No. 648,581. Patented May 1, 1900.

# G. BENGER.

## KNITTED OR NETTED FABRIC.

(Application filed Dec. 5, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

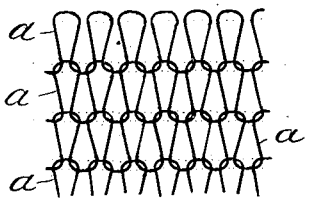



Fig. 2.

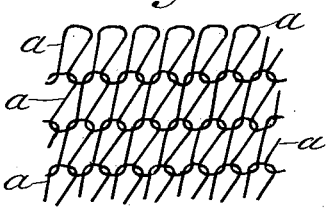



Fig. 3.

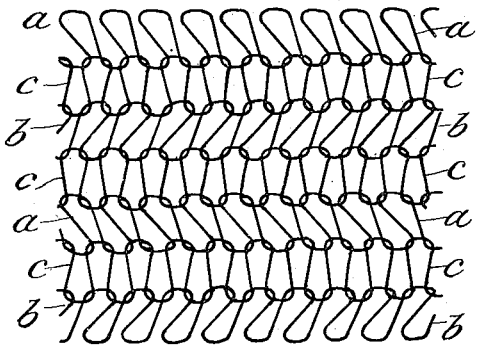
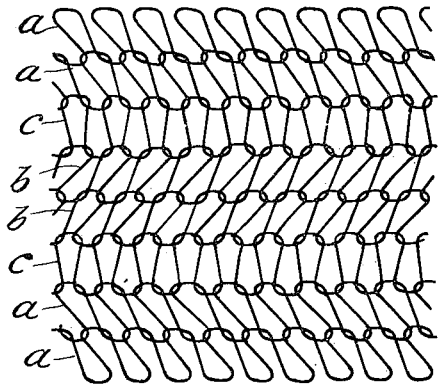



Fig. 4.




Witnesses
H. C. Schott
Anton Stoetzer

Inventor:
Gottlieb Benger,
by Mason & Fenwick
Attorneys.

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# G. BENGER.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 5.

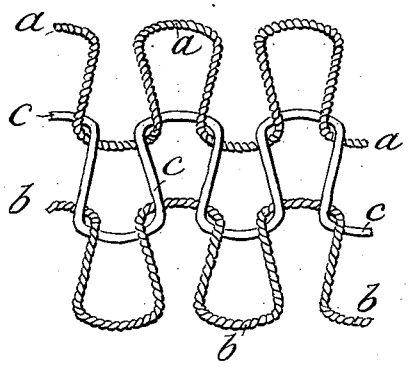



Fig. 6.

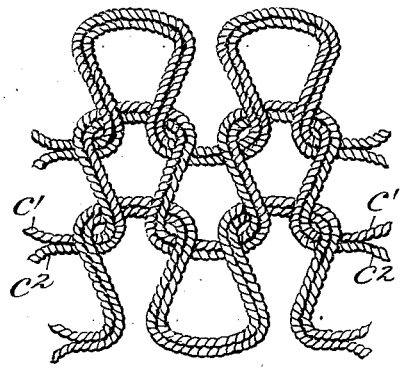



Fig. 7.

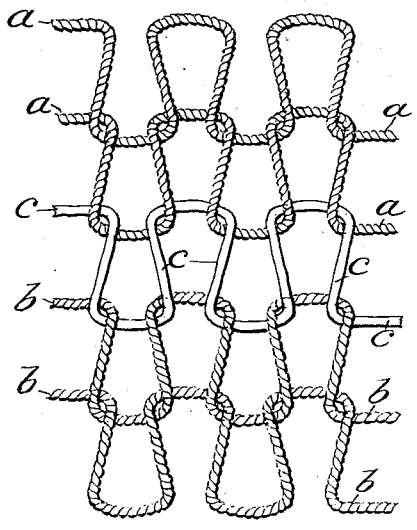
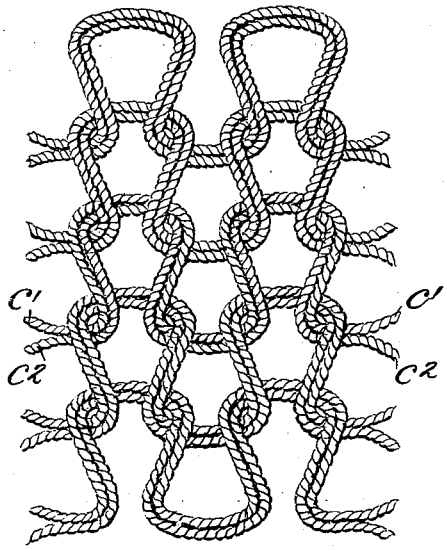



Fig. 8.




Witnesses
F. H. Schott
Anton Albertzner

Inventor:
Gottlieb Benger,
by Max Wagner
Attorney.

# UNITED STATES PATENT OFFICE.

GOTTLIEB BENGER, OF STUTTGART, GERMANY.

## KNITTED OR NETTED FABRIC.

SPECIFICATION forming part of Letters Patent No. 648,581, dated May 1, 1900.

Original application filed November 28, 1898, Serial No. 697,615. Divided and this application filed December 5, 1899. Serial No. 739,264. (No specimens.)

*To all whom it may concern:*

Be it known that I, GOTTLIEB BENGER, a citizen of the Empire of Germany, residing at Stuttgart, Germany, have invented certain new and useful Improvements in Knitted or Netted Fabrics, (which were set forth in my application filed November 28, 1898, Serial No. 697,615, of which this application is a division;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to knitted or netted fabrics.

The object of my present invention is to provide a fabric of this character which will not shrink materially on washing, which will not become felted in use, and at the same time will be free from a tendency to warp or become distorted or out of shape.

The knitted or netted fabrics and underclothing as manufactured hitherto, more particularly those made of wool, have in addition to a number of advantageous properties the great disadvantage that when being worn and washed they shrink greatly and in time become felted. It has been attempted to overcome these disadvantages by using strongly-twisted yarns; but by doing so a fabric was produced which was unfit for use or at least objectionable on account of the fact that it soon became warped and twisted out of shape, particularly after washing. This so-called "warping" (getting out of shape) of the hitherto-known manufacture results from the fact that the yarn or thread hitherto used was all twisted in one direction and that this one-sided twist of the yarn or of the thread exercises a one-sided strain on the meshes or stitches of the ready-made fabric, thus causing a distortion of each stitch, whereby the stitches all assume a slope in one general direction, which direction depends upon the direction of the twist of the yarn or thread employed. It is obvious that the stronger the one-sided twist of the thread or threads the greater will be the unsymmetrical strain on and consequent warping of the fabric. For these reasons only softly-twisted yarns have been hitherto employed in actual practice for knitted and netted goods—*i. e.*, so-called "hosiery-yarns"—with which the felting and the great shrinking during wear and washing has to be accepted as inevitable. The present invention renders possible the use of strongly-twisted yarns without affecting the elasticity or the production of a straight-running fabric and with the advantage that shrinking or felting of the fabric when being washed and worn is considerably reduced.

My invention, which thus accomplishes the objects hereinabove stated, consists, first, in a knitted or netted fabric or garment consisting of one or more rows of meshes or stitches made from yarn or thread twisted in one direction alternating with one or more rows of meshes or stitches made of yarn or thread twisted in the opposite direction in combination with interposed rows of meshes or stitches made of neutral thread or yarn, or, more specifically, second, in such a fabric or garment in which one or more rows of meshes or stitches made from yarn or thread twisted in one direction are followed by a row or rows of meshes or stitches made of neutral yarn or thread, these being in turn followed by a row or rows of meshes or stitches of yarn or thread twisted oppositely to the yarn or thread of the first row or rows of meshes, and so on, the same order of meshes being continually repeated throughout the fabric.

I will now describe my invention more in detail by describing what I consider the best embodiment of the same, reference being had to the accompanying drawings for this purpose.

In the drawings, Figure 1 is an enlarged view representing a portion of a raw unwashed fabric as it came from the circular head, manufactured of softly-twisted yarn or thread, so-called "hosiery-yarn," as hitherto practiced. Fig. 2 is a similar view of the same fabric, showing the warped or distorted condition assumed by the meshes of the same, in many cases even for lightly-twisted yarns, but always and in a marked degree where yarns or threads strongly twisted in but one direction are employed. Fig. 3 shows, diagrammatically, an enlarged view of a portion of a fabric embodying one preferred form of

arrangement of the meshes under my invention; Fig. 4, a similar view of a somewhat-modified arrangement; Figs. 5 and 6, enlarged views of a number of interlocking meshes under the arrangement shown in Fig. 3, and Figs. 7 and 8 similar views under the arrangement shown in Fig. 4.

It will be noted that in the old mode of manufacture, as shown in Fig. 1, the meshes, loops, or stitches *a* of the fabric, when it is first made and before it is washed, are without any slope—that is to say, have their axes at right angles to the direction of the material. After the fabric has been washed, however, and more particularly after the use of the ready-made garments, the crimping tendency of the loosely-twisted woolen fibers, together with the one-side twisting of the yarn or thread, causes the stitches to assume the sloping direction as shown in Fig. 2.

In all knitted or netted fabrics hitherto known the meshes or stitches were constructed from one continuous single or multiple thread (made from yarns twisted in the same direction) which is carried throughout the fabric. Under my present invention, however, two or more yarns twisted in opposite directions are employed for the first time, whereby I am enabled for the first time to use strongly-twisted yarns without incurring the danger of warping or distortion while reducing the shrinkage and felting to a minimum. Fig. 3, for instance, shows an enlarged diagrammatic view and Figs. 5 and 6 enlarged detail views of a portion of fabric as manufactured in accordance with my invention and composed of three horizontal rows of meshes *a c b*, the first and the third of which, *a* and *b*, are made of oppositely-twisted yarns or threads in such a way that between the row *a* of the right-hand-twisted yarn or thread and the row of the left-hand-twisted yarn or thread *b* one neutral row of meshes *c* is inserted, and so on throughout the fabric. In other words, each row of right-hand-twisted yarn or thread is connected with the row of left-hand-twisted thread on each side by a row of neutral thread, as shown in Fig. 3.

The neutral row or rows of meshes inserted between a row or a number of rows of meshes made alternately of right and left hand twisted yarn or thread, as above described, may be formed, first, of a lightly-twisted yarn or thread, so-called, "hosiery-yarn," as indicated in Fig. 5, or, second, in case of multiple-thread fabrics instead of yarn or thread of neutral twist oppositely-twisted yarns or thread $c' c^2$ may be used to form the interspersed neutral row or rows of meshes in such a manner that the left-hand twist and the right-hand twist are equalized in each stitch or mesh, thus neutralizing strain and counterstrain in each stitch or mesh. This arrangement is indicated in Fig. 6.

In Figs. 4, 7, and 8 I have shown another manner of carrying out my invention. Under this form a number—*e. g.*, two—of rows of meshes *a* of thread or yarn twisted in one direction are followed by a row of meshes *c* of neutral thread or yarn, and this row in turn is followed by a number—for example, two—of rows of meshes *b* of yarn or thread twisted in a direction opposite to that of the first number of rows, these rows being again followed by a neutral row, &c., throughout the fabric. Here, again, in the form shown in Fig. 7, the neutral yarn *c* may consist of a single lightly-twisted yarn or it may be arranged as in Fig. 8—that is to say, composed of a right and a left hand twisted yarn $c' c^2$, or a right and a left hand twisted set of yarns.

Owing to the strain acting on opposite sides in the alternating rows of meshes or stitches, which are made of oppositely-twisted yarns or threads, after the washing the latter assume an opposed position to one another and an inclined position to the inserted neutral row of meshes—that is to say, a zigzag-shaped diagram of mesh or stitch is produced, only interrupted by the straight-running row or rows of neutral meshes arranged between the row or rows of meshes of oppositely-twisted yarn or thread. From the above it will be seen that considerable changes in detail are possible under my invention. Such rows of meshes of course may change in every suitable proportion and succession, such as the occasion or the requirements may demand. The fabric may be made with any suitable number of consecutive rows of meshes of right-hand-twisted yarn or thread followed by a suitable number of consecutive rows of meshes of left-hand-twisted yarn or thread, neutral rows being inserted at intervals if only in all these instances the amount of right and left hand twist is equalized between the rows of meshes throughout the fabric. I do not, therefore, desire to be confined to the precise forms shown in illustration of my invention, which, broadly considered, consists in a series of rows of meshes of thread twisted in one direction in combination with a series of rows of meshes of thread oppositely twisted and a series of rows of meshes of neutral thread, the three series of mesh rows being distributed suitably throughout the fabric. This fabric is even more elastic in all directions and also longitudinally than that formerly made. This is evidenced by the fact that when the fabric is pulled longitudinally the opposite inclined meshes or stitches thereof straighten out, and as soon as the strain of the pull is released the said meshes or stitches return to their former position.

The present invention, as above stated, overcomes and entirely removes the warping of the fabric or of the garment made therefrom by the counteracting strain of the yarn or threads twisted in opposite directions in such a manner that the amount of the left-hand twist of one row or of a number of rows of meshes is counterbalanced by the same amount of right-hand twist in the following row or rows of meshes, and so on throughout

the garment. Different strength of twist in opposite directions may be employed with equal effect, so long as the arrangement is such as to produce an equalization in the total of the strains acting in opposite directions transversely throughout the fabric.

The further disadvantage of the old web—*i. e.*, the great shrinking and felting—are considerably reduced by the use of stronger-twisted yarns or threads, softly-twisted yarns causing a large amount of felting or shrinking of the fabric both during wear and washing, because the soft twist of the yarn or thread promotes the tendency of the woolen fibers for crimping and because there are more loose fibers in a soft-twisted yarn or thread to catch together and become matted across the meshes, whereby the garment loses its elasticity and porosity, and hence is less advantageous for underclothing. By using strongly-twisted yarns or thread, however, there is considerably less tendency of the fabric or of the garment made therefrom felting and shrinking, because the strongly-twisted yarn or thread has more stability and an increased durability and less loose fibers, thus diminishing and nearly avoiding the felting, and consequently also the shrinkage. A further circumstance that counteracts the felting qualities of the wool is the fact that the oppositely-twisted yarns or threads take an opposite position to one another, thus preventing the fibers from catching together, while, on the contrary, the elongated closed shape of the meshes of the old web, as shown in Fig. 1, promotes and facilitates the felting, and consequently, also, the shrinking, of the fabric.

In my aforesaid application, Serial No. 697,615, filed November 28, 1898, I have described the matter herein set forth, together with other things in illustration of the generic invention there claimed, but have not there claimed the same specifically, since this is the purpose of the present application.

In the following claims the word "fabric" is of course understood to embrace fabrics whether in the form of or made up into garments, such as underwear, or in an unmade-up condition.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a knitted or netted fabric, a number of rows of meshes made from yarn or thread twisted in one direction in combination with a number of rows of meshes made from yarn or thread twisted in an opposite direction, and a number of rows of meshes made from neutral yarn or thread, the three sets of rows being suitably distributed throughout the fabric, substantially as set forth.

2. In a knitted or netted fabric, a row of meshes made from yarn or thread twisted in one direction, and a row of meshes made from yarn or thread in an opposite direction in combination with a row of meshes made from neutral yarn or thread and interposed between and connecting the said rows of oppositely-twisted yarn or thread.

3. In a knitted or netted fabric, rows of meshes of yarn or thread twisted in one direction alternating with rows of meshes of yarn or thread twisted in an opposite direction and combined with rows of meshes of neutral yarn or thread arranged between the rows of meshes of oppositely-twisted thread.

In testimony whereof I affix my signature in presence of two witnesses.

GOTTLIEB BENGER.

Witnesses:
A. DRAUTZ,
H. WAGNER.