

Aug. 29, 1944.

C. R. BURNS

2,356,819

WARP KNIT FABRIC AND METHOD OF MAKING THE SAME

Filed Jan. 13, 1941

4 Sheets-Sheet 1

Fig. 2.

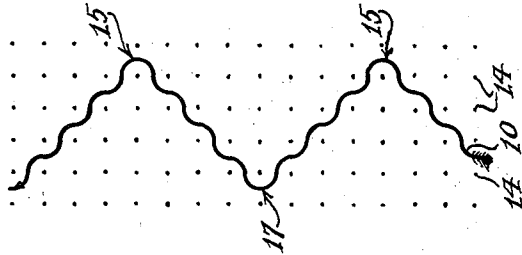


Fig. 1.

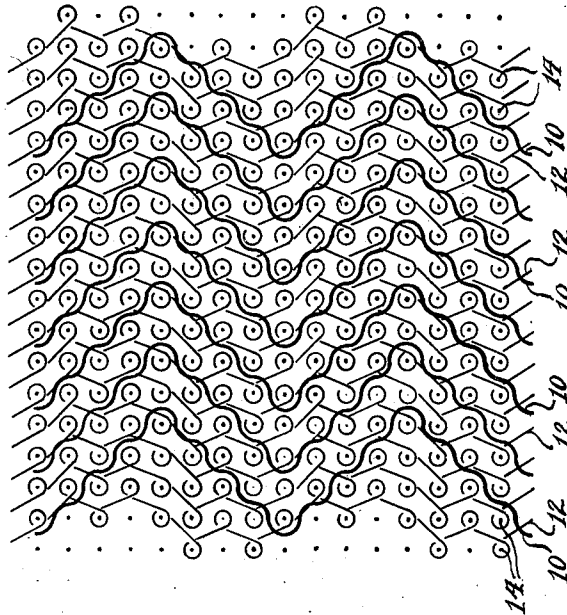
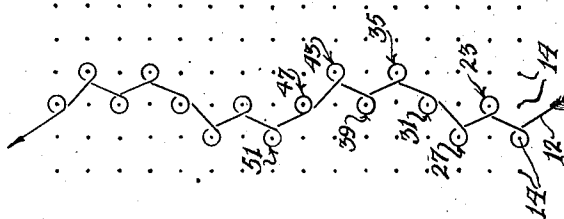


Fig. 3.



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Fig. 5.

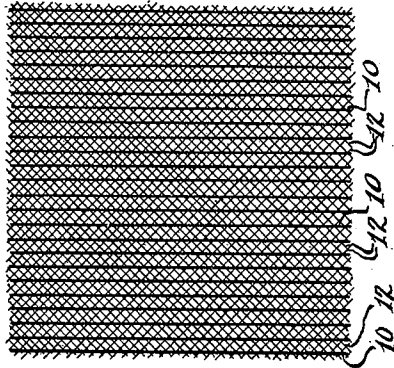
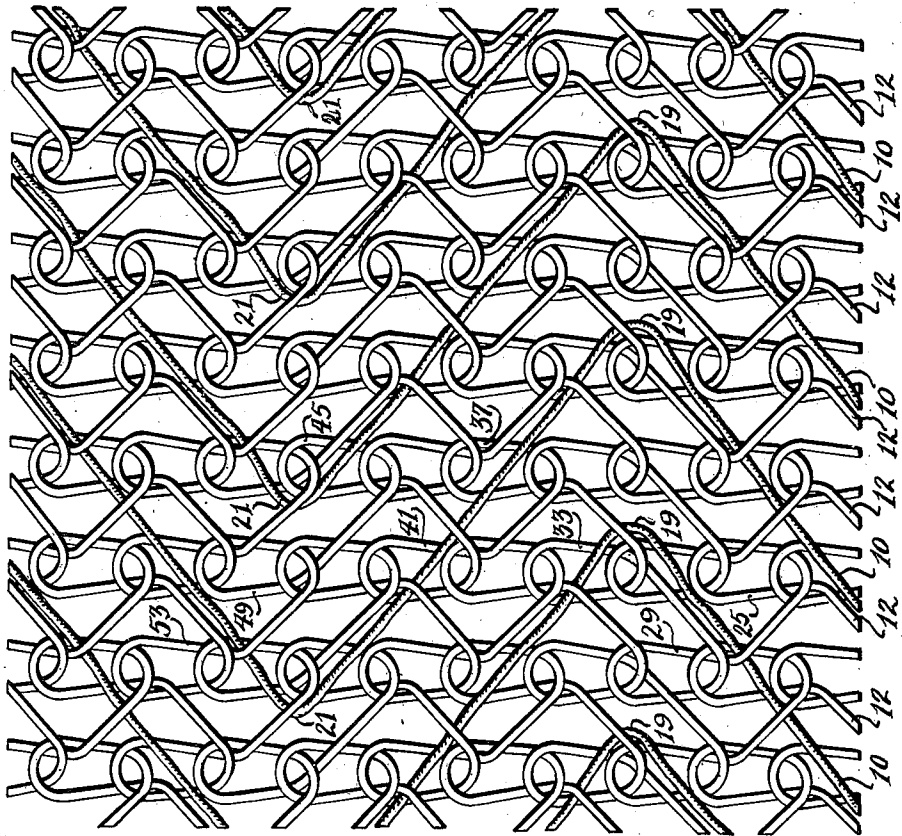


Fig. 4.



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Fig. 8.

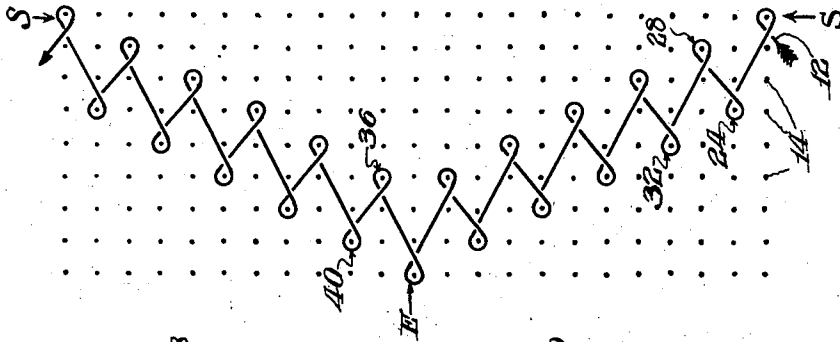


Fig. 6.

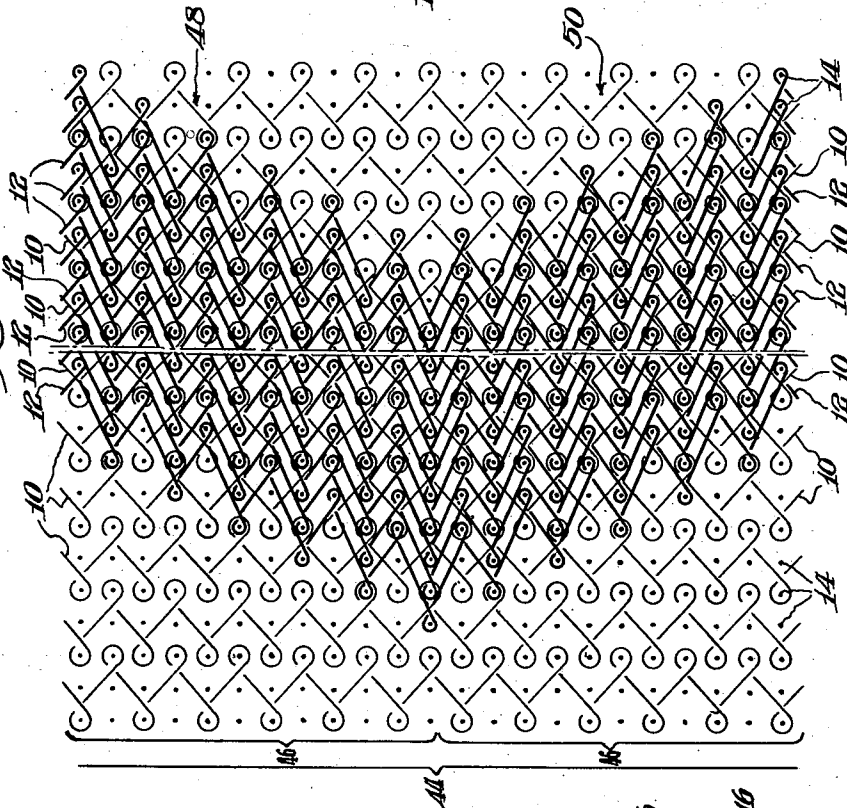
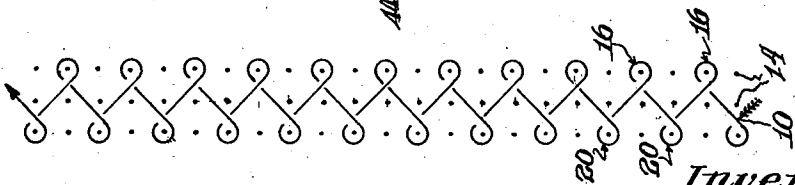


Fig. 7.



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Fig. 10.

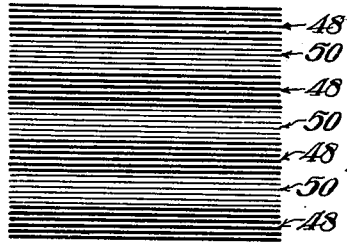


Fig. 11.

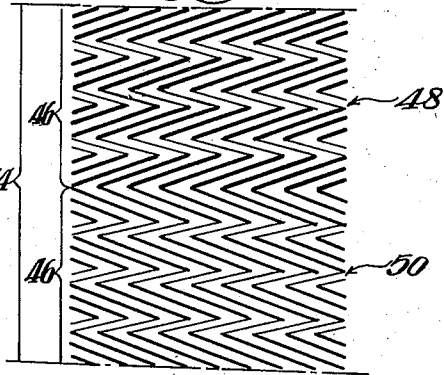
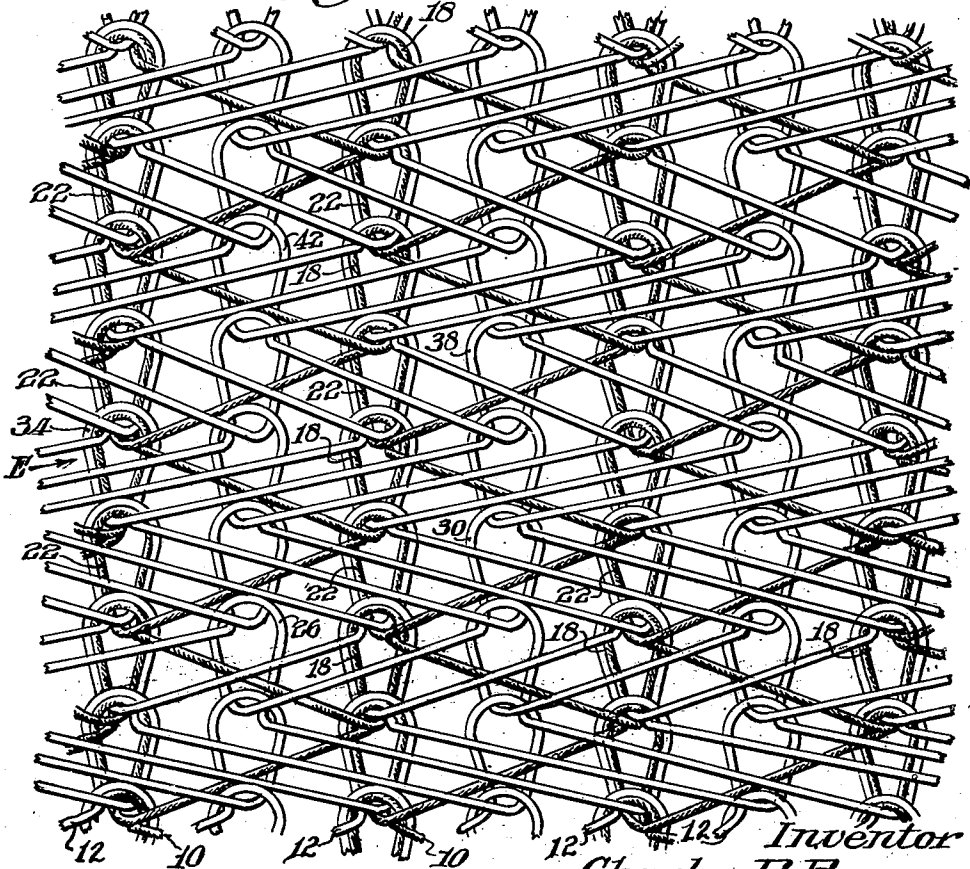


Fig. 9.



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UNITED STATES PATENT OFFICE

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WARP KNIT FABRIC AND METHOD OF MAKING THE SAME

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Application January 13, 1941, Serial No. 374,219

5 Claims. (Cl. 66—192)

The present invention generally relates to warp knit fabric and the method of making the same, and has for its basic object the provision of a stretchable warp knit fabric possessing a greater amount of snap than is usually present in known fabric of this kind.

The invention more particularly contemplates the provision of a stretchable warp knit fabric produceable on a usual warp knitting machine of the type commonly known as tricot machines, the machine, however, being operated according to an improved method in order to produce a fabric of usual knit construction which imparts to said fabric an increased ability to stretch and, at the same time, supply the fabric with an inherent ability to snap back to its normal intended and original form.

It is one of the most important features of the invention to provide a warp knit fabric wherein the yarns are so laid as to acquire a particular characteristic formation which gives to the fabric an extraordinary degree of stretchability and snap.

Another important feature of the invention is found in the provision of a warp knit fabric wherein certain yarns are so related with certain other yarns as to assume a zig-zag or accordion formation, whereby said fabric, by reason of the zig-zag or accordion formation of said certain yarns, inherently and constructionally acquires an extraordinary degree of elasticity.

Among the specific objects of the invention is the provision of a fabric knitted in tricot fashion from a set of inelastic yarns and a set of elastic yarns, the inelastic yarns being knitted into a base fabric and the elastic yarns being laid in zig-zag direction and tied within said fabric in such a manner as to produce a finished fabric of uniform surface by preventing said elastic yarns from crawling or creeping which is known to be one of the primary causes of the production of a wrinkled effect in such fabrics.

The invention is specifically characterized in that it results in the production of fabric possessing a great many desirable advantageous features such as strength, elastic stretchability, and distinctive surface appearance.

Other important objects, features, and advantages of the invention will be in part obvious and in part pointed out hereinafter.

The improved fabric, in accordance with the invention, is made on a tricot warp knitting machine employing a needle bar and two yarn guide bars respectively known as the back guide bar and the front guide bar. The needle bar is provided

with a bank of needles which vary in number according to the gauge, and each guide bar has a bank of yarn guides corresponding to the number of needles in the needle bar. The guide bars are slidable in reverse directions longitudinally of the needle bar, each guide bar being controlled by individual cam or cams. Both guide bars, moreover, are swingable transversely of the needle bar.

Also, in accordance with the present invention, every other yarn guide of the back guide is threaded with a warp yarn (preferably an elastic yarn), and every yarn guide of the front guide bar is threaded with a warp yarn (preferably an inelastic yarn). Thus there are twice as many inelastic yarns as there are elastic yarns.

According to one aspect of the invention, the back and front guide bars respectively slide longitudinally of the needle bar, at times in the same direction, and at other times in the opposite direction, but the sliding motion of one guide bar (specifically, the back guide bar) occurs only in front of the needles, whereas the sliding motion of the other guide bar (specifically, the front guide bar) occurs either in front or in back of the needles. One guide bar, that is, the back guide bar, has a sliding motion longitudinally of the needle bar a certain number of needles at a time for the distance of a predetermined fixed number of needles in one direction and for the distance of a predetermined fixed number of needles in the other direction, and the other guide bar, that is, the front guide bar, has a sliding motion longitudinally of the needle bar a certain number of needles at a time for the distance of a predetermined variable number of needles in one direction and for the distance of a predetermined variable number of needles in the other direction.

Thus, to give a specific example: Each yarn in the back guide bar laps over four needles, one needle at a time, and then drops back over four needles, one needle at a time, whereas each yarn in the front guide bar laps over one needle, under one needle, and drops back over one needle, under one needle, and then laps over two needles, under one needle, this relative lapping and dropping back of the yarns in the rear and front guide bars being repeated throughout the length of the fabric.

As a result of this particular procedure, there is produced a warp knit fabric consisting of courses knitted from the yarns in the front guide bar, certain spaced courses being formed of non-reversing closed stitches on which the yarns in the rear guide bar are hung. Further, the par-

tical procedure results in that the yarns in the rear guide bar are laid in zig-zag or accordion-like fashion so that said yarns, upon being relieved of the tension under which they are laid, tend to straighten out, causing the loops of the courses knitted from the yarns in the front guide bar to gather, accordingly producing a fabric having an increased ability to stretch and snap back, and possessing a characteristic surface appearance.

According to another aspect of this invention, the back and front guide bars respectively slide longitudinally of the needle bar in reverse directions, but one guide bar (specifically, the back guide bar) has a continuous uniform sliding motion longitudinally of the needle bar for a distance of a predetermined number of needles in one direction, and for the distance of an equal predetermined number of needles in the other direction, whereas the other guide bar (specifically, the front guide bar) has a continuous uniform sliding motion longitudinally of the needle bar for the distance of a predetermined number of needles in one direction and for the distance of a different predetermined number of needles in the other direction, the motion of said other or front guide bar progressing in one direction for a certain number of courses, and then progressing for a like number of courses in the other direction.

Both guide bars undergo a swingable motion transversely of the needles at the beginning and end of each of their sliding motions, accordingly forming fully closed loops throughout the knitting of the fabric.

Thus, to give a specific example: Each of the yarns in the back guide bar laps over two needles, under one needle, for the formation of one stitch, and drops back over two needles and under one needle for the formation of the next stitch, this lapping and dropping back of each yarn in the back guide bar being repeated throughout the knitting of the successive courses in the fabric, whereas each yarn in the front guide bar laps over three needles, under one needle for the formation of one stitch, then drops back over two needles, under one needle, for the formation of the next stitch this lapping and dropping back of each yarn in the front guide bar being repeated for twelve stitches when the front guide bar reaches its highest point and then starts to move in the opposite direction until it again reaches the starting point.

As a result of this particular procedure, there is produced a warp knit fabric, the courses of which assume a zig-zag or accordion-like formation, said courses, in turn, being assembled in groups constituting strips respectively disposed in zig-zag or accordion-like relationship, the association of such courses and groups of courses producing a fabric of improved elastic stretch and characteristic surface appearance.

Further, this procedure results in the production of a fabric warp knitted from a set of elastic yarns and a set of inelastic yarns, wherein the two sets of yarns are so interlooped that the inelastic yarns are knitted into and over the elastic yarns in a diagonal, chevron, or herring-bone manner, thus producing a two-way elastic stretch fabric because the arrangement and relation of the elastic yarns permit the fabric to stretch crosswise while the arrangement and relation of the elastic and inelastic yarns permit the fabric to stretch lengthwise.

In order that the invention and its mode of operation may be more readily understood by those skilled in the art, I have, in the accompanying

drawings and in the detailed description based thereupon, set out the specific example of the invention hereinbefore mentioned.

In these drawings:

Figure 1 indicates the combined motions of the front and rear guide bars of a tricot machine operated to produce one fabric construction in accordance with the invention;

Figure 2 indicates the motion of the back guide bar in the making of said fabric construction;

Figure 3 indicates the motion of the front guide bar in the making of the fabric construction;

Figure 4 illustrates on a greatly enlarged scale the loop formation of the fabric construction as knitted on the machine;

Figure 5 is a diagrammatic representation of one face of the fabric construction upon being completed;

Figure 6 indicates the combined motions of the front and rear guide bars of a tricot machine operated to produce a modified fabric construction in accordance with the invention;

Figure 7 indicates the motion of the back yarn guide bar in making said modified fabric construction;

Figure 8 indicates the motion of the front guide bar in making said modified fabric construction;

Figure 9 illustrates on a greatly enlarged scale the loop formation of the modified fabric construction;

Figure 10 is a diagrammatic representation of the front face of such a fabric construction;

Figure 11 is an enlarged diagrammatic representation of a portion of Figure 10.

It is pointed out that, for the sake of clarity in illustration, the motion of the back guide bar is shown in heavy lines, and the motion of the front guide bar is shown in light lines in Figures 1 through 3, whereas the motion of the back guide bar is shown in light lines, and the motion of the front guide bar is shown in heavy lines in Figures 6 through 8.

Referring more particularly to the fabric construction shown in Figures 1 to 5 inclusive, it will appear from Figure 1 of the drawings that in the manufacture of the fabric illustrated, two sets of warp yarns 10 and 12 are employed, one set of warp yarns 10 being elastic and the other set of warp yarns 12 being inelastic. It will be noted that the elastic yarns 10 and the inelastic yarns 12 at times are laid in front of the needles 14 in opposite directions, and at other times are laid in front of the needles in the same direction, and that moreover, while the number of inelastic yarns 12 is equal to the number of needles 14, there are only half that number of elastic yarns 10.

The movement of the guides for the respective yarns 10 and 12 are represented separately in Figures 2 and 3. As clearly appears in Figure 2, each elastic yarn 10 is moved, for instance, to the right in front of the needles one needle at a time for a certain number of needles, and then to the left in front of the needles one needle at a time for a certain number of needles. In the example shown, the movement of each elastic yarn to the right and to the left is over four needles, although it will be understood that such movement may be over a different number of needles than that specified in either or both directions.

It is to be noted particularly that each elastic yarn, in its movement to the right and to the left, does not lap around any one needle at any time, but is merely laid in a lengthwise position in front of the needles, the yarn at its reversal

points indicated at 15 and 17 (Figure 2) becoming hung, as shown at 19 and 21 in Figure 4.

As shown in Figure 3, each inelastic yarn 12 is moved to the right over one needle, under one needle, so that the yarn is wrapped around the needle as shown at 23 in Figure 3, forming a reversing closed stitch as shown at 25 (Figure 4). Then the inelastic yarn is moved to the left over one needle, under one needle, so that the yarn is wrapped about the needle as shown at 27 (Figure 3) forming a reversing closed stitch as shown at 29 (Figure 4). Thereafter, the inelastic yarn is moved again to the right over two needles, under one needle, so that the yarn is wrapped about the needle as shown at 31 (Figure 3) to form a non-reversing closed stitch as shown at 33 (Figure 4), and continues to move to the right over one needle, under one needle, so that the yarn is wrapped about the needle as shown at 35 (Figure 3) forming a reversing closed stitch as shown at 37 (Figure 4). Then the inelastic yarn is moved to the left over one needle, under one needle, so that the yarn is wrapped about the needle as shown at 39 (Figure 3) forming a reversing closed stitch as shown at 41 (Figure 4). Then the inelastic yarn is moved to the right over one needle, under one needle, so that the yarn is wrapped about the needle as shown at 43 (Figure 3) forming a reversing closed stitch as shown at 45 (Figure 4). Thereafter, the inelastic yarn is moved to the left over two needles, under one needle, so that the yarn is wrapped about the needle as shown at 47 (Figure 3) to form a non-reversing closed stitch as shown at 49 (Figure 4) and continues to move to the right over one needle, under one needle, so that the yarn is wrapped about the needle as shown at 51 (Figure 3) forming a reversing closed stitch as shown at 53 (Figure 4). This constitutes one repeat, which is duplicated throughout the length of the fabric.

The relative movements of the elastic yarns 10 and inelastic yarns 12 cause the interknitting of the inelastic yarns and the tying in of the elastic yarns in the manner more clearly illustrated in Figure 4 of the drawings.

Attention is particularly called to the fact that the elastic yarns 10 necessarily are laid under tension. Because of this, although the elastic yarns are laid in zig-zag directions as illustrated in Figures 1 and 2, and are hung at staggered points, as indicated at 19 and 21 in Figure 4, such elastic yarns come out straight in the completed fabric, as is diagrammatically represented in Figure 5. Thus the elastic yarns, in their straightening, are relieved of their tension without crawling and, therefore, do not cause a wrinkled effect in the fabric. Moreover, the straightening out of the elastic yarns relatively shifts and gathers in coursewise direction the loops of inelastic yarns constituting the base fabric, with the result that a considerable increase in stretchability and snap is imparted to the fabric. Also, as a result of the straightening of the elastic yarns and the shifting and gathering of the loops of inelastic yarns, there is produced on one face of the fabric a distinctive program-like surface appearance, as diagrammatically illustrated in Figure 5.

In Figures 6 to 11 inclusive there is shown a modified fabric construction.

Referring more particularly to Figure 6, in the manufacture of this modified fabric construction, a set of elastic warp yarns 10 and a set of inelastic warp yarns 12 are also employed, but

it will be noted that the elastic yarns 10 and inelastic yarns 12 always lap in opposite directions and for different distances when fed to the bank of needles 14 to form loops in a course and that, moreover, while the elastic yarns 10 are fed to alternate needles of the bank of needles 14, the inelastic yarns are fed to every needle of said bank of needles.

The movements of the guides for the respective yarns 10 and 12 are represented separately in Figures 7 and 8. As clearly appears from Figure 7, the elastic yarn 10 is moved to the right over two needles, under one needle, so that the yarn is caused to wrap around the needle as shown at 16 (Figure 7) to form a closed stitch 18 (Figure 9). Thereafter, the yarn is moved to the left over two needles and under one needle so that the elastic yarn wraps around the needle, as shown at 20 (Figure 7) to form a closed stitch 22 (Figure 9). After forming said loop, the elastic yarn 10 again returns to the first mentioned needle, then back again to the second mentioned needle, and so on throughout the knitting of the fabric. Thus the elastic yarn 10 is wrapped repeatedly around alternating needles in the manner represented at 16 and 20 in Figure 7 to form closed stitches in successive courses, as shown at 18 and 22 in Figure 9.

As shown in Figure 8, each inelastic yarn 12 is moved to the left over three needles and under one needle so that the yarn is wrapped around the needle as shown at 24 (Figure 8) forming a closed stitch thereon as shown at 26 (Figure 9). Then the inelastic yarn is moved to the right over two needles and under one needle so that the yarn is wrapped about the needle, as shown at 28 (Figure 8) forming a closed stitch thereon, as shown at 30 (Figure 9). Thereafter, the inelastic yarn 12 is moved again to the left over three needles under one needle and wrapped around the same as shown at 32 (Figure 8), forming a closed stitch thereon as shown at 34 (Figure 9), and then again to the right over two needles, under one needle, forming a closed stitch thereon in the manner stated, the inelastic yarn being repeatedly moved in this manner for twelve stitches. Thus it will be noted that, during the formation of each of these twelve stitches, the inelastic yarn 12 progresses to the left by the distance of one needle at a time. Upon completion of the last stitch of this series of twelve stitches, or when the end of point E of the progressive movement to the right is reached, the inelastic yarn 12 reverses its direction of progressive movement, that is, said yarn then moves to the right over three needles, under one needle, so that the yarn is wrapped about the needle, as shown at 36 (Figure 8) to form a closed stitch 38 (Figure 9), and then to the left over two needles, under one needle, so that the yarn is wrapped about this needle, as shown at 40 (Figure 8) to form a closed stitch 42 (Figure 9). This reverse direction of progressive movement continues for a series of twelve stitches, or until the starting point S of the first mentioned series is reached.

The relative movements of the elastic yarns 10 and inelastic yarns 12 cause the interknitting of said yarns in the manner more clearly illustrated in Figure 9 of the drawings, so that each yarn becomes positively tied into the fabric, resulting in the production of a flat fabric that will not pucker nor ladder or run. Thus the fabric constructed in accordance with the invention may be cut without the necessity of treating the edges

with latex or other compounds, and vulcanizing to prevent the elastic yarns from pulling back through the fabric, causing unsightly appearance and breaking down of the knitted structure which is characteristic of certain fabrics wherein the elastic yarns are merely laid in.

Moreover, because of the mode of feeding the inelastic yarns, there is produced, as diagrammatically shown in Figure 11, a series 44 of relatively zig-zag stitches in the consecutive courses assembled in relatively zig-zag groups 46, thus providing a somewhat double accordian structure in the fabric which imparts to said fabric an increased ability to stretch, the interknitting of the elastic yarns in the mode hereinbefore specified acting to impart elasticity to such stretchable fabric.

As diagrammatically shown in Figure 10, the mode of laying the inelastic yarns also results in producing on the front face of the fabric a series of alternating stripes 48 and 50 running transversely of the fabric, that is, at right angles to the direction of knitting. The formation of these alternating stripes 48 and 50 is attained by the particular method followed in laying the inelastic yarns which, as hereinbefore stated, progresses in zig-zag fashion, first in one direction for a number of courses, then in the opposite direction for a number of courses. This mode of laying the yarns causes the lapping portions thereof in one series of courses constituting one stripe 48 to intercept light at an angle different from that of the lapping portions of the yarns in the adjoining series of courses constituting an adjoining stripe 50. Because of the interception of light at different angles, it will be appreciated that the adjoining stripes 54 and 56 in the fabric possess different degrees of light reflectability and, therefore, have different degrees of surface brightness which imparts to the fabric a characteristic and unusual surface appearance.

Whereas I have described herein the specific details of possible embodiments of the invention, it is to be understood that the invention is not restricted to such details, but embraces such modifications as come within the scope of the subjoined claims.

What I claim is:

1. The method of making a warp knit fabric, which comprises supplying a yarn to each of a plurality of needles, lapping the yarns over three needles, under one needle, in one direction for the formation of one course, and then over two needles, under one needle, in the other direction for the formation of the next succeeding course, and repeating said lapping of yarns for a number of successive courses; then lapping the yarns over three needles, and under one needle, in the second mentioned direction for the formation of a course, and then over two needles, under one needle, in

the first mentioned direction for the formation of the next succeeding course, and repeating this lapping of yarns for a number of successive courses.

2. In a method of making a warp knit fabric, the steps of: supplying a yarn to each of a plurality of needles; lapping the yarns over three needles under one needle in one direction for the formation of one course, and over two needles under one needle in the other direction for the formation of the next succeeding course, and repeating said lapping of yarns for a multiplicity of successive courses; and then lapping the yarns over three needles under one needle in the second mentioned direction for the formation of a course, and over two needles under one needle in the first mentioned direction for the formation of the next succeeding course, and repeating this lapping of yarns for a multiplicity of successive courses.

3. A warp knit fabric comprising successive courses knitted from a plurality of warp yarns, each yarn lapping over three wales in one direction, and over two wales in the other direction, in every two consecutive courses for a multiplicity of successive courses, and then lapping over three wales in the second mentioned direction, and over two wales in the first mentioned direction, in every two consecutive courses for a multiplicity of successive courses.

4. A warp knit fabric comprising successive courses knitted from two sets of warp yarns, each yarn in one of said sets lapping over two wales in both directions in said successive courses throughout the fabric, and each yarn in the other of said sets lapping over three wales in one direction, and over two wales in the other direction, in every two consecutive courses for a multiplicity of successive courses throughout a portion of the fabric, and then lapping over three wales in the second mentioned direction, and over two wales in the first mentioned direction in every two consecutive courses for a multiplicity of successive courses throughout the adjacent portion of the fabric.

5. A two-way elastic stretch warp knit fabric comprising successive courses knitted from a set of elastic warp yarns and a set of inelastic warp yarns, each elastic warp yarn lapping over two wales in both directions in said successive courses throughout the fabric, and each inelastic warp yarn lapping over three wales in one direction, and over two wales in the other direction, in every two consecutive courses for a multiplicity of successive courses in a portion of the fabric, and then lapping over three wales in the second mentioned direction, and over two wales in the first mentioned direction, in every two consecutive courses for a multiplicity of successive courses throughout the adjacent portion of the fabric.

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