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KNITTED PAPER FABRIC

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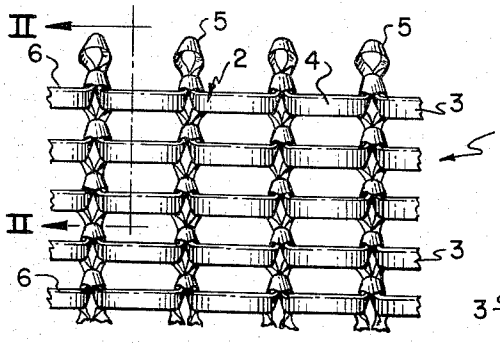


FIG.-1-

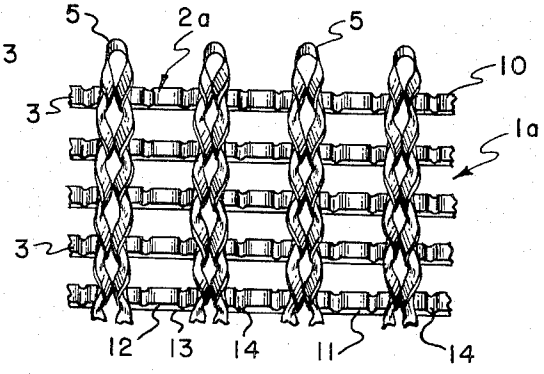


FIG.-3-

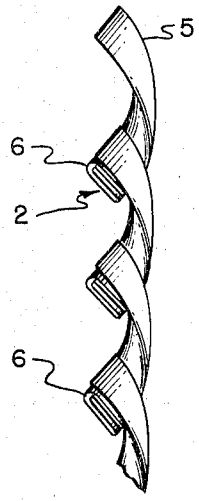


FIG.-2-

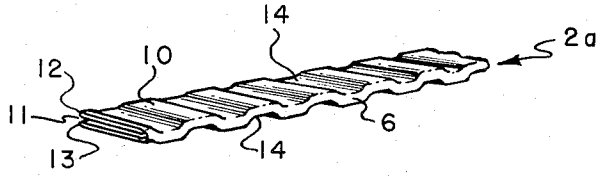


FIG.-4-

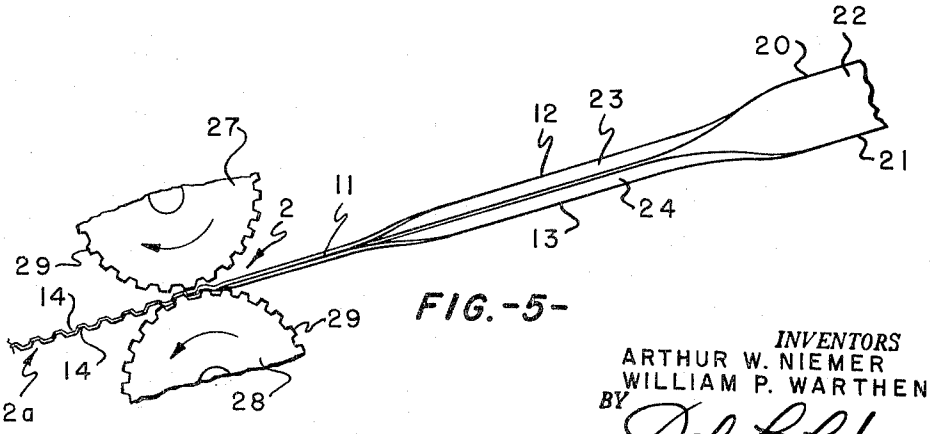


FIG.-5-

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This invention relates to novel knitted fabrics, more particularly to knitted fabrics formed from twistless flat folded paper yarns and having a Venetian blind effect.

Knit paper fabrics formed of twister paper yarn are used in large amounts as shade cloth for crops and as soil erosion fabric. In both these uses, the economical cover from the sun provided by the fabric is the major reason for its use. However, to obtain the desired degree of cover, the yarns must be placed closely together. Because paper yarns are heavier than cotton yarn, this reduces some of the savings realized in using paper yarn an also produces a heavy and bulky fabric. Also, such a dense fabric prevents free circulation of air through the fabric, thus promoting fungus growth and other plant diseases when the fabric is used as ground cover. It would be desirable in these end uses if the fabrics could have a lower yarn count, for reasons of economy and ease of handling and to permit air circulation, while still retaining good cover from the sun.

It has now been found that a knitted paper fabric having these desirable properties can be obtained by knitting the fabric from flat, untwisted folded paper in a manner such that the stitch is elongated in the course direction, so that the yarn in the horizontal legs is substantially parallel from course to course and canted with respect to the face of the fabric and is in a substantially untwisted state in the fabric. Such fabrics produce a Venetian blind effect which provides excellent cover yet permits free circulation of air. The use of flat yarns gives maximum cover per unit weight of yarn and because the yarns are spaced and canted with respect to the face of the fabric, permits air flow while still providing good shielding power from the sun, particularly if the fabric is positioned so that the outer face of the canted yarns in the horizontal legs are as close to 90° as possible with respect to the rays of the sun.

If it is desired to have the yarns in the courses of the fabric parallel to the face of the fabric, rather than canted, so as to increase somewhat cover while decreasing air flow, the knitted fabric can subsequently be passed through pressure or calender rolls to flatten the fabric and bring the yarns in the horizontal legs of the fabric more parallel with respect to the face of the fabric.

Fabrics of this invention and the yarns and the manner of producing the yarns employed to produce these fabrics are illustrated in the accompanying drawings in which:

FIG. 1 is an enlarged plan view of the outer face of a circular knit jersey fabric of this invention;

FIG. 2 is a highly enlarged sectional side view of the fabric shown in FIG. 1 taken along section II—II;

FIG. 3 is an enlarged plan view of the inner face of the same type of fabric as shown in FIG. 1;

FIG. 4 is a highly enlarged perspective view of a short length of crimped yarn useful in forming these novel fabrics; and

FIG. 5 is a schematic view of a method of producing the yarn shown in FIG. 4.

The fabric **1** shown in FIG. 1 is the outer face of a simple jersey, one needle in and one needle out, loose knit construction. The folded flat twistless paper yarn **2** employed in forming the fabric is in a substantially parallel and an untwisted configuration in the horizontal legs **3** of the courses of the fabric so that for the most part the same face **4** of the yarn **2** presents itself from

course to course. The loops **5** of the wales of the fabric are sufficiently large so that these legs **3** are spaced with respect to each other so as to provide an open stitch fabric and so that the yarn in the horizontal legs **3** can follow a relatively straight path between wales. Because of the canting of the yarn **2** in the horizontal legs **3**, one edge **6** of the yarn **2** is also visible in this view.

The canted position of the yarn **2** in the horizontal legs **3** with respect to the face of the fabric **1** is illustrated by the enlarged sectional side view of FIG. 2.

The opposite, i.e., inner, face of a fabric **1***a* of the same type as shown in FIG. 1 is shown in FIG. 3. The opposite face **10** of an untwisted flat folded yarn **2***a* appears in this view and, because of the canting of the yarn **2***a* in the horizontal legs **3**, the opposite edge **11** of the yarn **2***a*, provided by the exterior edges **12** and **13** of the folded panel portions described below, are also visible. In this figure, the optional transverse edge-to-edge creases or crimps **14** of the yarn **2***a* also are illustrated.

The short length of yarn **2***a* is shown in an enlarged manner in FIG. 4 to illustrate in a somewhat exaggerated manner the transverse edge-to-edge creases **14** in its faces which provide the crimps which are preferably present in the yarns forming the fabric of this invention.

A method of producing a flat, untwisted folded yarn employed in the fabric of this invention is shown schematically in FIG. 5. The edges **20** and **21** of a paper strip **22** are folded toward each other into an adjacent but non-overlapping parallel relationship to form two-layered panel portions **23** and **24** having external edges **12** and **13**, respectively. Conventional formers, not shown, can be employed for this purpose. The paneled strip is then folded along its longitudinal center to bring the panel portions **23** and **24** into superimposed relationship so that their external edges **12** and **13**, respectively, meet to form an edge **11** of the resulting folded, flat paper yarn **2**. This yarn **2** can then be crimped with gears **27** and **28**, one or both of which are driven by means not shown, to form a crimped yarn **2***a*. The number and depth of the crimps will depend, of course, upon the number of teeth **29** in and the spacing of gears **27** and **28**.

The single jersey stitch fabrics shown in the drawings can be prepared on simple jersey tubular knitting machines. Employing a tension which will produce about 6 to 8 courses per inch in the relaxed fabric, and a one needle in and one needle out knitting pattern with, about 4 wales per inch in the relaxed fabric produces the desired canted or Venetian blind effect with the yarns in the horizontal legs substantially parallel and untwisted. At the same tension, employing a one needle in and two needle out knitting pattern, an entirely different appearing fabric is produced. The yarn in the horizontal legs appears twisted and are positioned randomly, quite unlike the neat, uniform appearance of the fabrics of this invention. Thus, while it is important that the fabric have stitches elongate in the course direction, the stitch must not be so elongated that the yarn in the horizontal legs is free to rotate about its axis and to bend so as to destroy its parallel relationship. In other words, the selected stitch must impart rigidity to the yarn in the horizontal legs yet be elongate so as to permit the yarn to assume a canted but linear configuration rather than a looped or convoluted configuration. Thus the number of wales and courses per inch, the width of the paper yarn and its weight all influence the type of fabric produced.

The paper strip used to produce the yarns of the fabrics of this invention are generally slit from so-called slitting grade kraft, e.g., 5 to 35 and even up to 50 or higher lbs./ream, preferably about 10–25 lbs./ream. The strip

is preferably about ¼" wide but can vary from about 3/16" to ½". Other papers, with and without wet strength, varying from tissue and onion skin types to rag content bond can also be used.

It is desirable, and sometimes necessary when using wet strength paper or paper of 10 or more pounds per ream, weight, that the paper strip be moist during the formation into yarn. Moisture sufficient to impart a slightly damp but not a wet feel to the paper is ideal and can be obtained by conditioning the paper in a high humidity atmosphere prior to the forming operation. If the paper is in the form of a pancake package, this conditioning can also be achieved by immersing at least the edge portions of the package for a few moments in water, which preferably contains a lubricant such as emulsified polyethylene, or by spraying the edges, and then storing the package for at least several hours in a sealed container, e.g., a polyethylene bag, prior to use to permit the moisture to distribute itself evenly throughout the package. Spraying is preferred for the lighter weight, e.g., 5–15 lbs./ream, papers.

If desired, the forming operation in which the strip is formed into yarn, can be made an integral part of the slitting operation, in which a paper web is slit into strips, by employing a multiplicity of formers and crimping means to accept each end of slit paper as it is formed. In this situation, the paper can be moistened before slitting or after, avoiding such excessive moistening as would cause excessive weakening of the paper.

The yarn used in the fabric of this invention can contain 2, 3, 4, 5, 6 or more layers of folded paper, i.e., by varying the number of times the edge portions **20** and **21** of the strip **22** are folded to produce the panel portions **23** and **24** before the strip is finally folded at its longitudinal center to form the yarn **2** or by varying the manner in which the yarn is folded, e.g., by folding the yarn so that one or both edges of the paper strip is positioned exteriorly rather than interiorly. However, 4 layer yarn as shown in FIGS. 3–5, is preferred because of its greater strength and flexibility.

The yarns used to form the fabrics of this invention preferably are about 1/32"–⅛" wide, more preferably about 1/16" wide and also preferably contain between 10 and 20 transverse edge-to-edge crimps per inch, e.g., as shown in FIGS. 4 and 5. The number of crimps can be varied by varying the number of teeth **29** in gears **27** and **28**. These crimps are important as they impart greater flexibility and elongation to the yarn, as well as retaining the folds. Unfolding of the yarn, particularly those formed of wet strength paper, can be a problem without the crimps. While the crimps shown in the drawings are preferred, the crimps can also be of a diagonal or herringbone type . These crimps are shown in FIGS. 4 and 5 as passing through the yarn **2***a* so that they appear on both face **10** and the opposite face of the yarn. However, when this yarn is knitted into fabric **1***a*, the knitting tensions tend to remove the crimps in the face of the yarn forming the outer face of the fabric, so that the outer face of the resulting fabric tends more to have the appearance of the fabric shown in FIG. 1.

The fabric of this invention is highly decorative and appealing to the eye. Thus, while it is economical enough to be used as ground cover, e.g., for soil erosion control and seeding purposes, and for animal and plant cover from the sun, it can also be used for wall coverings, as the facing for acoustical board, and as window and room screens. In some of these uses, it is useful to coat the fabric with paint for decorative purposes or with a protective coating, e.g., polyethylene film, paint or other waterproof material, when the fabric is to be used for extended periods of time of for exterior purposes. This can be be done after knitting the fabric or before, by applying the coating to the yarn.

What is claimed is:

A knitted fabric formed from folded untwisted flat paper yarn, said paper yarn having multiple edge-to-edge transverse creases therein which impart a crimped configuration thereto when said yarn is in an untensioned state, said knitted fabric having a stitch elongated in the course direction with the yarns in the horizontal legs being substantially untwisted and parallel between wales and canted with respect to the plane of the fabric, thereby imparting a Venetian blind effect thereto.

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