, resulting in the formation of a short stitch L′ looped at the left of wale D^3 in longitudinal alignment with the short stitch L but positioned at the opposite end of the balloon stitch K′. It will, therefore, be seen that the decorative pattern is changed from a simple strip effect as previously described to a zigzag or grapevine ornamentation.

Figs. 9 and 10 disclose one form of cam for embodiment in a machine of the type disclosed in Fig. 8 for varying the decorative pattern imparted by application of the embroidery or decorative thread, but it will be obvious that further variations will readily occur to those skilled in the art, to still further vary the decorative pattern. It will also be clear that the invention is applicable to knitting machines other than the type herein disclosed, for example, a machine which knits a flat fabric, as distinguished from the ribbed fabric herein disclosed.

Since certain changes in carrying out the above process and in the construction set forth, which embody the invention may be made without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a device of the character described, in combination, means for knitting a textile fabric from textile thread, including a needle cylinder and a series of cylinder needles, thread-guiding or positioning means mounted exteriorly of said cylinder needles for movement along the series of needles for positioning one or more additional unknitted textile threads so as to be entwined with the stitches as formed by said needles.

2. In a device of the character described, in combination, means for knitting a textile fabric from textile thread, including a needle cylinder and a series of cylinder needles, thread-guiding or positioning means mounted exteriorly of said cylinder needles for movement along the series of needles for positioning one or more additional textile threads so as to be entwined with the stitches as formed by said needles, cam mechanism for effecting such movement of said guiding and positioning means, and means for automatically varying the movement of said guiding and positioning means so as to cause an additional thread to be entwined with different wales of the fabric in successive courses.

3. In a knitting machine, the combination with mechanism for knitting a textile fabric, including movable knitting needles, and a needle cylinder around which said needles are arranged and guided for longitudinal movement, of a thread-guide mounted outside of said cylinder and needles, a lever adjacent said thread-guide and operatively connected thereto, and a rotary cam cooperating with said lever to move said thread guide in a horizontal plane on its support for guiding a thread first to one side and then to another side of the path of movement of one of said needles.

4. In a knitting machine, the combination with mechanism for knitting a textile fabric, including knitting needles and a needle cylinder around which said needles are arranged and guided for longitudinal movement, of a supporting bar mounted on the outside of said needle cylinder, and extending circumferentially thereof outside of said needles, and a thread-guide mounted for horizontal movement upon said supporting bar circumferentially of the needle cylinder for guiding a thread to the textile being knit.

5. In a rib knitting machine, a needle cyl-

inder, a dial, a plate extending circumferentially about the cylinder and providing a horizontal track, a block slidable on said track, one or more yarn guiding tubes on said block extending adjacent the cylinder needles, a cam rotatable relatively to the cylinder, and connections operable by said cam for moving the block along the track.

6. In a rib knitting machine, a needle cylinder, a dial, a plate extending circumferentially about the cylinder and providing a horizontal track, a block slidable on said track, one or more yarn guiding tubes on said block extending adjacent the cylinder needles, a cam rotatable relatively to the cylinder, connections operable by said cam for moving the block along the track, including a pivoted lever bearing at one end against said block, and a spring acting on said block to return it.

7. In a rib knitting machine, a needle cylinder, a dial, a plate extending circumferentially about the cylinder and providing a horizontal track, a block slidable on said track, one or more yarn guiding tubes on said block extending adjacent the cylinder needles, a cam rotatable relatively to the cylinder, connections operable by said cam for moving the block along the track, including a lever pivoted on said plate, a bar pivoted on said lever and adapted to be operated by said cam, and means whereby the angular relation of said bar and said lever may be varied for changing the throw of the block.

8. In a rib knitting machine, a needle cylinder, a dial, a plate extending circumferentially about the cylinder and providing a horizontal track, a block slidable on said track, one or more yarn guiding tubes on said block extending adjacent the cylinder needles, a plurality of cams of different height rotatable relatively to said cylinder, and connections operable by said cams to move the block along its track.

In testimony whereof I affix my signature.

ROBERT GOULD JENNINGS.