No. 648,582. Patented May 1, 1900.

G. BENGER.

KNITTED OR NETTED FABRIC.

(Application filed Dec. 5, 1899.)

(No Model.)

Fig. 1.

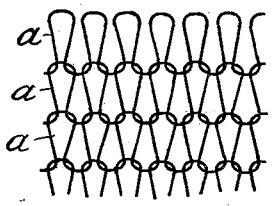


Fig. 2.

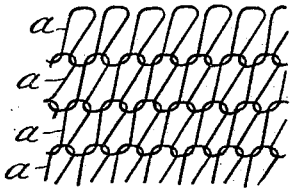


Fig. 3.

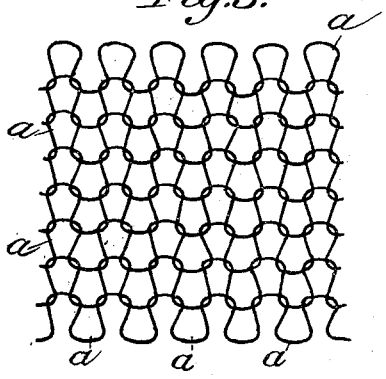


Fig. 4.

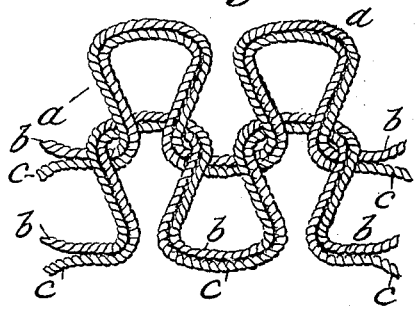
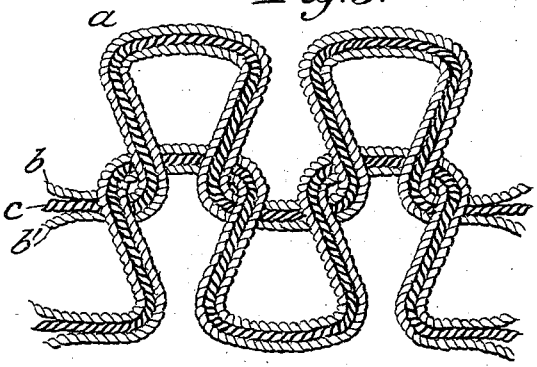


Fig. 5.



Witnesses
F. H. Schott
Anton Ablowitzer

Inventor:
Gottlieb Benger
by Mast Foss & Co
Attorneys.

UNITED STATES PATENT OFFICE.

GOTTLIEB BENGER, OF STUTTGART, GERMANY.

KNITTED OR NETTED FABRIC.

SPECIFICATION forming part of Letters Patent No. 648,582, dated May 1, 1900.

Original application filed November 28, 1898, Serial No. 697,615. Divided and this application filed December 5, 1899. Serial No. 739,265. (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 and garments made therefrom, the object of the invention being to provide a fabric which while entirely overcoming the tendency of warping or distortion will be subject to a minimum of felting and shrinkage.

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 so doing a fabric so twisted, warped, and tending to get out of shape is produced that cannot be used. This so-called "warping" (getting out of shape) of the hitherto-known manufacture results from the fact that the one-sided twist of the yarn or of the thread exercises a one-sided strain on the meshes or stitches of the ready-made fabrics, thus causing a distortion of each stitch, the stitches all assuming 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 warping of the fabric. For these reasons only softly-twisted yarns have been hitherto employed for knitted and netted goods—*i. e.*, so-called "hosiery-yarn"—with which the felting and great shrinkage during wear and washing has to be accepted as inevitable.

The present invention renders possible the use of strongly-twisted yarns without detracting from the elasticity or the straightness of the fabric and with the advantage that shrinking or felting of the fabric when being washed and worn is considerably reduced.

My present invention, which is designed to accomplish the objects hereinabove stated, broadly speaking, consists in a knitted or netted fabric or garment comprising rows of meshes, each made from a multiple yarn or thread composed of a yarn or set of yarns or journals twisted in one direction and a second yarn or set of yarns twisted in the opposite direction, the said component yarns or journals lying side by side or parallel to each other, having been laid on the needles in loose parallel strands in the process of knitting or netting.

I will now describe the invention more in detail by setting forth what I consider the preferred 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 comes from the circular head, manufactured, as hitherto practiced, of softly-twisted yarn or thread, so-called "hosiery-yarn." 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 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 my invention, indicating that the fabric does not warp or shift on washing. Fig. 4 is a view, on a still more enlarged scale, of a number of interlocking meshes under my invention; and Fig. 5, a similar view of a modified form of arrangement.

It will be noted that in the old mode of manufacture, as shown in Fig. 1, the meshes, stitches, or loops *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 parallel to the direction of the material. After the fabric has been washed, however, and more especially after the use of the ready-made garment the crimping tendency of the loosely-twisted woolen fibers, together with the one-sided 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 are constructed from one continuous single or multiple thread, which is carried throughout the fabric, all the component yarns in the case of a multiple thread being twisted in the same direction. Under my present invention, however, two or more yarns or sets of 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 at the same time reducing the shrinkage and felting to a minimum.

In Figs. 4 and 5 I have shown two forms of meshes embodying my invention, each showing each stitch or mesh *a* as formed of a multiple yarn or thread the component threads or sets of threads of which are twisted in opposite directions in such a manner that the tendencies of the twist of the threads to draw the stitches in sloping directions in both ways will counterbalance each other, and as a result the stitches will not be drawn in either direction—that is to say, the warping of the fabric or garment is entirely prevented. The counterbalancing of the tendencies of the various threads may be accomplished in two ways at least under my present invention. For example, an even number of threads may be employed, half of which are twisted in one direction and the other half in the opposite direction, the amount of twist in each thread being the same, or any number of threads, either odd or even, may be employed, more than half of the threads having a twist in one direction and the others a twist in the opposite direction, the amount of the twist in the individual threads of the latter set being greater than in the first set, which contains the larger number of threads. In the former case the threads are equally twisted and are counterbalanced by putting an equal number in each set of oppositely-twisted threads. In the latter case the counterbalancing is done by giving to the individual threads comprising the set which has the smaller number of threads a greater twist than that of the threads in the set containing the greater number of threads. For example, as shown in Fig. 4, I may employ two parallel threads *b* and *c*, each equally twisted, but in opposite directions, or, say, three parallel threads, as in Fig. 5, two of which, *b b'*, are softly twisted in one direction, and the third, *c*, is twisted strongly enough in the opposite direction to counterbalance the tendency of the first two to draw the stitch to a sloping direction.

From the above it will be seen that my invention may be carried out in a variety of ways:

First. I may manufacture a fabric consisting of individual stitches or meshes, each composed of two threads arranged parallel or side by side, said threads having equal twists, one thread being twisted in a right-hand direction and the other in a left-hand direction. This is shown in Fig. 4. When such a fabric is washed, the amount of the twist of the threads—say *b* and *c*—will be substantially equal, and consequently the tendency of the thread *a* to draw the stitches or meshes to a slope in one direction will be counterbalanced by the tendency of the thread *c* to draw the stitches to a slope in the opposite direction. Hence the stitches will not be drawn to a slope in either direction, and therefore the fabric will remain substantially the same after washing as it was before.

Second. Or each individual stitch or mesh may be composed of three threads *b b' c*, arranged side by side, two of which, *b b'*, are twisted in one direction and the third one strongly enough in the opposite direction to counterbalance the strain of the first two threads. The amount of strain being the same in the one thread—say *c*—as in the two threads—say *b b'*—it is evident that the tendency of each amount of twist to draw the stitches in one direction is counterbalanced by that of the other, and the effect in washing and wearing the fabric is the same as above stated in the explanation to example one.

Third. Again, the stitches or meshes may be formed of four threads arranged parallel or side by side, three of which are twisted in one direction and the fourth strongly twisted in the opposite direction, so as to counterbalance the strain of the first three threads. This example is essentially the same as that under two.

Fourth. Finally, the stitches or meshes may be composed of four or more threads, some of which are strongly twisted in one direction and the balance strongly twisted in the opposite direction, so as to completely counterbalance the twist of the first set.

Examples three and four embody substantially the same arrangement as set out in connection with examples one and two, and as the amount of twist is always equalized by strain and counterstrain the effect in wearing and washing the material or the made-up garment is also the same as pointed out in the foregoing explanations. It is obvious that these examples could be augmented by a great many others made on the same principle; but it is not my purpose to enumerate the various modifications my invention comprises, the principles of my invention being sufficiently described and ascertained by the foregoing examples and explanations.

It is further to be understood that I use the terms "softly-twisted" and "strongly-twisted" threads in a relative sense only as indicating that one thread is twisted more or less than the other.

In all the various forms of manufacture mentioned herein the shape of the mesh or stitch differs in a remarkable way from the meshes or stitches of the hitherto known

manufacture, the new web showing a more rounded shape of mesh, Fig. 3, when compared with Fig. 1, representing, respectively, the new and the old web in the accompanying drawings.

My new invention, as above stated, overcomes and entirely removes the warping of the fabric or of the ready-made garment by the counteracting strain of the yarns or threads twisted in opposite directions in such a manner that the amount of the left-hand twist and the right-hand twist is counterbalanced in each stitch throughout the garment. Different strength of twist in opposite directions may be employed, so long as the arrangement is such as to produce an equalization in the total of the strains acting in opposite directions in each mesh or stitch. 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 larger 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 ready-made garment to felting and shrinkage, 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 has its cause in the fact that the oppositely-twisted yarn or threads by mutually counteracting each other prevent the fibers from catching together, while, on the contrary, the elongated narrow 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.

Such qualities as I have described for the present invention do not exist with a fabric such as is shown in Figs. 1 and 2 made of softly-twisted yarns, according to the old mode of manufacture.

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 invention there claimed generically, but have not there claimed the same specifically, this being the object of the present application.

The word "fabric" as employed in the following claims is of course understood to include fabrics in the form of or made up into garments as well as unmade-up fabrics.

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

1. In a knitted or netted fabric, a row of meshes made from a multiple yarn composed of individual yarns laid side by side one or more of said individual yarns being twisted in one direction, and one or more in an opposite direction.

2. In a knitted or netted fabric, a series of rows of meshes made from a multiple yarn composed of individual yarns laid side by side, one or more of said individual yarns being twisted in one direction, and one or more in an opposite direction.

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

GÖTTLIEB BENGER.

Witnesses:
A. DRAUTZ,
H. WAGNER.