Dec. 25, 1962 W. P. COOPER ET AL 3,069,885

KNITTED FABRIC

Filed March 16, 1959

FIG. 1

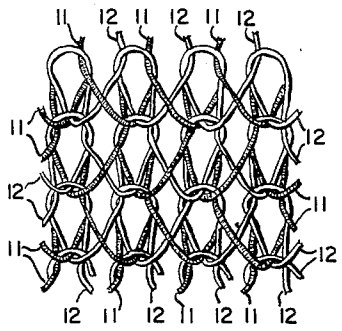


FIG. 2

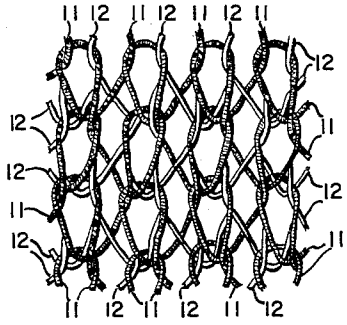
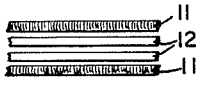


FIG. 3



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KNITTED FABRIC

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3 Claims. (Cl. 66—195)

This invention relates to knitted fabrics. More particularly, this invention relates to flat-knit fabrics which exhibit the property of two-way stretch and to a method for the manufacture of such fabrics.

In the manufacture of two-way stretch fabrics, it has heretofore been customary to provide increased elasticity by feeding or laying-in an elastic yarn. The usual procedure has been to knit successive chain stitches on individual needles with a relatively inelastic yarn and to lay-in the elastic yarn between the face and the back needles during knitting. The preparation of flat-knit, two-way stretch fabrics has been confined to the Raschel type fabrics. Such fabrics have not been entirely satisfactory for a number of reasons, among which is the expense involved in their manufacture. Such fabrics also suffer from the same objectionable characteristics of fabrics prepared by other methods in which the elastic yarns are laid in. For example, the laying-in of the elastic threads leads to a relatively heavy fabric construction which limits their use in certain types of finished garments. The elastic threads are also susceptible to being pulled from the fabric, leaving unsightly blemishes and resultant weakness of the fabric which shortens the life of the articles prepared therefrom. In addition, it has generally been necessary to use covered elastic yarns in order to provide a comfortable garment and to provide desired aesthetic properties. Light-weight, sheer fabrics having two-way stretch, particularly of the tricot construction, have been heretofore unknown.

It is, therefore, an object of this invention to provide a flat-knit, two-way stretch fabric which is lighter in weight, thinner and sheerer than present known fabrics. Another object of this invention is to provide a two-way stretch fabric which is capable of being formed into garments which give compression and support without restricting the movement or general exercise of the wearer. It is a further object of this invention to provide a comfortable, abrasion-resistant fabric which has a wide range of uses. Another object of this invention is to provide a process for preparing such fabrics. Still another object of this invention is to provide a relatively inexpensive process for preparing two-way stretch fabrics of fine texture utilizing bare elastic threads.

The objects of this invention are accomplished by providing a two-way stretch, warp knitted fabric which is comprised of a plurality of courses of elastic and relatively inelastic threads in which each of the threads is knitted into every stitch across the fabric. Surprisingly, such fabrics exhibit superior properties when compared with the two-way stretch fabrics heretofore known. By knitting the elastic thread into every stitch, the fabrics of this invention are much lighter in weight and finer in texture than the known two-way stretch power net fabrics. In addition, they exhibit outstanding compression and supporting characteristics when incorporated in finished garments. Even more surprising is the fact that it is not necessary to use covered elastic threads such as those used in known fabrics. Bare abrasion-resistant elastic threads of synthetic segmented elastomer polymers are used in the fabrics of the present invention. Due to the novel fabric construction, the inelastic threads are prominent on both the face and back of the fabric and substantially cover the elastic threads.

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The aforementioned features are more fully illustrated in one embodiment of the fabric of this invention shown in the accompanying drawings in which:

FIGURE 1 is an enlarged, fragmentary, diagrammatic view of the back of a fabric in which the inelastic threads are indicated by the shaded lines, and the elastic threads are illustrated by open lines;

FIGURE 2 is an enlarged, diagrammatic view of the face of the fabric shown in FIGURE 1; and

FIGURE 3 is an enlarged, fragmentary side view of an isolated portion of the fabric showing the relative position of the elastic and inelastic threads.

In the discussion which follows, the terms "threads" and "yarns" will be used interchangeably in referring to the filamentary components.

By "inelastic" it is meant a thread or yarn which substantially retains its length under normal stress during processing and wearing.

By "elastic" thread it is meant an uncovered thread prepared from a synthetic segmented elastomer polymer made of segments of a high-melting, crystalline polymer alternating with segments of a low-melting, amorphous polymer. A wide variety of suitable segmented elastomers exists. The crystalline, high-melting segment may be derived from a urea polymer, urethane polymer, amide polymer, bis-ureylene polymer or polyester, for example. The low-melting, amorphous segment may be derived from an ester polymer, an ether polymer, or a hydrocarbon polymer, for example. Segmented elastomers of this type together with a process for obtaining them in filamentary form are described in U.S. Patents No. 2,813,775 and 2,813,776. Suitable polyether-polyester segmented polymers are also described in British Patent No. 779,054. The preferred segmented elastomers are those containing a bis-ureylene segment alternating with segments of a low-melting polyether or polyester. These preferred elastomers as well as a process for their preparation are more fully described in copending application Serial No. 556,071, filed December 29, 1955, now U.S. Patent 2,957,852. Generally speaking, such segmented elastomers, wherein the low-melting polymer has a melting point below 50° C. and a molecular weight above about 600 and which contain from 10% to 40% of the high-melting segment derived from a polymer melting above 200° C., will have elongations over 150%, tensile recoveries over 90%, and stress decays less than 20%.

By "two-way stretch fabric" is meant a fabric which will stretch in both the cross-wise and length-wise direction.

By "flat knit fabrics" is meant those prepared when knitting is carried out on a flat machine in contrast to circular knit.

Referring now to FIGS. 1, 2, and 3 of the drawing, inelastic threads **11** appear most prominently on both the face and back of the fabric. As shown most clearly in FIG. 3, elastic threads **12** lie between the face and the back of the fabric. In the fabric samples shown, the inelastic threads **11** are looped in zigzag fashion in adjacent wales along successive courses. The elastic threads **12** are likewise looped in a zigzag fashion, but in a direction opposite to that of the inelastic threads. Thus, the elastic and inelastic threads each appear in every stitch across the fabric.

In the process for preparing the fabrics of this invention, a conventional two-bar warp knitting machine is used. In one embodiment of the process, two sets of warp threads, which are wound onto suitable beams, are brought forward the beams to the knitting point. The threads are passed through a sley or point bar which separates the individual ends and insures the proper relative positioning along the length of the warp. A tension rail

is provided to control the tension on the threads and to absorb the excess thread which becomes available at certain stages of the knitting cycle. Each of the warp threads is passed through a separate guide with the inelastic threads being threaded through the front guide bars and the elastic threads being threaded through the back guide bars. The relative movement of the guide bars with respect to the needles and the sinkers is controlled to provide lapping of the elastic threads in a direction opposite to that of the inelastic threads on the needles. A balanced lapping movement is used with the two sets of guide bars making similar movements in opposite directions. In the knitting step, each of the needles makes a separate chain stitch with the chains being tied together by the crossover of the threads from one needle to another. In this manner an elastic and inelastic thread are knitted into each stitch of the fabric.

In selecting a knitting machine for carrying out the process of this invention, tricot type warp knitting machines may be used; however, it is necessary to limit the design to those which do not knit successive chain stitches on individual needles.

The threading and operation of the knitting machine may be varied within certain limits to provide fabrics having designs suitable for various purposes. It is a fabric having high covering power is desired, large move numbers, that is, zigzagging across more than two wales, may be used. If a less powerful fabric is desired, alternate or spaced back guide bars may be omitted in the threading of the knitting machine.

As previously indicated, this invention permits the utilization of bare or uncovered elastic threads in fabric construction. In order to provide an acceptable fabric having a plated construction, i.e., with the yarns of the back guide bar being covered by the yarns of the front guide bar on both the face and back of the fabric, the ratios of the original relaxed deniers of the elastic yarns to the inelastic yarns must be below about 4:1. At ratios above this limit, incomplete covering of the bare elastic yarns results. Denier ratios between about 4:1 and 1:6 are preferred.

In practicing this invention, warp beams having good end-to-end length uniformity must be used. In order to obtain uniform elasticity in the fabrics, known automatic let-off and take-up devices should be utilized.

In one embodiment of this invention, a 14-gauge, tricot type, warp knitting machine was used. The inelastic thread, 100/50 continuous filament nylon, i.e., a 50-filament yarn having an over-all denier of 100 (11 tex), was threaded through the guides of the front bar in a pattern 1–0, 1–2, with the threading being accomplished on 14 bars. The guides of the back bar were threaded with a bare segmented elastomer thread having a denier of 280 (31 tex) prepared as described in Example I of copending application Serial No. 709,445, filed January 17, 1958, now U.S. Patent 2,999,839, in the pattern 1–2, 1–0. The fabric knitted, using this arrangement, was similar to that shown in FIGS. 1 and 2. The ratio of the original relaxed denier of the yarns was 2.8:1.0.

Although it is possible to use covered elastic yarns in preparing fabrics similar to those of the present invention, bare elastic threads obtained from synthetic segmented elastomers give superior and less expensive fabrics. As previously indicated, the elastomers from which the threads are obtained are those comprising segments of high-melting crystalline polymers alternating with segments of low-melting, essentially amorphous polymers.

The type of yarn used as the inelastic component will generally be governed by the desired characteristics of the type of fabric to be prepared. Synthetic and natural yarns, e.g., cotton, wool, rayon, nylon, acrylic fiber, polyester fiber, etc., may be used in staple, textured, or continuous filament form to produce a desired effect in the finished fabric. The amount of compression in the finished fabric may be readily controlled by those skilled in the art.

The fabrics of this invention are useful in a variety of articles of apparel. They are particularly desirable in the preparation of foundation garments. Likewise, they may be utilized in the fabrication of surgical garments and dressings, swim wear, knitted sports outer wear, and athletic garments.

The process of this invention is particularly advantageous since it permits the direct knitting into the fabric of uncovered elastic threads. In addition, lower cost, wider fabrics having a two-way stretch may be prepared.

It will be apparent that many widely different embodiments of this invention may be made without departing from the spirit and scope thereof, and therefore it is not intended to be limited except as indicated in the appended claims.

We claim:

1. A knitted two-way stretch fabric comprising a plurality of courses formed from bare elastic threads prepared from a synthetic elastomeric polymer and relatively inelastic thread, said elastic threads and said inelastic thread each being disposed in adjacent wales in a zigzag fashion along at least two wales such that each of said threads is knitted into every stitch in successive courses, said elastic threads being looped in a direction opposite to the direction of said inelastic threads and crossing over said inelastic threads between said wales and courses, the ratio of the denier of said elastic threads to said inelastic threads being less than about 4:1, said inelastic thread being prominent on the face and back of said fabric and substantially covering said elastic threads.

2. A knitted two-way stretch fabric comprising a plurality of courses formed from bare elastic threads prepared from a synthetic segmented elastomer having bisureylene segments alternating with segments of a low-melting polyether and relatively inelastic threads, said elastic threads and said inelastic threads each being disposed in adjacent wales in a zigzag fashion along at least two wales such that each of said threads is knitted into every stitch in successive courses, said elastic threads being looped in a direction opposite to the direction of said inelastic threads and crossing over said inelastic threads between said wales and courses, the ratio of the denier of said elastic threads to said inelastic threads being less than about 4:1, said inelastic threads being prominent on the face and back of said fabric and substantially covering said elastic threads.

3. A warp knitted two-way stretch fabric prepared from elastic and inelastic threads comprising a plurality of courses formed from said threads with at least one elastic thread prepared from a synthetic polymer and at least one inelastic thread being knitted into each stitch in adjacent wales across said fabric, said elastic threads being looped in a direction opposite to the direction of said inelastic threads and crossing over said inelastic threads between said wales and courses, said inelastic threads being prominent on the face and back of said fabric and substantially covering said elastic threads.

References Cited in the file of this patent

UNITED STATES PATENTS

1,482,705	Serra	Feb. 5, 1924
1,811,813	Wagner	June 23, 1931
1,965,860	Rutledge	July 10, 1934
2,009,361	Lawson	July 23, 1035
2,030,459	Meinig	Feb. 11, 1936
2,078,050	Beniston	Apr. 20, 1937
2,108,735	Wirth	Feb. 15, 1938
2,114,004	Reinthal	Apr. 12, 1938
2,130,655	Schonfeld	Sept. 20, 1938
2,147,169	Mendel et al.	Feb. 14, 1939
2,267,578	Schonfeld	Dec. 23, 1941
2,536,163	Feild et al.	Jan. 2, 1951
2,720,097	De Mond	Oct. 11, 1955
2,999,839	Arvidson et al.	Sept. 12, 1961