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## PATTERNED FABRICS HAVING RELIEF PATTERNS AND METHOD OF PRODUCING THE SAME

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### ABSTRACT OF THE DISCLOSURE

Patterned fabrics having relief patterns consisting of at least two types of yarn each having a different shrinkability and different dye affinity, the less shrinkable yarn forming the relief pattern while the more shrinkable yarn forms the base or ground of the fabric.

This invention relates to patterned fabrics particularly knitted fabrics provided with relief patterns and to a method of making the same. More particularly this invention relates to patterned fabrics having at least two color relief patterns.

Relief patterned and differently colored fabrics are known in the textile industry and have heretofore been produced by knitting and in particular by weft knitting or warp knitting, their relief patterns being obtained for example, in the process of stitch formation by making the lengths of the sinker loops on relief pattern forming threads different from those of sinker loops of threads constituting the fabric base or ground.

According to another known method, the relief effect of the pattern has been produced by the combination of rib courses and plain courses interlocked according to a given design. The difference between the height of the relief effect and the ground depends on the difference in the length of the aforesaid sinker loops forming the rib and plain stitches respectively.

One of the disadvantages of relief patterns which have been made in this manner lies in that when knitting the individual wales forming the relief pattern, the long sinker loops which project out from the pattern are frequently prone to damaging the fabric during the manipulation and subsequent finishing steps thereof. A further disadvantage of this method of producing relief patterned fabric consists in the tedious, time consuming preparation of the conventional and/or synthetic yarns involved. The synthetic yarns are usually textured and have to be predyed in order to produce color patterns therefrom as it is not possible to produce fabrics from the undyed yarns and to then subject them to piece-dyeing for obtaining multi-color effects. Finally, it is necessary to use for forming the rib stitches particularly high grade and therefore expensive yarns or textured yarns if expressive relief effects are to be produced. Still further the output of the machines involved is relatively low since in producing relief patterns according to the known methods one rib course and two plain courses usually alternate so that the output of the machine having 36 feeders amounts to 12 courses per revolution.

The coloration of the relief patterned knitted fabric prepared by the known processes is accomplished by the coloration of the respective binding yarns it having been found desirable that the shrinkability of the relief pattern forming yarns and that of the yarns forming the fabric ground be the same or at least approximately similar.

The patterning is obtained by the well known methods of knitting wherein two or more types of yarn are used varying in dye affinity.

The dyeing of relief patterned knitted fabrics has heretofore been carried out using separate dyeing procedures.

It is an object of the instant invention to provide patterned fabrics having relief patterns while avoiding the aforementioned disadvantages of the prior art.

It is another object of the invention to provide a method of producing knitted fabrics having improved relief pattern effects enabling simpler dyeing processes to be used.

Still another object of the invention is to provide a method of producing knitted fabrics having a relief pattern permitting higher productivity to be obtained.

Yet another object of the invention is to provide such a method where new and improved results in the production of patterned fabrics and especially of knitted fabrics can be realized.

In accordance with the invention the above and other objects and advantages are realized by providing a relief patterned fabric consisting of at least two yarn types each having a different shrinkability as well as a different dye affinity, the less shrinkable yarns forming the relief pattern and those of higher shrinkability forming the ground of the fabric. The difference in shrinkability between the two types of yarns amounts most advantageously in accordance with the invention to at least 15%.

As instances of the more shrinkable yarns which can be used in the invention there may be mentioned yarns containing filaments or staple fibers prepared from co-polyesters of polyethylene terephthalate and polyethylene isophthalate. The less shrinkable yarns are preferably mechanically textured synthetic filament yarns. The less shrinkable yarns are dyeable at temperatures up to the shrinkage temperature of the more shrinkable yarns by other dyestuff groups than those associated with the dyeing of the more shrinkable yarns.

The method in accordance with the invention for producing relief patterned fabrics consists in producing a patterned fabric from at least two different types of yarn each having a different shrinkability as well as a different dye affinity, subjecting the resultant fabric simultaneously or in sequence to a thermal treatment and a dyeing procedure in a dyeing bath having a substantially different affinity for one of the types of yarn forming the fabric, the more shrinkable yarns which form the ground of the patterned fabric shrinking to a greater extent and thereby increasing the relief effect of the pattern made of the less shrinkable yarn whereby there is realized an at least two color effect. The shrinkage of the fabric can be preferably carried out in a dyeing bath having a marked affinity for the less shrinkable yarns which form the relief pattern.

Further advantages and characteristics of the invention will become apparent from the following more detailed description of the invention.

A knitted fabric having a relief pattern in accordance with the invention is made for example on a Jacquard weft knitting machine, the more shrinkable yarns being used for knitting the rib courses while the less shrinkable yarns are used for knitting the plain courses forming the relief pattern, the difference in shrinkability between the two different types of yarn amounting to at least 15%. The knitted fabric is made of an undyed material, the ground yarns, i.e., the more shrinkable yarns consisting of filament or synthetic spun yarns containing as shrinkable component copolyester fibers prepared from polyethylene terephthalate and polyethylene isophthalate or of shrinkable fibers base on polyacrylonitrile, polyvinyl chloride, polypropylene and the like.

The shrinkage and the imparting of an at least two color dyeing to the knitted fabric is carried out in the wet state by heating the fabric in a dyeing bath having an affinity for only one of the types of yarn forming the fabric. In this manner there is realized, on the one hand, a shrinkage of the more shrinkable yarn forming the ground of knitted fabric and thus an increased relief effect of the pattern formed from the less shrinkable yarns, and on the other hand, a coloration of the yarn type which is dyeable in the said dye bath within the range of its active temperature. The latter type of yarn can be constituted by the pattern forming yarn, i.e., the less shrinkable yarn. However, the use of the more shrinkable yarn for this purpose is not excluded. By the shrinking of the ground of the fabric and especially of a knitted fabric there is obtained or even increased the relief effect of the pattern made from low shrinking or non-shrinking binding yarn of up to 20-30% in comparison with the heretofore known techniques. There is also obtained an at least two color effect of the fabric by using a shrinking and simultaneous dyeing bath having an increased affinity for one of the types of binding yarn.

If the affinity of the dyeing and shrinking bath is increased particularly with respect to the pattern forming or less shrinkable yarn, the relief pattern becomes not only more obvious as hereinabove set forth but differs moreover in color from the shrunk threads forming the fabric ground.

If the method of the invention is utilized in connection with the above described knitting machines having 36 feeders, it is possible by using materials with different shrinkabilities to obtain a relief pattern with an alternating one rib course and one plain course in the fabric, the output of the machines thereby being increased to 18 courses per revolution, i.e., by more than 1/2 as compared with the usual method of knitting one rib course and two patterned plain courses.

In addition it is possible to increase the height of the relief pattern by up to 50%.

For these reasons the method of the invention for producing at least two color relief patterned fabrics from the point of view of both quality and output are more advantageous than any of the heretofore known combinations of materials or techniques. The considerably simplified method according to the invention makes it possible in a single operation to obtain an excellent relief effect which is apparent after shrinking on the face of the fabric together with the simultaneous or eventual different coloration of the corresponding binding threads forming the pattern.

By shrinking the more shrinkable yarn forming the ground of the weft knitted fabric, the extensibility of the fabric is reduced. This reduction of extensibility is proportional to the difference in shrinkability between the binding yarns involved. The results of tests carried out by applicants have proved that it is possible to obtain in this way an extensibility of knitted fabrics similar to that obtained with warp knitted fabric but whose performance when the fabrics are manufactured in accordance with the invention is much more satisfactory because its drape has not been impaired. This latter feature is very important for certain types of fabric and especially in connection with fabrics intended for outer wear. Further advantageous effects are due to the considerable weight proportion of non-shrinkable binding threads in the knitted fabric, the shrink resistance of these binding threads rendering the relief pattern on the face side more marked.

It is to be understood that instead of two yarn types each having a different shrinkability there can be used a combination of non-shrinkable and shrinkable yarn. Further the knitted fabric can be produced as a patterned single jersey fabric using the same method. Still further it is possible to use more than two types of yarn each having a different shrinkability and possibly each having a different dye capacity.

The following examples are given from more fully illustrating the invention but are in no way to be construed as a limitation of the scope thereof.

#### EXAMPLE 1

There was used in this case for the production of a knitted fabric having a colored relief pattern a Jacquard knitting machine ODZI provided with pattern wheels,  $\phi 36$ , 7", gg. 18" and 36 feeders. The material for the rib courses was a yarn Nm 48 consisting of 40% of Velana, i.e., copolyester fiber based on polyethylene terephthalate and polyethylene isophthalate and 60% of Tesil 31, i.e., a copolyester fiber and the material for the plain courses was a polyamide textured yarn Td 120.

#### FINISHING

Shrinkage: Steaming for 30-60 seconds or 10 minutes shrinking at boil. The shrinking can also be carried out in the dyeing bath during the dyeing process.

Scouring: For 30 minutes in a bath containing 0.2 g./l. of Slovaton, (manufacturer's mark for non-ionic ethylene oxide condensate) and 3 g./l. of sodium carbonate at a temperature of 60° C., or at boil.

Dyeing: 0.1 g./l. of Sovaton, trademark of National Enterprise, Novaky, Czechoslovakia

2% of Neckal BX, manufactured by Spolek pro chemickou a hutni výrobu Usti nad Labem, Czechoslovakia (a sodium dibutyl-naphthalenesulfonate), formic acid, pH 4-5, 3-5% of a dyestuff.

The starting temperature of 40° C. was slowly increased to the boiling point of the bath and after 1-1.5 hours slowly reduced. The fabric was thereafter rinsed in warm and cold water.

Softening: 1 g./l. of Synthamin KX manufactured by Spolek pro chemickou a hutni výrobu Usti nad Labem, Czechoslovakia (a cationic lubricating and softening agent) 20 minutes at 30-40° C.

Hydroextracting: Slight

Drying: To 100° C., or heat-setting at 190° C. for 30 to 60 seconds.

#### EXAMPLE 2

There was used for the production of a knitted fabric having a color relief pattern a knitting machine METO, 32", gg. 20" and 44 feeders. The material for forming the rib courses was a Nm 48 yarn containing 40% of Velana S manufactured by Silon National Enterprise, Plana, Czechoslovakia, i.e., copolyester fiber formed from polyethylene terephthalate and polyethylene isophthalate, and 60% of Velana N manufactured by Silon National Enterprise, Plana, Czechoslovakia, i.e., a non-shrinkable copolyester fiber, and for the plain course there was used a polyamide textured yarn, Td 120.

Finishing:

Shrinking: as described in Example 1

Heat-setting: 30-60 seconds at 190° C.

Dyeing: as described in Example 1

Softening: as described in Example 1

Hydroextracting: as described in Example 1

Drying: to 100° C.

#### EXAMPLE 3

There was used for the production of a knitted fabric having a colored relief pattern a Jacquard knitting machine ODZI provided with pattern wheels  $\phi 36$ , 7", gg. 18" and 36 feeders. As material for forming the rib courses there was used a yarn Nm 50 containing 67% of Tesil manufactured by Silon National Enterprise, Plana, Czechoslovakia, and 33% of cotton and for forming the plain courses there was used a yarn Nm 50 containing 40% of Velana S (a copolyester fiber based on polyethylene terephthalate and polyethylene isophthalate) and 60%

of Tesil 31 or a highly extensible textured polyamide yarn, Td 120 (Titer-denier).

Finishing:

- Shrinking: as described in Example 1
- Heat-setting: 30-60 seconds at 190° C.
- Dyeing: as described in Example 1
- Softening: as described in Example 1
- Hydroextracting: as described in Example 1
- Drying: to 100° C.

EXAMPLE 4

For the production of a knitted fabric having a colored relief pattern there was used a raschel machine, gg 24 sax. The knitted fabric was made by using two or more yarn systems, some of which contained Nm 48 x 2 yarn consisting of 40% Velana S (a copolyester fiber based on polyethylene terephthalate and polyethylene isophthalate) and 60% of Tesil 31, and the other containing a textured yarn Td 120 formed from polyamide, polyester, or polypropylene.

Finishing:

- Shrinking: as described in Example 1
- Heat-setting: 30-60 seconds at 190° C.
- Dyeing: as described in Example 1
- Softening: as described in Example 1
- Hydroextracting: as described in Example 1
- Drying: 100° C.

EXAMPLE 5

There was used for producing a knitted fabric having a colored relief pattern a Jacquard knitting machine ODZI provided with pattern wheels, gg. 18". As material for the rib courses a yarn Nm 60 was used, containing 40% Velana S, i.e., copolyester fiber based on polyethylene terephthalate and polyethylene isophthalate, and 60% of Velana N, i.e., non-shrinkable polyester fiber, and for the plain courses a textured polyester yarn, Td 150.

Finishing:

- Shrinking: as described in Example 1
- Heat-setting: 30-60 seconds at 190° C.
- Dyeing: as described in Example 1
- Softening: as described in Example 1
- Hydroextracting: as described in Example 1
- Drying: to 100° C.

We claim:

1. A shrunk and dyed knitted fabric, the said fabric being composed of interlooped rib courses and plain courses of yarns arranged in a relief pattern, the yarns of each course having different heat-shrinkability characteristics, different affinity for particular dyes, and being shrunk to different lengths, so that the less-shrinkable yarns form a relief pattern having a first color and the more-shrinkable yarns form a base for the relief pattern and have a different second color.
2. A patterned fabric according to claim 1 wherein the difference in shrinkability between the yarns of the two different systems amounts to at least 15%.
3. A patterned fabric according to claim 1 wherein the more shrinkable yarns contain filaments or staple fibers prepared from copolyesters of polyethylene terephthalate and polyethylene isophthalate.
4. A patterned fabric according to claim 1 wherein said less shrinkable yarn is a synthetic yarn.
5. A patterned fabric according to claim 4 wherein said shrinkable yarn is a textured yarn.
6. A patterned fabric according to claim 1 wherein said less shrinkable yarn is dyeable up to a shrinkage temperature of the more shrinkable yarn by other dyes than are required for dyeing the more shrinkable yarn.

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