June 25, 1935. F. MEIWALD 2,006,275

KNITTED YARN AND FABRIC MADE THEREFROM

Filed May 21, 1932

Fig. 1

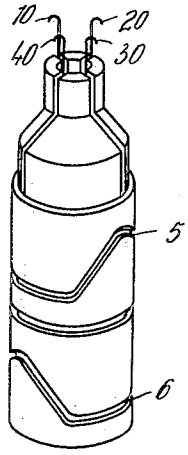


Fig. 2

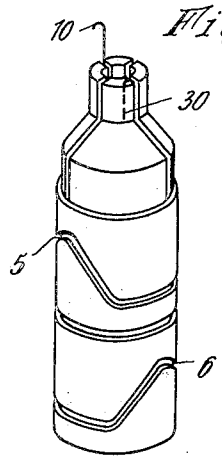


Fig. 7.

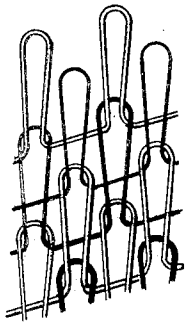


Fig. 3

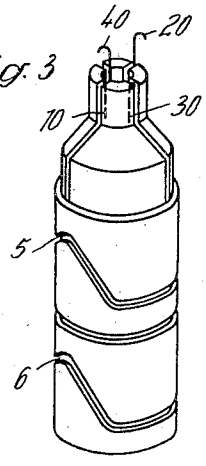


Fig. 4

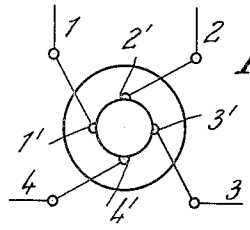


Fig. 5

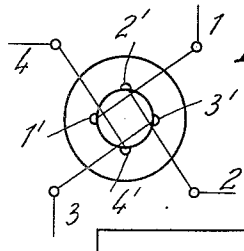


Fig. 9.

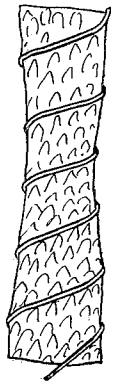
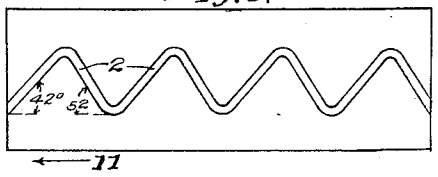


Fig. 6.



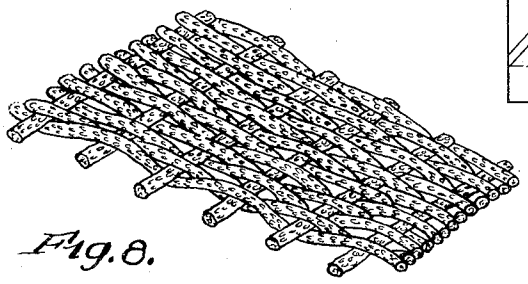


Fig. 8.

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KNITTED YARN AND FABRIC MADE THEREFROM

Franz Meiwald, Vienna, Austria

Application May 21, 1932, Serial No. 612,687
In Austria October 15, 1931

7 Claims. (Cl. 66—169)

My invention relates to a novel yarn and textiles made thereof.

Textiles woven, braided, knitted or crocheted, in the manner heretofore customary in the art, have usually threads consisting of one or several parallel or twisted fibres. Textiles made of such threads or yarns have, as is known, only a comparatively small elasticity, and therefore the disadvantage that, when being stretched they will not quite resume their original form or shape. The original, for instance smooth flat form can be restored only by special treatment, such as by ironing. A further essential disadvantage of the textiles heretofore used is the fact that in order to obtain a heat retaining material, it must be made very dense and thick, and requires therefore a large amount of fibre material. This considerably increases the cost of the textile and of the garments or objects made from it.

Similar disadvantages are inherent essentially also to textiles composed of crocheted threads or yarns, because a crocheted yarn consists of successive air loops not bound laterally to one another. Therefore, a textile material composed of such crocheted yarns has, owing to its lack in elasticity, insufficient softness, especially in transverse direction. Besides, the rate at which a crocheted yarn or thread can be produced is so low that the manufacture of yarns of this type is too expensive to render such yarns useful for manufacturing textiles from it.

These disadvantages are avoided according to the present invention by building up the textile, contrary to the prior art methods, not of individual threads or yarns or the like, but to build up these materials entirely or at least partly of variously knitted yarns or threads, which in the following will be shortly designated as knitted yarns. Such yarns have a by far higher elasticity in longitudinal and transverse direction than twisted or laid yarns or crocheted yarns.

A knitted yarn which is particularly adapted for further working, and which also permits of sufficient varieties with respect to patterns, is obtained by alternately knitting at least two ordinary threads into one another. According to whether the number of threads used is large or small, the diameter of the knitted thread or yarn becomes large or small. In case of a larger number of needles a knitted tube is obtained. If only two threads and needles are used, the knitted product is no more a knitted tube but becomes a knitted thread. The character, the modes of production and the advantage of the knitted product, however, do not depend upon the number of threads used.

In selecting the knitted yarns for producing textiles it is of advantage to use those, whose loops are at an angle to the longitudinal axis of the yarn, because such yarns have a still greater elasticity than yarns whose loops are in the direction of the yarn axis. This elasticity is the greater the more the loops are inclined to the yarn axis. Tubular fabrics of this type and devices for producing this fabric with inclined loops are disclosed for instance in my U. S. Patents Nos. 1,814,324 and 1,936,519. If tubular yarns of this type are used for manufacturing textiles, the finished product is possessed not only of great flexibility and ductility, but also of great elasticity resulting in the advantage that such material resumes automatically its original form even after it has been subjected to considerable tension stresses in any direction. This characteristic is of particular advantage for materials for garments, or for knitted textiles or the like.

A further great advantage of textiles made of knitted yarns is their heat retention property, because knitted yarns enclose a relatively large amount of air. This renders it possible to use less of the heretofore customary materials for heat retaining garments, such as cotton, wool and silk, so that the cost of producing such materials is considerably lessened. The cost for manufacturing such materials can be further lessened owing to the fact that tubular yarns containing a large number of threads can be worked into a textile, for instance into a woven textile, in much shorter time than is possible with the weaving of individual threads or yarns, without however thereby giving the textile so produced a coarser appearance than a thread woven textile. This advantage in turn simplifies the looms so that still further advantages accrue in this direction. Knitted yarns may be produced at very low cost on high speed knitting machines which according to the length of the loops are capable of producing from 500 to 1000 meters of knitted yarn per hour.

In order to produce loops inclined to the direction of the yarn axis as mentioned hereinbefore, machines are used of the type disclosed for instance in my U. S. Patent No. 1,814,324.

In order to distribute the loops most favorably and as uniformly as possible over the surface of the yarn, it is of advantage to offset adjacent loops longitudinally of the yarn so that a circumferential line drawn around the yarn through adjacent loop heads forms a zigzag line. This

type of tubular fabric knitted around a core is more particularly disclosed and claimed in my U. S. Patent Reissue No. 19,551, and a machine for producing it is disclosed more specifically in my copending application Serial No. 612,688.

The offset arrangement of the loops aforementioned has the advantage that the surface of the yarn becomes smoother by the more uniform distribution of the loop heads over the yarn surface. This feature, of course, improves also the textile into which yarns knitted in this manner are worked.

Textiles made with yarns referred to hereinbefore are useful not only for garments, but can be employed with advantage also for rugs, wall coverings, draperies, blankets, and the like. For some purposes, and in order to vary the appearance of the manufactured textile, the yarn may be knitted around insertions or cores, such as threads, yarns, cords, or the like, as is shown in my aforementioned patents and applications.

The fibres for knitting the yarns or threads used in such textiles may be those of wool, cotton, ramie, hemp, jute, bast fibres, silk, rayon, paper, asbestos, glass, metal or the like materials, having natural fibres or being workable into single fibres or threads or into spun threads.

In the accompanying drawing I have illustrated examples of knitted yarns, and of textiles manufactured of such yarns.

In the drawing—

Figs. 1, 2 and 3 represent each in perspective view a needle cylinder and its cam rings, showing the different relations between the number of needles and cam high points for producing the different fabric patterns;

Figs. 4 and 5 show diagrammatically in two operating positions the thread interlocking principle involved in producing the knitted yarns according to the invention;

Fig. 6 represents a needle cam cylinder, developed into a plane and showing a specific form of cam curve;

Fig. 7 represents an example of tubular knitted yarn shown as developed into a plane and produced with four threads and four needles, such as is shown in Figs. 3, 4 and 5.

Fig. 8 represents an example of a textile fabric produced with knitted yarn, according to the invention, and

Fig. 9 represents a sample of knitted thread wrapped spirally with a twisted thread or yarn for effect purposes.

For the manufacture of loop patterns, such as are shown in Fig. 7, the knitting needles may be divided into several groups and the movement of the needles may be controlled by individual needle cam rings. Figs. 1 and 2 show the needle cylinder **7** surrounded by two needle cam rings **8** and **9** disposed one above the other and provided each with a cam groove **5** and **6** respectively. The needle cylinder in Fig. 1 carries, for instance, four needles **10, 20, 30, 40** arranged in diametrically opposite pairs **10, 30** and **20, 40**, the two pairs being shifted relative to one another by 90°. Pair **10, 30** is operated by cam groove **5**, and pair **20, 40** by cam groove **6** in a conventional manner. As the cam high points of rings **8** and **9** are displaced 90°, all needles will always operate at the same time, i. e. they reach their high or low points simultaneously. In Fig. 2 the angular relation between the two cam grooves is the same as in Fig. 1, but a number of needles is employed smaller than the total number of high points employed in all cam grooves, for instance for two cam grooves **5, 6**, each with two high points, there are only two needles **30, 10**. The latter are again displaced 180°, but needle **30** is controlled by groove **5**, and needle **10** by groove **6**. Consequently, the foot of needle **30** will be in one of the low points of groove **5** when the foot of the other needle **10** is in one of the high points of cam groove **6**, i. e. the needles will operate alternately. Fig. 3 shows another modification of a needle cylinder with four needles arranged in pairs **10, 30** and **20, 40** similar to Fig. 1, and controlled by cam grooves **5** and **6** respectively. The embodiment shown in Fig. 3 differs from the above-described embodiments in that the cam high points are not displaced in relation to one another, by 90° as in Fig. 1, i. e. the high and low points of both curves are respectively in axial alignment. Consequently, the pair of needles **20, 40** will always be at the same time at the high points when the pair of needles **10, 30** is at the low points.

Many other modifications may be obtained by displacing the cam rings a few degrees only, for instance by causing the high points of the two cams to follow apart from one another 5, 10 or 15 degrees. Furthermore, particular patterns may be produced by employing at the same time for one or more cam rings needles of different lengths in any arrangement.

In order to adjust the needles, the several cam rings may be axially adjustable, for instance as shown and claimed in my copending application Serial No. 612,688. To determine or to adjust the length of the loop, either the needle cylinder or all the cam rings together may be made axially movable by means of special adjustments which form the subject matter of my aforementioned copending application.

Fig. 4 shows the principle of operation with four needles with four threads guided thereto, and Fig. 5 the position of the threads after the bobbin plate (not shown) has rotated 90° clockwise. In these figures **1, 2, 3, 4** represent the thread guides, **1', 2', 3', 4'** represent fabric loops formed from the threads supplied respectively from these guides. As will be seen from Fig. 5 the threads for successive needles cross each other inside of the needle circle, thereby producing a fabric which consists of two tubular fabrics, whose loops are intertwined as shown in my U. S. Patent Reissue No. 19,551, above referred to.

Tubular yarns made in such a manner may be varied at will with respect to their exterior appearance, and to their mechanical properties by a suitable selection and combination of the above-described different devices. Other fancy patterns may be attained by knitting on a needle two or more threads preferably of different colors which are in parallel relation to one another or twisted with one another.

Furthermore, the products may be wound with one or more threads and, if desired, with any variable pitch as shown in Fig. 9, which may be carried out particularly with yarns employed for knitting purposes in order to attain special effects. If the pitch of the winding is varied during the winding, yarns are obtained which have thin and thick portions. If such yarns and those with intertwined loops as above described consist chiefly of wool, they are particularly suitable for the manufacture of woolen articles of clothing, such as sweaters, caps and the like.

The novel article produced according to my invention may be improved by knitting the tubular fabric around a more or less firm core which

may consist of threads of any kind or of any material to be employed as insert in the manner shown in my copending application Serial No. 612,688. If the core is rotated or drawn straight through the needle cylinder and the cylinder is rotated at the same time, the loop patterns may be varied to the effect that the individual columns of knitted loops form no longer lines parallel to the axis of the core, but wind spirally about the axis of the core, as shown in my U. S. Patent No. 1,814,324 above referred to.

A further advantage of the novel tubular yarn lies in the fact that inferior materials which as a rule have not been used for fabrics may be employed to advantage for the manufacture of tubular yarns. By using such a cheap raw material, a particularly economical product may be manufactured which in view of the manifold kind of interlacing possesses valuable properties, such as elasticity, strength, and heat insulating capacity.

The manufacture of threads for fabrics may be rendered more economical by the adoption of special measures. For instance the needle cams may be designed with different angles of ascent and descent. The cam curve may be so designed that the inclination angle of the descending groove portion to the needle cylinder axis is smaller than the inclination angle of the rising groove portion to the same axis.

Fig. 6 shows the development of a control cam ring embodying my invention. The cam groove has four high and four low points. The cam ring moves in the direction of the arrow f. The angle of the rising groove amounts to 42° and the angle of the descending groove amounts to 52°. The needles will, consequently, rise slowly and fall rapidly. Such a design has the advantage that more cams may be disposed on a given peripheral length of the cam cylinder than has hitherto been possible, so that the number of operations for a needle per cylinder revolution is increased accordingly, which renders the system more efficient. If one is, however, not bound to the diameter of the cam cylinder, its diameter, while maintaining the output, may be decreased in accordance with the steepness of the angle of the descending groove portions. In this way, a decrease of the weight of the knitting head is brought about which effects on the one hand a saving in material so that light supporting members may be provided, and on the other hand advantages are attained in operation, owing to the reduced weight of the gyrating masses. These features are applicable to knitting machines of every description, for instance to machines with two or more systems of cam rings. These features are equally applicable to other textile machines with cam ring controls, such as circular knitting machines.

The tubular yarn produced according to the invention permits among many others the manufacture of the following articles: driving belts, fuse cords, ropes, wicks, tubular yarns, packings, bath robes, towels, ribbons, particularly woven ribbon wares, shoe laces, suspenders, garters, belts, bandages, coverings for electrical conductors for cables, and for lead sheaths, also for conductors, for communication circuits and the like.

Fig. 7 illustrates a tubular yarn longitudinally cut open and developed into a plane, this yarn being knitted with four threads and four needles according to the manner shown in Figs. 1 and 4 and 5. In Fig. 8 a piece of textile is shown which is woven for example with knitted or knitted tubular yarn. In Fig. 9 is shown a piece of knitted yarn which has for effect purposes a thread wound around it. The manner in which this thread may be applied to the yarn is immaterial so far as the present invention is concerned.

I claim:

1. A yarn composed of a plurality of threads knitted into a plurality of individual courses of loops spaced in the direction of the courses with floats between the adjacent loops, the loops of each successive course extending part-way into the spaces between the adjacent loops of the next preceding course, and crossing with their floats the loops of said preceding course, whereby the bight ends of the loops of adjacent courses form a zigzag line, the general direction of which line follows the direction of said adjacent courses.

2. As a new article of manufacture, a knitted multi-ply tubular yarn, each of said plies being a separate and distinct knitted tube, the stitches of each ply being opposite floats between the stitches of another ply.

3. As a new article of manufacture, a knitted multi-ply tubular yarn, each of said plies being a separate and distinct knitted tube with interlocking connections between said plies.

4. A fabric having its constituent threads composed of knitted multi-ply tubular yarn in which each of said plies is a separate and distinct knitted tube, the stitches of each ply being opposite the floats between the stitches of another ply.

5. A fabric having its constituent threads composed of a plurality of threads knitted into a plurality of individual courses of loops spaced in the direction of the courses with floats between the adjacent loops, the loops of each successive course extending partway into the spaces between the adjacent loops of the next preceding course, and crossing with their floats the loops of the said preceding course, whereby the bight ends of the loops of adjacent courses form a zigzag line, the general direction of which line follows the direction of said adjacent courses.

6. A fabric having its constituent threads comprising knitted yarn composed of a plurality of threads knitted into a plurality of individual courses of loops spaced in the direction of the courses with floats between the adjacent loops, the loops of each successive course extending partway into the spaces between the adjacent loops of the next preceding course, and crossing with their floats the loops of the said preceding course, whereby the bight ends of the loops of adjacent courses form a zigzag line, the general direction of which line follows the direction of said adjacent courses.

7. A fabric having some of its constituent threads comprising knitted yarn composed of a plurality of threads knitted into a plurality of individual courses of loops spaced in the direction of the courses with floats between the adjacent loops, the loops of each successive course extending partway into the spaces between the adjacent loops of the next preceding course, and crossing with their floats the loops of the said preceding course, whereby the bight ends of the loops of adjacent courses form a zigzag line, the general direction of which line follows the direction of said adjacent courses.

FRANZ MEIWALD.