June 25, 1946. O. FREGEOLLE 2,402,744

METHOD OF KNITTING

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FIG.26.

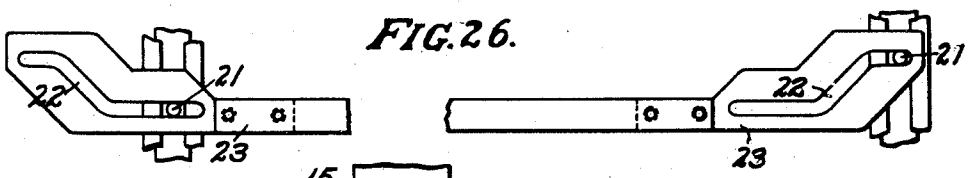


FIG.1.

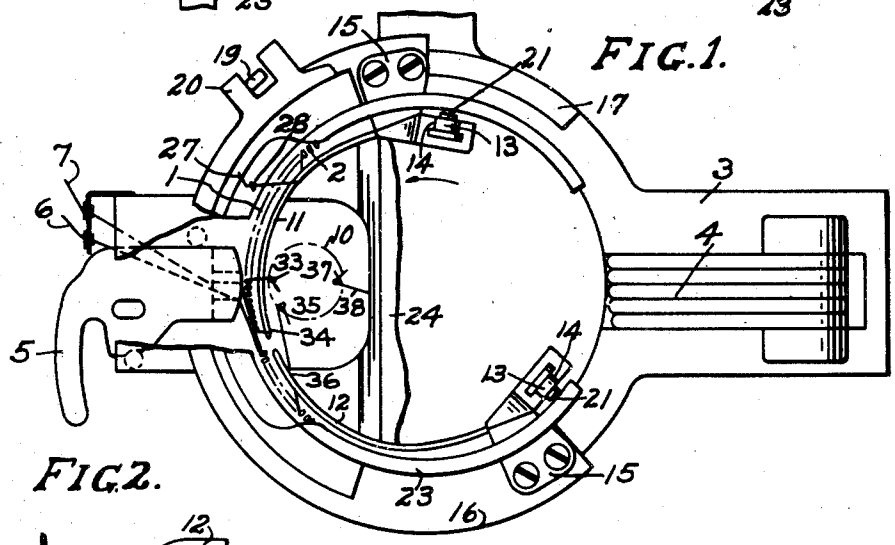


FIG.2.

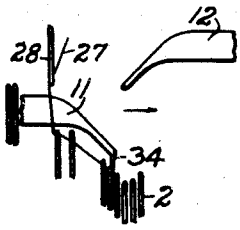


FIG.3.

FIG.21.

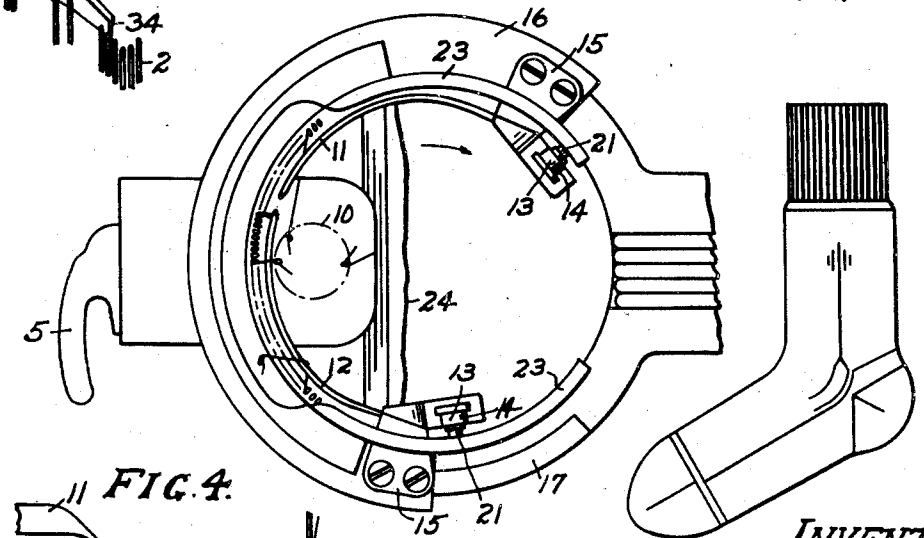
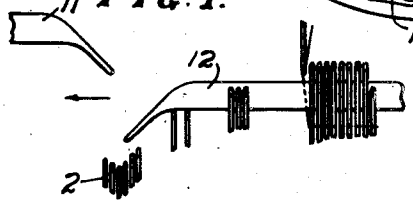


FIG.4.



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FIG. 5.

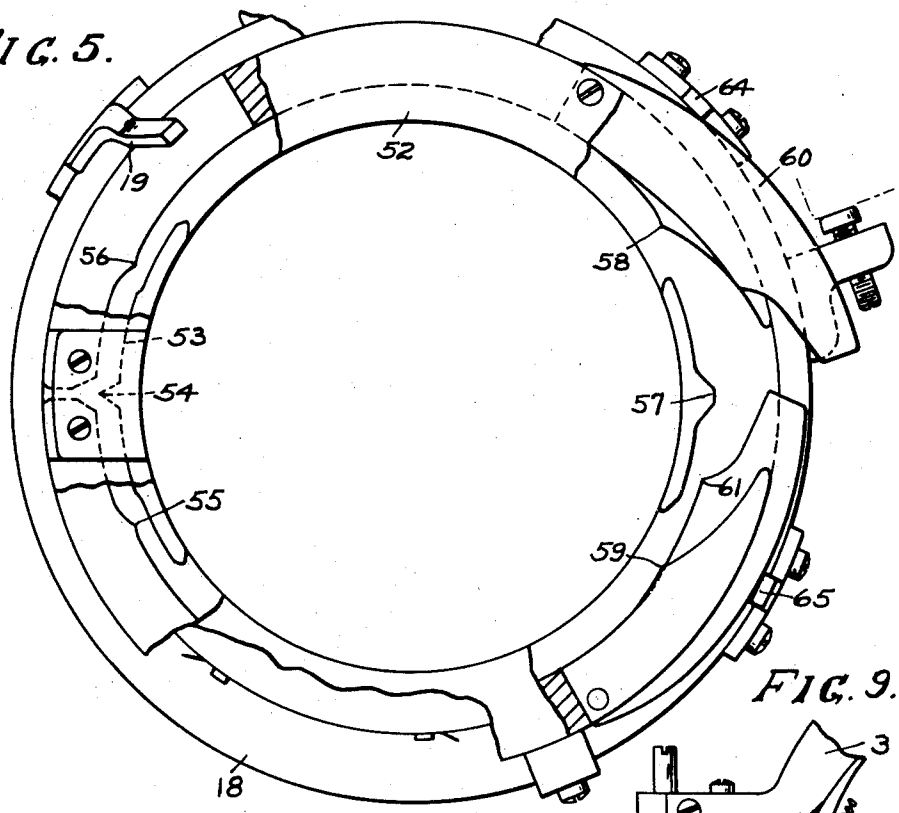


FIG. 9.

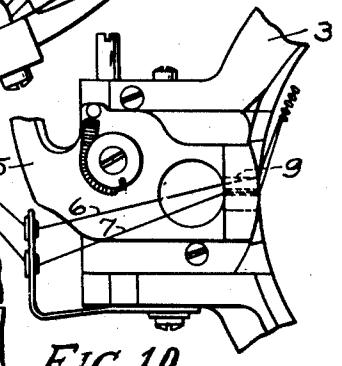


FIG. 6.

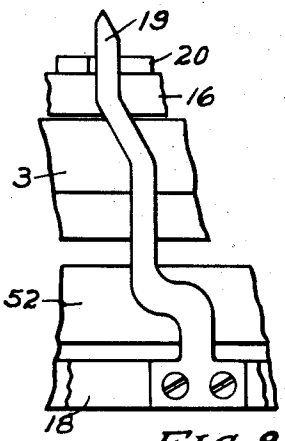


FIG. 7.

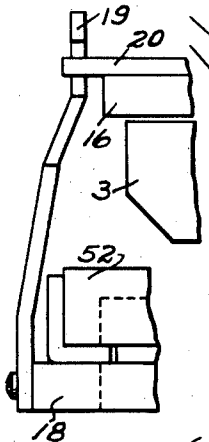


FIG. 10.

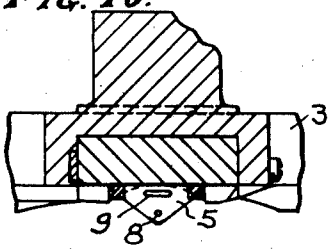
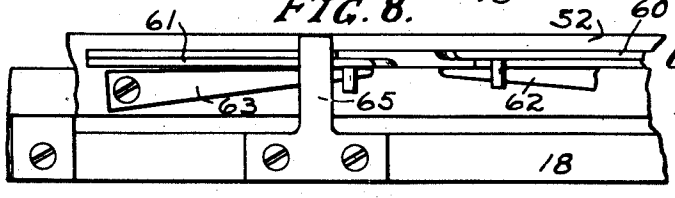


FIG. 8.



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FIG. 13.

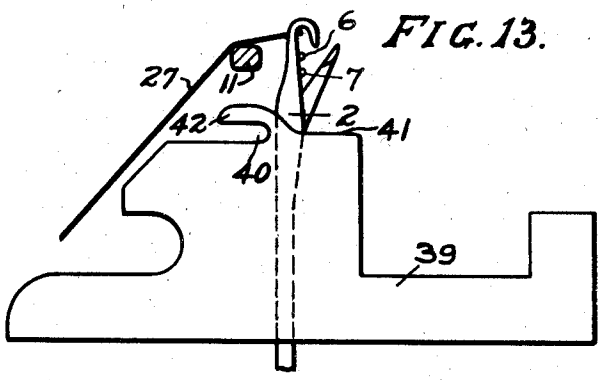


FIG. 12.

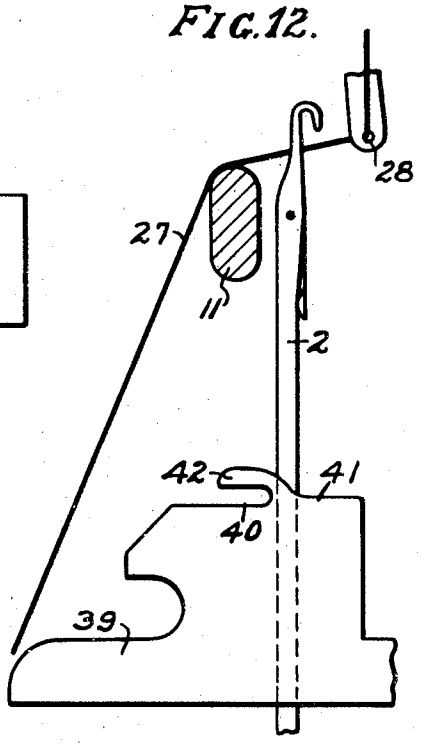


FIG. 14.

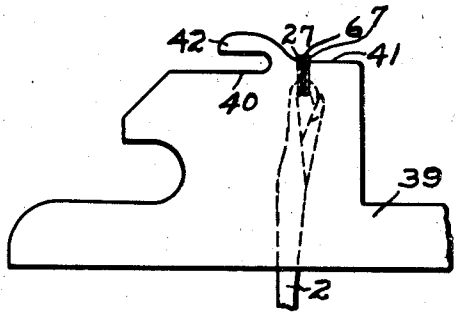


FIG. 15.

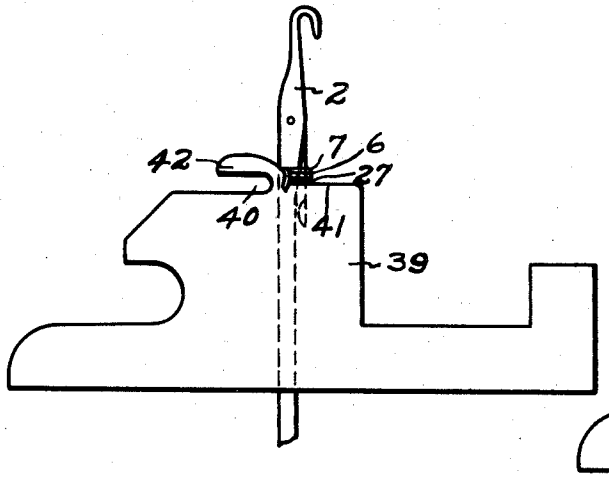
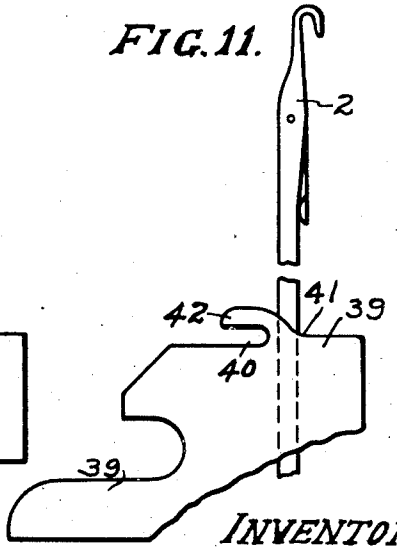


FIG. 11.



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FIG. 16.

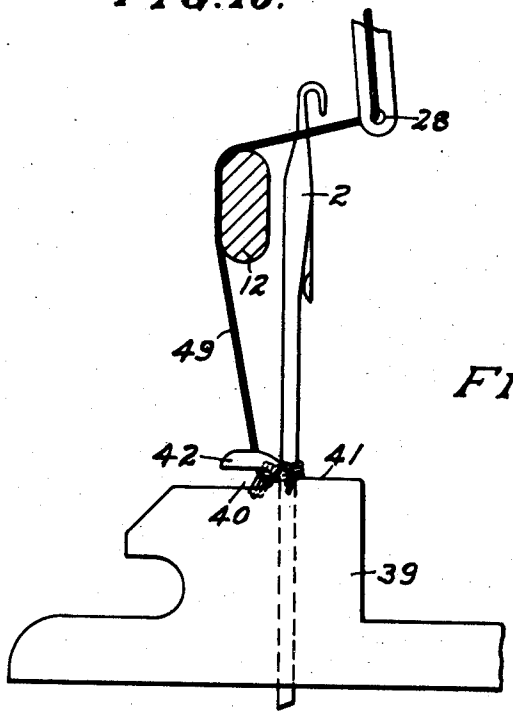


FIG. 19.

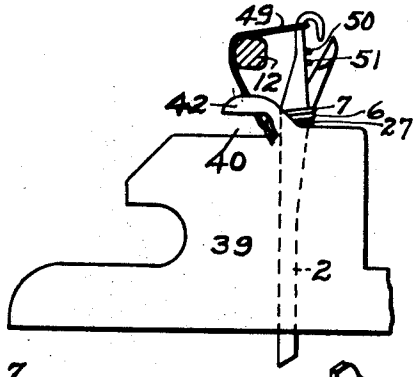


FIG. 17.

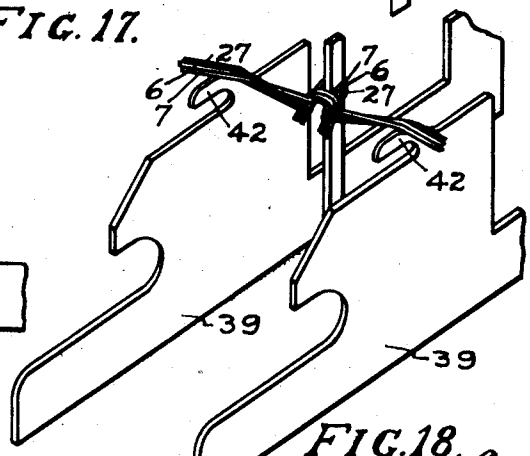


FIG. 20.

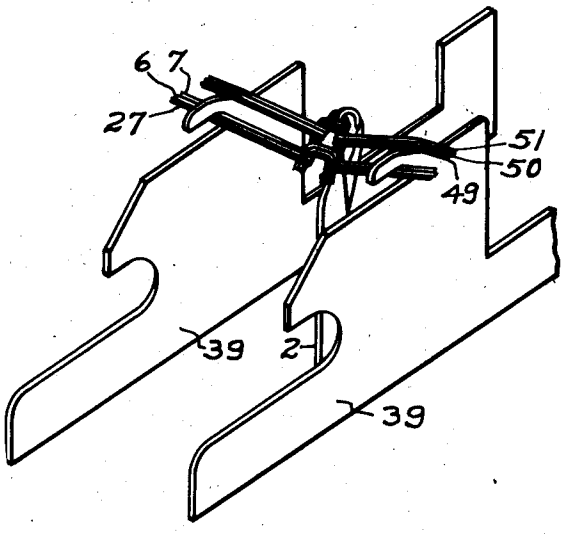
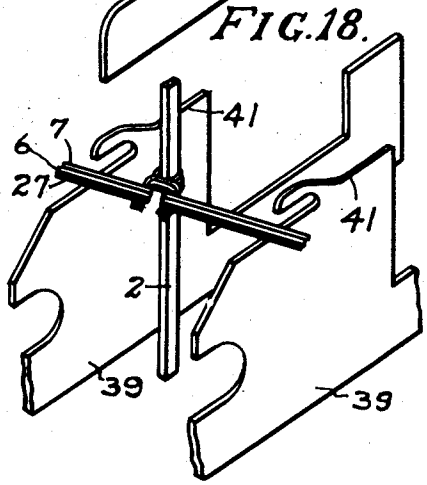


FIG. 18.



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FIG. 22.

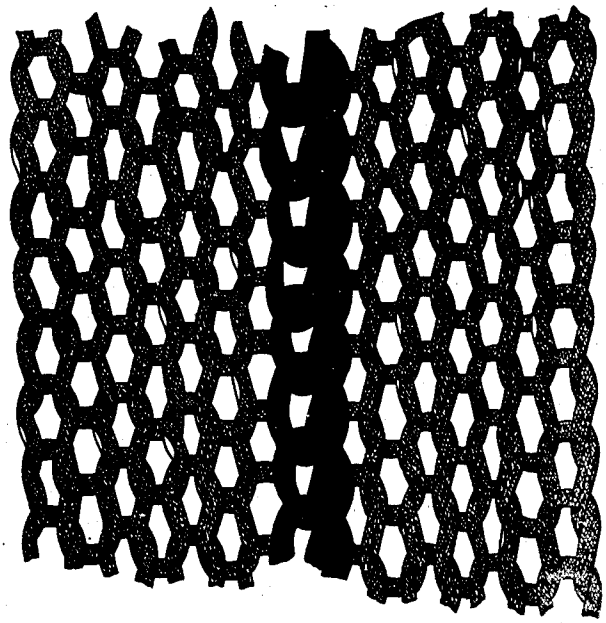
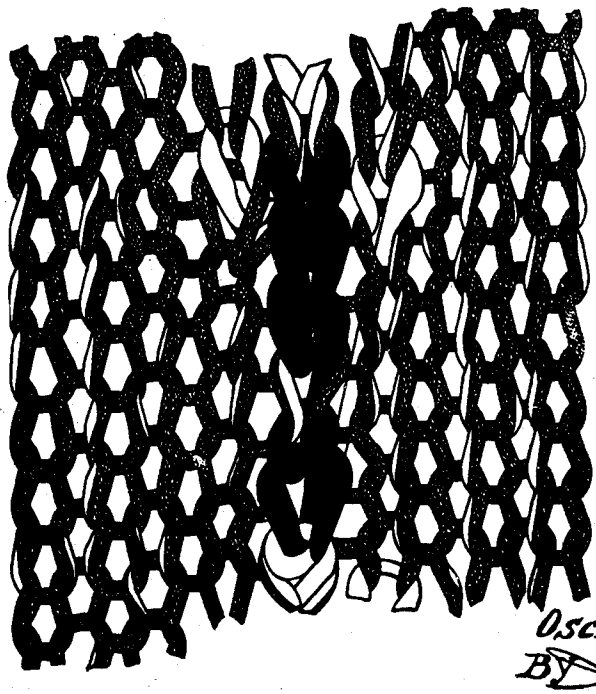


FIG. 23.



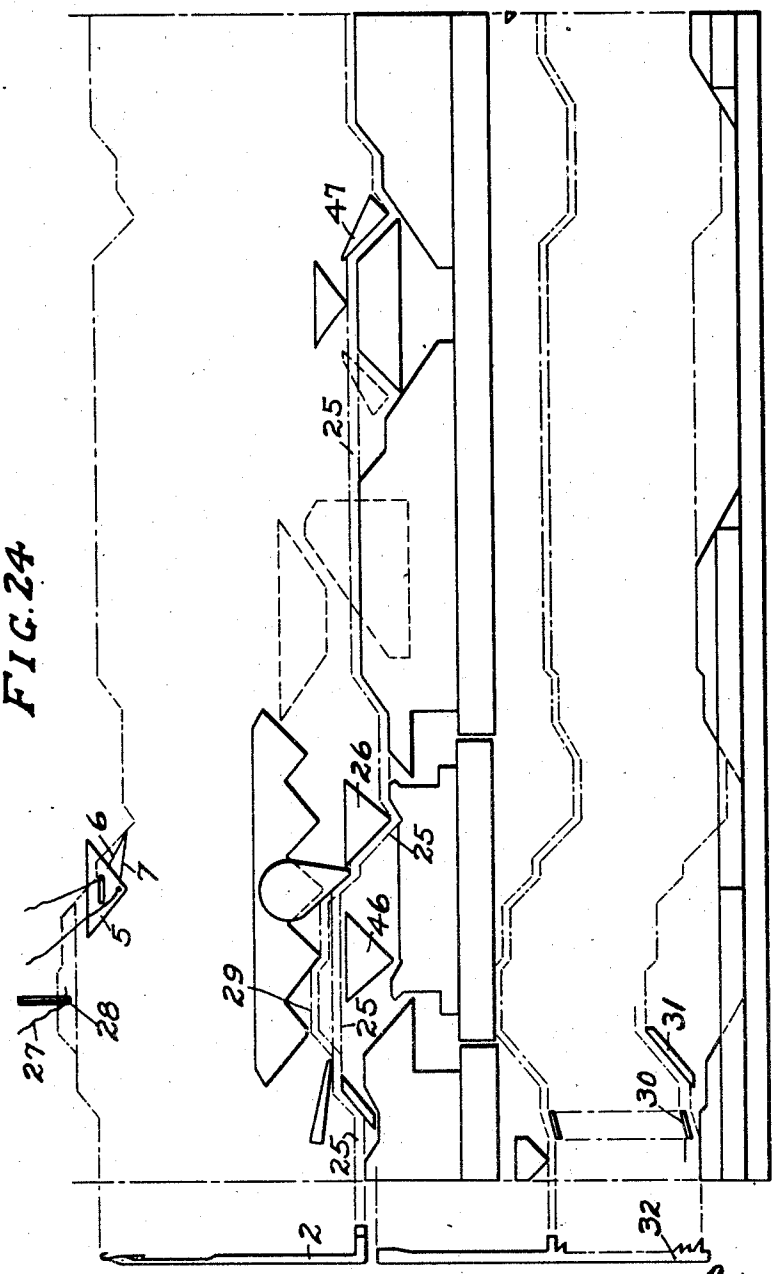
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FIG. 24



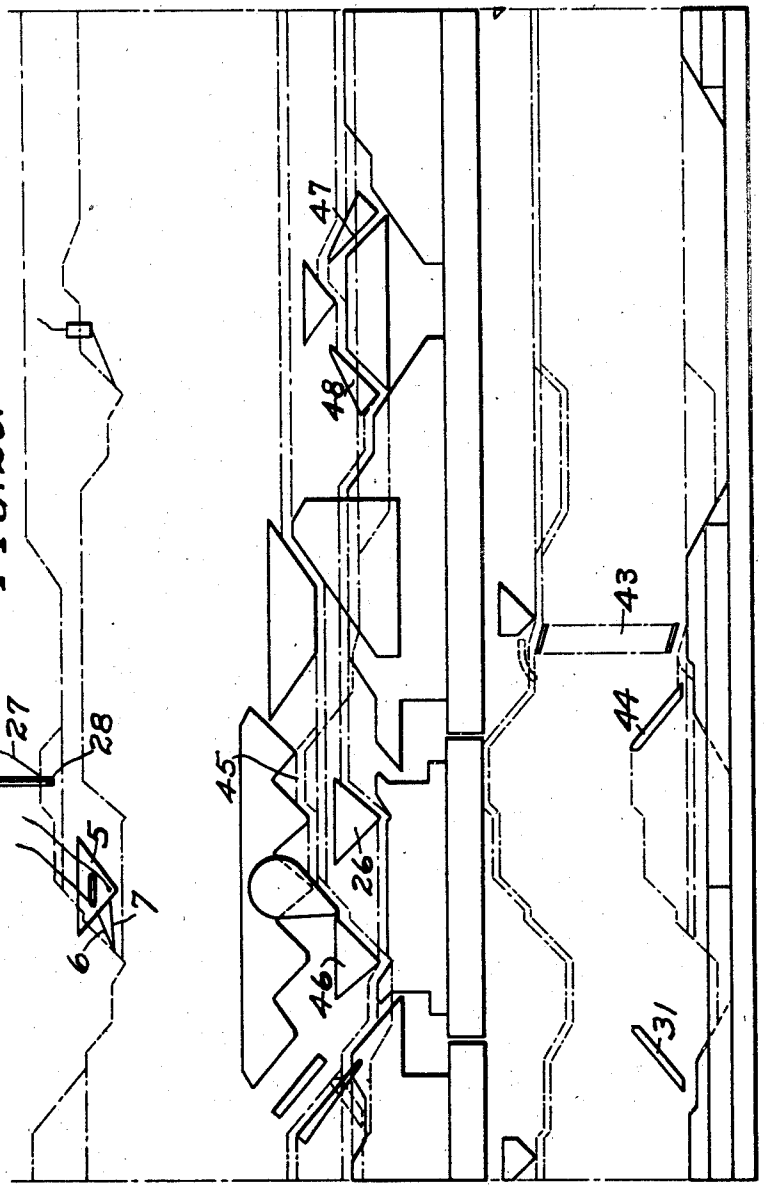
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FIG. 25.



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UNITED STATES PATENT OFFICE

2,402,744

METHOD OF KNITTING

Oscar Fregeolle, Central Falls, R. I., assignor to Hemphill Company, Central Falls, R. I., a corporation of Massachusetts

Application August 12, 1944, Serial No. 549,157

1 Claim. (Cl. 66—136)

1

This invention relates to a new and useful improvement in a method of knitting on machines of the circular, independent needle type to the fabric produced by it and to the mechanism for performing it. It relates particularly to a new method of making plated hosiery fabric by both rotary and reciprocatory knitting.

Although some attempts have been made to plate comparatively coarse gauge split fabric the results were so unreliable that the attempts were abandoned long ago. As far as is known by applicant there have been no plated, split foot stockings of finer gauge, say, from 220 needles up, commercially produced and he is aware of no successful attempts to produce such stockings even experimentally. By the method of knitting of this invention, plated fabric of even finer gauges can be commercially produced the perfection of plating being far superior to anything heretofore made even in the coarser gauges. While the method is more or less similar in some respects to some of the methods heretofore followed, there are important differences which are responsible for the great improvement in the plating.

It has always been difficult to insure that the plating yarn is exactly superimposed upon the body yarn beneath it. This is particularly true in split work and in this work it is particularly true at the beginning of each course. Any deviation from the correct position of the plating loops in relation to the body loops beneath them permits the body yarn, which is generally of a different color, to show through in the form of streaks or mottled patches. In coarse gauge stockings knit of heavy yarns the size of the yarns tend to correct such defects to some extent by their greater covering ability. The finer and more tightly twisted yarns cannot do this so that heretofore it has been considered impossible to produce high grade, fine gauge, split foot plated stockings. In fact, there are no such stockings on the market.

Plated stockings produced by this invention may also be provided with wrap patterns. If they are, these patterns are also more perfect because they are produced by the same or a similar method to that employed for plating and also because the plated fabric, being more perfect, supplies a more perfect base for the wrap pattern. Since wrapping is in itself a form of plating, it is obvious that it will be improved if the underlying loops are more perfect in formation and more perfectly plated.

The accompanying drawings illustrate one

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manner in which the method of this invention may be performed and to some extent, the mechanism for performing it as applied to a machine of the Banner type. Since, as stated, the plated fabric may be ornamented with a wrap pattern the production of which is directly related to the production of the plated fabric, the making of the wrap will be included in this description.

In the drawings:

Fig. 1 is a diagrammatic illustration of a carrier ring for a circular independent needle split foot machine equipped for plating in accordance with the method of this invention and also provided with wrap mechanism. In addition, it illustrates four steps in the process of wrapping in counter-clockwise direction;

Fig. 2 is a fragmentary diagrammatic illustration of the two wrap yarn horns under the conditions assumed for Fig. 1;

Fig. 3 is a view similar to Fig. 1 when the needles are moving in the other or clockwise direction;

Fig. 4 is an illustrative view similar to Fig. 2 showing the relative positions of the two wrap horns under the conditions of Fig. 3;

Fig. 5 is a plan view of one form of sinker head and cam cap;

Figs. 6 and 7 are elevations of part of the same head and cap showing the means for operating the wrap horns;

Fig. 8 is an elevation of part of the same head and cap showing the means for operating the flopper cams shown in Fig. 5;

Figs. 9 and 10 are partial views of the carrier ring showing the auxiliary yarn lever and the method of feeding the body and plating yarn.

Fig. 11 is a diagrammatic view illustrating a needle and sinker before any yarn is taken by the needles;

Fig. 12 is a similar view illustrating a sinker and needle and other associated parts as the needle is about to take a wrap yarn;

Fig. 13 is a similar view after the needle has taken the wrap yarn and is about to receive the plating and body yarns;

Fig. 14 illustrates the manner in which the three yarns are drawn over the back of the sinkers;

Fig. 15 illustrates a further step when the needle has risen so that the three yarns are around its latch;

Fig. 16 illustrates the feeding of the wrap yarn to a needle in the following course which is assumed to be knit in the reverse direction. The previously fed and knit wrap, plating and body

yarns are shown in the throat of the sinker and around the shank of the needle;

Figs. 17 and 18 are views of a needle and two adjacent sinkers showing the manner in which the wrap, plating and body yarns of the course relating to Figs. 1–5 are transferred from the backs to the throats of the sinkers over the tops of the nibs and the relative positions of these yarns;

Fig. 19 represents the taking of a wrap yarn for the second mentioned course. It also shows, as in Fig. 13, its position in relation to the plating and body yarns being fed to the needle;

Fig. 20 illustrates the manner in which the loops of the first course are cast off by the throats of the sinkers acting directly against the yarns of that course. It also shows the yarns of the succeeding course still over the backs of the sinkers;

Fig. 21 is a diagrammatic illustration of a plated split foot stocking having a wrap pattern not only in the leg but in successive courses of the split foot instep;

Fig. 22 is an accurate reproduction of an enlarged projection of actual fabric plated and wrapped in accordance with this invention;

Fig. 23 is a similar reproduction of similar fabric produced on the same make of machine by one of the outstanding quality hosiery mills of the United States as a specimen of the quality of plating and wrapping obtainable by methods now in use;

Fig. 24 is a developed view showing the paths followed by the jacks and needles in rotary or counter-clockwise reciprocatory knitting and also the point at which the wrap, plating and body yarns are fed;

Fig. 25 is a similar view illustrating the paths followed by the jacks and needles during clockwise reciprocatory knitting and also the relative positions of the feeding points of the wrap, plating and body yarns; and

Fig. 26 is a view of the mechanism for controlling the two wrap horns.

As shown in Figs. 1 and 3, the machine is provided with the usual rotatable needle cylinder, indicated by the broken lines 1, complement of needles 2 and carrier ring 3 equipped on the main side with the usual yarn levers 4. On the auxiliary side is another yarn lever 5 for feeding the plating and body yarns 6 and 7, respectively, for the leg and instep. This is mounted on the underside of carrier ring 3 so that these yarns are fed from a lower point than usual and also so that the lever can be moved outwardly radially when the feeding of the plating and body yarn is temporarily discontinued, as when knitting the heel and toe, and so that it can be swung on a pivot to move these yarns completely away from the knitting field whenever the feeding of them is discontinued for longer periods. Mechanisms for imparting these movements to auxiliary yarn lever 5 are not shown since they form no part of this invention.

The inner end of yarn lever 5 may have the construction shown in Figs. 9 and 10 including an eyelet 8 through which the body yarn is threaded and a slit 9, symmetrically positioned above eyelet 8, through which the plating yarn is threaded. Yarn lever 5 is also symmetrically positioned with respect to the instep needles so that the feeding of the body and plating yarns during reciprocatory knitting will be exactly the same in both directions. Plating yarn 6 will feed from one corner or the other of slit 9 depending upon the direction of knitting but its angular relation with body yarn 7 will be exactly the same in both positions.

The machine is also provided with a wrap spindle 10, preferably having a plurality of feeds, and two wrap yarn horns 11 and 12 for guiding the wrap yarn as will be explained later. Horns 11 and 12 are each provided with rollers 13 each sliding in a vertical guide 14 in the inner end of a bracket 15 which is attached to an arcuate ring 16 adapted to swing through a definite arc on a suitable guide ring 17 on carrier ring 3. The swinging of arcuate ring 16 is controlled from the sinker head friction ring 18 (Figs. 5, 6, 7 and 8) which is frictionally associated with the sinker head and capable of swinging through a certain arc as determined by suitable stops by means of a connection 19 attached to the sinker head friction ring 18 and engaging fork 20 on arcuate ring 16. A pin 21 which may be the pivot of a roller 13 projects into a camway 22 in a stationary arcuate plate 23 (Figs. 1, 3 and 36). There are two opposed camways 22, one for each horn, so that when ring 16 is rotated in one direction horn 11 will be lowered and horn 12 raised and vice versa by the movement of pins 21 along camways 22. These is also the usual binder plate 24.

The leg and instep of the stocking are assumed to be knit on the auxiliary side of the machine, as is now customary, so that the same yarns can be used throughout and uniformity of yarn and stitch in these parts assured. The leg is knit in a rotary manner and the high heel and foot by reciprocatory knitting.

When knitting the leg, plating yarn 6 and body yarn 7 are fed to the needles by means of lever 5 on the auxiliary side and are knit on that side, all the needles traversing the path 25 (Fig. 24) and knitting at cam 26. Plating yarn 6 is fed above body yarn 7 as will be evident from Figs. 9, 10, 24 and 25 and is positioned above the body yarn on the needles (see Figs. 13 and 19). Heretofore the reverse order has been customary.

If this part of the stocking is to be provided with a wrap pattern the wrap yarn 27 is fed over horn 11, which is in its low position (Fig. 2), to the needle or needles which are to be wrapped by wrap spindle 10 one finger of which has been swung out by suitable mechanism so that its eyelet 28 lies outside the needle circle as shown in Fig. 1. Wrap spindle 10 rotates one to one with needle cylinder 1 as usual.

The needles to be wrapped have been selected and elevated to a position 29 (Fig. 24) higher than the usual yarn receiving position, by a suitable selector means 30 and master cam 31 operating upon jacks, such as 32, to receive the wrap yarn 27. When the wrap yarn has been fed to the selected needles eyelet 28 moves back to a position inside the needle circle indicated at 33 in Fig. 1, the wrap yarn dropping off the end of horn 11 as shown at 34. Upon further rotation of the needle cylinder and wrap spindle, eyelet 28 assumes a position 35 the wrap yarn now passing under binder plate 24 as indicated at 36 and under horn 12. As the rotation of the cylinder and wrap spindle continue eyelet 28 continues to move to a position such as 37 and the wrap yarn, extending to the last needle wrapped, also continues to swing around under binder plate 24 as indicated at 38 and so on until the cycle is completed.

Although horn 11 has been in its low position shown in Fig. 2, as above stated, this position,

as a matter of fact, may be considerably higher than usual so that wrap yarn 27 is held high up on the needles and moves into the hooks earlier than usual and, consequently, is positively positioned above the plating and body yarns on the needles. Heretofore the wrap yarn has been positioned below the other yarns. Just before the wrap yarn 27 drops off the end of horn 11 plating yarn 6 and body yarn 7 are fed to the needles by yarn lever 5 which, since it is mounted on the underside of the carrier ring feeds these yarns to the needles below wrap yarn 27 and at a much lower angle than the wrap yarn is fed by wrap spindle 10 and horn 11. The feeding of the wrap yarn high on the needles and above the plating and body yarns leaves plenty of room for feeding the plating and body yarns well above the latch pivots so that there is no danger that the yarns will be cut or frayed by the closing of the latches.

The feeding of the yarns to the needles is also illustrated by Figs. 11 to 14. In Fig. 11 is shown a needle 2 and sinker 39 before the feeding of any yarn. In Fig. 12 needle 2 is in the elevated position 29 (Fig. 24) to receive wrap yarn 27 as fed by a wrap spindle eyelet 28 over horn 11. In Fig. 13 the needle 2 has descended to a lower position for the reception of the plating and body yarns 6 and 7 as fed by yarn lever 5. It will be noted that wrap yarn 27 is now in the hook of the needle and passes over a smaller portion of horn 11 and that the plating and body yarns 6 and 7 are fed to the needle below the wrap yarn and in the order named. In Fig. 14 the needle has descended still further and has drawn the three yarns over the sinker in the same relative positions. However, instead of drawing these yarns in the throat 40 of the sinker in the usual way the sinker has been moved inward soon enough and far enough so that the yarns are drawn over the flat back 41 of the sinker behind its nib 42. In Fig. 15 the needle has risen again so that the yarn loops are now on its latch. Thereafter the cycle is completed until the needle has again assumed the position shown in Fig. 11 the sinkers being drawn out meanwhile so that the sinker loops have been transferred from the backs to the throats of the sinkers over the nibs 42. In the next course the wrap, plating and body yarns 27, 6 and 7, respectively, are again fed to the needles and drawn in the manner just described.

When the change is made from rotary to reciprocatory knitting as, for example, at the beginning of the high-heel and in the foot, the three yarns continue to be fed and knit as above described, at the auxiliary side of the machine, by the instep needles when these needles are moving in counter-clockwise direction. When knitting in the other or clockwise direction the method is similar but in this instance horn 11 has been raised and horn 12 lowered and shifted as shown in Figs. 3 and 4 by the mechanism already described and wrap yarn 27 is fed over horn 12 instead of horn 11 and on the other side of needles 2 as shown in Figs. 3 and 16. Then sinkers 39 are drawn out so that previously formed loops are transferred from the backs to the throats of the sinkers over the nibs as shown in Figs. 17 and 18. Then the plating and body yarns are fed to the needles by yarn lever 5 as shown in Fig. 19 after which the yarns are drawn over the backs of sinkers which have been again moved inwardly far enough to make this possible and the knitting cycle completed.

When the machine reverses again to knit the next course in counter-clockwise direction horn 12 is again raised and horn 11 lowered and swung into operative position and the feeding and knitting of the wrap, plating and body yarn proceeded with as originally described. Yarn lever 5 and wrap spindle 10 are so positioned on the auxiliary side that the wrap, plating and body yarns are fed to the long butt needles including, of course, any short butt needles which have been added to the long butt group, at the same relative points regardless of the direction in which the needles are moving as shown in Figs. 1, 3, 9, 10, 13, 19, 24 and 25 and at the same angles in relation to the needles and to each other.

It has been stated that wrap horns 11 and 12 when in working position can be higher than usual. This is because the yarns are drawn over the backs of the sinkers instead of in their throats. This also makes it possible to position the tip of each horn, when working, more closely to the knitting point than heretofore. In fact, the wrap yarn loops do not pass from the tip of the horn until almost the instant of knitting. In consequence, these loops are under control at all times and have no opportunity to change their size or shape as is very likely to happen if control of them is lost at an earlier point. (See Figs. 2 and 4.)

Drawing the loops over the back of the sinkers also makes it possible to feed the wrap yarn above the other two yarns instead of below it as has been customary and to follow this by the plating yarn and then the body yarn down the needle. This without further manipulation arranges the three yarns in their proper relation so that no change is required. Because of this the sinkers may be moved in early to position them correctly for receiving the yarns upon their backs and they can then be held motionless while the draw is made. Since the yarns are in their correct order it is no longer necessary to move the sinker out to push one yarn past the other.

The yarns, if they contact the backs of the nibs at all, simply slide down them to the backs of the sinkers where the actual draw occurs. Consequently, every loop is drawn the same length. This is not possible when the sinkers are moving so that the yarns are drawn over the sloping backs of the nibs.

Also the former necessity of maintaining a heavier tension on the lower yarn than on the other yarn is eliminated. Whatever tension is best for each yarn, depending upon its nature, can be used. This also results from the fact that the yarns are engaged by the needles in the correct order and do not require positioning by tension or sinker movement.

By feeding and drawing in this way and by using the two horns 11 and 12 working in alternation it becomes possible for the first time to feed and knit wrap yarns in every course of the instep during reciprocatory knitting and thus to provide in the instep section a continuous pattern similar to that usually included in the leg superposed upon an almost perfect plated fabric.

Of course to do this, means must be provided for selecting the needles to be wrapped in each direction of reciprocation. This is done by means of jacks operating upon the needles under the control of appropriate selectors. For example, when knitting in counter-clockwise direction selector 30 (Fig. 24) and master cam 31 may be utilized to elevate jacks and, through them, the desired needles to wrapping position 29 whereas when wrapping in clockwise direction a similar

selector 43 and master cam 44 may be utilized to elevate the needles to be wrapped to the equivalent position 45 as shown in Fig. 25 after which the instep needles will knit at cam 46 in clockwise direction and cam 26 in counter-clockwise direction. Of course, the remaining needles are simultaneously knitting the foot of the stocking at cam 47 or 48, as the case may be, at the main side of the machine following present split foot practice.

As previously stated the sinkers are so manipulated that at the auxiliary side of the machine the yarns are drawn over their backs instead of their throats and subsequently the loops so drawn are transferred from the backs to the throats over the nibs. This is illustrated by Figs. 17 and 18. These loops are finally cast off from the needles after the corresponding loops of the next course have been drawn. This is accomplished by projecting the sinkers inwardly so that their throats engage with these previously formed sinker loops as shown in Fig. 20. In this figure these sinker loops are indicated by the numerals 27 and 6 and 7 by which the wrap, plating and body yarns have been identified throughout this description and the newly formed loops of these same yarns are indicated by the numerals 49, 50 and 51, respectively. As will be seen the newly drawn yarns 49, 50 and 51 resting on the backs of the sinkers are not affected in any way by the engagement of the previously formed loops 27, 6 and 7 with the throats of the sinkers.

A sinker cap suitable for operating the sinkers for drawing and knitting the yarns in this way is generally indicated by the numeral 52 in Fig. 5. This cap is provided with a center sinker cam 53 on the auxiliary side having a rather sharp and narrow point 54 by means of which the sinkers are drawn out to transfer the loops from the backs to the throats thereof over the nibs and are immediately moved in again so as to be in a position to receive the yarn over the backs behind the nibs as they are fed from yarn lever 5. Sinker cap 52 does not rotate or swing and point 54 is positioned directly below the yarn lever 5 so that the yarns are fed to the needles and drawn in exactly the same way in both directions of reciprocatory knitting. When knitting in counter-clockwise direction the loops are cast off by cam 55, the yarns for these loops having been fed and taken and knit by the needles between cams 54 and 55. Similarly, when knitting in clockwise direction the loops are cast off by cam 56.

The main side of the machine where the heel, sole and toe are knit presumably in the conventional way, the loops being drawn in the throats of the sinkers, is provided with the usual center cam 57 and casting off cams 58 and 59. Preferably, two flopper cams 60 and 61 are also provided for the purpose of moving the sinkers in earlier than usual after they have been drawn out by center cam 57 so that they will hold down the fabric while the needles which knit at the main side are being raised by main stitch cams 47 and 48. Flopper cam 60 is swung in for counter-clockwise knitting and flopper cam 61 for clockwise knitting as shown in Fig. 5.

These cams are urged outwardly by springs 62 and 63 and are swung in by short arms 64 and 65 attached to sinker head friction ring 18. As previously explained, friction ring 18 is swung through a certain arc in either direction by means of the sinker head upon which it is frictionally mounted and which turns with the cylinder. The distance ring 18 is permitted to move is that required to operate the flopper cams and also the wrap horns 11 and 12 through finger 19.

The drawing of the loops over the backs of the sinkers and their subsequent transference to the throats over the nibs and the casting off from the needles of these loops without engaging the newly formed loops have a surprisingly beneficial effect upon the shape and uniformity of size of the loops apparently for the following reasons. When the needle loops pass from around the latches of the needles to the shanks they hang somewhat loosely upon the shanks because this part of the needle is smaller. However, when the sinkers are retracted so that the loops are caused to pass from the backs to the throats over the nibs each sinker loop receives a slight tug which tightens the adjacent needle loops around the shanks of the needles. In this way they are brought to substantially the same size. When the needles descend to cast off these loops the loops must, of course, pass again over the latches. In so doing they are slightly stretched but because they have already been equalized this stretching is substantially the same for each loop. This tightening and stretching of the needle loops in this equalizing way has a similar effect upon the adjacent sinker loops so that both the needle and sinker loops are straightened and equalized in size to a degree which is very evident in the finished fabric. Furthermore, and most important, the fact that the sinkers when moving in to cast off loops from the needles engage only with the comparatively stable loops of the previous course which are to be cast off and not at all with the newly formed loops, leaves the newly formed loops undisturbed. This is far from the case when casting off involves the engagement of the sinkers with the newly formed loops also as is inevitable when the loops are drawn in the throats of the sinkers in accordance with previous practice.

These beneficial results are also shared by the loops of the wrap pattern. In the case of a single needle wrap the wrap yarn does not make contact with the sinkers. However, the character of the wrap benefits greatly from the fact that the underlying plated loops are straight and uniform and unaffected by the casting off process so that wrap yarn loops are more exactly positioned upon them. Where the wrap extends across more than one needle the wrap yarn passes through the same process as the plating and body yarns, as clearly illustrated by Figs. 17, 18 and 20, and consequently, benefits directly and to the same extent.

A comparison of fabric plated and wrapped by the customary method and by the method of this invention is afforded by Figs. 22 and 23. Fig. 22 is an accurate copy of an actual enlargement of 220 needle fabric plated and wrapped as heretofore described. It will be noted that the loops are all of substantially the same size and shape, that they are all vertical, the plating is substantially perfect, the body yarns showing only at a very few small spots which are scarcely noticeable even in this greatly enlarged reproduction, the wrap is excellent.

Fig. 23 is a similar reproduction of fabric also made on a Banner machine by one of the leading manufacturers of high grade hosiery in the United States. This plating and wrapping was done in the old way in which the yarns are drawn in the throats of the sinkers. This is a fair sample of the best plating which heretofore has been commercially possible. The loops vary in size and shape, they tilt from the perpendicular, the body

yarn can be seen in one part or another of almost every loop. The wrap is not nearly as uniform.

I claim:

A method of knitting upon a circular, independent needle, knitting machine which includes the steps of moving the sinkers inwardly soon enough and far enough that yarns will be drawn over their backs and causing them to remain stationary during the drawing of the yarns, feeding a plating yarn and a body yarn to the needles,

the plating yarn being positioned on the needles above the body yarn, drawing these yarns over a part of the backs of the sinkers having a definite height and through the needle loops of the previous course casting off the previously formed needle loops by the sinkers acting upon the intervening sinker loops only and causing the newly drawn sinker loops to pass from the backs to the throats of the sinkers upwardly to the tops of the nibs.

OSCAR FREGEOLLE.