

Dec. 22, 1959

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2,917,912

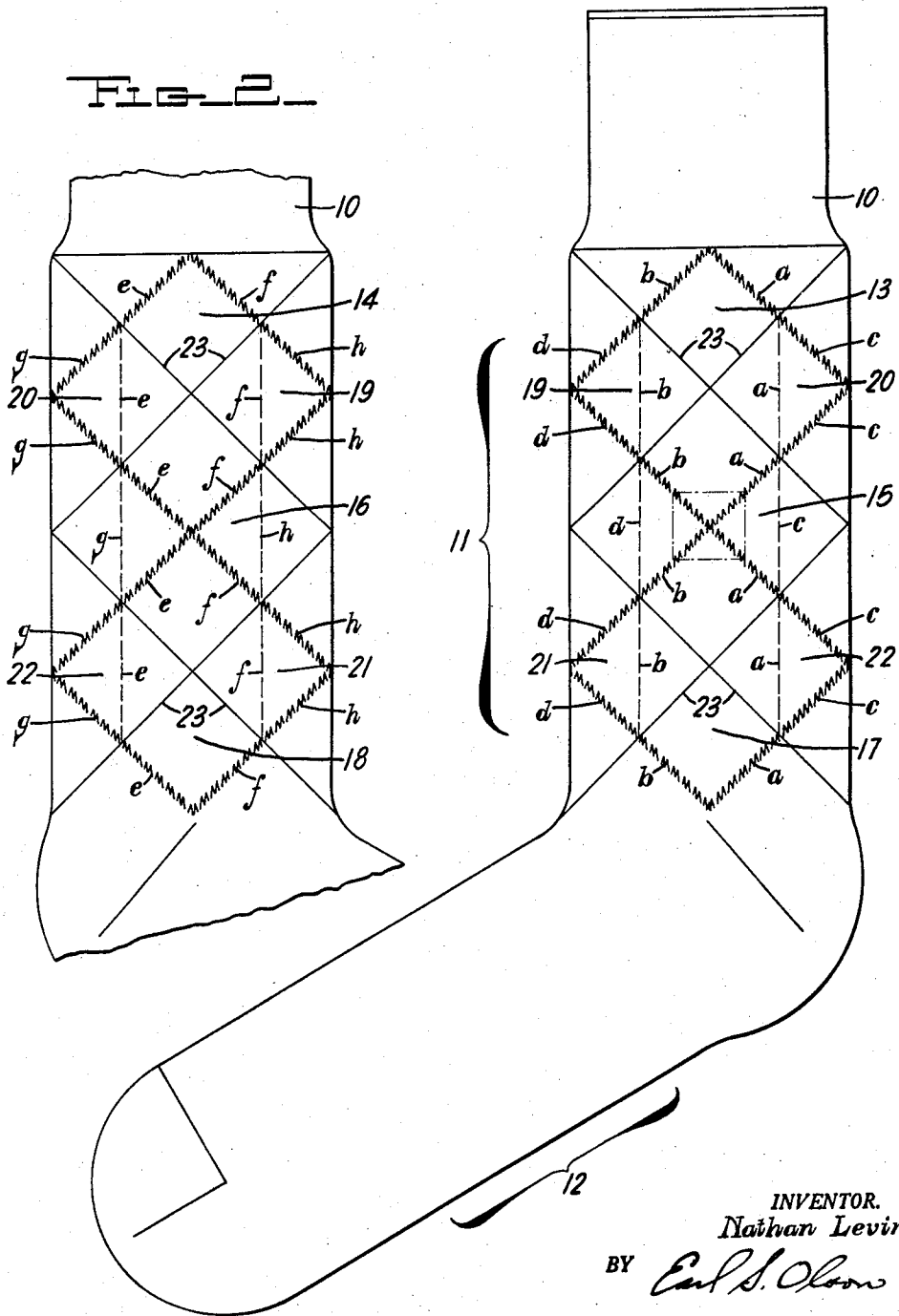
METHOD AND APPARATUS FOR MAKING PATTERNED HOSIERY

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4 Sheets-Sheet 1

Fig. 1

Fig. 2



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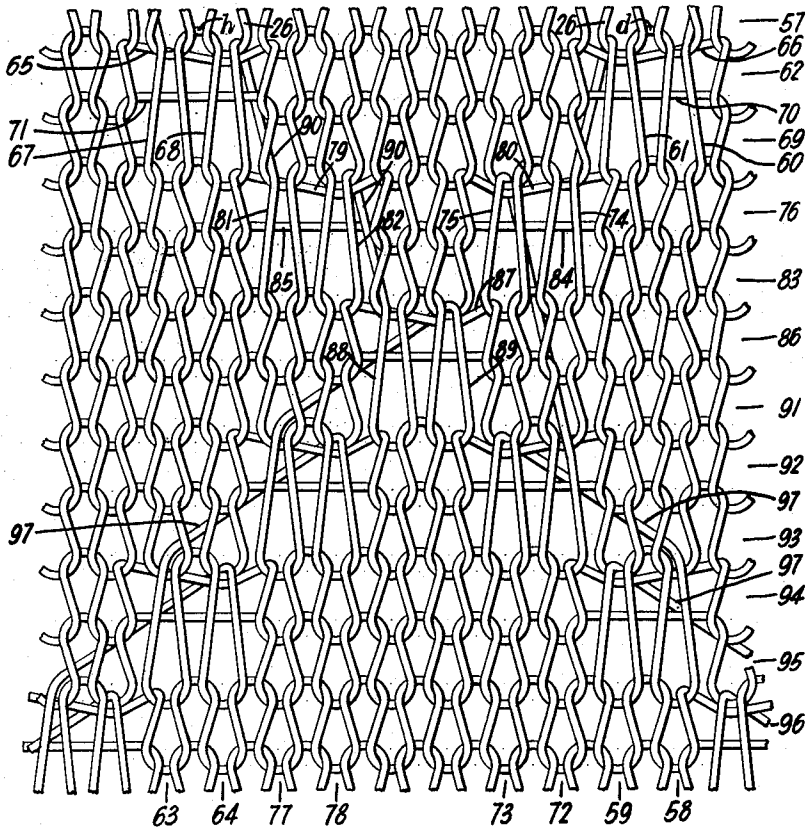
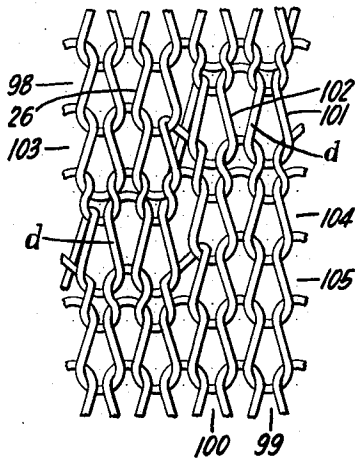


FIG. 3

FIG. 4



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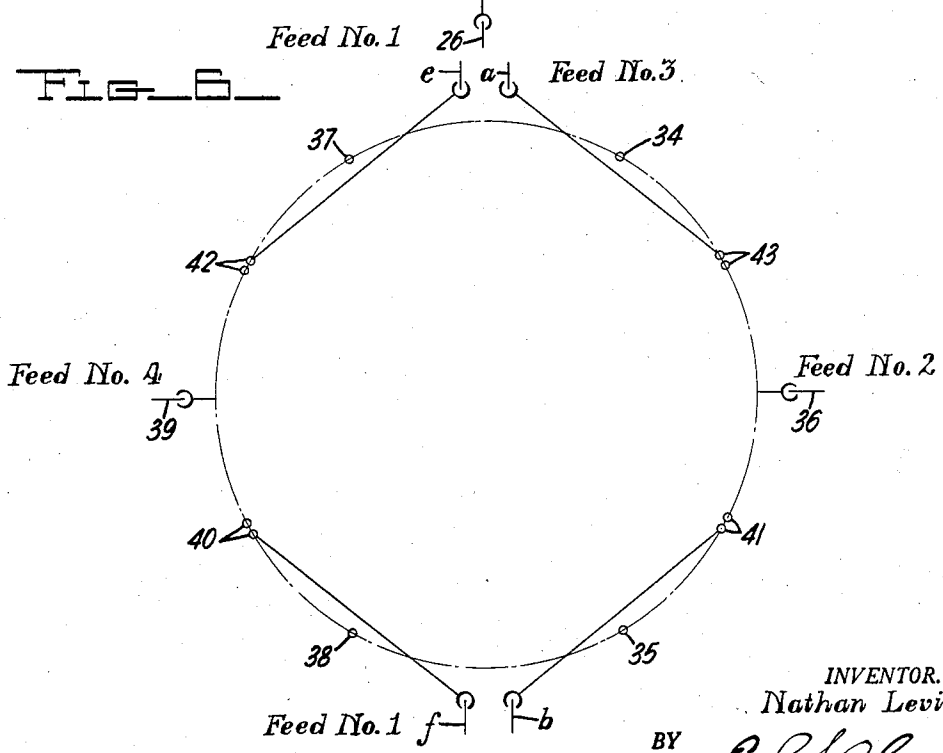
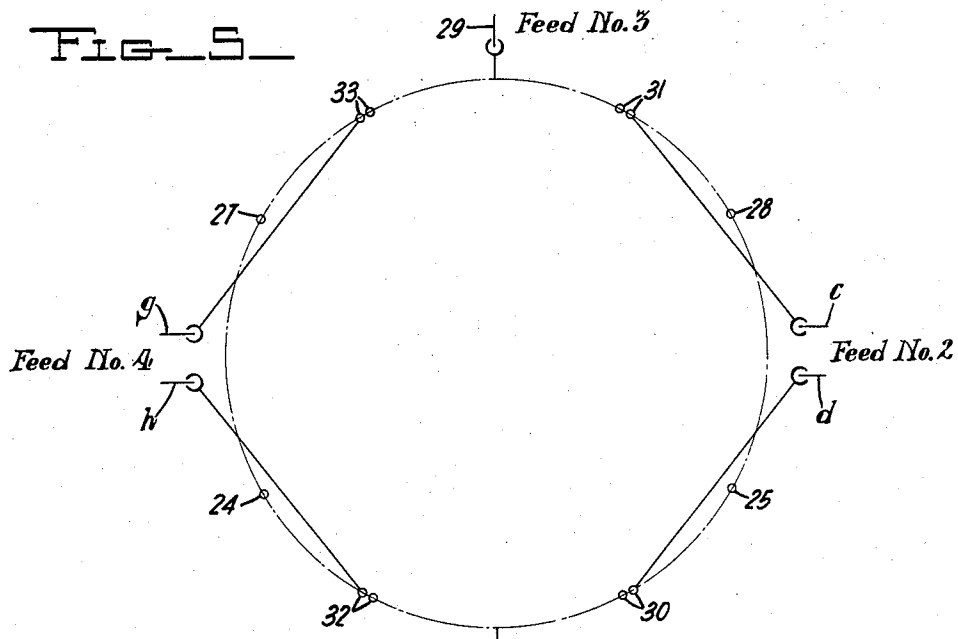
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METHOD AND APPARATUS FOR MAKING PATTERNED HOSIERY

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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

Fig. 7

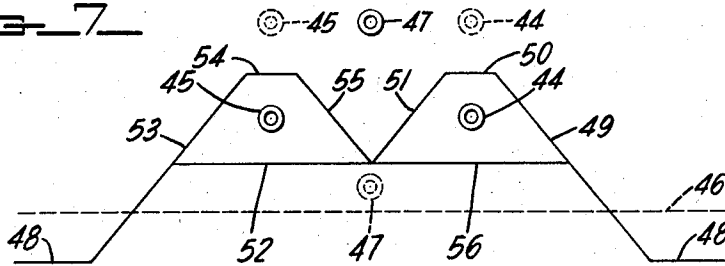


Fig. 8

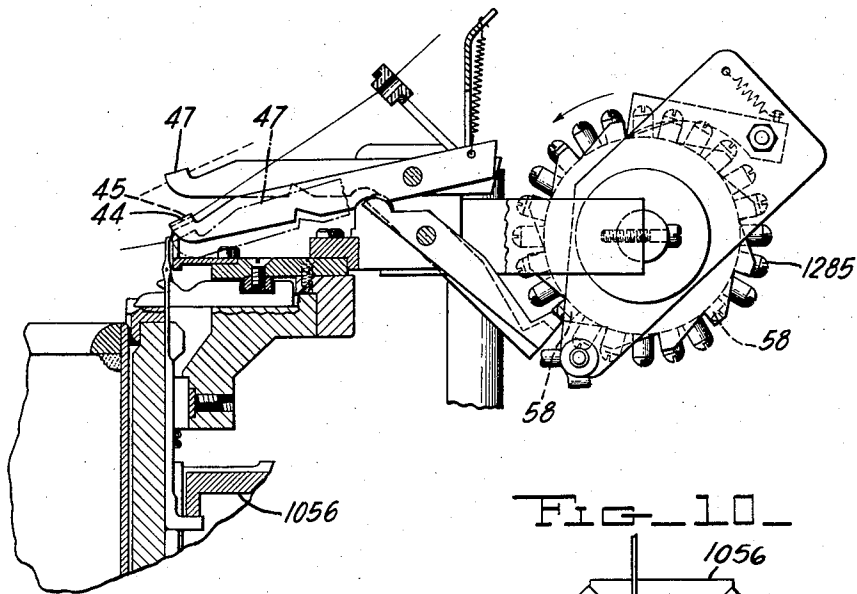


Fig. 9

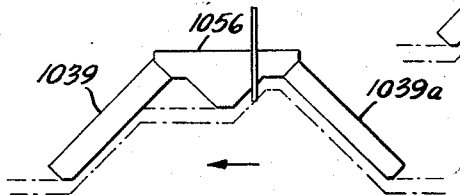
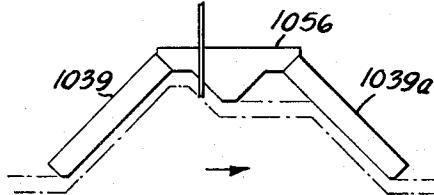


Fig. 10



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**METHOD AND APPARATUS FOR MAKING
PATTERNED HOSIERY**

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Application May 15, 1956, Serial No. 584,932

18 Claims. (Cl. 66-43)

The present invention relates generally to the art of knitting and more particularly to a manner and means for incorporating an overplaid design in weft knit fabrics, and to the fabric resulting therefrom.

It is an object of the present invention to incorporate an overplaid design in tubular weft knit fabric, sometimes known as Argyle or Intarsia fabric, which comprises solid color suture joined sections of separate yarns as made by reciprocating knitting upon a circular knitting machine.

It is also an object of the invention to incorporate an overplaid design as above set forth, upon a multi-feed circular knitting machine wherein certain of the feeds are operated to knit certain of the suture joined fabric sections while other feeds are operated to incorporate the overplaid design within the certain fabric sections during the knitting thereof. It will be understood that the term "feed" is used herein in a conventional sense to include the knitting station or mechanism for knitting the yarn fed as well as the yarn feeding means per se.

It is a further object of the invention to incorporate an overplaid design as above set forth upon a four feed circular machine wherein an opposite pair of feeds is operated to knit a corresponding pair of fabric sections while the remaining pair of feeds is operated to incorporate the overplaid design within the pair of fabric sections during the knitting thereof.

It is a still further object of the invention to provide a method of reciprocating knitting upon at least one feed of a circular machine wherein at least a pair of yarns is fed to the needles and wherein one of said yarns is knit by needles when knitting in one direction and wherein the other of the yarns is knit by needles when knitting in the opposite direction.

It is also a feature of the invention to provide Argyle or Intarsia knit fabric sections having an overplaid design incorporated therein which includes overplaid yarns knit along lines extending at an angle to the wales and wherein the stitch formation is uniform within each line of the design over a plurality of courses.

With these and other objects in view which will become apparent from the following detailed description of the illustrative embodiment of the invention shown in the accompanying drawings, the invention resides in the novel elements, features of construction and cooperation of parts, as hereinafter more particularly pointed out in the claims.

In the drawings:

Figure 1 is a view of one side of a solid color stocking of the Argyle type with an overplaid design incorporated therein;

Fig. 2 is a partial view of the opposite side of the stocking shown in Figure 1;

Fig. 3 is an enlarged diagrammatic stitch diagram of a small portion of the fabric enclosed by the dot-and-dash square of Fig. 1;

Fig. 4 is an enlarged diagrammatic stitch diagram similar to Fig. 3 of a small portion of a modified form of fabric;

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Fig. 5 is a view illustrating a stage in a method of knitting, according to the invention, upon a four feed circular machine;

Fig. 6 is view similar to Fig. 5 illustrating a second stage in the method;

Fig. 7 is a diagrammatic view illustrating the path of needle travel in relation to the yarn guides during rotary and reciprocating knitting at the feeds; and

Fig. 8 is a diagrammatic view partially in section taken through the needle cylinder and partially in elevation of the yarn finger control drum, parts being broken away for clearness of illustration, of one feed of a four feed circular machine and showing the relationship of the needles and the yarn fingers for the incorporation of the overplaid design; and

Figs. 9 and 10 are views of the needle operating cams and indicating in dot-and-dash outline the path followed by the needles through the cams during movements in opposite directions.

The overplaid design, of the present invention, is preferably incorporated in circular knit hosiery and is preferably made upon a multifeed machine of the type shown and illustrated in the copending application of Benjamin Franklin Coile, Serial No. 329,801, filed January 6, 1953, to which reference may be made as required.

In the machine of the Coile application, hosiery of the Argyle or Intarsia type ornamented with solid color, suture joined, four section pattern areas may be knit by more than one method. One method includes the formation of a complete course, containing suture joined partial courses of each of the four sections, on the four feeds during each stroke of the cylinder. In a second method the machine may be operated to knit an opposite pair of partial courses of an opposite pair of pattern areas on correspondingly opposite feeds, with the other pair of feeds normally inactive, during each stroke of the machine. In this latter method, known as the fill-in system, the opposite pair of pattern areas may be completed, or partially completed, by their associated pair of feeds, after which the said pair of feeds is made inactive and the previously inactive pair of feeds is made active to knit the inbetween pair of pattern areas. For example, in the case of diamond shaped areas of an Argyle pattern, the feeds Nos. 1 and 3 (see Figs. 5 and 6) may knit an opposite pair of diamonds with feeds Nos. 2 and 4 inactive, after which the feeds Nos. 2 and 4 may be activated to knit and fill-in an inbetween pair of diamonds with feeds Nos. 1 and 3 inactive. It will be understood that the contiguous diamonds are suture joined along their outlines as the held loops thereof on needles retired during the knitting of any one pair of diamonds are knitted through when the retired needles are made active during knitting of the other pair of diamonds. The fill-in system is not limited to the formation of diamond shaped areas but may be used for solid color areas of other formation, depending upon the needle selection set up of the machine.

It is with the fill-in system of solid color knitting that the method of incorporating an overplaid design is herein described, however, it should be understood that the principle of the invention is not so limited and that it is applicable to machines wherein a complete course of fabric is knit during each stroke. For example, the base fabric may contain but a single pair of suture joined areas in which case a complete course may result from the operation of a pair of feeds, or the machine may be provided with overplaid feeding means in addition to the four feeds in which case the four feeds may be used to provide a four section pattern area of which each complete course may be knit during each stroke of the machine.

As illustrated in Figure 1, the stocking includes a

top 10, a leg portion 11 and the usual foot portion 12. The leg portion, see Figs. 1 and 2, is ornamented by way of example, with a diamond shaped Argyle pattern of which there are the upper opposite pair of side half diamonds 13 and 14; the intermediate opposite side pair of diamonds 15 and 16; the lower opposite pair of side half diamonds 17 and 18; the front and rear upper pair of diamonds 19 and 20; and the front and rear lower pair of diamonds 21 and 22. The various diamonds are joined along diagonally extending suture lines 23. The diamonds themselves, each of a solid color, are further ornamented by an overlaid design comprising relatively narrow lines of stitches of contrasting colored yarn, the overlaid generally dividing each diamond into a group of four smaller diamonds.

The side half diamonds 13 and 17 and the intermediate side diamond 15 are provided with knit overlaid yarns *a* and *b* which start generally at the mid-point of the widest portion of half diamond 13 and, as the knitting continues, diverge to meet the mid-points of suture lines 23 about half way down the half diamond 13, then float vertically past the rear faces of front and rear diamonds 19 and 20 to the mid-points of the upper suture lines of diamond 15 where they are incorporated along converging and then diverging lines to the mid-points of the lower suture lines of the diamond 15, then again float vertically past the rear faces of the front and rear diamonds 21 and 22 to the mid-points of the upper suture lines of the lower half diamond 17 where they are incorporated along converging lines to meet and terminate generally at mid-point of the widest portion of this half diamond.

In a similar manner the side half diamonds 14 and 18 and the intermediate side diamond 16 are provided with knit overlaid yarns *e* and *f* incorporated therein during the knitting of these diamonds.

The front diamonds 19 and 21 are provided with knit overlaid yarns *d* and *h* which start, respectively at about the mid-point of the suture between the diamond 19 and the half diamond 13 and at about the mid-point of the suture between the diamond 19 and the half diamond 14, then, as the knitting proceeds, converge and diverge within the diamond 19 to the mid-points of its lower suture lines, then float vertically to the mid-points of the upper suture lines of the diamond 21 where they are incorporated along converging and then diverging lines to terminate at the mid-points of the lower suture lines of the diamond 21.

In a similar manner the rear diamonds 20 and 22 are provided with knit overlaid yarns *c* and *g* incorporated therein during the knitting of these diamonds.

It should be understood that the particular location of the overlaid yarns shown in the drawing is by way of example only and that these may be placed wherever desired in accordance with any design desired by the knitter, the overlaid being incorporated in accordance with the particular needles selected to knit the overlaid yarns.

The arrangement of the feeds Nos. 1 to 4 of the machine is shown in Figure 5 for the knitting of the front and rear diamonds of body yarn at the feeds Nos. 1 and 3 while the overlaid yarns *c*, *d*, *g* and *h* are incorporated at the feeds Nos. 2 and 4. In the disposition shown in Figure 5, a course in the overlaid portion of the diamonds is being knit, the particular course being one that is spaced from the widest part of the diamond. The needles between the points 24 and 25 will be taking and knitting a body yarn 26 at feed No. 1 during each stroke of the needle cylinder, each stroke adding a course to the appropriate diamond, and terminal needles in successive strokes being either added to or retired from this active needle group depending upon whether the diamond courses are then being lengthened or shortened. In like manner the needles between the points 27 and 28 will be taking and knitting a body yarn 29 at feed No. 3.

At this stage of the knitting, overlaid yarn *d* will extend from one side of feed No. 2 to a pair of needles designated at 30 in the 24 to 25 needle group; overlaid yarn *c* will extend from the other side of feed No. 2 to a pair of needles designated at 31 in the 27 to 28 needle group; overlaid yarn *h* will extend from one side of feed No. 4 to a pair of needles designated at 32 in the 24 to 25 needle group; and overlaid yarn *g* will extend from the other side of feed No. 4 to a pair of needles designated at 33 in the 27 to 28 needle group. The pairs of needles 30, 31, 32 and 33 will have knit the overlaid yarns *d*, *c*, *h*, and *g* previously and pairs of needles adjacent thereto will next knit these overlaid yarns.

Assuming the needle circle to be moving in a counter-clockwise direction, Fig. 5, which is the forward stroke of the machine (the stroke in each direction being approximately 360 degrees), the needle group 24 to 25 will be knitting body yarn 26 at feed No. 1 to form a front diamond course while the needle group 27 to 28 will simultaneously be knitting body yarn 29 at feed No. 3 to form a rear diamond course. After passing feed No. 1, the needles of group 24 to 25 will be selected as they approach feed No. 2 so that, in this instance, a pair of needles adjacent to needles 30 are raised to take and knit yarn *d* without taking yarn *c*. In a like manner during this forward stroke, after passing feed No. 3, the needles of group 27 to 28 will be selected as they approach feed No. 4 so that, in this instance, a pair of needles adjacent to needles 33 are raised to take and knit yarn *g* without taking yarn *h*.

Then as the needle circle changes direction and moves in clockwise direction, Fig. 5, which is the reverse stroke of the machines, the needle groups 24 to 25 and 27 to 28 will knit at feeds Nos. 1 and 3 similarly to the manner in which they knit on the forward stroke, except that the knitting will be in the opposite direction, and a pair of needles adjacent to needles 32 will be selected to knit yarn *h* at feed No. 4 while missing yarn *g* and a pair of needles adjacent to the needles 31 will be selected to knit yarn *c* at feed No. 2 while missing the yarn *d*.

As above described, for each two strokes of the machine, forward and reverse, two partial courses of front and rear diamonds are formed while a single partial course (two wales wide) is formed of each of the overlaid yarns, there being courses of body yarn knit between the knitting of the overlaid yarns. It will be understood that the number of needles selected to knit the overlaid yarns may vary as required for any particular pattern and may comprise a single needle or more than two needles. The overlaid stitches may be described as extra stitches interposed between adjacent body yarn courses in selected wales as seen in Fig. 4. It will be understood that, from course to course of the diamonds, the number of needles knitting at the feeds Nos. 1 and 3 may be progressively changed and that the particular needles taking the overlaid yarns may vary from course to course so that the overlaid design extends at an angle to the wales as shown and as described in connection with Figs. 1 and 2. With respect to each of the diamonds, the body yarn is knit during a forward and a reverse stroke while one of the overlaid yarns is knit only during the forward stroke and the other of the overlaid yarns is knit only during the reverse stroke.

In the above described method of knitting on groups of needles represented by needle groups 24 to 25 and 27 to 28, no variation in the knitting thereof at feeds Nos. 1 and 3 has been set forth so that complete partial courses of consecutive loops in each of the consecutive wales would result, with extra stitches of the overlaid yarns knit at feeds Nos. 2 and 4 interposed at selected wales between the courses as in Fig. 4. The machine may be also operated so that selected needles in each of the courses be actuated to remain at the low idle level so as not to knit at times at the feeds Nos. 1 and 3

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thereby to provide floats of the body yarns at least in those wales and courses in which the overplaid yarns are knit, with the result that the body yarns float to the rear of the overplaid stitches. This will be set forth in more detail in connection with the description of the stitch diagram of the fabric shown in Fig. 3.

For the knitting of the side half and full diamonds, the arrangement of the feeds Nos. 1 to 4 is shown in Fig. 6, the necessary changes being made automatically when each of these diamonds is to be made. The side diamonds are knit of body yarn at feeds Nos. 2 and 4 while the overplaid yarns *a*, *b*, *e*, and *f* are incorporated at feeds Nos. 1 and 3. In the disposition of Fig. 6, a course in the overplaid portion of the diamonds is being knit, the particular course being one that is spaced from the widest part of the diamond. The needles between the points 34 and 35 will be taking and knitting a body yarn 36 at feed No. 2 during each stroke of the needle cylinder, each stroke adding a course to the appropriate diamond, and terminal needles in successive strokes being either added to or retired from this active needle group depending upon whether the diamond courses are then being lengthened or shortened. In like manner the needles between the points 37 and 38 will be taking and knitting a body yarn 39 at feed No. 4.

At this stage of the knitting, overplaid yarn *f* will extend from one side of feed No. 1 to a pair of needles designated at 40 in the 37 to 38 needle group; overplaid yarn *b* will extend from the other side of feed No. 1 to a pair of needles designated at 41 in the 34 to 35 needle group; overplaid yarn *e* will extend from one side of feed No. 3 to a pair of needles designated at 42 in the 37 to 38 needle group; and overplaid yarn *a* will extend from the other side of feed No. 3 to a pair of needles designated at 43 in 34 to 35 needle group. The pairs of needles 40, 41, 42 and 43 will have knit the overplaid yarns, *f*, *b*, *e*, and *a* previously and pairs of needles adjacent thereto will next knit the overplaid yarns.

The action is similar to that described in connection with Fig. 5 except as to the particular diamonds being made, the needle group 34 to 35 will be knitting body yarn 36 at feed No. 2 to form courses of side diamonds 13, 15 and 17, while the needle group 37 to 38 will simultaneously be knitting body yarn 39 at feed No. 4 to form courses of the opposite side diamonds 14, 16 and 18. As the needle circle moves in a forward stroke, after passing feed No. 2, the needles of group 34 to 35 will be selected as they approach feed No. 3 so that, in this instance, a pair of needles adjacent needles 43 are raised to take and to knit yarn *a* without taking yarn *e*. In a like manner during this forward stroke, after passing feed No. 4, the needles of group 37 to 38 will be selected as they approach feed No. 1 so that, in this instance, a pair of needles adjacent to needles 40 are raised to take and to knit yarn *f* without taking yarn *b*.

Then as the needle circle changes direction and moves on its reverse stroke, the needle groups 34 to 35 and 37 to 38 will knit at feeds Nos. 2 and 4 similarly to the manner in which they knit on the forward stroke, except that the knitting will be in the opposite direction, and a pair of needles adjacent to needles 41 will be selected to knit yarn *b* at feed No. 1 while missing yarn *f* and a pair of needles adjacent needles 42 will be selected to knit yarn *e* at feed No. 3 while missing yarn *a*.

It will be understood, as the needle circle makes its forward and its reverse strokes, that the various yarns mentioned will be extending from their yarn guides to the final loops previously knit of each of the yarns, some of the yarns then extending from inactive yarn guides to the fabric while the active yarns extend from their guides to loops on the needles. The yarns will change their relative dispositions as the knitting continues and as the cylinder reciprocates so that it may

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appear that the yarns are being twisted and will interfere with each other. However, the yarns continue to twist and to untwist without such interference. No showing has been made in Figs. 5 and 6 of the inactive yarns then attached to the fabric, nor has any attempt been made to show the various changing positions of the floats of the six yarns being knit since this is not essential to an understanding of the invention by those skilled in the art.

It should be noted in Figs. 5 and 6 that the overplaid yarns are circumferentially spaced at each of the feeds and this, in conjunction with a higher feeding level for the overplaid yarns and a special path of travel for the needles, causes the selected needles to take one only of the overplaid yarns when moving in one direction and to take only the other of the overplaid yarns when moving in the opposite direction. Fig. 7 shows the relative disposition of the body and overplaid yarn guides, the low inactive level of the needles, the throat plate level, and the separate paths of travel for the needles, to enable the herein described method of knitting to be carried out. It is illustrative of the action of each of the feeds Nos. 1 to 4 when used to feed body yarn and when used to feed overplaid yarn. A pair of yarn guide ends 44 and 45 are shown as representative of the means for feeding a pair of overplaid yarns at each of the feeds and these are shown circumferentially spaced as well as being disposed somewhat above the normal throat plate level shown at 46 when in their active feeding positions indicated by full lines. The inactive positions of the guide ends are shown in dotted lines. The dotted line showing of a yarn guide end at 47 represents the active position of the body yarn feeding means relative to the active positions of the overplaid yarn guides and to the throat plate level. It will be understood that the overplaid and the body yarns are not in active feeding positions at the same time and hence the body yarn guide is shown in full lines in its inactive position. The needle path is such that selected needles move from low idle level 48 upwardly across throat plate level 46, as they move from right to left in Figure 7, along path 49 to upper level 50 where they have cleared latches, thence downwardly along path 51 to intermediate level 52 and thence downwardly again to the idle level 48. This path is such that needles will take a yarn from the guide indicated at 44 and will not take yarn from the guide indicated at 45. Similarly the needle path is such that, as the needles move from left to right, they move from low idle level 48 upwardly across throat plate level 46, thence along path 53 to upper level 54 where they have cleared latches, thence downwardly along path 55 to intermediate level 56 and thence downwardly again to the idle level 48. This path is such that needles will take a yarn from the guide indicated at 45 and will not take yarn from the guide indicated at 44. The means for operating the needles includes a needle lowering or center cam 1056 and stitch cams 1039 and 1039a (Figs. 8, 9 and 10) as provided in the machine of the Coile application the cams being appropriately shaped to provide the needle paths 51 and 55 shown in Fig. 7. Also in the machine of the Coile application, a portion of the yarn guide control means of this machine being illustrated in Fig. 8, as one means of accomplishing the result, selected ones of the studs 1285 on the yarn finger control drum at each of the feeds may be made of lesser height, as illustrated at 58, to position the spaced end yarn guides which are to feed the overlay yarns so that their feeding ends are disposed as shown in Fig. 7. It may be desirable to have these overlay yarn guides spaced further apart than the end yarn guides are shown on the machine of the application and this may be readily accomplished in any desirable manner.

It will be understood that when body yarn guide 47 is in feeding position, with guides 44 and 45 elevated to inactive positions, that the needle path is such that the

body yarns may be taken and knit by the needles in both directions of knitting.

In the formation of the fabric illustrated by Fig. 3, as the knitting is carried out on a forward stroke of the machine, say as shown in Fig. 5 and as indicated by the arrow in Fig. 9, the body yarn 26 is knit from right to left to form course 57 of the fabric, as the needles pass through the needle operating cams at feed No. 1. When the needles of wales 58 and 59 come to feed No. 2 and are selected to knit thereat, they will knit stitches 60 and 61, in that order, at the feed No. 2 of the overplaid yarn *d*, these being the only needles then knitting at feed No. 2 on this forward stroke. Then as the needles pass through the operating cams in the next reverse stroke of the machine as indicated by the arrow in Fig. 10, the body yarn 26 is knit from left to right to form course 62 of the fabric and as this course is made at feed No. 1, the needles of wales 63, 64, 59, and 58 will remain at low idle level holding the loops then thereon (these will be body yarn loops on the needles of wales 63, 64 and the stitches 61, 60 of overplaid yarn *d* on the needles of wales 59, 58) so that the floats 65 and 66 will be made. When the needles of wales 63 and 64 come to feed No. 4 and are selected to knit thereat, they will knit stitches 67 and 68, in that order, at the feed No. 4 of the overplaid yarn *h*, these being the only needles then knitting at feed No. 4 on this reverse stroke.

As the next forward stroke of the machine is made, the body yarn 26 is knit from right to left to form course 69 of the fabric and as this course is made at feed No. 1, the needles of wales 58, 59, 63 and 64 will remain at low idle level holding the loops then thereon (these will be stitches 60, 61 of overplaid yarn *d* and stitches 67, 68 of overplaid yarn *h*) so that floats 70 and 71 will be made. When the needles of wales 72 and 73 come to feed No. 2 and are selected to knit thereat, they will knit stitches 74 and 75, in that order, at the feed No. 2 of the overplaid yarn *d*, these being the only needles then knitting at feed No. 2 on this forward stroke. Then as the next reverse stroke of the machine is made the body yarn 26 is knit from left to right to form course 76 of the fabric and as this course is made at feed No. 1, the body yarn stitches will be knit through overplaid stitches 60, 61 and 67, 68, and the needles of wales 72, 73, 77 and 78 will remain at low idle level holding the loops then thereon (these will be body yarn loops on the needles of wales 77, 78 and will be the stitches 74, 75 of overplaid yarn *d* on the needles of wales 72, 73) so that the floats 79 and 80 will be made. When the needles of wales 77, 78 come to feed No. 4 and are selected to knit thereat, they will knit stitches 81 and 82, in that order, at feed No. 4 of overplaid yarn *h*, these being the only needles then knitting at feed No. 4 on this reverse stroke.

As the next forward stroke of the machine is made, the body yarn 26 is knit from right to left to form course 83 of the fabric and as this course is made at feed No. 1, the needles of wales 72, 73, 77 and 78 will remain at low idle level holding the loops then thereon (these being stitches 74, 75, 81 and 82) so that floats 84 and 85 will be made.

The next course is 86, formed on a reverse stroke at feed No. 1 similar to the other reverse strokes and in which the body yarn 26 is knit through stitches 74, 75, 81 and 82 of the overplaid yarns, and the float 87 is formed, while the stitches 88 and 89 are knit of overplaid yarn *h* at feed No. 4 on the same reverse stroke.

The above described knitting action and fabric in connecting with the stitch diagram of Fig. 3 will illustrate that for each pair of consecutive courses of body yarn there are stitches (here shown in adjacent wales and comprising pairs) of the overplaid yarns which extend walewise over said pair of courses and that while each course of a pair of the adjacent pairs of courses is knit in opposite directions, each of the overplaid yarns is always

knit in the same direction, although the direction in which yarn *d* is knit is opposite to that in which yarn *h* is knit. Accordingly the stitch formation of each unit of the overplaid yarn incorporated into the fabric is always the same with the result that the overplaid design is uniform in character. It will be noted that the yarn *d* and the yarn *h* in passing from the last stitch thereof in one course to the first stitch thereof in the next course, as indicated at 90, does not take a reverse path but always continues to move in the same direction. Whenever overplaid stitches are arranged at an angle to the wales as shown in the courses 57, 62, 69, 76, 83 and 86, their relation to the base fabric will be similar to that shown and described in connection with Fig. 3.

The remaining courses 91 through 96 are made in a manner similar to the manner of making the previously described courses of Fig. 3 with the exception that the float path of yarns *h* and *d*, at the rear of the fabric, as they travel from the last stitch knit in one course to the first stitch to be knit in a following course is such that it extends over a number of wales in a direction opposite to the direction in which these overplaid stitches are knit, as indicated at 97. The reason for the longer floats 97 as compared to the shorter floats 90 is that when the angle of the overplaid design, relative to the wales, is such that it moves in the direction of the knitting in the successive courses, as in the courses 57, 62, 69, 76, 83 and 86, then there are short floats 90, but when it moves in the opposite direction as in the courses 91 through 96, there are the longer floats 97.

A modified form of fabric previously referred to is illustrated in Fig. 4 as resulting from the operation of the machine and method herein described in which no floats are formed in the body fabric at any of the body knitting feeds. The course 98 may be knit upon feed No. 1 of body yarn 26 during a forward stroke, the knitting being from right to left, and, during the same stroke the needles of wales 99 and 100 will knit stitches 101 and 102, in that order, of overplaid yarn *d*. The next is a reverse stroke to form course 103 which is knit from left to right and this course, for so much of the fabric as is shown, comprises a stitch of body yarn 26 in every wale. It will be understood that overplaid yarn *h* may be incorporated in other portions of the fabric in a manner similar to the manner of incorporating the yarn *d*. The courses 104 and 105 are then formed similarly to the formation of courses 98 and 103, and it will be noted that the extra stitches of the yarn *d*, included between adjacent courses, are each separated walewise by a pair of intervening courses. The overplaid yarn stitches may be drawn longer than the body yarn stitches, in the fabrics of Figs. 3 and 4, if so desired. In the fabric of Fig. 3, the holding of the overplaid stitches on their needles during the body yarn float formation courses, will tend to lengthen the same.

It will be understood that the overplaid stitches may be in single wales or may extend over any desired number thereof and that they do not necessarily have to step over in the successive courses but may continue in the same wale or wales for a number of courses or for the entire height of the patterned area if desired. While the body yarn floats have been shown in Fig. 3 as extending over two wales for two courses directly beneath the overplaid stitches for best results, it should be understood that their length, and number thereof, and their relation to the overplaid stitches may be varied so some extent within the principle of the invention.

I claim:

1. A circular knitting machine having at least one knitting station and adapted to reciprocate to knit at said station during each stroke of the reciprocating movement, means adapted to simultaneously position at least a pair of yarns at said station to be fed to the needles, and means to cause selected needles to knit one only of said yarns during a knitting stroke in one direction and

to cause selected needles to knit only another of said yarns during the opposite knitting stroke.

2. A circular knitting machine having at least one knitting station and adapted to reciprocate to knit at said station during each stroke of the reciprocating movement, yarn guides adapted to simultaneously position a pair of yarns to be fed to the needles at said station, and means to cause selected needles to knit one only of said yarns during a knitting stroke in one direction and to cause selected needles to knit only the other of said yarns during the opposite knitting stroke.

3. A circular knitting machine having at least one knitting station and adapted to reciprocate to knit at said station during each stroke of the reciprocating movement, yarn guides adapted to simultaneously position a pair of yarns to be fed to the needles at said station, means providing one path of travel for the needles during a knitting stroke in one direction to cause selected needles to knit one only of said yarns and means providing a different path of travel for the needles during the opposite knitting stroke to cause selected needles to knit only the other of said yarns.

4. A circular knitting machine having at least one knitting station and adapted to reciprocate to knit at said station during each stroke of the reciprocating movement, a plurality of yarn guides at said station adapted to feed yarns to said needles, means to position a yarn guide at said station to feed a yarn at a certain level to said needles during reciprocating knitting, means to position a pair of yarn guides at said station at a level above said certain level to feed a pair of yarns to the needles during other reciprocating knitting, and means to cause selected needles to knit one only of said pair of yarns during a knitting stroke in one direction of said other reciprocating knitting and to cause selected needles to knit only the other of said pair of yarns during the opposite stroke of said other reciprocating knitting.

5. A circular knitting machine having at least one knitting station and adapted to reciprocate to knit at said station during each stroke of the reciprocating movement, a plurality of yarn guides at said station adapted to feed yarns to the needles, means to position a yarn guide at said station to feed a yarn at a certain level to said needles during reciprocating knitting, means to position a pair of yarn guides at said station at a level above said certain level to feed a circumferentially spaced pair of yarns to the needles during other reciprocating knitting, means providing one path of travel for the needles during a knitting stroke in one direction to cause selected needles to knit one only of said pair of yarns during one stroke of said other reciprocating knitting and means providing a different path of travel for the needles during the opposite knitting stroke to cause selected needles to knit only the other of said pair of yarns during the opposite stroke of said other reciprocating knitting.

6. A circular knitting machine having at least one knitting station and adapted to reciprocate to knit at said station during each stroke of the reciprocating movement, means providing one path of travel for the needles during a knitting stroke in one direction and a different path of travel for the needles during the opposite knitting stroke, a plurality of yarn guides at said station adapted to feed yarns to said needles, means to position a yarn guide to feed a yarn to said needles taking both paths of travel during reciprocating knitting, and means to position a pair of yarn guides to feed a circumferentially spaced pair of yarns to the needles during reciprocating knitting in such manner that selected needles knit one only of said pair of yarns during travel along one of said paths of travel during a knitting stroke in one direction while selected needles knit only the other of said pair of yarns during travel along the other of said paths of travel during the opposite knitting stroke.

7. A circular knitting machine having four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement, means at certain of said stations adapted to knit body fabric of body yarn, and means at other of said stations adapted to incorporate an overplaid type of design of separate yarn within said body fabric formed at said certain stations, all of said stations performing their functions during a single stroke of reciprocation.

8. A circular knitting machine having four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement, means at certain of said stations adapted to knit body fabric of body yarn during knitting strokes in opposite directions, and means at other of said stations adapted to incorporate an overplaid type of design of separate overplaid yarn within said body fabric during the knitting thereof, individual overplaid yarns being knit only during knitting strokes in one direction.

9. A circular knitting machine having four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement, means at an opposite pair of said stations adapted to knit body fabric of body yarn during knitting strokes in opposite directions and means at at least one of the other pair of said stations adapted to knit one only of a pair of yarns during knitting strokes in one direction and to knit only the other of said pair of yarns during knitting strokes in the opposite direction.

10. A circular knitting machine having four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement, means at an opposite pair of said stations adapted to knit body fabric of body yarn during strokes in opposite directions and means at each of the other pair of said stations adapted to knit one only of a pair of yarns during knitting strokes in one direction and to knit only the other of said pair of yarns during knitting strokes in the opposite direction.

11. A circular knitting machine having four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement, means at each of an opposite pair of said stations adapted to knit body fabric of body yarn on a series of needles during strokes in opposite directions and means at each of the other pair of said stations adapted to knit one only of a pair of yarns upon needles of one of said series of needles and to knit only the other of said pair of yarns upon needles of the other series of needles.

12. A circular knitting machine having four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement, means at an opposite pair of said stations adapted to knit a pair of body fabric areas of a pair of body yarns upon a pair of needle groups during knitting strokes in opposite directions, means adapted to feed a pair of yarns to the needles at each of the other pair of said stations, and means at each of said other pair of said stations adapted to knit one only of each of said pairs of yarns upon needles of one of said needle groups and to knit only the other of each of said pairs of yarns upon needles of the other of said needle groups.

13. A method of knitting a tubular fabric having a plurality of fabric areas including the step of simultaneously forming a pair of said areas by reciprocating knitting of the courses thereof and the step of simultaneously incorporating an overplaid design within each of said areas during the knitting thereof.

14. A method of operating a circular knitting machine having four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement including the step of knitting a yarn on selected needles at each of an opposite pair of said stations to knit during strokes in opposite directions, the

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step of knitting a yarn at each of the other pair of said stations on certain of said needles selected at said first mentioned pair of stations only during strokes in one direction and the step of knitting another yarn at each of the other pair of said stations on selected needles of said needles selected at said first mentioned pair of stations only during strokes in the opposite direction.

15. A method of knitting on a circle of needles of a circular knitting machine having at least three knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement including the step of knitting a yarn upon a needle group of said circle of needles at one of said knitting stations during strokes in opposite directions, the step of knitting a yarn upon selected needles of said needle group at a second of said knitting stations during strokes in one direction, and the step of knitting a yarn upon selected needles of said needle group at the third of said knitting stations during strokes in the opposite direction.

20 16. A method of knitting on a circle of needles of a circular knitting machine having at least four knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement including the step of knitting a yarn upon a needle group of said circle of needles at each of an opposite pair of said knitting stations during strokes in opposite directions, the step of knitting yarns upon selected needles of said needle groups at the intervening pairs of said knitting stations during strokes in one direction, and the step of knitting other yarns upon selected needles of said needle groups at said intervening pairs of said knitting stations during strokes in the opposite direction.

17. A method as set forth in claim 16 including the

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additional step of reversing the knitting action on the pairs of knitting stations.

18. A method of knitting on a circle of needles of a circular knitting machine having at least three knitting stations and adapted to reciprocate to knit at said stations during each stroke of the reciprocating movement including the step of knitting a yarn upon a first group of needles at one of said knitting stations during strokes in opposite directions, the step of knitting a second yarn upon a second group of needles at a second of said knitting stations during strokes in opposite directions, the step of knitting a third yarn upon selected ones of said first group of needles at a knitting station intermediate of said one and said second knitting stations during strokes in one direction, and the step of knitting a fourth yarn upon selected ones of said second group of needles at said intermediate knitting station during strokes in the opposite direction.

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