

June 4, 1929.

T. G. VORCK

1,715,482

KNIT FABRIC

Filed Nov. 12, 1925

3 Sheets-Sheet 1

Fig. 2.

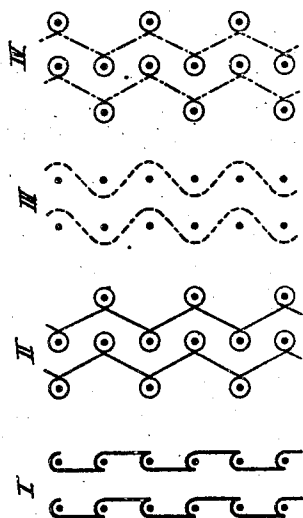


Fig. 3.

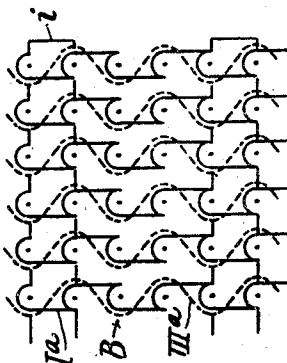
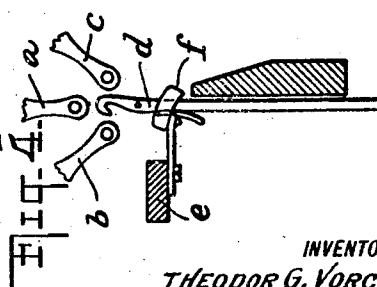
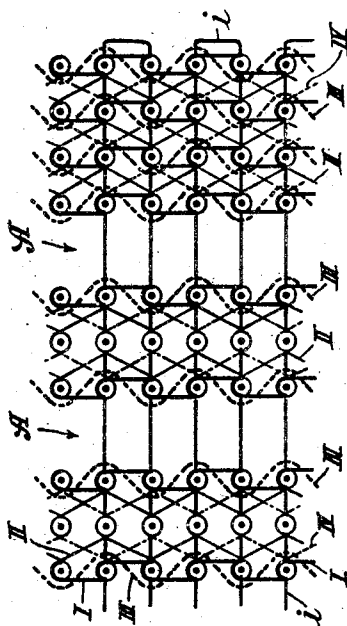


Fig. 1.



WITNESS
G. V. Rasmussen

INVENTOR
THEODOR G. VORCK
BY
Riesend Schenk
ATTORNEYS

June 4, 1929.

T. G. VORCK

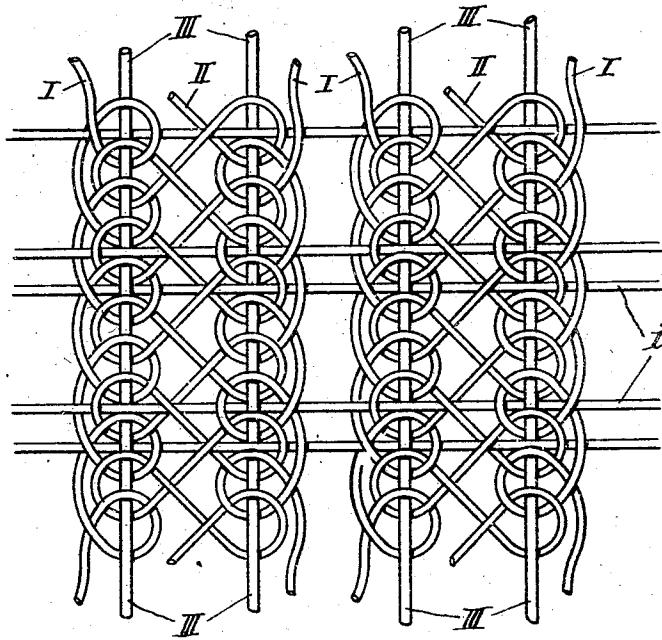
1,715,482

KNIT FABRIC

Filed Nov. 12, 1925

3 Sheets-Sheet 2

Fig. 1.^a



WITNESS

G. V. Rasmussen

INVENTOR

THEODOR G. VORCK

BY

Riesent Schenk

ATTORNEYS

June 4, 1929.

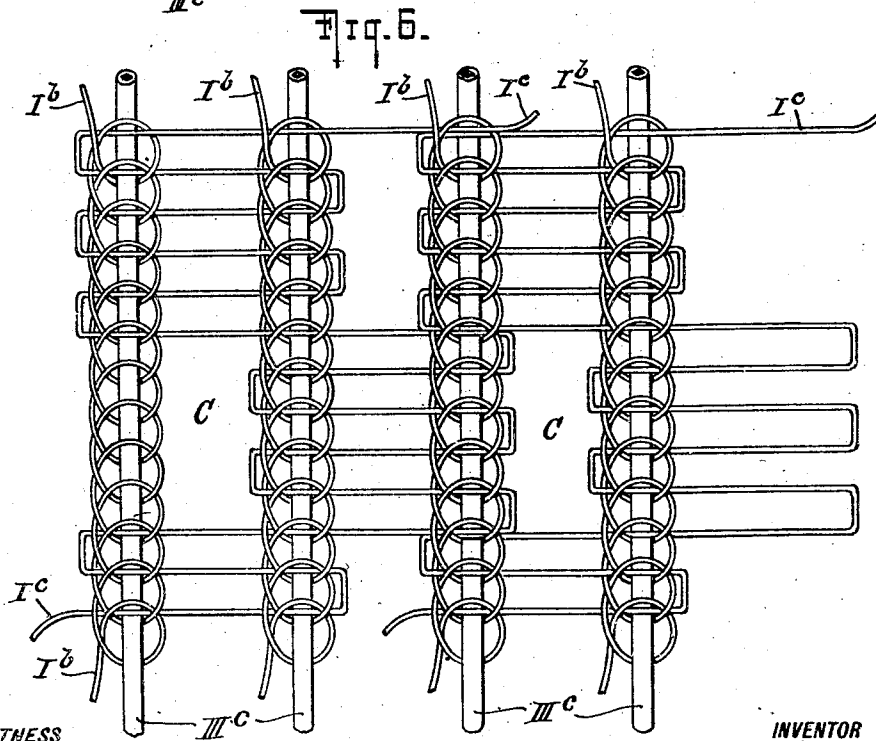
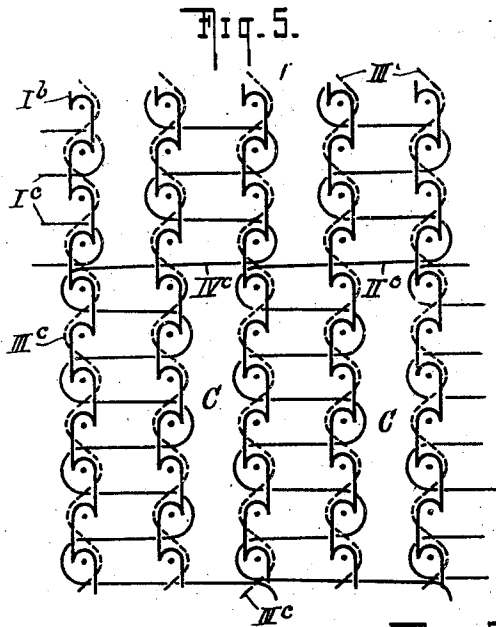
T. G. VORCK

1,715,482

KNIT FABRIC

Filed Nov. 12, 1925

3 Sheets-Sheet 3



WITNESS

G. V. Rasmussen

INVENTOR

THEODOR G. VORCK

BY

Miesent Schenk

ATTORNEYS

Patented June 4, 1929.

1,715,482

UNITED STATES PATENT OFFICE.

THEODOR G. VORCK, OF BARMEN, GERMANY.

KNIT FABRIC.

Application filed November 12, 1925, Serial No. 68,493, and in Germany January 28, 1925.

My invention relates to that class of fabrics in which during their manufacture, elastic strands, such, for example, as strands of india-rubber, are combined with threads of vegetable or animal fibre forming the body of the fabric.

More particularly stated, the invention relates to elastic fabrics of a porous structure particularly suitable for use in the manufacture of abdominal supports, bandages, corsets, suspenders, and the like, and for technical purposes. I am aware that several varieties of elastic knit fabrics are commonly used in the manufacture of these articles.

The most common variety of elastic fabric is a woven fabric having transverse or weft threads of rubber, but it is also known to make a knit fabric having similarly disposed rubber weft threads which are held in place by the longitudinal or warp courses of stitches. Moreover, it has also been proposed to construct a porous elastic knitted fabric with parallel longitudinal rubber warp threads enclosed and held in place by longitudinal or warp courses of looped stitches, the adjacent composite warp courses being connected together by weft threads running from one course to the adjacent course and inter-linked with the warp threads forming the stitches enclosing the rubber warp. However, in this fabric the weft knitting threads were not looped about the rubber warp threads, and did not assist in holding same in position.

The chief disadvantage of porous elastic knit fabrics as hitherto proposed was that the rubber threads were not tightly held in place, and were, therefore, capable of being easily pulled out. Furthermore, the continuity of the knitted meshes has not permitted of threads being omitted to form openings in predetermined positions for increasing the porosity and flexibility of the fabric and to permit the formation of patterns therein. The only method of producing patterns in these fabrics has been by omitting certain of the strands of rubber warp threads, with a corresponding loss of elasticity in the fabric, or by changing the regular succession of the front and back courses of the meshes in relation to the warp threads. In this latter case, however, the rubber strands are left at intervals free and unprotected on the surface of the fabric, which obviously diminishes the durability of the fabric.

I am further aware that a plain fabric has been produced in a warp frame, in such a manner as to comprise separate courses of warp meshes connected by weft threads enabling rubber strands to be used without a covering of wound threads. It will be readily understood that with this arrangement, the perspiration from the body has much easier access to the rubber strands than if these are thread-wound; as a result these rubber strands are quickly rotted and rendered useless. Because of the fact that the rubber strands are uncovered, no weft threads can be omitted from the regular succession in order to form openings in the fabric. On the contrary, the fabric requires an additional weft on one side in order to cover sufficiently the bare rubber strands and obviate ravelling. By reason of the closeness of the texture which results from the above, the fabric is too heavy and stiff for most of the purposes set forth.

The object of this invention is to provide elastic fabrics, particularly adapted for use in the manufacture of the articles mentioned, which fabrics present none of the objections referred to hereinbefore, but which are of relatively high flexibility and are porous to the desired extent, and which have the rubber strands firmly bound in their structure against removal and protected against moisture from the body.

With the above general objects in view, according to one feature of the invention, I provide an improved porous elastic knitted fabric having longitudinal parallel courses of stitches joined together to form a fabric by transverse threads passing from course to course and knitted into different longitudinal courses in consecutive stitches, wherein rubber or elastic warp threads are enclosed within the longitudinal courses of stitches by loops drawn from a textile warp knitting thread alternately on opposite sides of the elastic thread, each of said loops being drawn through a loop of the same thread drawn from the other side of the elastic thread. The fabric may also comprise fabric transverse warp threads extending transversely of the fabric across any desired number of longitudinal courses of stitches and held against the elastic warp threads by loops of the longitudinal courses of stitches which are formed to overlie same.

According to a further feature of the invention the improved fabric is one in which

longitudinal elastic warp transverse warp threads have fabric warp threads knitted about them so as to enclose and grip them, and the longitudinal elastic warp courses thus produced are united together to form a fabric by threads running transversely of the fabric from one course to another, said threads being knitted into loops forming stitches in the longitudinal courses of elastic warp covering stitches.

From the foregoing it will be appreciated that the invention provides a porous elastic knit fabric which is elastic in its longitudinal direction owing to the presence of rubber warp threads but is non-elastic in a transverse direction owing to the presence of fabric transverse warp threads which form loops partly encircling the rubber threads and drawn through other previously formed transverse warp thread loops encircling the remaining periphery of the rubber threads, whereby the rubber warp threads are gripped and held in place by said oppositely extending transverse warp threads. It also provides a porous elastic knit fabric comprising a series of parallel longitudinal rubber warps each forming the core of a longitudinal course of knitting, a corresponding series of fabric warp threads knitted round said rubber strands to enclose and grip same, and fabric transverse warp threads running across the rubber warp threads between consecutive stitches and held in place by stitch loops of the fabric warp threads.

In order that the invention may be clearly understood and readily carried into practice, I have appended hereto drawings illustrating the same, wherein:—

Fig. 1 is a diagram illustrating the manufacture of a fabric embodying the invention; certain parts thereof being shown separately, in Fig. 2.

Fig. 1^a is an enlarged showing of a slight modification of the fabric manufactured as in Fig. 1, with all threads in loosened condition.

Fig. 2 is a diagrammatic view showing threads of Fig. 1 separately.

Fig. 3 is a diagram similar to Fig. 1 illustrating the manufacture of a modified form of the fabric.

Fig. 4 is a fragmentary view showing the needles and thread guides of the machine.

Fig. 5 is a diagram similar to Fig. 1 illustrating the manufacture of another form of the fabric; and Fig. 6 is a thread diagram of the fabric of Fig. 5 of the same character as Fig. 1^a.

The improved fabric is made on a warp knitting machine, employing a row of latch needles for knitting threads to form parallel courses of stitches running longitudinally of the fabric adjacent courses of knitting being connected together by transverse warp threads knitted alternately into

adjacent courses. In addition the machine includes means for guiding elastic warp threads into the fabric longitudinally thereof, said threads not, however, being knitted into the fabric, i. e. not being used to form stitch loops. The machine may also include means for guiding weft threads (hereinafter referred to as "plain weft threads") transversely of the warp threads between the formation of consecutive stitches, said weft threads being held in position by the knitting loops of the warp courses. As will be hereinafter apparent, neither the elastic warp threads nor the plain weft threads engage with the needles, so that they do not form knitting loops and are only held in position by the knitted warp and weft threads.

A portion of the machine, which is generally of known type, is illustrated diagrammatically by Figure 4 in which *d* represents the row of parallel vertically movable latch needles, *b* represents the series of guide members for the elastic threads, *a* and *c* guides for the textile or non-elastic warp knitting threads, and *f* represents a tubular guide for the plain weft thread which projects from a carrier *e* reciprocated in a line parallel with the needles.

The guides *a*, *b*, *c* are carried by longitudinal bars which are intermittently rotated so that the guides are swung angularly between and past the needles so as to engage their threads with the needles, while the needles are in the raised position. Said bars are also given suitable longitudinal movements to lay the threads across the needles in the desired manner. The needles *d* are intermittently raised and lowered in the well known manner, the stitches being formed when the needles reach the bottom of their travel and the threads engaged with the hook beneath the latch are drawn through the old stitches on the needles, which old stitches then become cast off the needles.

Any suitable cam and lever mechanisms, which are well known in connection with knitting machines can be used for moving the guide bars longitudinally and rotating them to swing the guides past the needles, and for moving the weft carrier *e* in the required manner, all of such movements being controlled in well known manner by means of pattern chains.

One form of knitting is illustrated by the diagrammatic Figures 1 and 2, in which the dots represent the needles, and the lines of dots indicate the same needles in connection with the formation of successive stitches. The thick transverse lines *i* represent the path of movement of the weft thread carrier *e*, and the remaining lines running in vertical zig-zag directions indicate the transverse movements of the thread guides (caused by the longitudinal movements of the guide bars) in relation to the needles.

Referring now particularly to Figures 1 and 2 of the drawings, in the manufacture of the fabric as diagrammatically illustrated therein, two warp threads I and III are employed, the thread I being of textile material and the thread III being of rubber, which may be plain rubber or rubber covered with cotton or silk. In addition, two transverse warp knitting threads II and IV are employed. The fabric also includes plain weft threads *z* running transversely across the fabric.

The movements of the guides for the respective threads are illustrated separately in Figure 2. The warp knitting thread I is alternately moved by its guide *a* (or *c*) across the corresponding needle from opposite sides thereof, this being effected by giving a suitable longitudinal movement to the guide bar when the thread has been brought on the hook side of the needle by an angular swinging movement of the guide bar. The rubber warp thread III is not engaged with the needle, but is moved by its guide bar alternately on opposite sides of the needle, so that loops from the thread I are alternately drawn down by the needles on opposite sides of the rubber thread III, each loop thus drawn down being drawn through the loop previously drawn down from the other side of the rubber thread III.

The transverse warp knitting thread II is moved across the needle both before and after the guide bar swings angularly in relation past the needle, so that the thread is caused to encircle the needle, whereafter the guide bar moves so that on the next stitch the thread encircles the adjacent needle. After forming a loop about the last mentioned needle, the thread II again returns to the first needle. The action in the case of the transverse warp knitting thread IV is similar, with the exception that the thread moves in the opposite direction between successive stitches so that the two knitting threads II and IV cross each other between the longitudinal rows of stitches.

The weft thread *z* is drawn along by the weft carrier *e* between the formation of successive stitches by the needles, so as to lie across the rubber warp threads immediately above the last formed row of stitches. When the needles rise and draw down loops of the warp knitting threads through the old loops already on the needles, the weft thread *z* is bound into position against the rubber warp threads. The weft thread *z* runs continuously from side to side of the fabric, as will be readily appreciated, the carrier *e* reciprocating across the machine at intervals determined by the pattern chain mechanism controlling the operation of same.

The construction of the warp courses and covering of the rubber warps III, with the

binding of the weft threads *z* in place by the warp knitting threads I and the way in which the transverse warp knitting threads II combine together and with the rubber warp threads III and weft threads *z*, are apparent from the fabric illustrations in connection with the detail showings. It will be seen that the warp threads I are adapted to form rib-like windings on the rubber warps III, around which the diagonally transverse knitting threads II and IV pass in opposite directions. The transverse warp threads II and IV progress longitudinally with transverse movement and may be regarded partly as weft threads, their principal function being to fasten the warp courses together transversely of the fabric, loops of adjacent threads passing from opposite sides beneath a rubber thread III and one of said threads being drawn through the other so that in each course there is a chain of stitch loops embracing the rubber warps III and assisting in holding them in place.

It is to be noted in Figure 1 that warp courses have been omitted at the needle positions A, either by removing the needles, omitting the corresponding threads, or both, to produce a pattern in the fabric consisting of narrow longitudinal slits at regular intervals across the fabric, crossed regularly along each transverse stitch line by the plain weft threads *z*.

Figure 3 is a diagram corresponding to Figure 1, illustrating the manner of manufacture of a somewhat simpler construction of fabric, including only rubber warp threads III^a, textile warp knitting threads I^a, and weft threads *z*. The surface pattern of the fabric is, therefore, different, owing to the absence of the threads II and IV crossing on the surface of the fabric. Moreover, the surface pattern is additionally altered and the porosity of the fabric increased by omission of the weft thread *z* at the stitch line B and the subsequent stitch line.

Figure 5 is a diagram illustrating the manufacture of a modification of the fabric illustrated by Figure 1, in which rubber threads III^c and warp knitting threads I^b are used corresponding to the threads III and I of Figure 1, but in place of the threads II and IV, threads II^c and IV^c are each looped between three adjacent warp columns of stitches, so as to form groups of transverse warp threads alternately in adjacent columns. In this way open spaces C are left in the fabric alternating with closed spaces, between adjacent warp courses of stitches, thus producing a somewhat chequered surface pattern. In this fabric the plain weft threads *z* are omitted, but could be included if desired.

The run of the threads in the fabric corresponding to Figure 5 is shown in Figure 6.

As will be apparent from the foregoing description the pattern of the fabric and its porosity may be raised by omission of rubber warp threads III, or by omission of weft threads *i* at any selected stitch lines, and also by varying the travel of the warp knitting threads transversely of the fabric from two to any desired number of needles. Other pattern variations may be introduced by varying the stitch displacement longitudinally of the fabric of the weft knitting threads II and IV.

It will be seen that the action of the needles in relation to the movements of the rubber threads III and textile warp threads I is to draw down loops of the thread I alternately from opposite sides of the rubber thread III, each new loop being drawn through the old loop already on the needle, whereafter the old loop is cast off. Similarly, in regard to the transverse warp threads II and IV, they are formed into loops which are drawn under the rubber threads III and drawn through the old loop or loops on the needle, one of which consists of a similar loop of the other thread II or IV drawn under the thread III in the opposite direction. Thus the loops of any thread II in any longitudinal course of stitches are chain-linked with loops of a thread IV also incorporated in the same longitudinal course of stitches. At the same time these loops are also incorporated as loops in the chains of stitches formed by the threads I. Accordingly, all the threads of the fabric are knitted together with the exception of the rubber threads III and the weft threads *i*, which are held in place beneath the stitch loops of the other threads.

As already described the surface pattern of the fabric can be varied by omitting threads corresponding to certain of the needles, so that at intervals across the fabric no stitches are formed. Similarly the pattern can also be varied by so controlling the movements of the weft carrier, that weft threads *i* are omitted at intervals along the length of the fabric. Again, the pattern can be varied by varying the distance which the knitted weft threads II or IV travel. In the case of Figures 1 and 2 they only travel from one needle to the next needle and back again, but they may, if desired, cross intervening needles between consecutive stitches. Similarly, the weft threads *i* may traverse either the whole width or parts only of the width of the fabric. By providing a suitable pattern chain, the movements of

the transverse warp threads II and IV can be varied along the length of the fabric.

Owing to the fact that the rubber strands extend in a longitudinal direction, the elastic fabric may be made of unlimited length and can also be made of any desired width up to the needle capacity of the knitting machine employed, in contra-distinction to such fabrics in which the elastic strands run transversely to the length of the fabric, furthermore the rubber strands being covered with knitted coverings, closely knit thereon in a manner to grip said rubber strands, the latter are securely fixed in place in the fabric and cannot be pulled out of place by any ordinary force.

What I claim is:

1. An elastic knit fabric comprising a plurality of rubber warp strands, and separate transverse warp knitting threads looped around said rubber warp strands from opposite directions at substantially the same point lengthwise of the fabric so as to securely hold said warps against displacement.

2. An elastic knit fabric comprising a plurality of rubber warp strands, fabric warp threads encircling said strands to form a covering thereon, and separate transverse warp knitting threads looped around said covered strands from opposite directions at substantially the same point lengthwise of the fabric so as to securely hold said warps against displacement.

3. A porous longitudinally elastic knit fabric comprising a series of rubber warps, a corresponding series of fabric warp threads knitted around said rubber warps to enclose and grip same, and separate fabric transverse warp threads forming loops partly encircling said rubber warps from opposite directions substantially at the same point lengthwise of the fabric to grip and hold said rubber warps.

4. A porous longitudinally elastic knit fabric comprising a series of rubber warps, a corresponding series of fabric warp threads knitted around said rubber warps to enclose and grip same, and separate fabric transverse warp threads forming loops partly encircling said rubber warps from opposite directions substantially at the same point lengthwise of the fabric and held in place on said rubber warps by engagement with the loops of the fabric warp threads surrounding said rubber warps.

In testimony whereof I have hereunto set my hand.

THEODOR G. VORCK