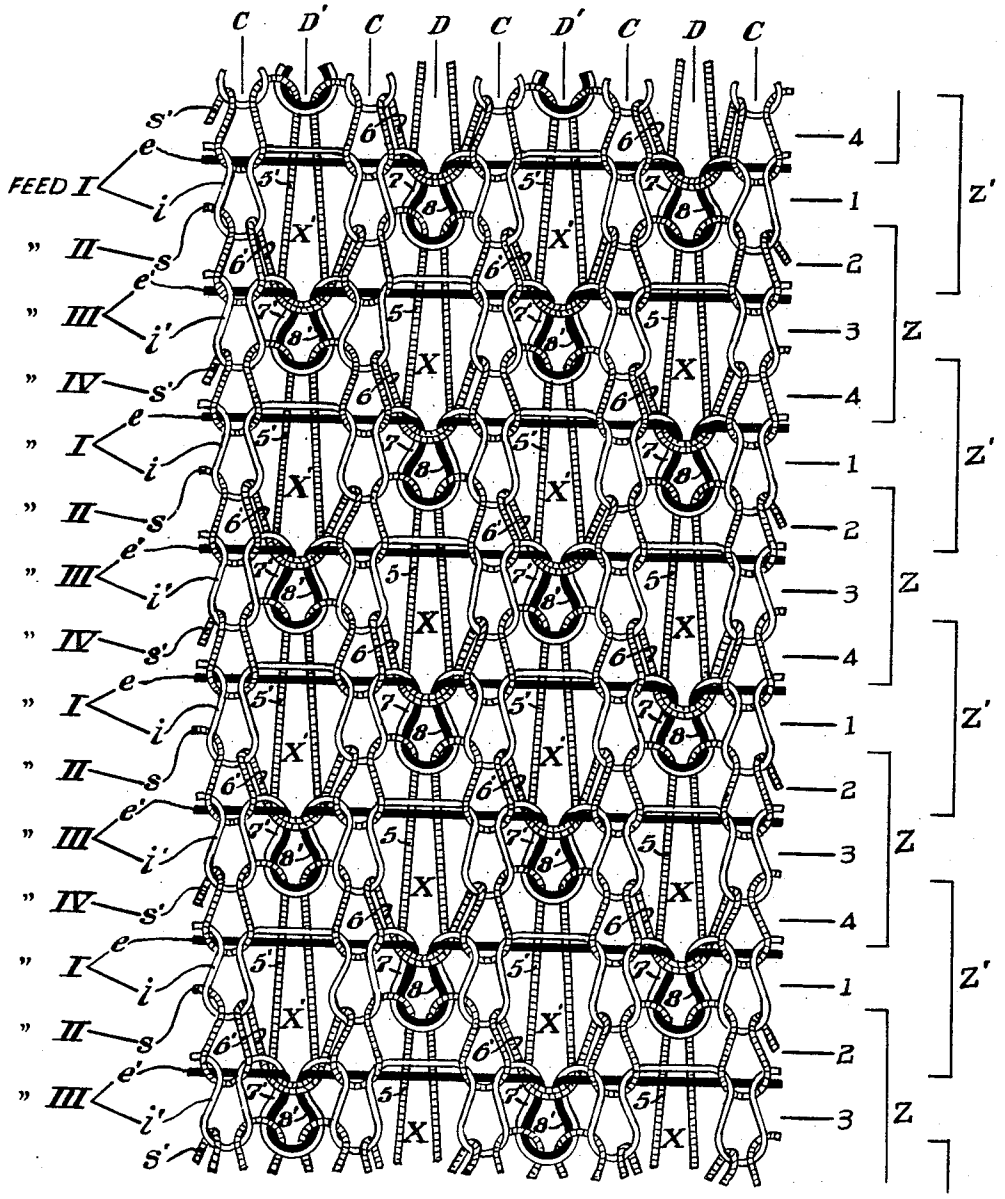
July 26, 1960 W. F. MORANCY 2,946,210

KNITTED FABRIC

Filed Oct. 8, 1957

6 Sheets-Sheet 1

FIG. 1



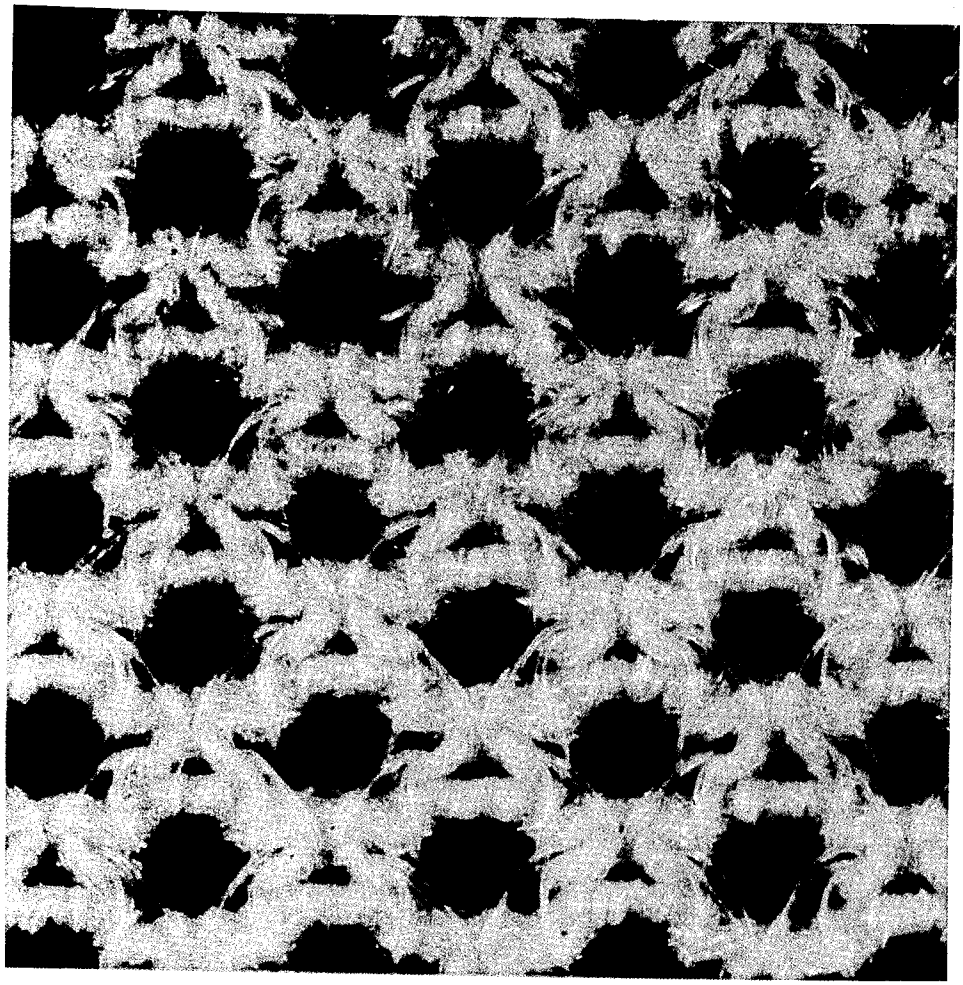
INVENTOR.
William F. Morancy,
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July 26, 1960 W. F. MORANCY 2,946,210

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FIG. 2



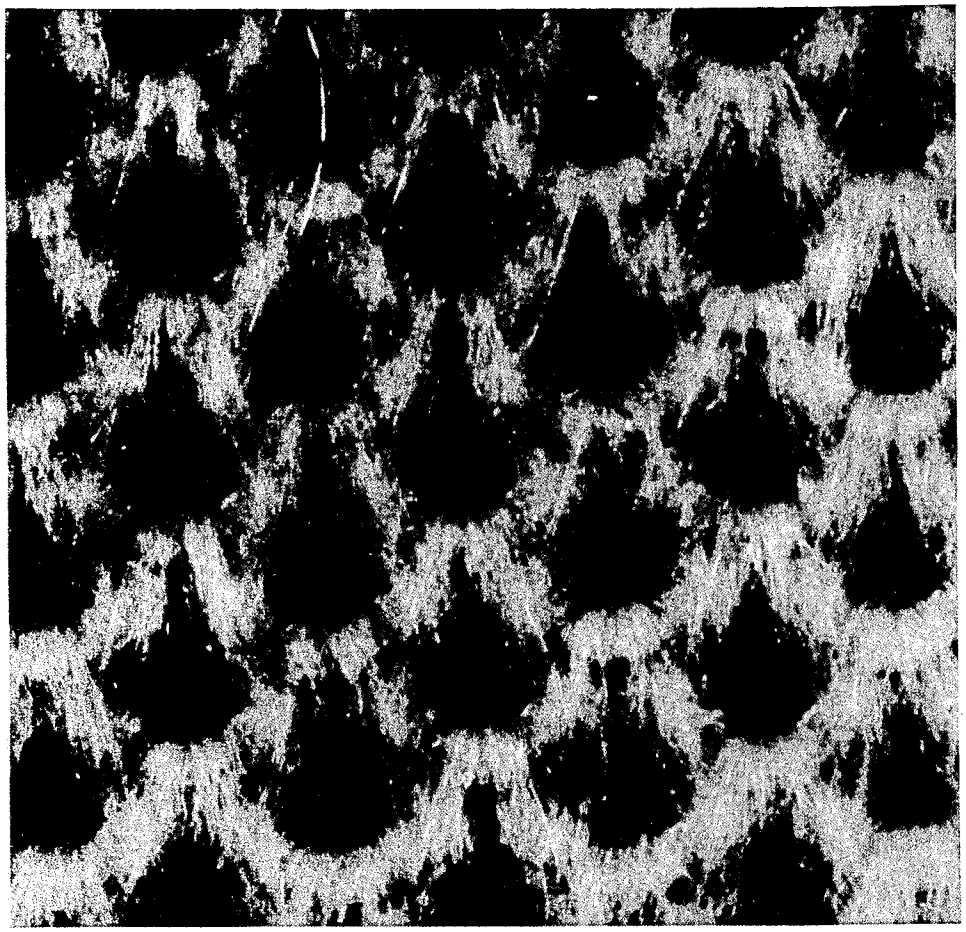
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ATTORNEYS.

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FIG. 3



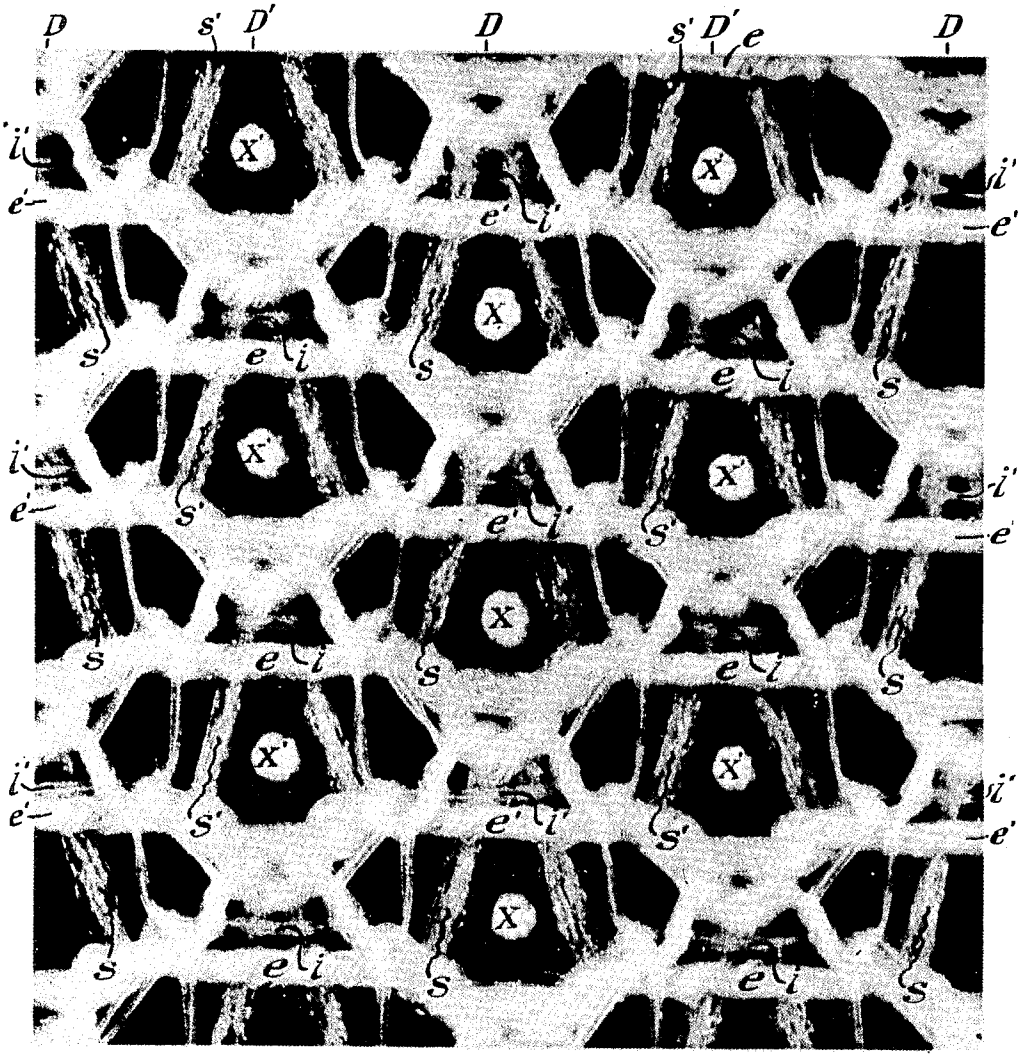
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July 26, 1960 W. F. MORANCY 2,946,210

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FIG. 4



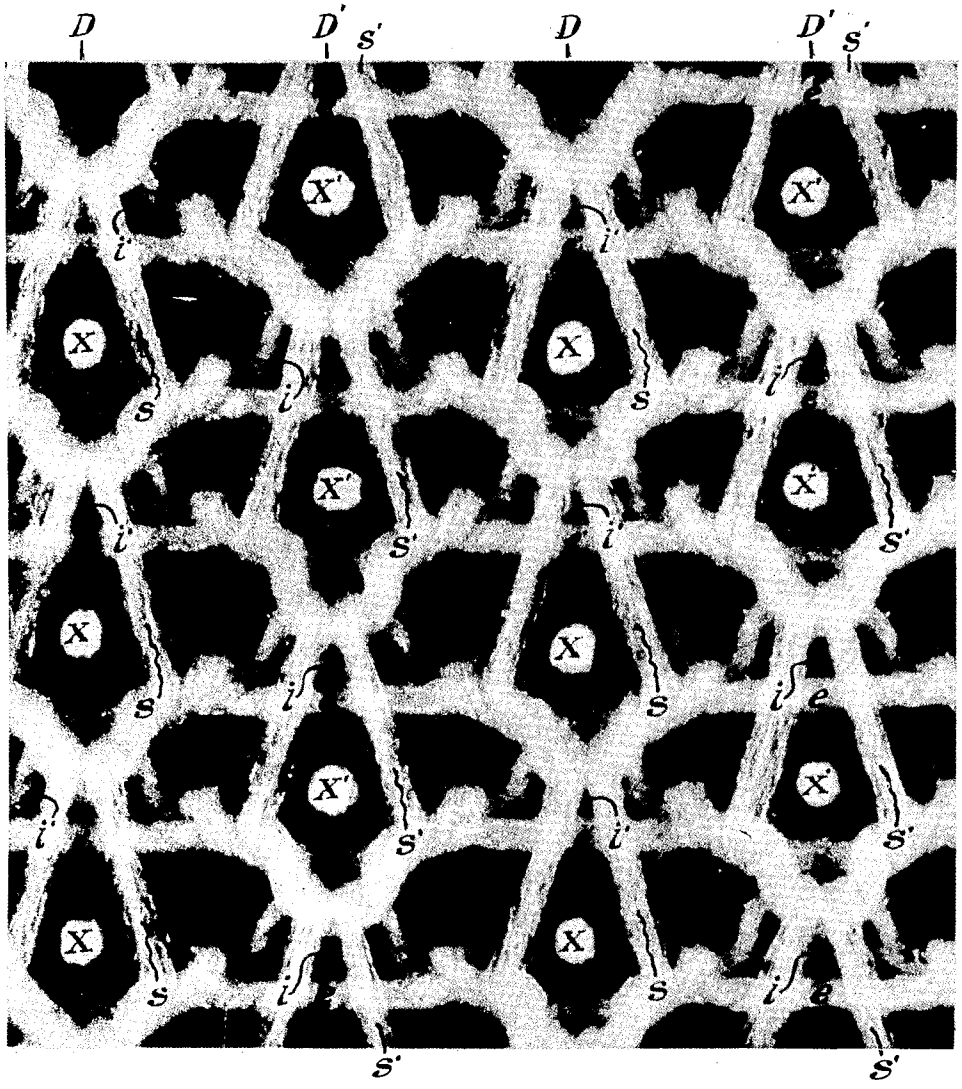
INVENTOR:
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July 26, 1960 W. F. MORANCY 2,946,210

KNITTED FABRIC

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FIG. 5



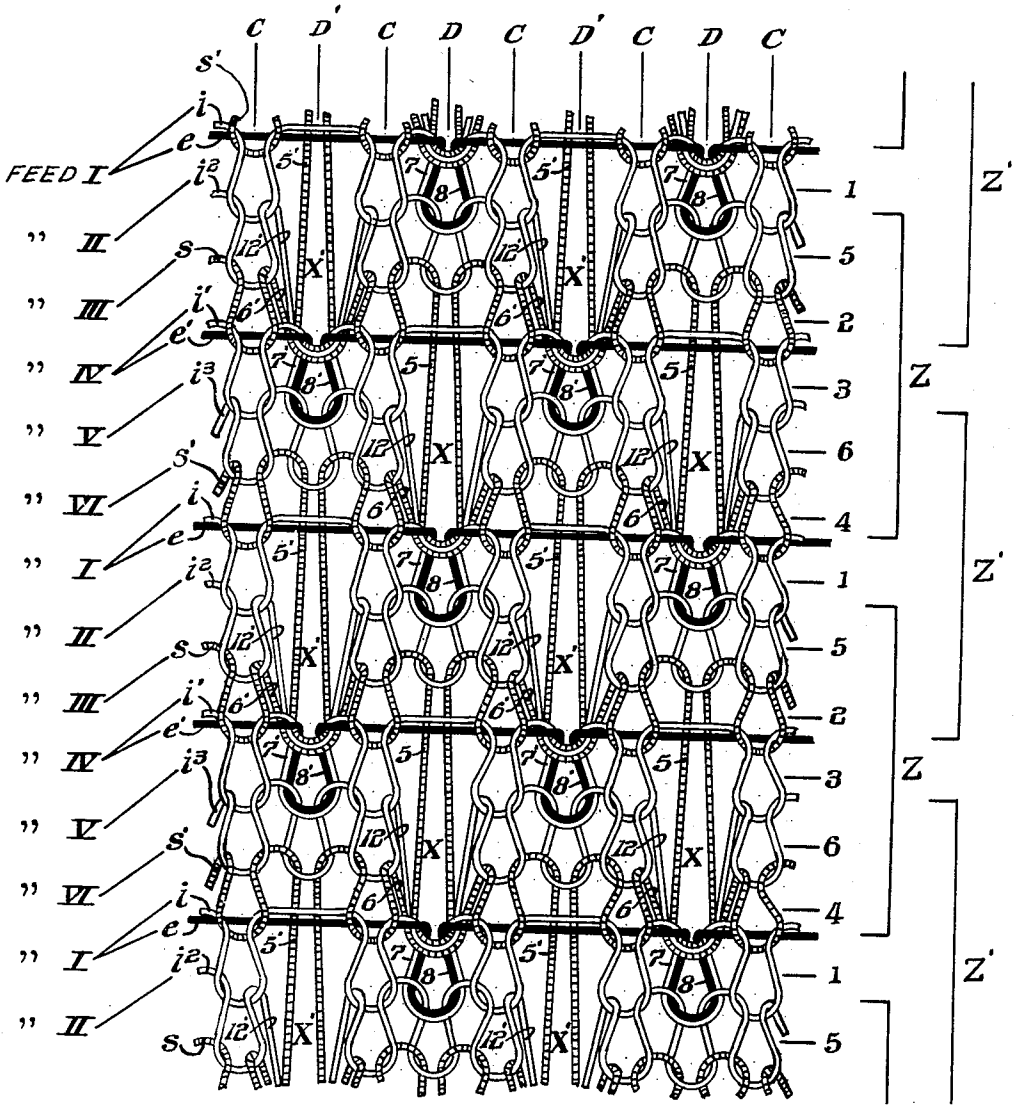
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KNITTED FABRIC

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FIG. 6



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2,946,210

KNITTED FABRIC

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Filed Oct. 8, 1957, Ser. No. 688,952

13 Claims. (Cl. 66—200)

This invention relates to knitted fabrics. More particularly, it is concerned with knitted fabrics primarily intended for use in the manufacture of supporting garments intended to be worn next to the body, such as foundation garments, brassieres and the like.

The chief aim of my invention is to provide knitted fabrics suitable for the above purposes which are porous, attractive in appearance, firm but light in weight, laterally elastic so that garments made therefrom will furnish the desired support, and longitudinally elastic for capacity of the garments to respond to the muscular movements of the wearers without tendency to creep or "ride up."

A further object of my invention is to provide elastic knitted fabrics having the above attributes which lend themselves to economic production in quantity by manufacture in tube form on circular knitting machines.

It is a further object of my invention to provide elastic knitted fabrics intended for use in the manufacture of supporting garments whereof one face is soft to the touch and the other face is relatively smooth and firm.

It is a further object of this invention to provide net elastic fabrics which are composed of inelastic, elastic and stretch yarns and which have staggered interstices formed therein.

It is a further object of this invention to provide knitted fabrics having spaced courses knit of one type of yarn with loops of one course in each of recurrent pairs of such spaced courses interlooped or tucked with loops of the other course of such pairs of spaced courses in spaced wales, having intervening courses of another type of yarn with such other yarn floated across said spaced wales and knitted in intervening wales and having spaced courses containing elastic yarn knit in spaced wales and floated across the wales intervening between said spaced wales.

Other objects and attendant advantages will appear from the following detailed description of the attached drawings, wherein:

Fig. 1 is a fragmentary, diagrammatic view showing the front face of a knitted fabric embodying my invention and produced on a circular knitting machine having four feeds or multiples thereof.

Figs. 2 and 3 are photographic views on a magnified scale of the front and back faces, respectively, of an actual, unstretched fabric of the type shown in Fig. 1.

Figs. 4 and 5 are magnified views of the fabric of Figs. 2 and 3 showing the front and back faces, respectively, when in stretched condition.

Fig. 6 is a fragmentary, diagrammatic view similar to Fig. 1 showing a modified fabric embodying my invention and produced on a circular machine having six feeds or multiples thereof.

The term "elastic yarn" as used herein shall mean any yarn having an inherent capacity to elongate under tension, and having an inherent tendency to contract from an elongated condition with a degree of power in contraction. Such yarns include, but are not necessarily limited to, rubber yarn, covered rubber yarn and elastic polymers of the type disclosed in U.S. Patent No. 2,623,031, one example of which is presently known as Du Pont MT80D yarn.

The term "stretch yarn" as used herein shall refer to inelastic yarns which have been treated in such manner as to have the capacity to elongate and contract. Such yarns have virtually no power in contraction and include, but are not necessarily limited to, yarns formed by twisting, heat-setting and reverse twisting synthetic yarns, as in the case of "Helanca" yarn, or by crush-crinkling and heat-setting synthetic yarns, as in the case of "Banlon" yarn, or by passing synthetic yarns through a heated zone and over a sharp edge to produce a permanent coil or kink therein, as in the case of "Agilon" yarn.

With specific reference to Fig. 1 of the drawings, it will be observed that the fabric there shown as illustrative of my invention is a one and one rib structure having outer face cylinder needle wales C in alternation, respectively, with inner face dial needle wales D and D' and having staggered interstices X and X' formed, respectively, in alternate zones Z and intervening zones Z'. This fabric can be produced rapidly and economically on any standard circular rib machine, such as a Scott and Williams or a Wildman Jacquard machine having complements of cylinder and dial needles, four feeds or multiples thereof, which are represented in Fig. 1 by the numerals I–IV, and means for variantly selecting dial needles for tucking or welting. In knitting the fabric of Fig. 1 on a four feed machine, six yarns are employed, comprising inelastic yarns *i* and *i'*, stretch yarns *s* and *s'* and elastic yarns *e* and *e'*. For convenience of distinction from the inelastic yarns *i* and *i'*, the stretch yarns *s* and *s'* are cross hatched and the elastic yarns *e* and *e'* are shown in heavy black lines.

In the embodiment shown in Fig. 1, the inelastic yarn *i* and the elastic yarn *e* are fed at feed I, the stretch yarn *s* is fed at feed II, the inelastic yarn *i'* and the elastic yarn *e'* are fed at feed III, and the stretch yarn *s'* is fed at feed IV. During formation of the fabric, all of the cylinder needles of the machine knit the inelastic yarns *i* and *i'* at the feeds I and III, and all cylinder needles knit the stretch yarns *s* and *s'* at the feeds II and IV. The elastic yarns *e* and *e'* are not knitted by any of the cylinder needles, and hence are floated across all the cylinder needle wales C.

At feed I alternate dial needles are moved out to clearing position to take and knit the inelastic yarn *i* and the elastic yarn *e* in the spaced wales D, while the intervening dial needles pass in welt position to hold the stitches previously formed by them from yarn *s'* and miss the yarns *i* and *e*, thereby causing the latter yarns to float across the intervening dial wales D'. At feed II alternate dial needles are moved out to clearing position to take and knit the stretch yarn *s* in the spaced wales D, while the intervening dial needles are moved out to tuck position to take and hold the yarn *s* in the intervening wales D'. Doubled with the stretch yarn *s* in the inter-

vening wales D' is the previously knit stretch yarn *s'* which was held on the needles forming wales D' during knitting at feeds I and II. At feed III alternate dial needles are moved out to clearing position to take and knit the inelastic yarn *i'* and the elastic yarn *e'* in the intervening wales D', while the intervening dial needles pass in welt position to hold the stitches previously formed by them from yarn *s* and miss the yarns *i'* and *e'*, thereby causing the latter yarns to float across the spaced wales D. At feed IV alternate dial needles are moved out to clearing position to take and knit the stretch yarn *s'* in the intervening wales D', while the intervening dial needles are moved out to tuck position to take and hold the stretch yarn *s'* in the spaced wales D. Doubled with the stretch yarn *s'* in the spaced wales D is the previously knit stretch yarn *s* which was held on the needles forming wales D during knitting at feeds III and IV.

Selection of dial needles such that alternate dial needles knit while the remaining dial needles welt or tuck, and reversing the procedure at other feeds, may be accomplished in various well known ways. For example, two lengths of needles may be used in the dial, as in interlock machines, together with double cam raceways. Selection also may be accomplished by use of long and short butt needles using cams in a manner well known to those skilled in the knitting art.

As a consequence of knitting the fabric in the manner just described, the interstices X in the alternate zones Z are staggered relative to the interstices X' in the zones Z' and the alternate zones Z overlap the intervening zones Z'. Such overlapping is due to the fact that one of each pair of stretch yarn courses **2**, **4** in any zone Z is also one of the pair of stretch yarn courses **4**, **2** in a next adjacent zone Z'. Thus, the pairs of stretch yarn courses in each of the zones Z overlap the pairs of stretch yarn courses in each of the zones Z'. It will be noted that the elongated and short tuck loops **5** and **6** formed of the stretch yarns *s* and *s'* in the courses **4** are anchored by doubled regular loops **7** and **8** of the inelastic and elastic yarns *i* and *e* in the courses **1**, and that the elongated and short tuck loops **5'** and **6'** formed of the stretch yarns *s'* and *s* in the courses **2** are anchored by doubled regular loops **7'** and **8'** of the inelastic and elastic yarns *i'* and *e'* in the courses **3**. In all instances floats of the inelastic and elastic yarns extend across the interstices X and X' at the outer face of the fabric.

Preferably, the inelastic yarns used in the practice of this invention should comprise monofilament or coarse denier filament synthetic yarns, such as nylon, polyesters (e.g. "Dacron"), acrylics (e.g. "Orlon"), or the like.

In Figs. 2 to 5 inclusive is shown an actual fabric having the loop and yarn construction of the fabric diagrammatically shown in Fig. 1. The outer face of the fabric is shown in Figs. 2 and 4 and its inner face is shown in Figs. 3 and 5. The fabric is unstretched in Figs. 2 and 3 and stretched in Figs. 4 and 5. In this fabric, the inelastic yarns *i* and *i'* each comprise two ends of 20 denier monofilament nylon yarn, rather than a single end of a coarser denier nylon yarn, such as 40 denier. Plural ends of smaller denier nylon yarn may be used in lieu of a single end of a coarser denier nylon yarn for various purpurposes, such as to reduce stiffness in the fabric, to add somewhat to the lengthwise stretch of the fabric, to permit more uniform tensioning and thereby reduce "wash boardiness" when large multiples of yarn feeds are used and to provide a safety factor in the case of yarn breakage, due to the yarn catching on the bobbin or other cause, which normally affects only one end, thereby reducing chances of the fabric being cast off the needles. The two ends of stretch yarn *s* and *s'* each comprise, in this particular fabric, crush crinkled and set yarn of the "Banlon" type, while the two elastic yarns *e* and *e'* each comprise 100 core nylon covered rubber yarn. The term "100 core" as applied to rubber yarn indicates a yarn of such diameter

that one hundred bare strands thereof may be laid side by side within the space of one inch. As will be seen from Figs. 2 to 5 inclusive, the loops of the "Banlon" yarn are brought to the inner face of the fabric, thus giving that face a relatively soft texture, while the outer face presents a somewhat stiffer and smoother texture.

As shown in Fig. 2, when the fabric is unstretched the elastic yarn loops, due to the contraction of the elastic yarns *e* and *e'*, are pulled back through the stretch yarn loops to form substantially straight line yarn strands coursewise of the fabric. The elastic yarns are not formed in absolute straight line strands, however, there being a somewhat sinuous or undulating effect produced by the anchoring of the elastic yarns by the succeeding stretch yarn courses. The tendency of the elastic yarns to form themselves into straight line strands has the effect of drawing the inelastic yarns *i* and *i'* back through the stretch yarn loops with the result that in the unstretched fabric the elongated loops of the stretch yarns *s* and *s'* in the dial wales appear to be interknit, i.e. to anchor each other successively. Thus, as shown in Fig. 3, the inner face of the unstretched fabric is covered with, and appears to be composed entirely of, stretch yarn, thereby giving to the inner fabric face a soft "feel" or texture. Even when the fabric is stretched, as shown in Fig. 5, its inner face essentially is composed of stretch yarn, and thus retains its soft texture.

As shown in Fig. 2, the outer face of the unstretched fabric is characterized by plural, substantially straight line, coursewise formations of spaced elastic yarn strands, each such strand having slightly undulating crests and depressions in alternation. The depressions, of course, are the quiescent, embryo-like loops of the elastic yarns. As will be seen, the crests and depressions of each alternate elastic strand are staggered with respect to the crests and depressions of the intervening elastic strands. Thus, the unstretched fabric is formed with a plurality of spaced, walewise extending crests of elastic yarn with each pair of such spaced crests separated by an intervening depression of elastic yarn. Since the elastic yarns tend to form into substantially straight line formations coursewise, the stretch yarns tend to disappear from the outer face of the fabric, as will be readily seen in Fig. 2, leaving the visual impression that the gossamer-like loops of the inelastic yarns anchor the relatively prominently displayed elastic yarns. The tendency of the stretch yarn to disappear from the outer fabric face results in that fabric face having a relatively smooth and stiff "feel" or texture.

When the fabric is stretched, as shown in Fig. 4, the depressions (i.e., loops) of each course of elastic yarn are greatly enlarged and become nearly contiguous with the crests of the next succeeding elastic yarn course. Thus, as readily will be seen from both Figs. 2 and 4, each successive pair of walewise extending elastic yarn depressions serve to form a boundary or framework for the top and the bottom of one of the interstices X or X'. The elastic yarn depressions, therefore, serve to accentuate the interstices in the fabric.

By the incorporation of the stretch yarn into a fabric in accordance with this invention, it is possible, to produce an elastic knit fabric which will have the capacity to stretch lengthwise as well as widthwise when placed on the body of the wearer. As a consequence, garments made from the fabric of this invention will be free to move with the wearer's body, thus eliminating the tendency to "ride up" during wearing with resultant formation of uncomfortable folds.

The modified fabric diagrammatically illustrated in Fig. 6 is made on a machine having six feeds or multiples thereof. It is constructed in the manner of the four feed fabric of Fig. 1, except additional courses **5** and **6** are knit between courses **1** and **2** and **3** and **4**, respectively. Courses **5** are formed from inelastic yarn i^2 fed at feed II and have their loops **12'** in the intervening dial wales D' tucked with the loops **5'** and **6'** of the stretch yarns *s'* and *s*

in the courses 2. Courses 6 are formed from inelastic yarn i^3 fed at feed V and have their loops 12 in the alternate dial needle wales D tucked with the loops 5 and 6 of the stretch yarn s and s' in the courses 4. As a consequence, the interstices X in the alternate zones Z are staggered relative to the interstices X' in the zones Z'. The elongate stretch yarn loops 5 and 5' are formed at the inner face of the fabric, while the floats of the inelastic and elastic yarns extend across the loops 5 and 5' at the outer face of the fabric, thereby providing a fabric having a relatively soft inner face and a relatively smooth and firm outer face.

While the specific illustrations herein shown and described relate to one and one rib knitted fabrics, it is to be understood that such fabrics are merely preferred embodiments of my invention. As will be well understood by those skilled in the art, my invention lends itself to weft knitted fabrics of all types, including plain knitted fabrics and the various rib knitted fabric constructions.

Similarly, the yarns fed at the various feeds may be reversed or varied without departing from the spirit of this invention. For example, in the fabric of Fig. 1, stretch yarn may be fed at feeds I and III and inelastic yarn fed at feeds II and IV, in which event the elastic yarns would be interlooped with the stretch yarns at spaced wales. In such construction, the soft face of the fabric would be its outer face.

Also, where a circular dial and cylinder machine is used, selection of needles for tucking and welting may occur on the cylinder needles instead of on the dial needles, in which event the elongated loops of the fabric will be formed at its outer face.

It is to be understood that while in both of the exemplified forms of the fabric shown in the drawings the zones Z and Z' overlap each other, they may be separated by one or more courses knitted either from inelastic or stretch yarn, as may be desired, in a manner which will also be readily understood by those skilled in the knitting art.

The term "alternating courses" as used in the claims is intended to denote a fabric in which courses of stretch yarn and courses of inelastic yarn are interspersed throughout the fabric in any desired order, and is not intended to be limited to a fabric in which each course of stretch yarn is followed by only a single course of inelastic yarn. As previously noted, in Fig. 6 each course of stretch yarn is followed by two courses of inelastic yarn. It is contemplated that the term "alternating courses" would also denote a fabric where two or more successive courses of stretch yarn are followed by two or more successive courses of inelastic yarn.

The term "inner face" as used in the claims may refer to one or the other side of a fabric while the term "outer face" refers to the opposite side thereof.

Having thus described my invention, I claim:

1. In a rib knit fabric having inner face wales and outer face wales, spaced courses of stretch yarn with selected loops of one course in each of recurrent pairs of such spaced courses doubled with loops of the other course of such pairs of spaced courses to form interstices in the inner face wales, and the courses intervening between the spaced stretch yarn courses containing inelastic yarn, at least one inelastic yarn course intermediate of the courses of each pair of stretch yarn courses being knit in the outer face wales and floated across selected inner face loops that form interstices in the fabric, said inelastic yarn comprising at least one strand of monofilament synthetic type yarn whereby the outer fabric face presents a relatively stiff and smooth texture and the inner fabric face presents a relatively soft texture.

2. In a rib knit fabric having inner face wales and outer face wales, spaced courses of stretch yarn having loops of one course in each of recurrent pairs of such spaced courses doubled with loops of the other course of such pairs of spaced courses to form interstices in selected inner face wales, and the courses intervening between the spaced stretch yarn courses containing inelastic yarn, at least one inelastic yarn course between each recurrent pair of stretch yarn courses also containing elastic yarn knit in the selected wales and floated across the wales intervening between said selected wales.

3. The fabric of claim 2 wherein loops of the elastic yarn are doubled with loops of the inelastic yarn in inner face wales to anchor the interlooped stretch yarn loops.

4. The fabric of claim 3 wherein the inelastic yarn comprises at least one strand of monofilament synthetic type yarn and the elastic yarn has a covering whereby the outer fabric face presents a relatively stiff and smooth texture and the inner fabric face presents a relatively soft texture.

5. The fabric of claim 4 wherein each strand of inelastic yarn is 20 denier.

6. In a knit elastic mesh fabric having a soft-textured inner face and a stiff-textured outer face, alternating courses of stretch and inelastic yarn, at least one course disposed between each pair of spaced stretch yarn courses containing both inelastic and elastic yarn knit in selected wales, and one course of each such pair of stretch yarn courses having elongated loops in inner face wales of the fabric doubled with loops of a subsequent course and anchored by elastic yarn stitches.

7. The fabric of claim 6 wherein the inelastic yarn comprises at least one strand of monofilament synthetic yarn.

8. The fabric of claim 6 wherein the elastic yarn is knit in spaced inner face wales and floated across at least three successive intervening wales.

9. The fabric of claim 6 wherein at least one inelastic yarn course between the courses of each pair of stretch yarn courses is knit in the outer face wales of the fabric and floated across the elongated loops of stretch yarn in the inner face wales.

10. The fabric of claim 6 wherein the elongated loops of stretch yarn are staggered throughout the fabric.

11. In a knit elastic mesh fabric having a soft-textured inner face and a stiff-textured outer face, alternating courses of stretch and inelastic yarn, at least one course disposed between each pair of spaced stretch yarn courses containing both inelastic and elastic yarn knit in selected wales, alternating pairs of spaced stretch yarn courses each having loops of one course of the pair of courses doubled in alternate inner face wales with loops of a subsequent course of the fabric and anchored by elastic yarn stitches, and the intervening pairs of spaced stretch yarn courses each having loops of one course of the pair of courses doubled, in inner face wales intervening between the alternate inner face wales, with loops of a subsequent course of the fabric and anchored by elastic yarn stitches.

12. The fabric of claim 11 wherein the alternating pairs of spaced stretch yarn courses overlap the intervening pairs of spaced stretch yarn courses.

13. The fabric of claim 11 wherein at least one course of each alternating pair of spaced stretch yarn courses comprises a course of an intervening pair of spaced stretch yarn courses.

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