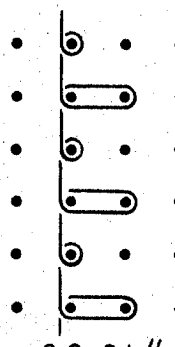
July 8, 1969 W. HEIJ 3,453,844

BULKY WARP-KNIT FABRICS

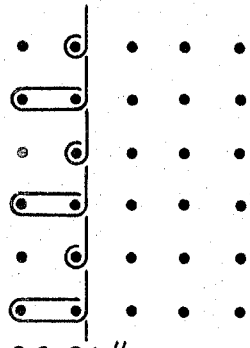
Original Filed Aug. 20, 1965

FIG. 1.



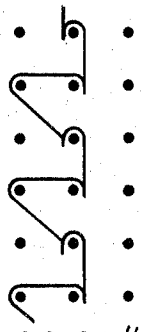
0.2-0.1 //

FIG. 2.



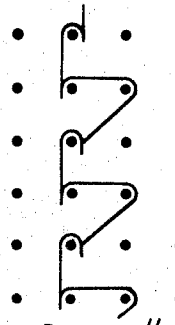
2.0-2.1 //

FIG. 3.



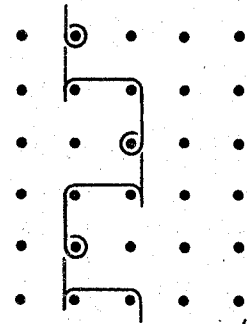
0.2-2.1 //

FIG. 4.



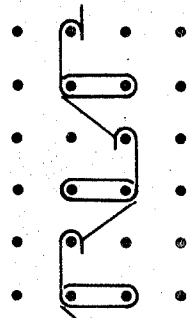
2.0-0.1 //

FIG. 5.



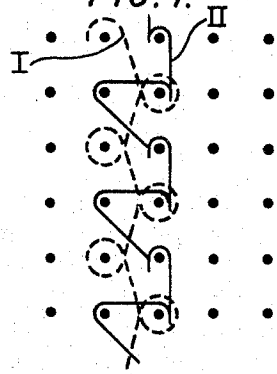
2.0-0.1-0.2-2.1 //

FIG. 6.



0.2-0.1-2.0-2.1 //

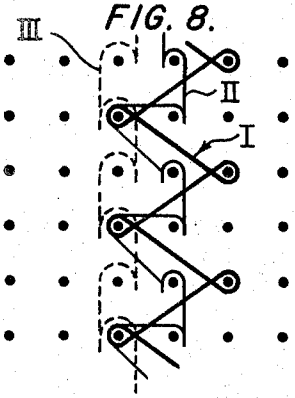
FIG. 7.



I: 1.2-1.0 //

II: 0.2-2.1 //

FIG. 8.

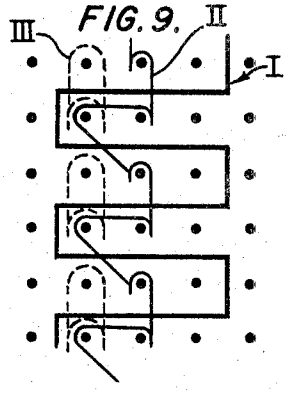


I: 1.0-2.3 //

II: 0.2-2.1 //

III: 1.0-0.1 //

FIG. 9.



I: 0.0-3.3 //

II: 0.2-2.1 //

III: 1.0-0.1 //

INVENTOR

Willem Heij

BY Stevens, Davis, Miller & Mosher

ATTORNEYS

United States Patent Office 3,453,844 Patented July 8, 1969

3,453,844

BULKY WARP-KNIT FABRICS

Willem Heij, Arnhem, Netherlands, assignor to N.V. Onderzoekingsinstituut Research, Arnhem, Netherlands, a corporation of the Netherlands

Continuation of application Ser. No. 481,193, Aug. 20, 1965. This application June 4, 1968, Ser. No. 739,931
Claims priority, application Netherlands, Aug. 27, 1964, 6409907
Int. Cl. D04b 21/14
U.S. Cl. 66—192 8 Claims

ABSTRACT OF THE DISCLOSURE

A bulky warp-knit fabric of smooth filament yarns having at least two yarn sets, the first set forming a random stitch pattern, the second set forming a chain stitch pattern wherein the stitches in successive courses are knit alternately over one and over two needles, with the length of yarn in one set being at least 1.4 times the length of the other yarn set.

This application is a continuation of application Ser. No. 481,193, filed Aug. 20, 1965, now abandoned.

This invention relates to bulky warp-knit fabrics of smooth filament yarns and of at least two yarn systems.

Warp-knit fabrics are mostly manufactured on warp-knitting machines and the yarns of each yarn set are fed to the machine from a separate yarn beam.

To denote the number of yarn sets forming a warp-knit fabric it is usual to refer to the number of yarn beams, and hence to the number of thread guide bars used for the given fabric; for instance: a two-bar warp-knit fabric, a three-bar warp-knit fabric, etc.

To distinguish one yarn set from another they will hereinafter be referred to as a first yarn set, a second yarn set, and a third yarn set, and like distinguishing terms. With the usual two-bar warp-knitting machine the first yarn set generally correspondings to the yarn from a bottom beam and the second set to the yarn from a top beam. With the usual three-bar warp-knitting machine the first yarn set generally corresponds to the yarn from tom beam, the second to that from the middle beam, and the third to that from the top beam.

It will be obvious that in the manufacture of some warp-knit fabric it will generally be possible for the beams to be changed about and obtain the same results, so that for the essence of the invention it does in principle not make any difference from which beams of the knitting machine the yarn set of the warp-knit fabric are supplied. When it is stated hereinafter that a given yarn set is supplied from a gien beam, this is only meant to illustrate the invention and should not be considered to restrict the scope thereof.

The warp knit fabrics according to the invention, which consists of at least two warp yarns or sets, is characterized in that a first yarn set forms a random stitch pattern and a second yarn set forms a chain in which the stitches in successive courses are knit alternately over one and over two needles whereby such stitches in the resultant fabric alternately extend over one and over two wales. Also, the amount of yarn of the second warp yarn set expressed in unit of length is at least 1.4 times that of the first yarn set.

Warp-knit fabrics according to the invention have special properties which render them of special importance to the textile industry. In the tricot industry an increasing use is made of rayon yarn and synthetic yarns made from

polyamides, polyesters and polyacrilonitrile. Warp-knit fabrics made from smooth synthetic filament yarns are generally characterized by a smooth appearance and a harsh handle. In many ways the appearance may be varied, as a result of which the knitwear becomes bulkier. For instance, the yarn may be pre-treated by subjecting it to a box crimping process so that it becomes bulkier. Such bulking processes, however, are very costly.

Alternatively, after-treatments are applied to warp-knit fabrics of smooth yarn for the purpose of giving these fabrics a bulkier appearance. For instance, the knitted article is napped for the purpose of giving it a velour-like appearance. To obtain a cloth having a uniform appearance requires great care so that these after-treatments, too, are very costly.

The warp-knit fabrics according to the present invention are bulky without the need for any after-treatment and they appear as if they were made of spun yarns.

The present invention makes it possible, without costly treatments either before or after the resultant fabric has been knit, to process smooth synthetic filament yarn into bulky knitwear which, as far as properties are concerned, compares with knitwear obtained so far by using as starting material textured yarns or by subjecting knitwear made up of smooth yarns to a napping treatment.

As mentioned before, the warp-knit fabrics according to the invention are made up of a plurality of warp yarn sets, with at least one yarn set forming chain stitches.

In the knitting art, chain stitches are well known. It is also generally known that there are four different types of chain stitch formations; namely an open formation over one needle, a closed formation over one needle, an open formation over two needles, and a closed formation over two needles.

The warp-knit fabrics of the invention are so obtained that in the longitudinal direction of the fabric in at least one warp yarn set successive stitches are formed alternately over one needle and over two needles. The stitches may all or partly be knitted in open or closed formation. Alternatively, the stitches over one needle may be open and those over two needles may be closed, or conversely.

However, preference is given to warp-knit fabrics in which the stitches of the second yarn set are formed in an open chain, since with these fabrics the favorable effect of the invention, namely the bulkiness, is the most pronounced.

The first yarn set and the third and following yarn sets, if any, may be knit in a random pattern.

It has been found, however, that for these yarn sets it is preferred, according to the invention, to use special stitch patterns in some types of warp-knit fabrics.

Thus, it has been found that with warp-knit fabrics consisting of two yarn sets according to the invention the yarn of the first yarn set is knitted to form a tricot fabric, because warp-knit fabrics so made are stabler than fabrics in which the first yarn set is knitted to form a cloth or satin fabric.

According to the invention particularly favorable warp-knit fabrics made up of two yarn sets are those in which the first set forms stitches for a tricot fabric and in which the number of yarns of the first yarn set is twice the number of yarns of the second yarn set. This means that in manufacturing such a warp-knit fabric the yarn is fed through every other eye of the bar for guiding the yarn of the second yarn set.

The above-described two-bar warp-knit fabrics according to the invention are stable bulky materials having a relatively low weight per square meter, which are partic-

ularly suitable for the manufacture of night wear, sports shirts, and the like.

If it is desired to manufacture, in accordance with the invention, materials having a higher weight per square meter, which materials are very suitable for outerwear and particularly for the upholstery of furniture, then three or multi-bar wrap-knit fabrics will be chosen.

It has been found that, with warp-knit fabrics of three yarn sets, various combinations of stitch formations are preferred.

For upholstery purposes very suitable warp-knit fabrics are obtained especially if the yarns of the first set are knit into stitches to form a cloth fabric and the yarns of the third yarn set from a chain stitch pattern over one needle.

A different warp-knit fabric according to the invention, which is preferred because of its high stability, bulkiness, and covering power, is warp-knit fabric of three yarn sets in which the yarns of the first set form inlays over at least two needles, and the yarns of the third yarn set are knit into a stitch pattern the same as the yarns of the second set, but so that forming of chain stitches over two needles of the third set is always one course ahead of the forming of chain stitches over two needles of the second yarn sets.

As is mentioned before, the ratio of the length of yarn of the second yarn set to that of the first yarn set must be at least 1.4:1. If this ratio is less than 1.4:1, the effect produced by the present invention is rarely obtained. To obtain a pronounced bulkiness, the ratio will generally be higher than 1.4:1, for instance 1.8:1 or 2.0:1.

The above ratio cannot be increased indefinitely, because at a given value thereof the yarn to be worked up can no longer be properly knitted on the usual knitting machines. Without making special provisions it will generally not be possible for the selected ratio to be higher than about 2.60:1. The effects produced in the case of the warp-knit fabrics according to the invention, namely, softness, bulkiness, and pleasant handle, are dependent on the stitch pattern selected and on the magnitude of yarn ratio.

When the yarns of the first yarn set are formed into stitches to produce a tricot fabric and those of the second yarn set alternately into chain stitches over one needle end and into chain stitches over two needles the particularly attractive warp-knit fabrics are obtained if the ratio is 1.8:1.

In the manufacture of warp-knit fabrics the ratio of the amount of yarn of the second set to that of the first set, which in the case of the warp-knit fabrics according to the invention must be at least 1.4:1, may be set in a simple manner by controlling the rate at which the yarn is fed to the knitting machine. With the modern knitting machines said feed rate may generally be set by controlling the speed of the positively driven yarn beams. With some of the older types of machines, which are not provided with positively driven yarn beams, special provisions are required to control the yarn supply.

Warp-knit fabrics according to the invention may be made of smooth filament yarns of a widely differing nature. Examples of suitable yarns are: dulled or nondulled, colored or noncolored rayon yarns, or yarns from polyamides such as nylon 6, polyesters such as polyethylene terephthalate, polyolefines such as polypropylene, polyethers such as poly(2,6-dimethylphenyleneoxide), and other thread-forming polymers which are already known.

The yarns may be free of twist, or have a low or a high degree of twist. Their number of component filaments and their deniers may vary widely. It will be clear that the yarns of warp-knit fabrics for upholstery purposes will have a higher denier than the yarns of warp-knit fabrics meant for clothing.

A yarn which is very suitable for the manufacture of warp-knit fabrics according to the invention is, for instance, a nylon 6 filament yarn which is dull (containing 2% by weight of titanium dioxide), has a draw-twist of about 20 turns per metre, a denier of 40, and is composed of 10 filaments.

The figures schematically show a variety of stitch formations for warp-knit fabrics according to the invention as these formations are illustrated in the relevant literature. Moreover, below each figure there is the point diagram used in the present art to indicate the selected stitch formation.

FIGURE 1 represents the stitch formation of the second yarn set with a warp-knit fabric in which this second yarn set forms stitches in a closed chain alternately over one and over two needles;

FIGURE 2 shows the same construction as FIGURE 1, except that the stitches are laid in opposite direction;

FIGURE 3 shows a stitch pattern which is formed when the stitches are laid in an open chain alternately over one and over two needles;

FIGURE 4 shows the same construction as FIGURE 3, except that the stitches are laid in opposite direction;

FIGURE 5 shows the stitch pattern formed when the stitches are made alternately in a closed chain over one needle and in an open chain over two needles;

FIGURE 6 shows the stitch pattern formed when the stitches are made alternately in an open chain over one needle and a closed chain over two needles;

FIGURE 7 shows the stitch pattern for a warp-knit fabric of two yarn sets I and II, in which the stitches of set II are identical with those in FIGURE 3, and yarn set I forms stitches for a tricot fabric;

FIGURE 8 shows the stitch pattern for a warp-knit fabric of three yarn sets I, II, III, in which the stitches of set II are identical with those in FIGURE 3, the yarns of set I form stitches for a cloth fabric and the yarns of system III form stitches in an open chain over one needle; and,

FIGURE 9 also shows the stitch pattern for a warp-knit fabric of three yarn sets I, II, III, in which sets II and III form the same stitch patterns as in FIGURE 8, and the yarns of the yarn set I form inlays over three needles.

EXAMPLE I

A two-bar warp-knit fabric is made in which the yarn from one beam is knitted into stitches of the type indicated by I in FIGURE 8 and the yarn of the other beam is knitted into stitches of the type indicated by II in FIGURE 8.

The ratio of the length of the yarn knitted into stitches indicated by II to that of the yarn knitted into stitches indicated by I is varied and it is found that the quality of the warp-knit fabric obtained is dependent on said ratio.

The yarn feed ratio of I is kept constant.

Ratio II/I:	Warp-knit fabric obtained
(a) 0.94:1 ____.	Smooth, harsh, nonvoluminous.
(b) 1.48:1 ____	Softer and somewhat thicker than (a).
(c) 1.68:1 ____.	
(d) 1.85:1 ____	Bulkiness increased.
(e) 2.01:1 ____.	Gives a very attractive regular cloth;
(f) 2.15:1 ____.	
(g) 2.31:1 ____	
(h) 2.37:1 ____.	
(i) 2.59:1 _____	Is very bulky but somewhat irregular; knitting is attended with difficulties because of the high rate at which yarn is supplied from beam II.

EXAMPLE II

A three-bar warp-knit fabric is made in accordance with the stitch pattern of FIGURE 8. The relative yarn feed rates of the three yarn sets I, II, and III are varied but so that the feed rate of I is kept constant.

The results obtained are as follows:

Ratio Feed rates: I II III	Warp-knit fabric obtained
(k) 1:0.94:0.67	Smooth and harsh fabric.
(l) 1:1.53:0.77	Somewhat softer and thicker than (k).
(m) 1:1.64:0.76	Softer than (l).
(n) 1:1.73:0.77	Very attractive and soft bulky fabric.
(o) 1:1.87:0.77	Very bulky fabric; but some knitting difficulties.

The above examples show that if the afore-mentioned conditions are satisfied, attractive bulky warp-knit fabrics may be obtained.

If the above-mentioned ratio is lower than 1.40:1, no bulky fabric is obtained. If this ratio does have the desired value but no use is made of a yarn set forming chain stitches alternately over one and over two needles, the products obtained have no stability, are irregular, and of no value. To produce the effect of the invention it is essential that the above-described stitch pattern should be combined with the said ratio of yarn lengths.

I claim:

1. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from at least a first and second set of yarns, said first set having a stitch construction of 0–2, 0–1, said second set having the same stitch construction as said first set only in the opposite direction, the yarns of said second set being knit such that the amount of yarn of said second set, expressed in units of length, is at least 1.4 to 1.8 times that of said first set.

2. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from at least a first and second set of yarns, said first set having a stitch construction of 0.2, 2–1, said second set having the same stitch construction as said first set only in the opposite direction, the yarns of said second set being knit such that the amount of yarn of said second set, expressed in units of length, is at least 1.4 to 1.8 times that of said first set.

3. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from at least a first and second set of yarns, said first set having a stitch construction of 2–0, 0–1, 0–2, 2–1, said second set having the same stitch construction as said first set only in the opposite direction, the yarns of said second set being knit such that the amount of yarn of said second set, expressed in units of length, is at least 1.4 to 1.8 times that of said first set.

4. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from at least a first and second set of yarns, said first set having a stitch construction of 0–2, 0–1, 2–0, 2–1, said second set having the same stitch construction as said first set only in the opposite direction, the yarns of said second set being knit such that the amount of yarn of said second set, expressed in units of length, is at least 1.4 to 1.8 times that of said first set.

5. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from at least a first and second set of yarns, said first set having a stitch construction of 1–2, 1–0, said second set having a stitch construction of 0–2, 2–1, the yarns of said second set being knit such that the amount of yarn of said second set, expressed in units of length, is at least 1.4 to 1.8 times that of said first set.

6. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from at least a first and second set of yarns, said first set having a stitch construction of 1–0, 2–3, said second set having a stitch construction of 0–2, 2–1, the yarns of said second set expressed in units of length being at least 1.4 to 1.8 times that of said first set.

7. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from three sets of yarns, the first set having a stitch construction of 0.0–3.3, the second set having a stitch construction of 0.2–2.1 and the third set having a stitch construction of 1.0–0.1, the yarns of said second set expressed in units of length being at least 1.4 times that of said first set.

8. A warp knit fabric having a bulky appearance, said fabric being knitted of smooth filament yarns and formed from three sets of yarns, the first set having a stitch construction of 1.0–2.3, the second set having a stitch construction of 0.2–2.1 and the third set having a stitch construction of 1.0–0.1, the yarns of said second set expressed in units of length being at least 1.4 times that of said first set.

References Cited

UNITED STATES PATENTS

577,702	2/1897	Woodcock	66—193
1,993,766	3/1935	Welch et al.	66—195
2,535,376	12/1950	Thompson	66—195 X
2,674,109	4/1954	Bassist	66—86
2,818,713	1/1958	Porter	66—86
2,996,906	8/1961	Ichibe	66—201
2,985,002	5/1961	Aibel	66—195
3,036,448	5/1962	Cundeff	66—86
3,222,893	12/1965	Busch et al.	66—192
3,254,510	6/1966	Lesby	66—191 X

OTHER REFERENCES

Press, J. J.: Man-Made Textile Encyclopedia, New York Textile Book Pub., 1949, p. 891 (Glossary).

RONALD FELDBAUM, *Primary Examiner.*