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(19)

(54) ARTICLES OF KNITTED FOOTWEAR

(71) We, H. FLANDERS & COMPANY LIMITED, a British Company, of Day's Lane, Belper, Derbyshire, DE5 1NQ and Channel Islands Knitwear Company Limited, a British Company, of Route Bounllion, St Helier, Jersey, Channel Islands, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to knitted articles of footwear and, in particular, the production of such articles having considerable stretch properties.

Hitherto it has been mainly common practice to produce knitted articles of footwear from natural yarns. Since natural yarns have limited stretch properties, one disadvantage of an article of footwear knitted therefrom is that with conventional stitch formations it has a limited degree of stretch in a walewise direction. Accordingly, it has been necessary for retailers to stock a plurality of sizes of footwear articles, each corresponding with a different foot size.

The invention seeks to provide an article of footwear knitted from a so-called non-stretch yarn, at least the foot portion of the article having appreciable stretch in both a walewise and a coursewise direction.

By the term non-stretch yarn is meant a yarn with less than about 9% elastic recovery, i.e. a non-stretch yarn stretched to an extent greater than about 9% will either:-

(a) break, or

(b) not return to its original length and will thus be extended permanently.

In the case of wool the elastic recovery is about 9% whereas in the case of cotton it is about 5%.

In accordance with the present invention there is provided a knitted article of footwear knitted from a non-stretch yarn in which at least the foot portion of the article has a structure composed of a first section comprising at lease one course of outward facing stitches, a second section comprising at least one course having a plurality of inward facing stitches interspersed with a predetermined number of outward facing stitches, a third section comprising at least one course of outward facing stitches and a fourth section comprising at least one course having a plurality of inward facing stitches interspersed with a predetermined number of outward facing stitches, the outward facing stitches in the fourth section being offset symmetrically coursewise with respect to the outward facing stitches in the second section.

It is preferred that the yarn is of a natural fibre such as wool or cotton, but a blend of natural and synthetic fibres may be used the blend incorporating at least 85% of natural fibres.

The following description will refer to the case where the knitted article of footwear is a half-hose. It is to be understood, however, that the invention applies equally to socks, stockings, three-quarter hose and like knitted foot coverings.

A half-hose in accordance with the invention may be knitted on a double needle-cylinder, circular knitting machine having a links-links pattern drum, such for example as a Bentley Komet (Registered Trade Mark) C.P. Machine. A conventional links-links machine has two needle beds with one set of double ended needles transferable from one bed to the other, the machine cams acting indirectly on the needles through transfer jacks or sliders.

Knitting commences at the leg opening with several courses of rib knitting, the rib stitching being stretchable laterally to enable a completed half-hose to grip the leg of the wearer. Conveniently, the rib knitting is of a 1 x 1 rib formation which is achieved in known manner by knitting on needles in

both cylinders.

The leg portion of the half-hose is then knitted and has a stitch formation which may be rib or plain. Alternatively the leg portion may have the same stitch structure as the foot portion and as described hereinabove. Where the leg portion is composed of plain or rib stitches interspersed with purl stitches, then the leg portion of the half-hose is stretchable walewise, i.e. in a longitudinal direction, by virtue of the incorporation of the purl stitches.

The heel pouch which consists of plain stitches is formed by reciprocating knitting on substantially half the needles in the bottom needle cylinder following completion of the leg portion. Thereafter the foot portion of the half-hose is knitted. The stitch structure of the foot portion is such as to permit both walewise and coursewise stretching.

In the preferred embodiment of the invention the stitch structure of the foot portion comprises stitches knitted on both needle cylinders of the knitting machine, the stitches comprising 37.5% inward facing and 62.5% outward facing stitches knitted on selected needles in the top and bottom needle cylinders and thus in selected wales and courses. It has been found that this stitch structure permits both walewise and coursewise stretching of the knitted structure so that the foot portion of the completed article can expand both peripherally and longitudinally to accommodate both the cross-section of the foot and the length of the foot of a wearer.

Other stitch configurations of inward facing stitches and outward facing stitches which have been tested include respectively 25%/75%, 30%/70%, 33%/67% and 40%/60%. The interspersed inward facing stitches may be in regions of different dimensions. Thus, for example, 50% inward facing stitching may be achieved in a plurality of regions of small dimensions or, alternatively, in a lesser number of regions of larger dimensions.

Finally, the toe pouch is knitted like the heel pouch, and the toe opening subsequently closed by linking on a linking machine by running the loops of knitted fabric onto a series of points, these loops being connected by means of a single or a double chain of loops, or by other toe closing means on the machine.

The invention will now be described further by way of example with reference to the accompanying drawings in which:-

Fig. 1 is a loop diagram of one knitted fabric of the foot portion of an article of footwear embodying the invention.

Fig. 2 shows the pattern of plain or rib stitches for one fabric used in the foot portion of a knitted article of footwear, and

Figs. 3, 4 and 5 illustrate the knitting of the fabric shown upon a double cylinder axially-opposed circular knitting machine.

In the drawing a sample fabric area is shown in dotted outline.

The top two knitted courses numbered 1 and 2 within the dotted area are of outward facing stitches. The following two courses (3,4) are mainly of inward facing stitches but with every fourth stitch 12 a outward facing stitch, the inward facing stitches in courses 3 and 4 being in the same wales. The knitting pattern is then repeated since the following two courses (5,6) are of outward facing stitches followed by two courses (7,8) again mainly of inward facing stitches but with the fourth stitches in the course being outward facing stitches 12 and the outward facing stitches in adjoining courses being connected waleswise. It will be seen that the outward facing stitching in courses 3 and 4 lie in different wales which are offset from the outward facing stitching in courses 7 and 8.

It has been found that the stitch configuration illustrated enables the fabric to stretch both in a coursewise and a walewise direction. Hence, as applied to knitted articles of footwear, the foot portion can stretch both peripherally and longitudinally. These stretch properties can be utilised by producing a single size of knitted footwear for a range of foot sizes, the footwear stretching to the extent necessary to accommodate the feet of a particular wearer.

An important advantage provided by the invention is that a single size of footwear can be provided for example for all adult males which means that a retailer no longer needs to stock a large range of different footwear sizes.

It will be understood that the invention is not restricted to the particular configuration illustrated in Fig. 1. Fig. 2 shows a sample fabric area of eight courses, knitted on twenty four needles. The unshaded areas represent zones of outward facing stitches, and the shaded areas zones of inward facing stitching. The fabric has 37.5% inward facing stitches and 62.5% of outward facing stitches.

Referring now to Figs 3, 4 and 5, part of the needle cylinders of a double cylinder axially-opposed circular knitting machine are designated 20 and 22. Both needle cylinders are axially tricked and each trick includes a latch needle in known manner. The opposed needles in the two cylinders are numbered 1 to 17 for the sake of simplicity of explanation.

The knitting machine has two feeders so that for each needle selection two identical courses of knitted fabric are produced. Clearly, if a single feeder was used only a single course would be produced for each needle selection.

COURSES 1 and 2

As may be seen from Fig 3 all the needles are placed in the bottom needle cylinder 20 and courses 1 and 2 of outward facing stitches produced.

COURSES 3 and 4

Three needles out of every four are selected by a suitable known needle selection apparatus and the selected needles transferred to the top cylinder 22. Referring to Fig. 4, it will be seen that needles 1, 5, 9, 13 and 17 are retained in the bottom cylinder to knit outward facing stitches while needles 2,3,4 - 6,7,8 - 10,11,12 etc. are transferred to the top cylinder and knit inward facing stitches. Needle transfer to the top needle cylinder is achieved by the provision of suitable cams on the machine cambox.

COURSES 5 and 6

At the start of these courses all needles are again transferred to the bottom needle cylinder and two courses of outward facing stitches knitted.

COURSES 7 and 8

These courses are similar to courses 3 and 4 in construction in that three needles out of every four are selected and transferred to the top needle cylinder. Thus, needles 1, 2 - 4, 5, 6, - 8, 9, 10 - 12, 13, 14, - 16, 17 are transferred to the top cylinder to knit inward facing stitches whereas needles 3, 7, 11 and 15 are retained in the bottom needle cylinder to knit outward facing stitches. Needle transfer is achieved by the provision of suitable cams on the machine cambox.

It will be seen that the outward facing stitches knitted upon needles 3, 7, 11 and 15 in courses 7 and 8 are displaced symmetrically coursewise by two wales relative to the outward facing stitches knitted upon needles 1, 5, 9, 13 and 17 in courses 3 and 4.

It is to be understood that the invention is not restricted to the production of knitted articles of footwear produced on a double cylinder knitting machine since a cylinder and dial machine for example could be used.

WHAT WE CLAIM IS:

1. A knitted article of footwear knitted from a non-stretch yarn in which at least the foot portion of the article has a structure composed of a first section comprising at least one course of outward facing stitches, a second section comprising at least one course having a plurality of inward facing stitches interspersed with a predetermined number of outward facing stitches, a third section comprising at least one course of outward facing stitches and a fourth section comprising at least one course having a plurality of inward facing stitches interspersed with a predetermined number of outward facing stitches, the outward facing stitches in the fourth section being offset symmetrically coursewise with respect to the outward facing stitches in the second section.

2. An article as claimed in Claim 1 in which the knitted structure comprises at least 25% inward facing stitches and 75% or the balance in outward facing stitches in selected wales and courses.

3. An article as claimed in Claim 1 or 2 in which the knitted structure comprises 37.5% inward facing stitches and 62.5% outward facing stitches.

4. An article as claimed in 1, 2 or 3 in which the yarn is a natural one such as wool or cotton.

5. An article as claimed in any one of Claims 1 to 4 in which the yarn is a blend composed of natural and synthetic fibres incorporating at least 85% of natural fibres.

6. An article as claimed in any one of claims 1 to 5 which is capable of sufficient stretching to accommodate a range of wearer feet sizes.

7. A knitted article of footwear knitted from non-stretch yarn and having a loop structure substantially as herein described with reference to and as illustrated in the accompanying drawings.

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5 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

FIG. 1

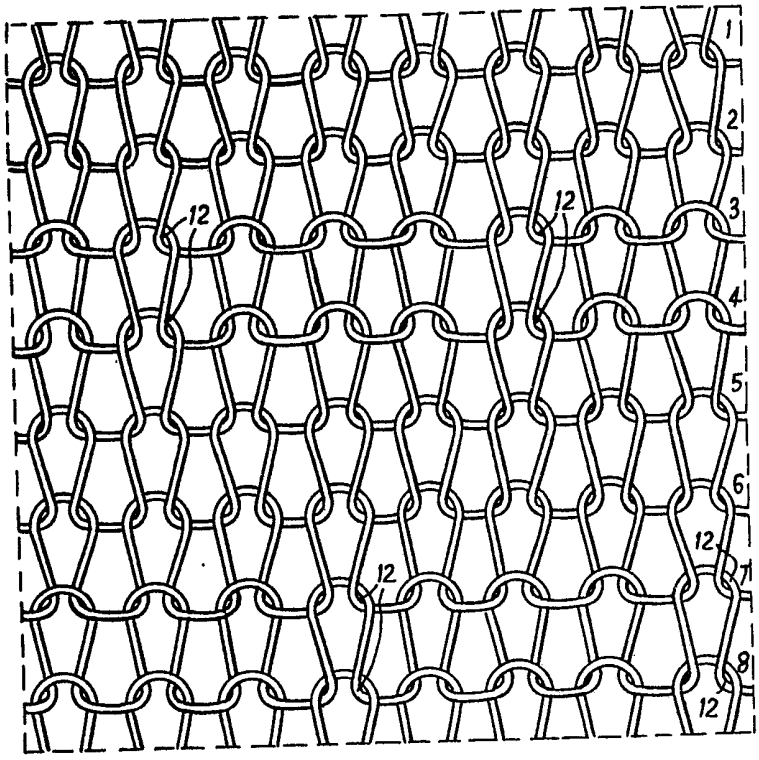

FIG. 2

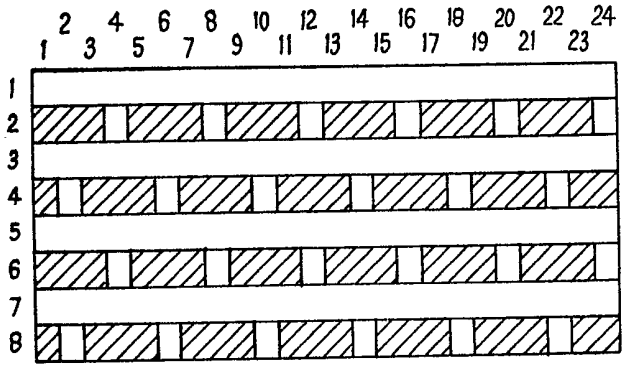

FIG. 3

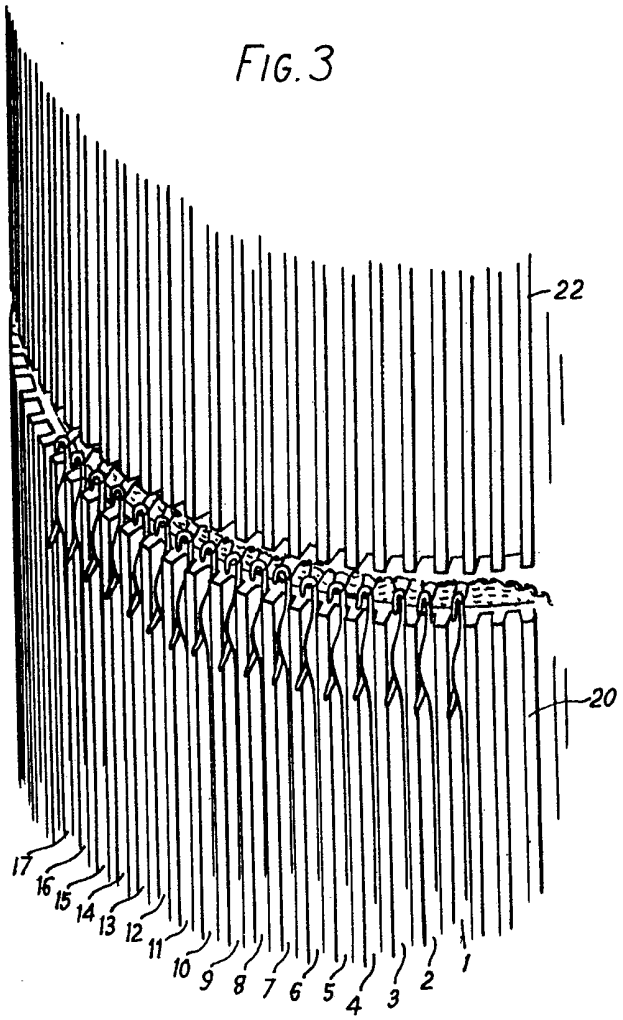

FIG. 4

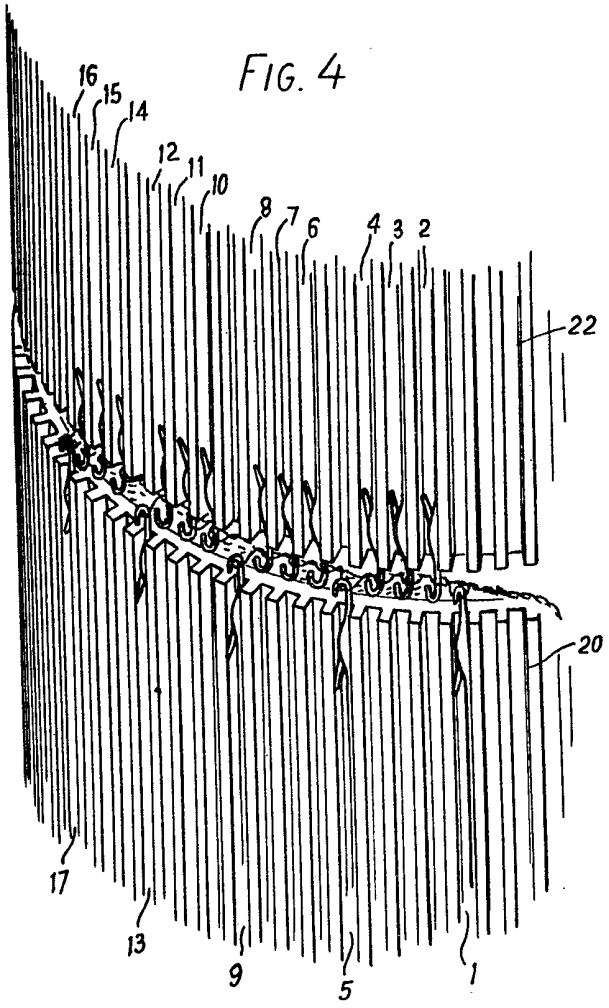

FIG. 5