May 26, 1942. A. L. HUTTON, JR., ET AL 2,283,995

KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 1.

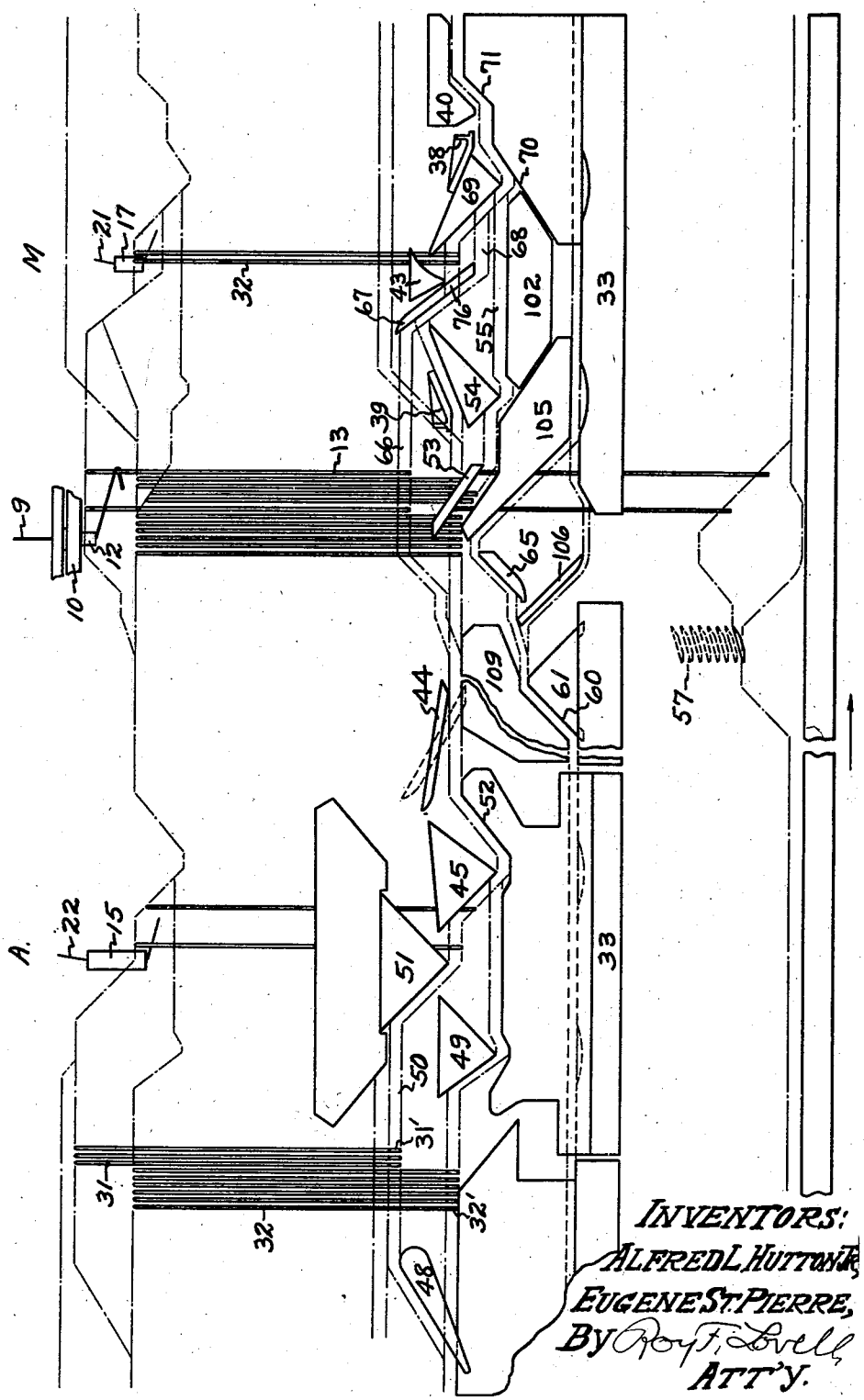

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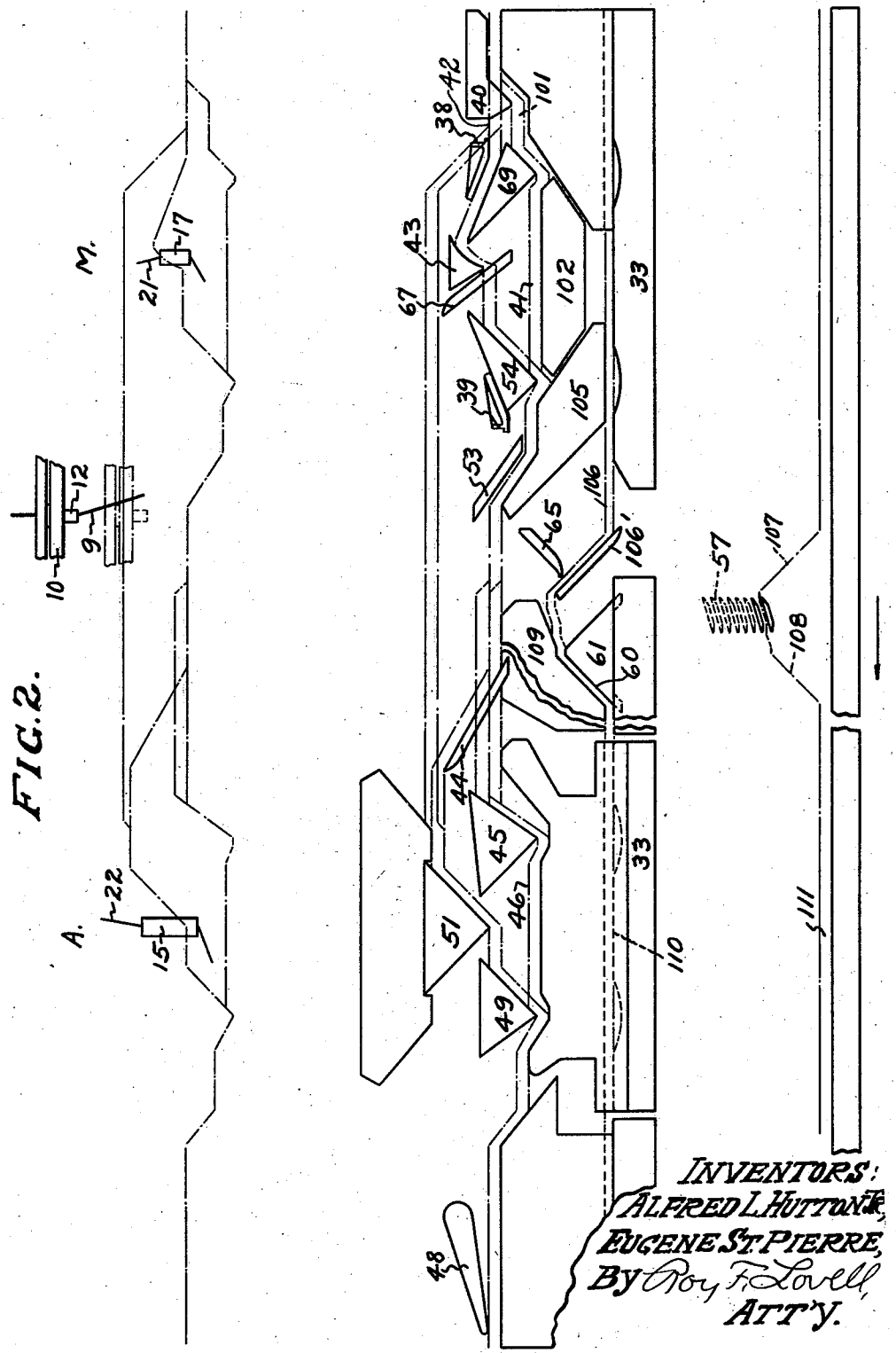
FIG. 2.



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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 3.

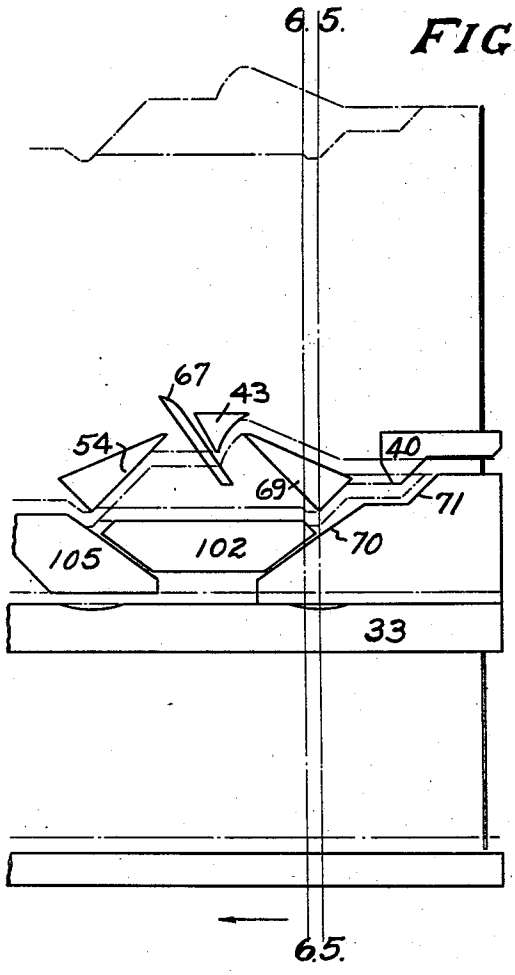


FIG. 4.

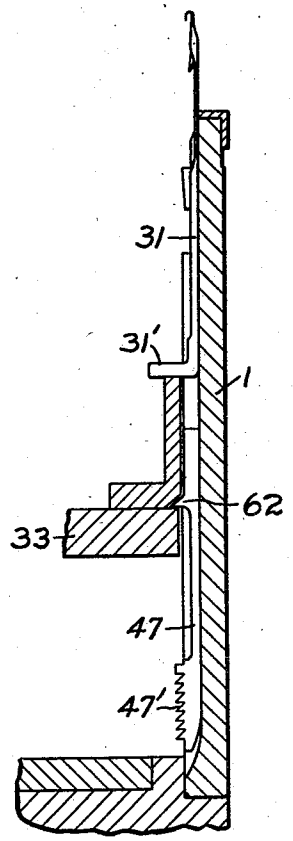


FIG. 5.

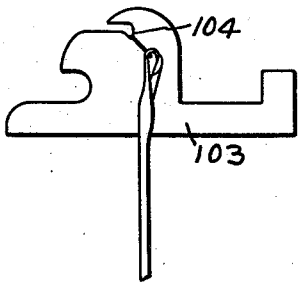
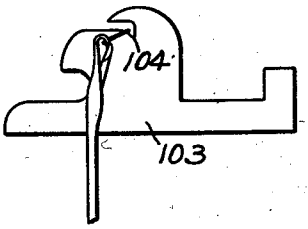


FIG. 6.



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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 7.

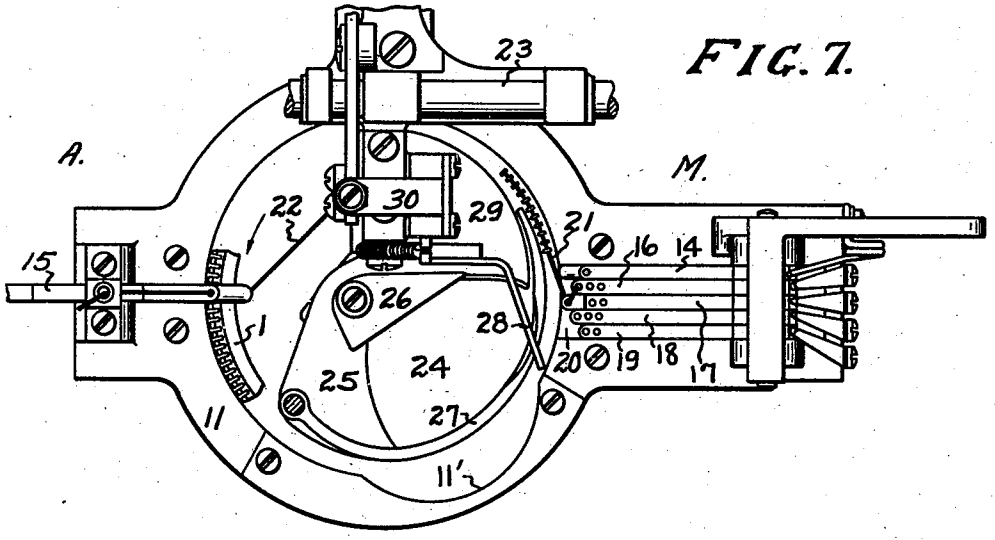


FIG. 8.

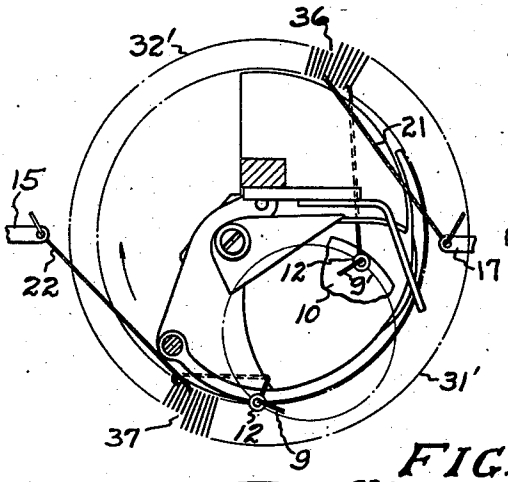


FIG. 9.

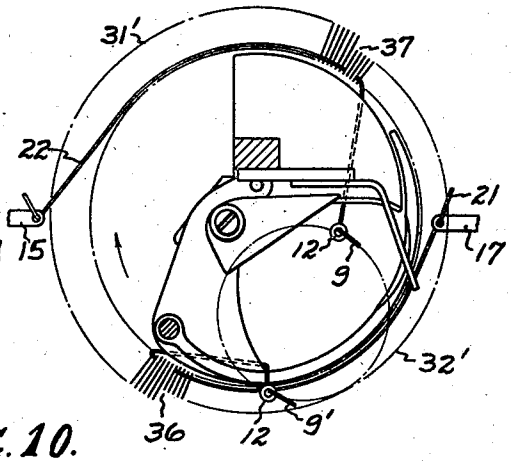
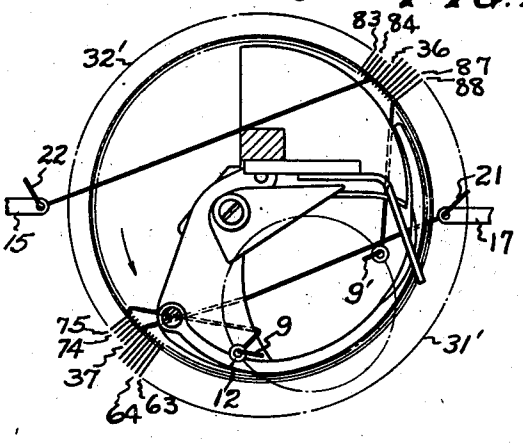


FIG. 10.



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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 11.

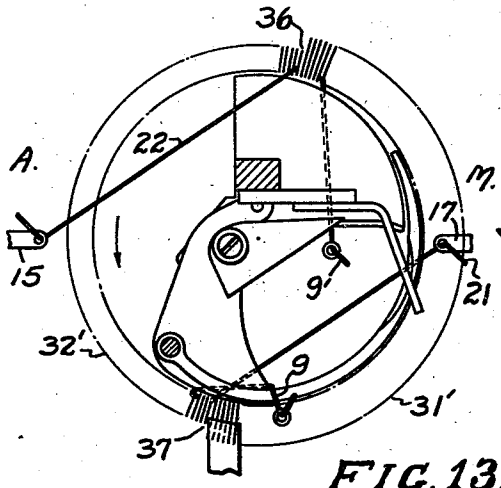


FIG. 12.

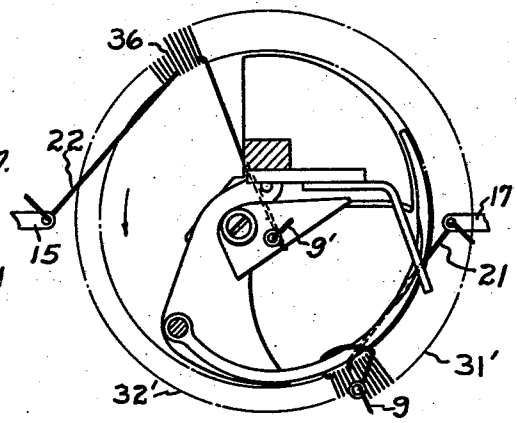


FIG. 13.

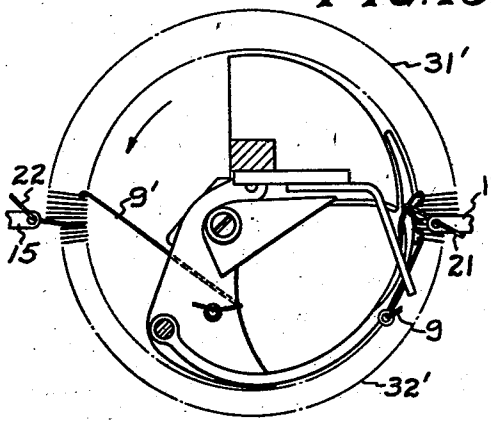


FIG. 14.

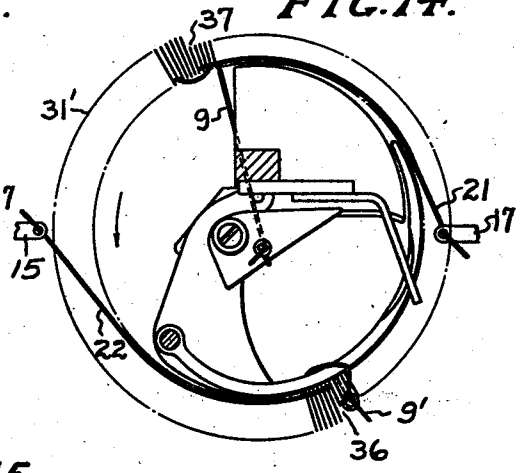
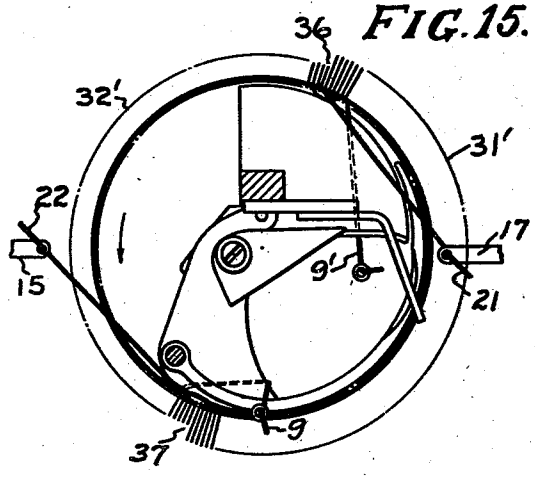


FIG. 15.



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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 16.

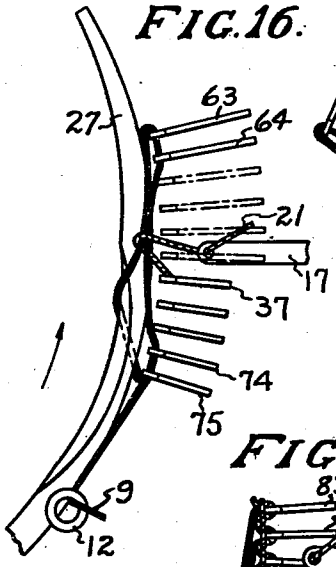


FIG. 17.

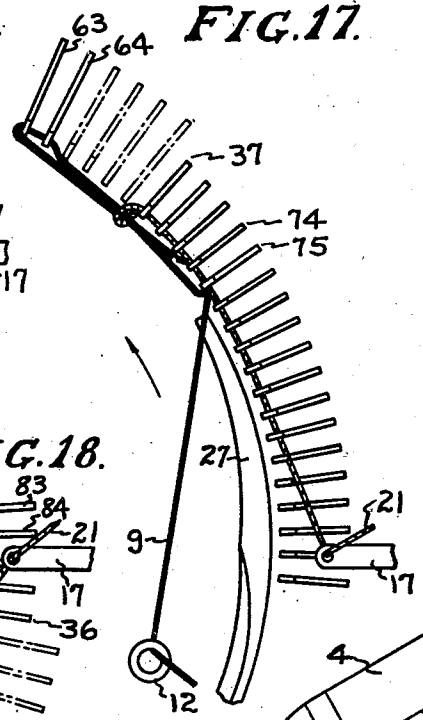


FIG. 22.

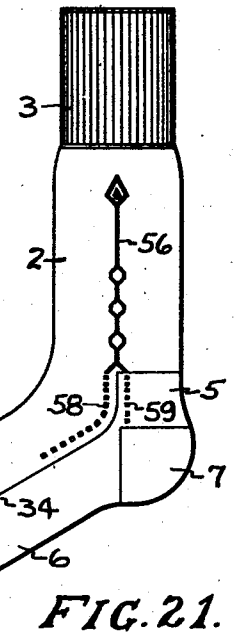


FIG. 18.

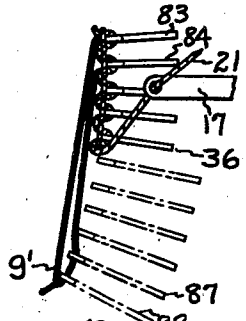


FIG. 19.

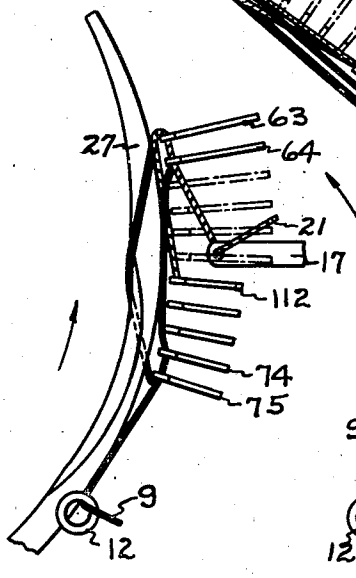


FIG. 20.

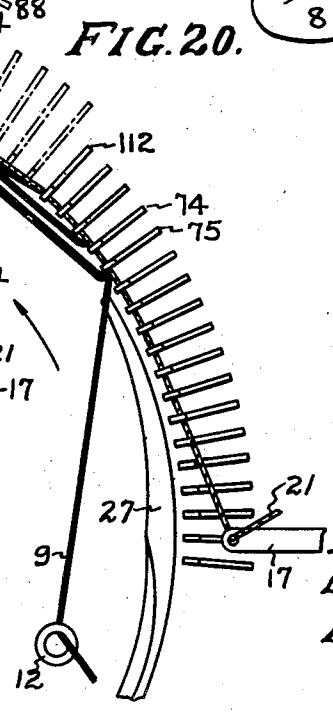
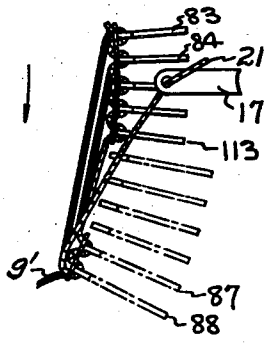


FIG. 21.



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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 23.

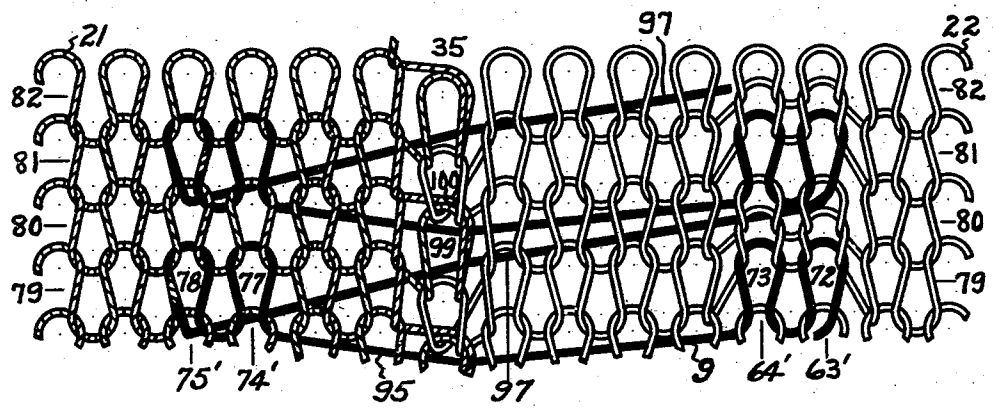
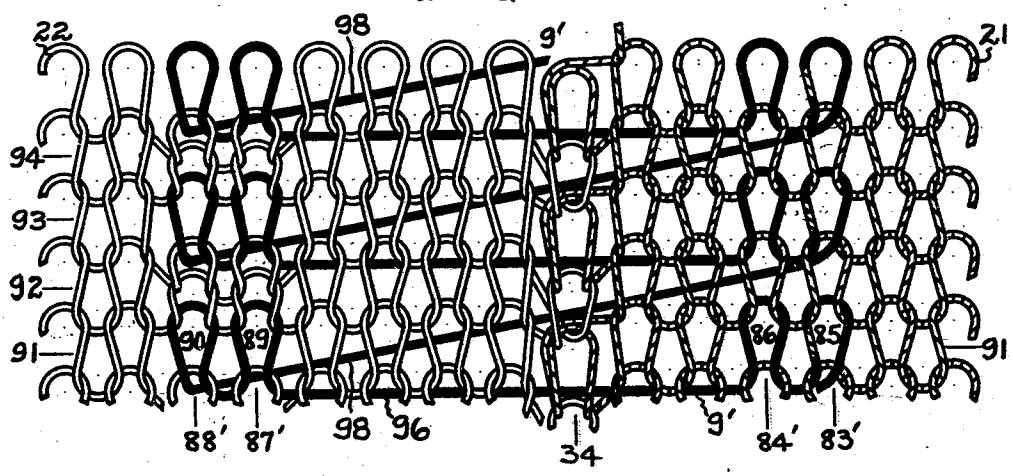


FIG. 24.



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KNITTING MACHINE AND METHOD OF KNITTING

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FIG. 25.

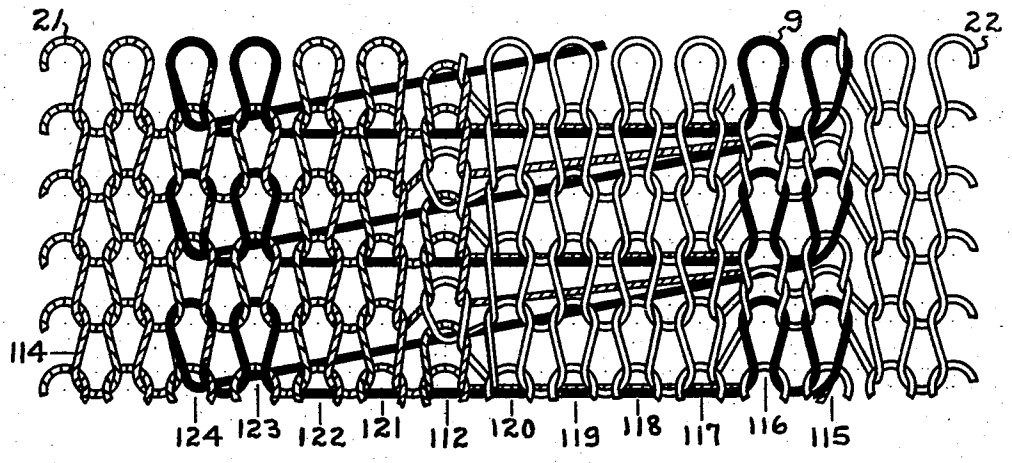
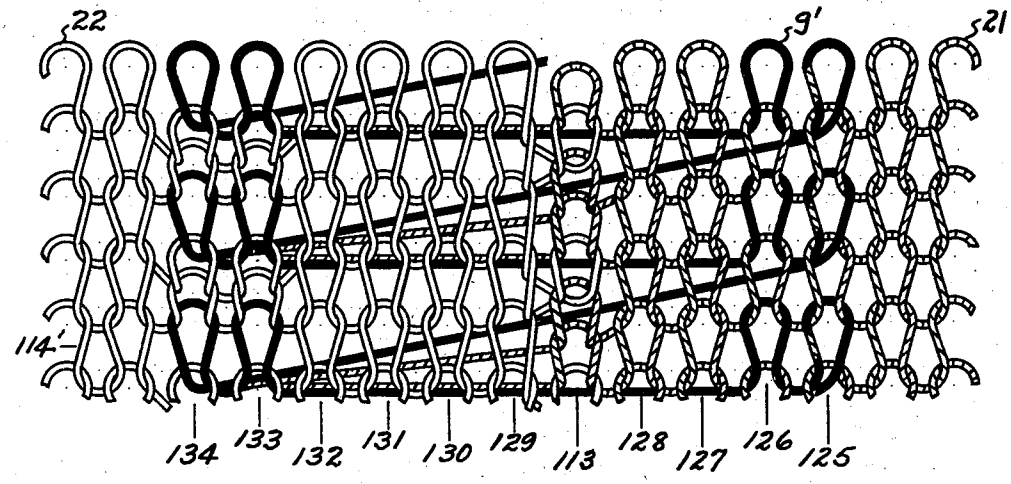


FIG. 26.



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Patented May 26, 1942

2,283,995

UNITED STATES PATENT OFFICE

2,283,995

KNITTING MACHINE AND METHOD OF KNITTING

Alfred L. Hutton, Jr., Lonsdale, and Eugene St. Pierre, Pawtucket, R. I., assignors to Hemphill Company, Central Falls, R. I., a corporation of Massachusetts

Application April 14, 1939, Serial No. 267,830

10 Claims. (Cl. 66—135)

This invention relates to knitting machines, methods of knitting and knitted fabrics. Specifically, the invention is directed to so-called split foot knitting and the wrapping of needles with ornamental threads in the split foot and other courses.

For a more detailed disclosure of one embodiment of split foot knitting that may be practiced, attention is called to the patent to Gagne No. 1,673,764, June 12, 1928. The wrapping of needles as hereinafter to be set forth, is similar to that shown in Lawson Patent No. 1,702,608, February 19, 1929.

In the drawings:

Fig. 1 is a developed view showing cams for effecting the movements of the needles for producing so-called split work courses in which courses at least one wrap thread is knitted, the cams being shown as they would appear from the outside of the knitting machine if the cam ring were removed;

Fig. 2 is a view similar to Fig. 1 showing another phase of the knitting cycle;

Fig. 3 is a view showing cams that control the movements of the needles at the main side of the machine;

Fig. 4 is a sectional view taken through the needle bed and cam ring, and showing a needle and associated jack;

Fig. 5 is a fragmentary view, at the phase of the knitting cycle indicated by line 5—5, Fig. 3, and showing how a specially constructed sinker cooperates with an adjacent needle in preventing the breaking of the yarn or thread when the long needles are again depressed by the cams as they pass through the main feeding station;

Fig. 6 is a view similar to Fig. 5 but showing a later phase of the knitting cycle indicated by line 6—6, Fig. 3;

Fig. 7 is a plan view of a latch ring showing the tops of some of the needles and indicating the knitting of circular courses, i. e., by continuous circular movements of the needle cylinder in the direction of the arrow;

Figs. 8 to 15 inclusive, are plan views showing, more or less diagrammatically, the knitting of a wrap thread in conjunction with split foot knitting;

Figs. 16 to 18 inclusive, are fragmentary enlarged views to supplement the showing in Figs. 8 to 15 inclusive;

Figs. 19, 20 and 21 are similar to Figs. 16, 17 and 18 respectively, but showing a modification;

Fig. 22 is a view showing a stocking, such as a half hose, having an ornamental clocking thread knitted at one side of the stocking both in the circular leg portion and the split foot portion, the clocking being duplicated at the opposite side of the stocking;

Fig. 23 is a view of a few wales and courses of split work fabric, showing both the suture construction and a wrap thread knitted in both fabric sections of the split work fabric, the knitting being accomplished in the manner illustrated in Figs. 8 to 18 inclusive;

Fig. 24 is a view similar to Fig. 23 but showing the suture at the opposite side of the stocking; and

Figs. 25 and 26 are similar, respectively, to Figs. 23 and 24, but of a modified form of fabric resulting from the knitting as illustrated in Figs. 19, 20 and 21 in conjunction with Figs. 8 to 15 inclusive.

The knitting machine disclosed more specifically in the Gagne Patent No. 1,673,764 includes a needle cylinder 1 which, preferably, rotates continuously in the direction of the arrow, Fig. 7, during the knitting of the so-called circular leg portion 2 (Fig. 22) of the stocking which may be joined to the rib or other top 3 in any conventional or other manner. During the split work knitting of the instep 4 and high splice 5 and the said instep and the double sole 6, the needle cylinder 1 reciprocates first in the direction of the arrow, Fig. 7, and then in a clockwise direction. The heel 7 and toe 8 are knitted by reciprocatory movements of the needle cylinder in any conventional or other manner.

The wrapping of selected needles with threads, such as the thread 9, is effected in the manner similar to that shown in Lawson Patent No. 1,702,608, the disc 17 shown therein being to all intents and purposes, the disc indicated at 10, in Figs. 1, 2 and 8 of the drawings. The disc 10 rotates one and one with the needle cylinder 1 in the same manner as disclosed in the said Lawson patent. To accommodate the disc 10, the latch ring 11 is recessed as at 11', Fig. 7, the dot and dash lines of Figs. 8, 9 and 10 indicating the rotary path of the center line of an eyelet 12 through which a thread 9 passes to the needles 13 or rather to those of them that have been selectively elevated as indicated in Fig. 1.

The latch ring 11 is provided with the usual yarn levers, such as 14, 15, 16, 17, 18 and 19, the yarn lever 17 being one of the levers located in the mouthpiece 20 at the main side M of the knitting machine while the yarn lever 15 is located substantially diametrically opposite and at the auxiliary side A of the knitting machine.

During the knitting of the circular leg of the stocking, a yarn 21 passing through the yarn guide 17, alone is being knitted and by all of the needles, an auxiliary yarn 22 passing through guide 15 at such time, being retained in a yarn clamp as indicated in Fig. 7. During the knitting of split foot portions of the stockings, the yarn 21, and yarn 22 are simultaneously knitted and at opposite sides of the knitting machine and as shown more or less diagrammatically in Figs. 8 to 15 inclusive.

At 23 are indicated generally fragmentary parts of the knitting machine pertaining particularly to the clamping and cutting mechanism. As the details of this mechanism form no part of the present invention, further description thereof will be omitted.

As more fully disclosed in Lawson Patent No. 1,702,608, the wrap threads, such as 9, are confined within a recess 24, within the latch ring, and defined by plates 25, 26 and fingers 27, 28. These parts are all supported by the usual so-called binder plate 29 upon which is also mounted the clamping and cutting mechanism 30, the said mechanism 30 being connected to the latch ring 11.

In one embodiment of the invention, the leg 2, heel 7, and sole 6 are knitted from yarns, such as 21, fed to the needles at the main side of the machine, whereas the instep 4 is knitted from the yarn 22 fed to the needles at the auxiliary side of the machine.

The instep 4 of the stocking is knitted on the long butt needles, some of which are shown at 31, Fig. 1, the said long butt needles having butts 31'. The high splice 5, sole 6, heel 7, and toe 8 are knitted by the short butt needles some of which are shown at 32, Fig. 1, the said short butt needles having butts 32'. The long butt needles are controlled by cams at the auxiliary side A of the machine and the short butt needles are controlled by cams at the main side M of the machine, all the said cams being mounted upon a split cam ring 33. At each end of the short butt needle series is located a suture needle which alternately knits first at the auxiliary feeding station A and then at the main feeding station M, the knitting by the so-called suture needles causing the respective fabric sections knitted by the long butt needles 31 and by the short butt needles 32 to be connected to form tubular fabric, as disclosed in Gagne Patent No. 1,673,764.

Referring particularly to Figs. 8 to 15 inclusive, long butt needles 31 are indicated by their butts 31', said needles knitting the thread 22 at the auxiliary side of the knitting machine during the knitting of split work portions of the fabric. The short butt needles 32 at the same time knit the thread or yarn 21 at the main side of the knitting machine. To effect the knitting of split work portions of a fabric, the needle cylinder 1 reciprocates thereby carrying the needles past the threads 21 and 22 and cams pertaining to the main and auxiliary feeding stations. The needle cylinder, in its reciprocations, rotates through approximately 390 degrees of circumference, the beginning of the rotation in a clockwise direction being indicated at Fig. 8 and the end of the circumferential movement of the needle cylinder being indicated at Fig. 10, the arrows indicating the direction in which the needle cylinder is about to move. The suture needles which alternately knit the threads 21 and 22 to form the sutures 34, 35, are at the end of the short butt series being designated by the numerals 36 and 37, respectively and their alternate knitting of the threads 21 and 22 is controlled in part by means of picks 38 and 39 as will be hereinafter more fully described.

When the needles move from the position indicated in Fig. 8, through that of Fig. 9, to that indicated in Fig. 10, the long butts 31' of the needles 31 are engaged and depressed by the cam 40, Fig. 2, the said butts moving along the path indicated by the dot and dash line 41, Fig. 2. The short butts 32' of the needles 32, however, are not engaged by the cam 40 and as a consequence thereof the said short butt needles move along the path indicated by the dot and dash line 42, Fig. 2, all of the short butt needles with the exception of the leading short butt suture needle 36 knitting at the main knitting side of the machine, the said needle 36 being engaged by the narrowing pick 38 and elevated above the top center cam 43. The suture needle 37 in the same direction of rotation of the needle cylinder, does not knit at the auxiliary feeding station, all of the short butts of the needles, with the exception of suture needle 36, moving past the long butt elevating, rocking cam 44, engaging the cam 45 and being lowered to move along the path 46, indicated by dot and dash lines in Fig. 2. Continued rotation of the needle cylinder in the direction of the arrows, Figs. 8 and 9, and from the position shown in Fig. 9 to that shown in Fig. 10, causes the suture needle 36 to move past the auxiliary cams and as the cam 44 does not engage the short butt needles, the said suture needle 36 is not elevated by the said cam 44, since needle 36 is at a raised elevation anyway. Jacks 47, Fig. 4, have one or more selective butts 47'. As stated, the suture needle 37 does not knit at the auxiliary feeding station when moving from position of Fig. 8 to that of Fig. 9, but continued rotation of the needle cylinder from the position shown at Fig. 9 to that shown at Fig. 10, causes the said suture needle 37 to knit the yarn 21 at the main side of the knitting machine, the knitting of the thread 21 by the suture needle 37 being normal, all of the short butt needles then knitting at the main side of the knitting machine.

Upon the needle cylinder reversing its direction of rotation and moving from the position indicated in Fig. 10 to that of Fig. 15, the suture needle 36 does not knit the yarn 22 at the auxiliary feeding station, the said needle 36, in common with all other short butt needles, missing the cam 48, Fig. 1, and being depressed by the cam 49. At about the same time the suture needle 37 is engaged by the pick 39 and elevated above the top center cam 43 so as not to knit at the main feeding station. Continued rotation of the needle cylinder causes the suture needle 36 to knit the yarn 21 at the main feeding station. The suture needle 37, when passing the main cam block, is elevated to pass over that cam block so as to knit the yarn 22 at the auxiliary feeding station. That needle may be raised either by the front narrowing pick or by one of the jacks 47. For some reasons it is better to employ one of the jacks for this purpose since selection for wrapping makes it desirable to withdraw the front pick away from the needle cylinder when the wrap stripe mechanism is working. For that reason jacks 47 may be employed to raise the needle 37 to knit at the auxiliary side in these counterclockwise strokes.

The long butt needles 31 are elevated by the cam 48 which engages their butts 31', which then

move along the horizontal path 50 until they engage the top center cam 51 which moves the long butt needles to a position to engage the knitting cam 45. In their movement past the cams 51 and 45, the long butt needles 31 engage and knit the yarn 22. The lower portion of the cam 45 which is at the level of the short butt needles, further depresses said needles. All needles then move up cam 52, tipping the cam 44, as indicated in Fig. 1. The butts 31' of the long butt needles then engage the cam 53 which depresses the said long butt needles 31, their butts then moving along a horizontal path until they engage cam 54 which causes the butts 31' to move along a low path 55 and at such a level that the hooks of the long butt needles do not engage the yarn 21.

The foregoing brief description of the operation of the needles to effect the knitting of split fabric is descriptive of the knitting of the instep 4, high splice 5, and double sole 6, and is more completely disclosed in Gagne Patent No. 1,673,764.

The knitting of wrap stripes in a circular portion of the leg 2 to produce a clocked design 56, as shown in Fig. 22, is effected in the usual manner, i. e., by causing selected ones of the jacks 47 to be elevated by selectively positioned cams 57 acting upon butts 47', in a manner similar to that shown in Lawson Patent No. 1,702,608, February 19, 1929, and in McNaughton Patent No. 2,058,481, October 27, 1936.

When commencing reciprocatory knitting, to effect the wrapping of long and short butt needles in the areas 58 and 59, Fig. 22, long and short butt needles are elevated by cams 57 selectively engaging butts 47' to raise needles companion to the said jacks 47, as just described, and during regular or anti-clockwise movements of the needle cylinder, i. e., in the direction of the arrow in Fig. 10. Prior to engagement of the butts 47' (Fig. 1) by cams 57, the leading edge 60 of cam 61 engages butts 62 (Fig. 4) of all the jacks moving them to such position that their butts 47' may be selectively engaged by cams 57.

The knitting of the wrap stripe split foot portion of the fabric will now be described with especial reference to Figs. 8 to 15, 23 and 24.

To knit the fabric adjacent to and including the suture illustrated in Fig. 23, and beginning the cycle of operations to be described with the needle cylinder about to rotate from the position shown in Fig. 10 in an anti-clockwise direction, long butt needles 63, 64 which knit wales 63', 64', having been selectively elevated by cams 57 and cam 65, move along the path indicated by dot and dash lines 66, Fig. 1, and past the wrap thread 9, being wrapped in a manner similar to that shown in Lawson Patent No. 1,702,608. The needles then continue to move along the path 66 until they are engaged by cam 67 which depresses them to the level 68 so as not to engage the main yarn 21. Continued rotation of the needle cylinder causes the said long butt wrap needles 63, 64 to be further depressed by the cam 69 and then elevated by means of the cam surfaces 70, 71 of the cam ring 33 as indicated at the right of Fig. 1. The described movement of the wrap needles 63, 64 causes them, alone of the long butt needles, to draw stitches 72, 73, Fig. 23, through stitches knitted by the said needles 63, 64 with the yarn 22 during the knitting of the previous course at the auxiliary side of the machine, said previously drawn loops having been cleared of the needle latches by reason of their elevation to the wrap taking level by the cam 65, Fig. 1. Continued rotation of the needle cylinder in the direction of the arrow, Fig. 10, causes short butt needles 74 and 75 to engage the wrap thread 9. The short butt needles 74, 75 are elevated in the manner hereinbefore described with respect to the needles 63 and 64 and continued rotation of the needle cylinder causes the short butts of the said needles 74, 75 to be engaged by the cam 67 and moved only to the level of the short butt needles 32, Fig. 1, the cam 67 being cut away as indicated by the shoulder 76 to avoid moving the short butts to the level 68. The partial depression of the short butt needles permits them to engage the main yarn 21, the cam 69 then completing the stitch drawing movements of the said needles 74, 75 which draw bights of the main yarn 21 as well as of the wrap thread 9 through previous course loops as indicated by the stitches 77, 78 in the wales 74', 75' knitted respectively by the needles 74, 75.

The knitting of the yarn 21 by the short butt needles and the knitting of the loops 72, 73 by the long butt wrap needles 63, 64, as just described, is supplemented, upon continued rotation of the needle cylinder, from the position illustrated in Fig. 13 to the position illustrated in Fig. 15. During this phase of the knitting cycle, the long butt needles knit the yarn 22 at the auxiliary side of the machine for the course 79, the knitting of that portion of the course 79 proceeding from right to left in the direction of the arrow, Fig. 23, the needles 63, 64 drawing bights of the yarn 22 through previously drawn wrap loops 72, 73.

Upon the needle cylinder reversing its direction of rotation and moving from the position of Fig. 8 to that of Fig. 10, i. e., in a clockwise direction, the course 80 is knitted, the knitting proceeding in the direction of the arrows, Fig. 23. At the main side of the machine, the short butt needles (Fig. 23) and including the short butt suture needle 37, knit the yarn 21, the needles 74, 75 drawing bights of the said yarn 21 through loops 77, 78 of the wrap thread 9 and simultaneously drawn loops of the yarn 21 of course 79. Simultaneously with the knitting of that portion of the course 80, the long butt needles, Fig. 8 to Fig. 10, knit the yarn 22 at the auxiliary side, the knitting of that portion of the course 80 likewise proceeding in the direction of the arrow, Fig. 23. During the knitting of this portion of the course 80, the long butt needles draw bights of the yarn 22 through previously drawn loops, the needles 63, 64 drawing their respective bights or loops of the yarn 22 through loops, which loops were, in turn, drawn through wrap loops 72, 73, as just described. The knitting of the following course 81 corresponds to the knitting of the course 79, and likewise the knitting of the course 82 corresponds to the knitting of the course 80, the described knitting of the courses 79, 80, thus completing a cycle of operations of the knitting of that portion of the fabric illustrated in Fig. 23.

The knitting of wrap stripes at the side of the stocking illustrated in Fig. 23, has just been described and the knitting of that side of the stocking illustrated in Fig. 24 will now be described. It will be understood that partial courses illustrated in Fig. 23 correspond to partial courses illustrated in Fig. 24, in other words, during one complete reciprocation of the needle cylinder in one direction, a complete circle of courses is knitted with two body yarns, the opposite sides of the fabrics knitted by the respective yarns 21

and 22 being connected along suture lines 34 and 35 by the alternate knitting of suture needles 36 and 37 respectively.

A wrap thread 9' is shown in Fig. 24 as being knitted itno the fabric in a manner corresponding to that just described with reference to Fig. 23. Short butt needles 83 and 84, Fig. 10, are first fed with the wrap thread 9', rotation of the needle cylinder in the direction of the arrow, Fig. 10, causing the short butt needles 83, 84 to be selectively elevated by a cam or cams 57, the needles then engaging the cams at the main side of the knitting station in the same manner as hereinbefore described with respect to the needles 74 and 75, the short butt needles 83 and 84 then engaging the main yarn 21 and drawing loops or bights 85, 86 in the wales 83', 84' respectively, of the yarns 9' and 21 through previous course loops of the body yarn 21. Continued rotation of the needle cylinder in the same direction, causes long butt needles 87 and 88 to engage the wrap thread 9, the said needles drawing loops 89, 90 respectively through previous course loops of the yarn 22. The loops 85, 86, 89 and 90 thus become part of course 91, the knitting of which occurs in the direction of the arrow. The course 91 is, in effect, a continuation of course 79. Said course 91 also includes the knitting of a partial course with the main thread 21 by the short butt needles and the knitting of a partial course of a thread 22 by the long butt needles, the suture needle 36 during this course knitting the thread 21. Upon the needle cylinder reversing its direction of rotation to knit the course 92 in the direction of the arrow, Fig. 24, the needles 88, 87, 84 and 83 knit in that order, needles 88, 87 drawing bights of the yarn 22 through loops 90 and 89, in other words, the needles 88 and 87 knit during this stroke of the needle cylinder in the same manner as the other long butt needles. The needles 84 and 83 knit the yarn 21 in the usual manner drawing bights of the same through loops 86 and 85 respectively, each of which consists of loops of the wrap thread 9' and of the main yarn 21. During this stroke of the needle cylinder, the suture needle 36 knits the yarn 22. The knitting of the following courses 93, 94 corresponds to the just described knitting of the courses 91 and 92, in other words, the knitting of the courses 91 and 92 constitutes a knitting cycle.

In the wrap areas of each suture, as illustrated in Figs. 23 and 24, the long and short butt wrap stitches are connected by floats 95 and 96 during the same reciprocating movement of the needle cylinder and the knitted courses are connected by more or less diagonally disposed floats 97 and 98, each float 97 extending from the last short butt wrap stitch of one course to the first long butt wrap stitch of a following course. Each float 98 extends from the last long butt wrap stitch of one course to the first short butt wrap stitch of a following course. At the side of the fabric, illustrated in Fig. 23, floats 95 and 97 pass to the back of the fabric but between a loop 99 and the half loop 100 formed by the yarn 21 upon reversal of the direction of the movement of the needle cylinder. The floats 96 and 98 at the side of the fabric, illustrated in Fig. 24, pass to the back of the fabric entirely free of the fabric loops.

When wrapping in the split work, Fig. 23, the floats of the wrap yarn are tied in at the suture because the suture needle is raised to pass over the main cam block since it is the leading short butt needle. That suture needle is in the middle of groups of needles which take the wrap yarn and incidentally is raised to a greater height than wrapping needles so that the wrap yarn passes below the latch of the said suture needle. When that needle is drawn down later the wrap yarn float is cast over the back of the needle but is tied in as illustrated. The wrap pattern which is knitted as in Fig. 24 does not have the float tied in since the suture needle intermediate the wrap needles is not raised to pass over the main cam block. It merely passes along at a low level going under that cam block. Wrapping takes place only in counterclockwise strokes of the cylinder so that the tying in of floats is always associated with that side at which the suture needle is raised to pass over the main cam block.

The cams 45 and 49 at the auxiliary side of the machine, are somewhat higher than the corresponding cams 69 and 54 at the main side of the machine and as a consequence thereof the short butt needles which are caused to knit by the cams 69 and 54, are depressed to a greater extent than are the long butt needles which are caused to knit by the depressing action of the cams 45 and 49. As hereinbefore described, some of the long butt needles, e. g., 63 and 64, are wrapped with a thread, such as 9, said needles then moving along the path 66 to be engaged and depressed by the cam 67, then moving along the path 68 and being engaged by the cam 69 to effect the drawing of the stitches, such as 72 and 73, and through previous course loops of thread 22. Upon reversal of the needle cylinder, as illustrated in Fig. 2, the long butt wrap needles 63 and 64 are engaged by the cam 40 and caused to move along the path 101 being then further depressed by the cam 69 to engage a rise on the cam 102 which causes the butts of the long butt needles 64, 63 to move along the path 41 and then in the direction of the auxiliary cam where all the long butt needles knit.

When the long butt needles 64 and 63 move in the direction just described and as indicated in Fig. 2, the point of the cam 69 causes the said needles 64 and 63, which have bights of the wrap thread 9 in their hooks, again to move to what may be termed stitch drawing position thus imposing a strain upon the wrap loops of stitches, such as 72 and 73. While the said needles 64, 63 are moving in the direction indicated in Fig. 1, the point of the cam 69 depresses the said needles to the same extent but at such time the wrap thread 9 is being drawn from the source of supply and such drawing imposes no undue strain on the stitches 72, 73, but when the needles 64 and 63 move in the direction from the right to the left, as indicated in Fig. 2, the point of the cam 69 imposes a breaking strain on the stitches 72, 73 and especially upon the stitch 72, because of the fact that said stitch 72 cannot draw thread from the source of supply, the stitch 73 being between the stitch 72 and the supply of the thread 9. Furthermore, stitches 77, 78 are between stitches 73, 72 and the source of supply of thread 9. In connection with the preceding remarks, it is noted that when needles draw their stitches in an independent needle machine of the type herein disclosed, the stitch cam, such as 69, causes the needles to be depressed to an extent beyond that which would be required for drawing the desired length of stitch, the extra movement of the needles causing each needle to rob from the needle immediately in advance as the latter moves up the other side of the cam 69. It is thus

evident that when the needle 63 is again depressed by the cam 69 when moving in the direction indicated in Fig. 2, the additional strain upon the stitch cannot be compensated for by robbing. What has been said with respect to the wrap stitches applies to some extent also to the stitches drawn by all the long butt needles at the auxiliary feeding station when they pass through the main feeding station and are depressed by the cam 69.

It is for the purpose of avoiding the breaking of wrap and other stitches or loops that the specially constructed sinkers 103, illustrated in Figs. 5 and 6, are used. The sinkers 103 are each provided with a notch 104 which (when the long butt needles, such as the wrap needles 64, 63, move in the direction indicated in Fig. 2 and are again depressed by the cam 69) permits the wrap or other stitches to rest in the said notches 104, as illustrated in Fig. 5, thus avoiding the necessity of, in effect, redrawing the stitches and imposing such a strain on the stitches as to break them. In Fig. 5, the relative positions of the needle and sinker are shown at the point of the knitting cycle indicated by the line 5—5, Fig. 3, while in Fig. 6 the relative positions of the needles and sinkers are shown at the point of the knitting cycle indicated by the line 6—6, Fig. 3, the needle having been elevated and the sinker retracted as compared with respective positions of the needle and sinker shown in Fig. 5.

Elevation of the needles from the position shown in Fig. 5 to that shown in Fig. 6, is effected by the cam 102 which causes the needles to be elevated slightly so that butts of the needles shall move along the path of the needles at 41. The slight elevation of the long butt needles relieves continued strain upon the stitches to avoid more or less permanent distortion of the stitches and thus improves the appearance of the fabric by making the loops uniform in length.

When the long butt needles move from the right to the left as indicated in Fig. 2, they are elevated by cam 105 passing between the same and the cam 53 then being elevated by the movable cam 44 to a position to engage the top center cam 51 which depresses the needles to a position to be engaged by cam 49. Coincidental with the movement of the needles in the direction from the right to the left, Fig. 2, the jack butts 62 move along a horizontal path 106 being elevated by cam 106' which causes the saw tooth butts 47' of the jacks 47 to be elevated along an inclined path coincidental with and parallel to the path indicated by the dot and dash line 107, Fig. 2, so as to pass between such of the cams 57 as may be in a forward position, the saw tooth butts being then depressed as indicated by the line 108, by the cam 109. The butts 62 and the saw tooth butts then move, respectively, along the horizontal paths 110 and 111. Upon reversal of the direction of the needle cylinder, the cams 57 selectively elevate the jacks 47 and as a consequence thereof permit the selective wrapping of the selected needles as well as to perform other functions common to machines of this character.

In Figs. 16, 17 and 18, the wrapping of the needles is more or less diagrammatically illustrated. Figs. 16 and 17 illustrate the wrapping of the needles on each side of the suture 35, having reference to Fig. 23. The needles 63, 64, 74 and 75 knit the wrap thread 9 in that order, the wrap thread floating across the intervening needles. Although the yarns 21 and 22 are both knitted by some of the needles illustrated in Fig. 16; for convenience, the yarn 21 only has been shown in Fig. 16, said yarn being knitted by the suture needle 37 and two short butt needles between the said suture needle 37 and needles 74, 75. Fig. 16 also illustrates the fact that the yarn 21 passes around the wrap thread 9. Fig. 17 is similar to Fig. 16 but illustrates the knitting cycle at a later phase and as the wrap thread 9 is about to be drawn off the tip of finger 27.

Fig. 18 is illustrative of the fabric structure shown in Fig. 24, the wrap thread 9 being knitted by the needles 83, 84, 87 and 88, in that order, and floating across intervening short and long butt needles including the suture needle 36. A main yarn 21 is shown as being knitted by five short butt needles including the needles 83, 84 and the suture needle 36. Yarn 22 is omitted from Fig. 18, said yarn does not wrap around wrap thread 9' as in Fig. 16.

The arrows in the respective Figs. 16 and 17 indicate the direction of rotation of the needles, the direction of knitting being in the direction reverse to that indicated by the arrow. In Fig. 18, the arrow represents the direction of rotation of the needles.

In Figs. 25 and 26 is shown a modification of the stocking fabric illustrated in Figs. 23 and 24. In Figs. 23 and 24 the suture is formed at each side of the stocking, or other fabric, at a single wale, e. g., wale 35, Fig. 23; likewise in Figs. 25 and 26 there are single-wale sutures 112, 113. In Fig. 25 the main yarn 21 is shown as being knitted in course 114 at wales 115, 116, then floating across wales 117, 118, 119 and 120, being knitted at suture wale 112 and as the body fabric at wales 121, 122, 123 and 124, the knitting proceeding in that order. In the suture at the other side of the stocking, as illustrated in Fig. 26, the main yarn 21 in course 114' (a continuation of course 114) is shown as being knitted at wales 125, 126, 127 and 128 to constitute the body fabric, being likewise knitted at wale 113. The said yarn 21 then floats across wales 129, 130, 131, 132, being again knitted at wales 133 and 134. At wales 115, 116, 123, 124, 125, 126, 133, 134, the main yarn 21 is knitted together with the wrap thread 9, i. e., in the course 114. As illustrated in Figs. 25 and 26, the long floats of the yarn 21 across the mentioned wales, are free on the inner face of the fabric, not being held as at the wale 35, in Fig. 23.

In Fig. 23, the wales 74', 75' are formed of single loops of the yarn 21 interknitted with double loops of the said yarn 21 and a wrap thread 9 in course 79, whereas at wales 63', 64' single loops of the wrap thread are drawn through single loops of the thread or yarn 22. Course 79, however, is composed of an extra loop by reason of the method of knitting hereinbefore described, there being three loops at wales 63', 64' for every two loops in the adjacent wales and in wales 74' and 75'. The foregoing also applies to Fig. 24, the wales 83', 84' corresponding to 74', 75' and the wales 87', 88' corresponding to the wales 63', 64'.

In Figs. 25 and 26, the wales 115, 116, 133, 134 have three loops for two loops of the other wales. The wales 123, 124 and 125, 126 are identical in construction with the wales 74', 75' and 83', 84' respectively.

Figs. 19, 20 and 21 are similar to Figs. 16 to 18 inclusive, being, however, illustrative of the knitting of the fabric sections illustrated in Figs. 25 and 26. Fig. 19 shows the wrap thread 9 being knitted by the needles 63, 64, 74 and 75 in

that order, wrap thread 9 floating across the wales knitted by the intervening needles including the suture needle 37. The body yarn 21 is shown as knitted by the needles 63, 64, the said yarn 21 floating across the wales knitted by seven intervening long and short butt needles, the said yarn 21 then being knitted by the needles 74, 75, in this form of the invention, all the wrap needles knitting both the wrap thread 9 and the yarn 21.

Fig. 20 is similar to Fig. 17, being illustrative of a later phase of the knitting cycle than that illustrated in Fig. 19.

Fig. 21 is illustrative of the fabric suture shown in Fig. 26. In said Fig. 21, a wrap thread 9' is shown as being knitted by needles 83, 84, 87 and 88 in that order, said wrap thread floating across the seven wales knitted by intervening long and short butt needles including suture needle 113. Although both body yarns 21 and 22 are knitted by some of the needles diagrammatically illustrated in Fig. 21, for convenience, the thread 21 alone is shown, said yarn being indicated as knitted by the needles 83, 84, the suture needle 113 and the two short butt needles between said suture needle and the needle 84. The yarn 21 floats across the wales knitted by the four long butt needles located between the suture needle 113 and the needle 87, the said yarn being knitted by the needles 87 and 88 in that order.

Specific terms have been used in the description for illustrative purposes only, there being no intention thereby of limiting the invention to the precise details of construction disclosed.

We claim:

1. A knitting machine adapted to reciprocate to knit split work, said machine having two feeding stations and means for feeding a yarn to the needles at each feeding station, means for knitting each of the two yarns upon portions only of the needles and connecting the two knitted portions along suture wales, means for feeding a thread to needles upon opposite sides of a suture.

2. A knitting machine adapted to reciprocate to knit split work, said machine having two feeding stations and means for feeding a yarn to the needles at each feeding station, means for knitting each of the two yarns upon portions only of the needles and connecting the two knitted portions along suture wales, means for feeding a thread to needles upon opposite sides of a suture and floating the same across the suture.

3. A circular knitting machine having independent needles, two feeding stations and means for feeding a yarn to a portion only of the needles at each feeding station, means for connecting the fabric portions along a suture wale, and means for wrapping a thread around selected needles at opposite sides of a suture wale and floating said thread across the suture wale.

4. A knitting machine of the circular, independent needle type having in combination two feeding stations and means for feeding yarn to needles at each feeding station, means for so controlling needles as to cause them to knit one yarn at one side of the fabric and the other yarn at the opposite side and to interlock these sides of the fabric knitted from separate yarns by knitted sutures, and means for feeding a wrap thread to certain selected needles, some of said selected needles being positioned at one side of each knitted suture and others of said needles being positioned at the other side.

5. A knitting machine of the circular, independent needle type having in combination two feeding stations, needles, cam means for causing said needles to knit at each feeding station and feeding means for feeding one yarn at one station and another yarn at the other station, said cam means being so constructed as to cause part of the needles to knit at one station and the remaining needles at the other station and to interknit yarns fed at each station to form knitted sutures at either side of the fabric, means for feeding wrap threads to selected ones of the needles at either side of the fabric, the construction being such that said wrap means will feed a wrap thread to a group of needles some of which are positioned at one side of a knitted sture and others of which are positioned at the opposite side of said suture.

6. A circular, independent needle knitting machine having in combination needles, two feeding stations and yarn feeding means at each feeding station, cam means at each feeding station adapted to cause needles to knit one of said yarns during continuous rotation of the needles in one direction and to knit both yarns, one at each side of the fabric, and to connect said yarns knitted at opposite sides of the fabric by knitted sutures during reciprocatory movement of said needles, wrap thread feeding means operable during both rotary knitting and reciprocatory knitting and being so constructed and operated as to feed its wrap threads at each course during rotary knitting, and to courses knitted in one direction of reciprocation but to needles at either side of each knitted suture during reciprocation.

7. A circular, independent needle knitting machine having in combination needles, two feeding stations and yarn feeding means at each station, cam means at each feeding station, adapted to cause needles to knit one of said yarns during continuous rotation of the needles past the feeding stations in one direction and to knit both yarns, one at each side of the fabric, and to connect said yarns at opposite sides of the fabric in knitted sutures during reciprocatory movement of said needles, wrap thread feeding means including an eccentrically mounted wrapping spindle carrying supplies of wrap threads and feeding means therefor operable during both rotary knitting and reciprocatory knitting and being so constructed and arranged as to feed its wrap threads at each course during rotary knitting, and to courses knitted in one direction of reciprocation.

8. A method of reciprocatory knitting including the steps of wrapping needles with a pattern thread, subsequently feeding a body yarn to said needles and then passing said needles through stitch drawing cams thereby forming a stitch of said body yarn plated by said pattern thread, and thereafter causing said needles to pass through a second group of stitch drawing cams and while said stitches of body yarn and pattern thread are still held in the hooks of said needles and so controlling said stitches that they are not redrawn to the extent to which they were originally drawn thereby avoiding placing undue strain upon said stitches.

9. A method of knitting in reciprocatory, split foot work and patterning the fabric thus knitted with a wrap stripe pattern including the steps of feeding two separate body yarns, one at either side of a fabric, and connecting said yarns by knitted sutures at opposite sides of the fabric, and at one side of a suture wrapping a wrap thread in such a manner as to plate stitches of

the body yarn, but at the opposite side of the said suture feeding said wrap thread to be drawn into an independently knitted stitch.

10. A circular, independent needle knitting machine having in combination needles, two feeding stations and yarn feeding means at each station, cam means at each feeding station adapted to cause needles to knit one of said yarns during continuous rotation of the needles past the feeding stations in one direction and to knit both yarns, one at each side of the fabric, and to connect said yarns at opposite sides of the fabric in knitted sutures during reciprocatory movement of said needles, wrap thread feeding means including an eccentrically mounted wrapping spindle carrying supplies of wrap threads and feeding means therefor operable during both rotary knitting and reciprocatory knitting and being so constructed and arranged as to feed wrap threads to selected needles during both rotary and reciprocatory knitting.

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