

July 22, 1941.

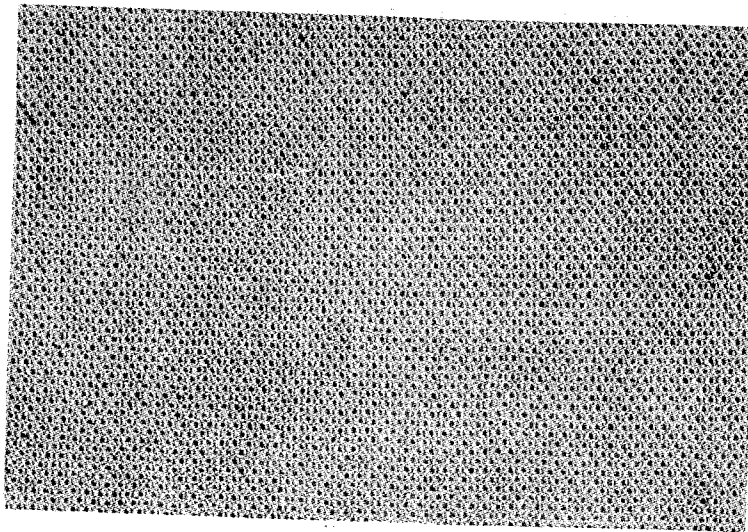
D. M. CLARK

2,250,359

ELASTIC FABRIC

Filed March 11, 1939

2 Sheets-Sheet 1



← DIRECTION OF WALES

*Fig. 3.*

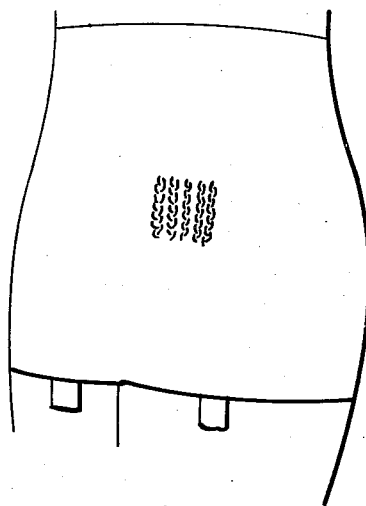


*Fig. 1.*

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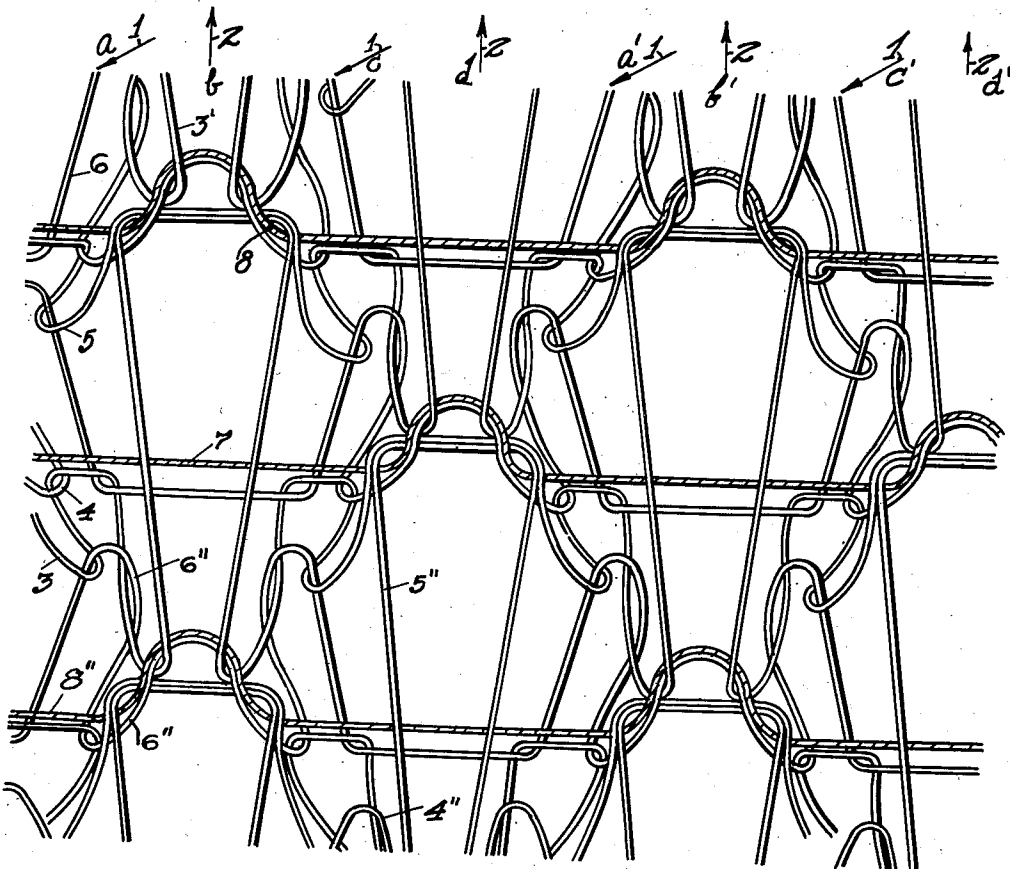


Fig. 2.

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## UNITED STATES PATENT OFFICE

2,250,359

## ELASTIC FABRIC

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Application March 11, 1939, Serial No. 261,199

10 Claims. (Cl. 66—176)

The present invention relates to elastic fabrics, and particularly to knitted fabrics having stretch in two or more directions, which is provided by the use of relatively heavy elastic threads. By a particular method of knitting, this thread will produce a stretch in two directions.

In prior devices of this character, fabrics having a stretch in two directions have been produced by knitting some or all of the courses of fine elastic thread. This produces a fabric having no more immediate resistance to stretch than knitted fabrics of non-elastic material, since the elastic threads do not function until the loops in the threads are at least partially straightened out.

To produce more resistance to stretching crosswise of the wales, elastic threads have been laid into the fabric between successive courses, and thus these threads immediately resist any crosswise stretching. In these fabrics both knitted elastic threads and elastic threads laid in but not knitted are used.

A later development in elastic fabrics having stretch in two directions is disclosed in applicant's prior Patent No. 2,016,168, dated Oct. 1, 1935, in which the stretch is produced by knitting some courses of inelastic thread and the remaining courses of elastic and inelastic threads. In these latter courses the elastic thread is knitted into certain of the wales of the fabric and the inelastic thread is knitted only in the remaining wales. By this type of knitting it is possible to utilize a relatively heavy elastic thread, thereby producing a garment having the desired characteristics, but requiring no extremely fine elastic threads.

This type of fabric is entirely satisfactory in use, and variations in the pattern of the fabric, without substantially affecting the two-way stretch, are possible, by varying the knitting of the inelastic threads in a manner well known, for example, in Jacquard controlled knitting machines. It has been found desirable in many instances to control the amount of stretch in either direction in the fabric, and one of the principal features of the present invention is to provide for a control and variation of the amount of stretch available.

When an elastic thread, which is knitted into a fabric, is broken from excessive stretch, or from deterioration of the elastic material, the stretch in the fabric produced by the elastic thread is no longer existent and the thread, having a tendency to pull out of the fabric, allows the knitted fabric to run. A further feature

of the present invention is to provide a fabric having a two-way stretch with a provision for stopping runs in the fabric in the event that any of the elastic threads are broken.

Other and further objects and advantages of the invention will appear from the following detailed description taken in connection with the accompanying drawings in which—

Fig. 1 is an elevation of a garment incorporating the fabric of the invention.

Fig. 2 is a diagrammatic view of a portion of the fabric embodying the invention, said fabric being stretched substantially to the limit in both directions and being greatly enlarged.

Fig. 3 is a plan view of a small section of the fabric of the invention in unstretched condition.

The invention resides in knitting elastic threads into a fabric so that the fabric is stretchable both crosswise and lengthwise of the wales, with the stretch controlled by elastic threads, which, although knitted into the fabric, extend normally crosswise of the wales and substantially straight. The fabric may be knitted on many of the well known knitting machines, as for example, reciprocating or circular knitting machines having suitable needle selecting devices. The embodiment shown has been knitted on a circular machine, which, as is well known, has a plurality of dial needles represented in Fig. 2 by the arrows 1, and a plurality of cylinder needles represented by the arrows 2. The cylinder needles are arranged in staggered relation to the dial needles and extend at an angle thereto, each of the needles being individually controlled to determine in which wales the threads are knitted. It will be apparent that other types of machines can be adapted to knitting this fabric.

In the knitting of the fabric embodying the invention on a circular machine, inelastic threads 3, 4, 5 and 6 are knitted successively into the fabric and elastic threads 7 and 8 are knitted into the fabric simultaneously with certain of the inelastic threads. As shown, the elastic threads 7 and 8 are incorporated in the fabric with the inelastic threads 4 and 6 respectively. These elastic threads may be of any well known character and normally comprise filaments of rubber which have been wound with non-elastic threads of any suitable character, such as cotton, silk or rayon. When formed on a circular knitting machine, successive wales of the fabric, one of which is produced by each needle, are alternately on the back and face of the fabric. Thus the wales *b*, *d*, *b'* and *d'* are on the front of the fabric, as it is shown in Fig. 2, and the

wales *a*, *c*, *a'* and *c'* are on the back of the fabric. The pattern repeats after each four wales and the wales *a'*, *b'*, *c'* and *d'* are thus duplicates of the wales *a*, *b*, *c* and *d* respectively. The pattern shown repeats itself lengthwise of the wales after each six threads, as will hereinafter appear.

In the following description the term tuck stitch refers to the treatment of threads of successive courses in the same wale in which in knitting the fabric the thread of one course is applied to the needle and is not immediately cast off, thereby forming the held loop of a tuck stitch. In the succeeding course or courses the thread is applied to the same needle so that it is not passed through the held loop, but forms a so-called tucked loop. Both of these loops are engaged by a conventional loop in a succeeding course. A thread which passes through a wale without being knitted or tucked is essentially laid into the fabric or unknitted in the particular wale. The term "loop" applies to the conventional knitting of a thread by the formation of a loop in a wale which is engaged and held by a similar loop in the succeeding course. The term "courses" as used hereinafter and in the claims, refers to a thread or set of threads of the fabric; for example, the thread 3 forms one course, the threads 4 and 7 the next course, the thread 5 the following course and thus the threads 6 and 8 the fourth course. It will be understood that a stitch or loop is not formed in each wale, but for the purpose of describing the fabric so that the knitting of the fabric may be understood, it has been found best to define the courses in this manner. Considering each thread separately, the thread 3 is looped or knitted in alternate wales *a* and *c* which are on the back of the fabric in the arrangement shown. This thread has a tucked loop in wale *d* forming a part of a tuck stitch in this wale. In wale *b* the thread 3 forms the held loop of a tuck stitch, and as will hereinafter appear, the thread 5 has a tucked loop in this same wale forming a part of the same tuck stitch.

Threads 4 and 7, which form the next course after thread 3, are not treated exactly alike. Thread 4 is looped or knitted in three out of four wales, being looped in wales *a*, *c* and *d*, and this thread is unknitted in wale *b*. The elastic thread 7 is looped or knitted in one out of four wales, being looped in wale *d* and is unknitted in the remaining three of the four wales *a*, *b* and *c*. The loop formed in the thread 3 of the preceding course is held in wale *b* since the threads 4 and 7 are unknitted in this wale and thus the loop in the thread 3 extends over and beyond the course consisting of the threads 4 and 7 to be cast off or knitted in a following course.

The subsequent course is formed by thread 5 which is treated similarly to the thread 3, except that the tucked stitch is formed in a different wale from that in which the thread 3 is tucked. Thus, with this thread, loops are formed in wales *a* and *c* and this thread is tucked in wale *b*. The tucked loop in wale *b* forms a part of the tuck stitch of which the held loop of thread 3 is a part. In wale *d* the thread 5 has a held loop forming a part of a tuck stitch, as will be apparent.

The inelastic thread 6 which goes into the fabric with the elastic thread 8 is treated similarly to the thread 4 except that the thread 6 is unknitted in a wale different from the wale in which the thread 4 is unknitted. Thus, this

thread is looped or knitted in wales *a*, *b* and *c* and unknitted in wale *d*. The elastic thread 8 which is knitted at the same time as the inelastic thread 6 is treated similarly to the previously inserted elastic thread 7 except that the loop formed in this thread in one out of every four wales is not in the same wale as the loop of thread 7 but is formed in an intervening or alternate wale. Thus this thread is unknitted in wales *a*, *c* and *d* and is looped in wale *b*.

In the formation of the loop of thread 7 in wale *d* the thread 3, which has been previously tucked, is caught and held by this loop, as shown in Fig. 2, and similarly, in the formation of the loop of thread 8, wale *b*, the inelastic thread 5 previously tucked, and also the inelastic thread 3 previously held, is caught and held by this loop. It will be apparent that the loops formed in the several threads vary greatly in size by reason of distortion through the use of elastic yarn, through the tucked and held loops on threads 3 and 5, and through the omission of stitches in certain wales on the other threads.

After the six threads above described, the cycle is repeated by six similar threads, of which 3' is the only one shown. For the sake of clarity, the set of six threads preceding those described in detail are correspondingly numbered, threads 4'', 5'', 6'', 7'' and 8'' being shown.

The fabric thus has elastic threads knitted in only certain selected wales in certain courses, in which wales an inelastic thread is also knitted in to prevent the stitches from running if an elastic thread breaks. By the alternation of wales on which the various loops in the different threads are formed and by having no course in which loops are formed in every wale, the resulting fabric has exceptional tensile strength lengthwise of the wales. The strains on the threads when the fabric has been placed under tension nearly to the breaking point are distributed over several of the courses, and thus no one course or thread takes all of the strain. As a result it is possible, by the particular arrangement of knitting above described, to produce a fabric having a very high tensile strength with the use of extremely light inelastic threads. Moreover, by the method of knitting it is possible to use, in extremely light weight fabrics, a relatively large or heavy elastic thread which is necessarily stronger than the lighter weight threads and less expensive to produce.

The crosswise stretch may be limited by the threads which are knitted into the fabric with the elastic threads, as will be apparent. Normally the threads which go into the fabric with the rubber or elastic threads (the threads 4 and 6 above described) are inserted in the fabric so that the length of these threads will correspond approximately to the length of the corresponding elastic thread when stretched substantially to its limit. Thus the inelastic threads act as a crosswise reinforcement for the elastic threads and prevent breaking of the elastic threads by a pull on the fabric crosswise of the wales. Obviously, by varying the inserted length of the inelastic thread relative to the length of the elastic thread, the amount of crosswise stretch may be controlled to a greater or less degree.

With reference to Fig. 3, the fabric has the appearance of diagonal lines of openings thereon resulting from the particular arrangement of stitches shown. Obviously, by a variation of the stitches in the inelastic threads or courses, the appearance of the fabric may be changed with-

out affecting the basic form of knitting by which the particular fabric having stretch in two directions is produced. Basically, the fabric is made up of courses of threads, some of which are inelastic and some of which are made up of both elastic and inelastic threads knitted together. In the courses where both elastic and inelastic threads are incorporated in the fabric, the elastic threads are unknitted in certain of the wales and the inelastic threads are unknitted in certain wales and knitted in certain of the other wales in which the elastic thread is unknitted. It may be desirable in certain fabrics made in accordance with the present invention to have more than one course of inelastic threads between successive elastic and inelastic courses and the insertion of an additional inelastic course is within the purview of the invention. It may be desirable in some instances to form the elastic stitches of successive courses of elastic and inelastic threads in the same wale rather than in alternate or intervening wales, as shown. This will not affect the stretch of the fabric and is within the scope of the invention.

The girdle of Fig. 1 shows a completed garment for which the above described fabric is particularly suitable by reason of its restraining action. The fabric is, however, useful for many other purposes, which will be apparent.

I claim:

1. A new elastic fabric having stretch in two directions, in which certain courses consist of inelastic thread and the remaining courses consist of elastic and inelastic threads, said elastic and inelastic threads in said remaining courses being knitted together into certain spaced wales only of the fabric and the inelastic thread in said remaining courses being unknitted in certain of the remaining wales in the same courses, the elastic and inelastic threads being knitted in alternate wales in successive courses.

2. A knitted elastic fabric having stretch in two directions, in which certain courses consist of inelastic thread and intervening courses consist of elastic and inelastic thread, said elastic and inelastic threads in said intervening courses being knitted together into certain spaced wales of the fabric, and the inelastic thread in said intervening courses being unknitted in certain of the remaining wales in the same courses, the wales in which the elastic and inelastic threads are knitted in one of the intervening courses alternating with the wales in which the elastic and inelastic threads are knitted in subsequent courses.

3. A knitted elastic fabric having stretch in two directions, in which certain courses consist of inelastic thread and the remaining courses consist of elastic and inelastic thread, there being at least one course of inelastic thread between each two of the next adjacent of said remaining courses, said elastic thread of said remaining courses being knitted into certain spaced wales only of the fabric and the inelastic thread in said remaining courses being knitted in said certain spaced wales and in certain of the remaining wales in the same courses, both the elastic and inelastic threads of said remaining courses being unknitted in at least one of the wales intervening between said certain spaced wales.

4. A knitted elastic fabric having stretch in two directions, in which certain courses consist of inelastic thread and the remaining courses consist of elastic and inelastic thread, there being at least one course of inelastic thread between

two of the next adjacent of said remaining courses, said elastic thread of said remaining courses being knitted into certain spaced wales only of the fabric and the inelastic thread in said remaining courses being knitted in said certain spaced wales and in certain of the remaining wales in the same courses, both the elastic and inelastic threads of said remaining courses being unknitted in at least one of the wales intervening between said certain spaced wales, the wales in which the elastic and inelastic threads of one of the remaining courses are knitted together alternating with the wales in which the elastic and inelastic threads are knitted together in a succeeding course of elastic and inelastic threads.

5. A knitted elastic fabric having stretch in two directions, in which certain courses consist of inelastic thread and the remaining courses consist of elastic and inelastic threads, there being at least one course of inelastic thread between each two of the next adjacent of said remaining courses, said elastic threads of each of said remaining courses being knitted into certain spaced wales only of the fabric and the inelastic thread in said remaining courses being knitted in said certain spaced wales and in some only of the remaining wales in the same courses, the courses of inelastic threads on opposite sides of each of said remaining courses having tuck stitches in wales intervening between said certain spaced wales.

6. In the method of forming an elastic fabric having stretch in two directions, the steps which comprise knitting certain of the courses of inelastic thread and the remaining courses of elastic and inelastic threads, knitting said elastic and inelastic threads of said remaining courses into said fabric only in spaced wales, said inelastic thread of the same courses being unknitted in certain only of the wales where the elastic thread is not knitted, the spaced wales in which the elastic and inelastic threads are knitted in one of said remaining courses intervening with the wales in which the elastic and inelastic threads are knitted in the succeeding course of elastic and inelastic threads.

7. In the method of forming an elastic fabric having stretch in two directions, the steps which comprise forming all of the stitches in certain of the courses of inelastic thread and forming the stitches of the remaining courses of elastic and inelastic threads, there being at least one course of inelastic stitches between each two of the next adjacent of said remaining courses, the stitches of the elastic thread in said remaining courses being formed only in spaced wales and the stitches of the inelastic thread in said remaining courses being formed together with and whenever an elastic stitch is formed, the inelastic thread being unknitted in certain of the wales where the elastic stitches are not formed.

8. A knitted elastic fabric having stretch in two directions and having adjacent wales located on opposite faces of the fabric in which certain courses consist of inelastic thread and the remaining courses consist of elastic and inelastic threads, said elastic and inelastic threads in said remaining courses being knitted together into certain spaced wales only of the fabric and the inelastic thread in said remaining courses being unknitted in certain of the remaining wales in the same courses, all of said certain spaced wales being located on the same face of the fabric.

9. A knitted elastic fabric having stretch in two directions and having adjacent wales located on opposite faces of the fabric in which certain courses consist of inelastic thread and the remaining courses consist of elastic and inelastic threads, said elastic and inelastic threads in said remaining courses being knitted together into certain spaced wales only of the fabric and the inelastic thread in said remaining courses being unknitted in certain of the remaining wales in the same courses, all of said certain spaced wales being located on the same face of the fabric, the elastic and inelastic threads being knitted in alternate wales in successive courses.

10. A knitted elastic fabric having stretch in two directions and having adjacent wales located on opposite faces of the fabric, in which certain courses consist of inelastic thread and the re-

maining courses consist of elastic and inelastic threads, there being at least one course of inelastic thread between each two of the next adjacent of said remaining courses, said elastic thread of said remaining courses being knitted into certain spaced wales only of the fabric and the inelastic thread in said remaining wales being knitted into said certain spaced wales and into certain of the remaining wales in the same courses, both the elastic and inelastic threads of said remaining courses being unknitted in at least one of the wales intervening between said certain spaced wales, all of said certain spaced wales and also wales in which both the elastic and inelastic threads are unknitted being located on the same face of the fabric.

DAVID M. CLARK.

CERTIFICATE OF CORRECTION.

Patent No. 2,250,359.

July 22, 1941.

DAVID M. CLARK.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 1, claim 4, before the word "two" insert --each--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of September, A. D. 1941.

(Seal)

Henry Van Arsdale,  
Acting Commissioner of Patents.