(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 421 041 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **89830429.0**

(51) Int. Cl.[5]: **D04B 1/00**

(22) Date of filing: **05.10.89**

(43) Date of publication of application:
10.04.91 Bulletin 91/15

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

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(54) A double-faced knitted fabric and manufacturing process.

(57) A double-faced weft knitted fabric comprises pairs of connecting lines; a first line forms tucks on alternate off-set stitches on one face and the other; a second connecting line, generally spaced from the first by at least one stitch line on each face, engages alternate, off-set stitches on both faces, in the positions not engaged by the first connecting line.

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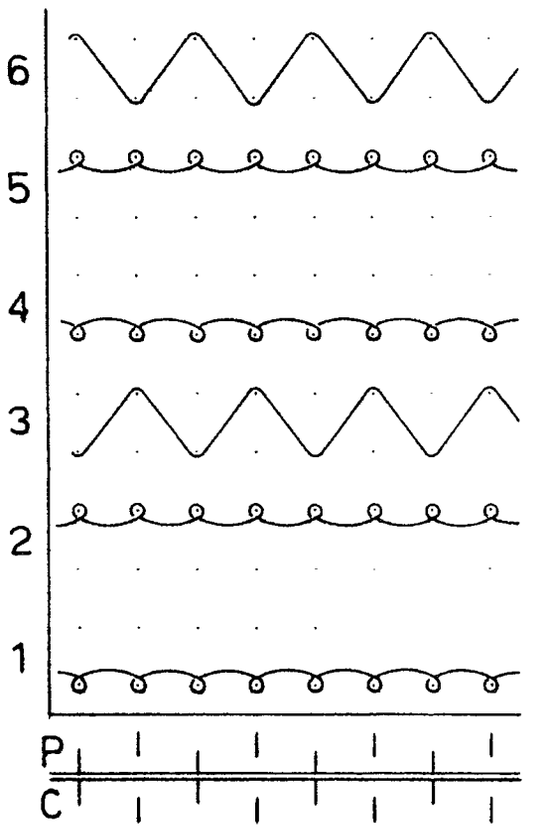


FIG. 1

A DOUBLE-FACED KNITTED FABRIC AND MANUFACTURING PROCESS

The present invention refers to a double-faced weft knitted fabric.

Knitted fabrics realized with two different yarns and having a structure made of one yarn predominantly on one face and a structure made of another yarn on the other face, are well known and widely used; for example, one yarn is cotton and the other can be wool or synthetic material. These double-faced fabrics allow the user to have a type of yarn with certain characteristics, for example cotton, in contact with his skin, and another yarn outside with different characteristics, for example wool. A known type of such knitted fabrics is produced on a circular knitting machine by means of a series of needles on the cylinder and a series of needles on the dial, the needles being off-set (therefore not adjacent); the needles of each series interloop the relevant yarn and each series of needles makes a line of jersey, the two lines facing each other; afterwards all the needles of both series intervene to form a connecting line or row with a connecting yarn, usually of nylon or the like, which forms tucks or loops on all the stitches.

This type of fabric, although it has two faces with different appearance, for example one face consisting of one material and the other of another material, does, however, have the following drawbacks; the connecting material is as much as 6-7% of the whole; in the case where the two yarns relating to the two faces are of different colours, the colour of each face shows through on the other face, since the fabric has a rib structure wherein the stitches of the dial are in an intermediate position with respect to the stitches of the cylinder; the fabric is relatively flat, heavy and not very elastic; it is impossible to have one face of the Jacquard-type since the fabric would turn out to be too thick and stiff; and therefore this type of fabric has never been realized with a Jacquard face.

The aim of this invention is to avoid the above-mentioned drawbacks.

An object of this invention is a knitted fabric consisting of two fabric structures, one forming one face and the other forming the other face, connected together with a first and a second connecting or weave line, the first connecting line forming loops or tucks on stitches of the first and second face alternately, and the second connecting line forming tucks on the stitches of the first and second face alternately, in the opposite way with respect to the first line.

Another object of the present invention is a process for manufacturing a fabric as described above, comprising the following steps or phases:

- positioning the dial needles and the cylinder needles of a circular knitting machine in an aligned, opposite position;
- realizing a knitted fabric structure on one face and a knitted fabric structure on the other face;
- realizing a first connecting or weave line for connecting or binding said fabric structures together, by engaging with a connecting yarn or thread one stitch on one side or face, the adjacent off-set stitch on the other face, the third adjacent off-set stitch on said one side and so on;
- realizing a second connecting line for connecting said knitted lines, by engaging stitches on the first and on the second face, in alternate off-set positions, i.e. the positions not engaged by the first connecting line.

The fabric structure on the one face and on the other face can be any known fabric structure, for instance jersey or even Jacquard.

In this way a soft, light, compact fabric is obtained, with two aesthetically independent faces, so that the colour of one face does not show through substantially on the other face, even in the case where they are realized in two very different colours. Such fabric can be produced easily with faces with different colours, material or structure; for example, as has already been said, one side can be jersey and the other can be Jacquarded, even in eight diffent colours; in addition the connecting thread or filament is a really very small percentage with respect to the overall quantity of yarn used (about 2,3%); such a quantity does not have to be declared on the label showing the material, which must be attached to every article by law, thus making it possible to declare 100% cotton next to the skin. The new fabric is also voluminous, elastic, indeformable by washing, and recovers its shape well; in addition, the connecting line form small cells which increase the fabric's insulating properties.

The fabric which is the object of the invention and the process for manufacturing it will now be explained more clearly with reference to the enclosed drawings, showing exemplary and not restrictive embodiments thereof. In the drawings:

figure 1 shows the so-called "stitch diagram" of a first type of fabric according to the invention, with the two faces in jersey;

figure 2 is an RGT (TREMELLONI diagram) of the fabric in figure 1;

figures 3, 4 and 5 respectively show a partial design, a stitch diagram and an RGT of a fabric according to the invention, with a two-colour Jacquard face and the other face in jersey;

figure 6 shows the position of the needles which intervene in the realization of the fabric in figures 1 and 2;

figures 7 to 12 show the needles in various phases of working the fabric shown in figures 1 and 2;

figures 13, 14 and 15 respectively show a partial drawing, a stitch diagram and an RGT of another fabric according to the invention, with one face Jacquarded in three colours and the other in jersey entirely of a fourth colour.

Referring first to figures 1 and 2, a first type of double-faced knitted fabric according to this invention is shown, by means of its so-called "stitch diagram" (figure 1) and the so-called RGT (figure 2), both these system being well known to a man of the art.

Here is a brief of the symbols used in the drawings.

Stitch diagram

. needle

plain stitch

purl or reverse stitch

tucks (loops)

RGT (Rappresentazione Grafica Tremelloni - i.e. Tremelloni diagram)

| plain stitch

– purl/reverse stitch

∧ tuck (loop)

. laying in point (the needle doesn't work)

The fabric can be made on a circular knitting machine or on a flat knitting machine.

At the foot of each diagram the arrangement and the position of the needles is shown, the needles of the cylinder C, or front needle bed or bar, are drawn below the double horizontal line, subdivided into two series, corresponding to the needles A and B drawn on the right in figure 6; the needles of the dial P are drawn above, subdivided into two series A′B′, as drawn on the left in figure 6. The difference between one series and the other lies in the position of the butt t of the needle, which allows one or the other series to intervene selectively during some working phases. It should be noted that the cylinder needles are positioned in an adjacent way (in other words, in a frontally corresponding position) to those of the dial, and vice versa.

In the phase or step at point 1 (figure 1), therefore, it can be seen that the cylinder needles A, B, make one line of plain stitches (the phase shown in figure 8) with a yarn 12, while in step or phase 2 the dial needles A′, B′, make a line of purl/reverse stitches (figure 7) with the other yarn 14. In phase 3 (figure 9) cylinder needles and dial needles (for example the needles AB′) intervene alternately, in order to carry out an interlacing or connection with a connecting yarn 16; the operating or intervening needles each make a tuck or loop of connecting yarn or thread on the previous stitch. It can be seen that, in this way, alternate off-set stitches of the two opposite layers or faces of the fabric are bound (connected) together.

In steps 4 and 5, in figures 1 and 2, another line or row of plain stitches is made with the yarn 12 by means of the cylinder needles (figure 11), and a further row of purl or reverse stitches is made by means of the dial needles (figure 10).

In step 6, a second weave or connecting line (connecting run) is carried out with yarn 16, by means of alternate off-set needles on the dial and on the cylinder, and it is precisely (figure 12) the needles B, A′ which intervene, which did not intervene in the first connecting run. In this way two connecting lines are made, separated by at least one stitch line and opposite to each other, since, while each one form tucks on alternate off-set stitches on one yarn and the other, the second connecting line engages the stitches in the positions not engaged by the first line.

In the "needle race" or representation of the cams arrangement (on the left of the RGT) it can be seen clearly that in operation or step 1 only the needles of cylinder C work (plain stitch, figure 8); in step 2 only

the needles of the dial p work (purl/reverse stitch, figure 7); in step 3 (figure 9) needles A of the cylinder and needles B′ of the dial work; in step 4 all and only the cylinder needles work once more; in step 5 all and only the cylinder needles work and in step 6 cylinder needles B and dial needles A′ work.

In figures 3, 4 and 5 a second fabric according to this invention is shown, one face of which has a two-coloured Jacquard structure according to the design shown in figure 3 (1st colour: white, 2nd colour: black), and the other face is worked in jersey, entirely in a third colour. The fabric is made on a circular knitting machine with a Jacquard mechanism for the cylinder needles. Obviously, although reference is made to yarns of a 1st and 2nd colours and so forth, use could also be made of yarn of the same colour but of a different type, for example brilliant-matt.

The needles of the cylinder C are arranged aligned in a single series for the execution of such work, they are operated by a Jacquard mechanism (not shown as it is already per se known) and the needles of the dial P are arranged aligned and adjacent to those of the cylinder, but subdivided into two series as for the previous fabric. The cylinder needles carry out the two-colured Jacquard working and the dial needles carry out the purl/reverse stitch knitting. In a first course (comprising the steps shown with 1′, 2′ and 3′), the cylinder works with yarn of the first colour, in the second course (comprising the steps 4′, 5′ and 6′), the cylinder works with yarn of the second colour. More particularly:

Step 1′ - the cylinder carries out a first line (engaging one needle in four) with yarn of the first colour);
step 2′ - alternate cylinder needles and dial needles intervene to form a weave or connecting line, as previously described with reference to figure 9;
step 3′ - the dial carries out a line of jersey with yarn of a 3rd colour;
step 4′ - the cylinder carries out a line with a yarn of the 2nd colour (engaging the three needles not engaged in step 1′);
step 5′ - alternate cylinder needles and dial needles (off-set with respect to step 2′) form a connecting line like the one shown in figure 12;
step 6′ - the dial carries out a second line of jersey in the 3rd colour.

From step 7′ another course begins, similar to the first, with the exception of the differeces due to the fabric structure required on the Jacquarded face.

As has been seen, each series of steps 1′-6′ comprises a connecting line or yarn (step 2′) which is worked with tucking by alternate opposite needles, and a second connecting yarn (step 5′) being tucked by the alternate opposite needles which did not operate with the first connecting yarn (step 2′). The first and the second connecting yarn are preferably separated by horizontal stitch lines.

With reference to figures 13, 14 and 15, a description will now be given of a fabric having a three-colour Jacquard knit face (in figure 13; 1st colour: white; 2nd colour: grey; 3rd colour: black) and jersey knit in a 4th colour on the other face.

The cylinder needles are arranged aligned in a single series and the dial needles are divided into two series:

step 1″ - the cylinder needles carry out a first line with yarn of the first colour;
step 2″ - the cylinder needles carry out a line with the second colour;
step 3″ - the cylinder needles carry out a line with yarn of the third colour;
step 4″ - alternate cylinder and dial needles carry out a weave or binding (connection) with connection yarn as in figure 9;
step 5″ - the dial carries out a line of jersey in the fourth colour;
steps 6″, 7″ and 8″ - the cylinder needles operate again in the first, second and third colours respectively, to realize the second line from the bottom in figure 13;
step 9″ - alternate cylinder and dial needles, off-set with respect to the needles in phase 4″, operate a connection or weave;
step 10″ - the dial carries out a line of jersey in the fourth colour.

From step 11″ a new series of operations begins similar to the first, with the exception of the different fabric structure required by the Jacquard working.

Obviously variations may be made to the invention by a technician of the art, without however going beyond the field of the exclusive right claimed herein. For example, it is possible to have B′ needles working in step 5″ (figure 6), and A′ needles working in step 10″ thus allowing a lighter and more elastic fabric to be obtained.

Claims

1. A double-faced weft knitted fabric, comprising two fabric structures, one forming one face and the other

forming the other face, bound together by a line of connecting yarn, characterized in that it comprises at least a first and a second line of connecting yarn, separated from each other by at least one line of stitches, the first connecting line forming tucks on the stitches of the first and second face, alternate and off-set with respect to each other, the second connecting line forming tucks on stitches of the first and of the second face in alternate and off-set positions, which are those positions not involved by the first connecting line.

2. A fabric according to claim 1, characterized in that the two successive connecting lines are separated by at least one line of stitches on one face and by one line of stitches on the other face.

3. A fabric according to claim 1, characterized in that it comprises a Jacquarded face.

4. A fabric according to claim 3, characterized in that it comprises a two-colour Jacquarded face and a face in jersey of a third colour, in which the series of lines is periodically repeated, comprising:
a line with yarn of a first colour on the Jacquarded face;
a first weave or connecting line with alternate tucks;
a line of jersey with yarn of the third colour on the other face;
a line with yarn of the second colour on the Jacquarded face;
a weave or connecting line with alternate off-set tucks;
a line of jersey with the third colour on the other face.

5. A fabric according to claim 3, characterized in that it comprises a three-colour Jacquarded face and a face in jersey in a fourth colour, in which the following series are periodically repeated:
- a line of yarn of the first colour on the Jacquarded face;
- a line of yarn of the second colour on the Jacquarded face;
- a line of yarn of the third colour on the Jacquarded face;
- a connecting line with alternate tucks;
- a line of jersey in the fourth colour on the other face;
- a line of yarn of the first colour on the Jacquarded face;
- a line of yarn of the second colour on the Jacquarded face;
- a line of yarn of the third colour on the Jacquarded face;
- a connecting line with off-set loops or tucks;
- a line of jersey on the other face.

6. A process for the production of a double-faced weft knitted fabric, comprising a fabric structure on one face and a fabric structure on the other face, connected together, the said process comprising the steps of realizing at least one stitch line of the fabric structure on one face and at least one stitch line of the fabric structure on the other face, characterized in that it comprises the further steps of:
- realizing a first weave or connecting line for binding the said stitch lines, by alternately engaging with connecting yarn one stitch on one face, the adjacent off-set stitch on the other face, the third adjacent off-set stitch one the first face and so on;
- realizing a second connecting line of the said stitch lines, by alternately engaging with the connecting yarn the stitches of the first and second face, in positions opposite to the position corresponding to the stitches engaged before in the first connecting line.

7. A process according to claim 6, characterized in that it is realized on a circular knitting machine, presetting the cylinder needles in two alternate series, the needles of the one and of the other series having their butts in a different position; presetting the dial needles in two alternate series, the needles of the one and of the other series having their butts in a different position; presetting the cylinder needles and dial needles in aligned, adjacent, opposite positions.

8. A process according to claim 6, characterized in that it is realized on a circular knitting machine with a Jacquard mechanism on the cylinder, presetting the dial needles in two alternate series, and the cylinder needles in one single series, facing and aligned with the dial needles and in adjacent positions.

9. A process according to claim 8, characterized in that it comprises the following steps:
step $1'$ - the cylinder carries out a first line (engaging one needle in four) with yarn of the first colour;
step $2'$ - alternate cylinder and dial needles intervene to form a connecting line, as previously described with reference to figure 9;
step $3'$ - the dial carries out a line of jersey with yarn of the third colour;
step $4'$ - the cylinder carries out a line (engaging the three needles not engaged in steps $1'$) with yarn of the second colour;
step $5'$ - alternate cylinder and dial needles (off-set with respect to steps $2'$) form a connecting line like the one shown in figure 12;
step $6'$ - the dial carries out a second line of jersey in the third colour.

10. A process according to claim 8, characterized in that it comprises the following steps:
step $1''$ - the cylinder needles carry out a first line with yarn of the first colour;

step 2″ - the cylinder needles carry out a line with yarn of the second colour;
step 3″ - the cylinder needles carry out a line with yarn of the third colour;
step 4″ - alternate cylinder and dial needles carry out a connection with the connecting yarn;
step 5″ - the dial carries out a line of jersey in the fourth colour;
steps 6″, 7″ and 8″ - the cylinder needles operate again in the first, second and third colour respectively;
step 9″ - alternate cylinder and dial needles, off-set with respect to the needles of step 4″, carry out a connection or binding;
step 10″ - the dial carries out a line of jersey in the fourth colour.

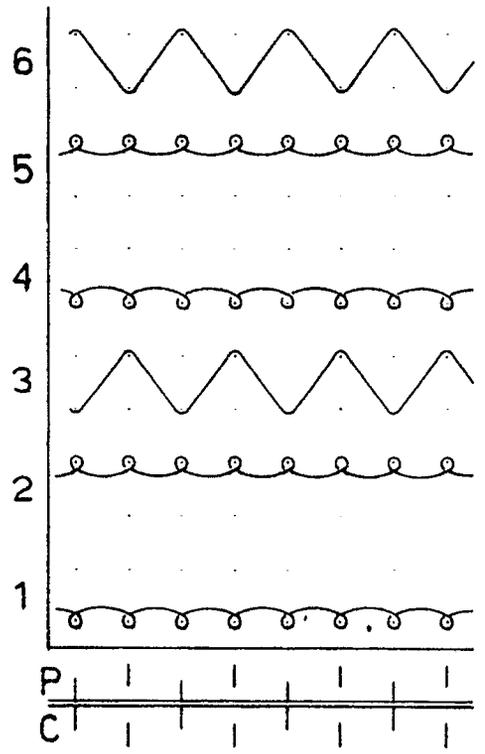


FIG. 1

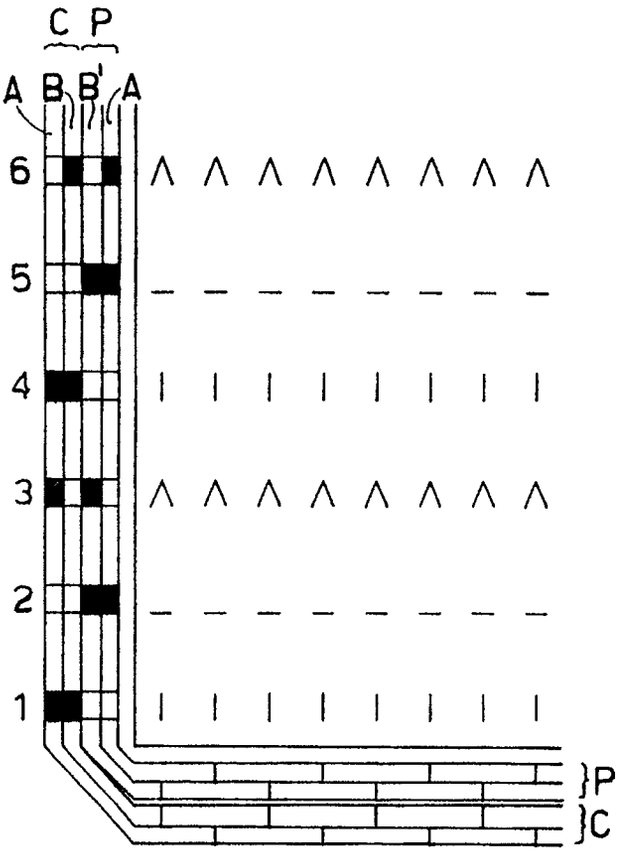


FIG. 2

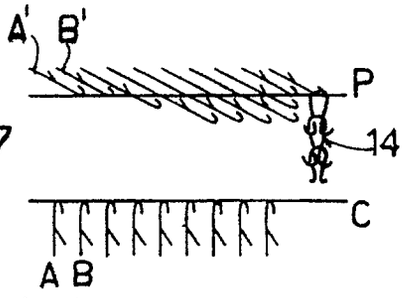


FIG. 7

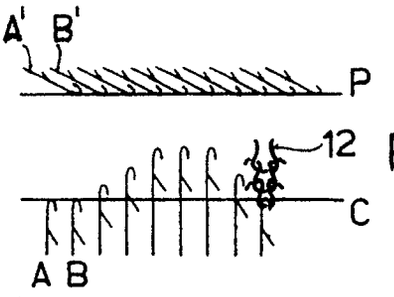


FIG. 8

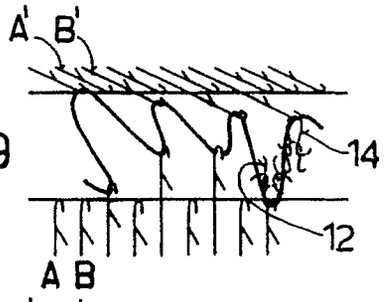


FIG. 9

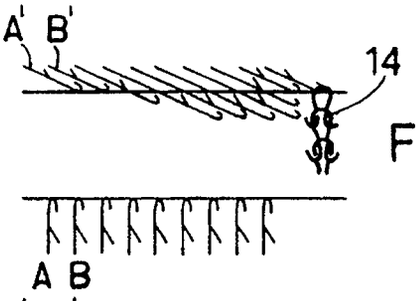


FIG. 10

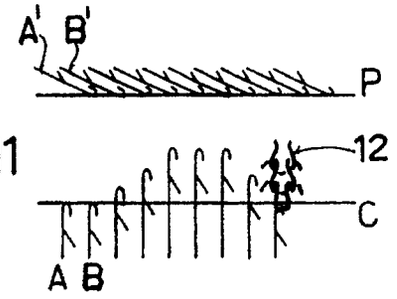


FIG. 11

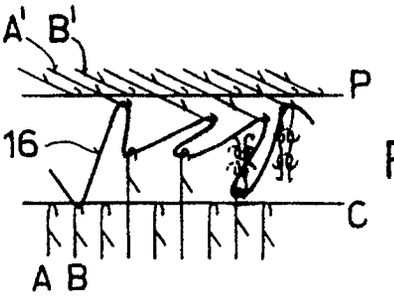


FIG. 12

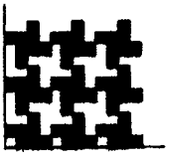


FIG. 3

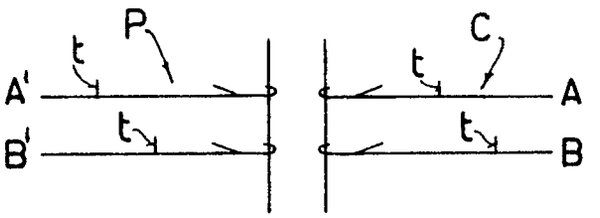


FIG. 6

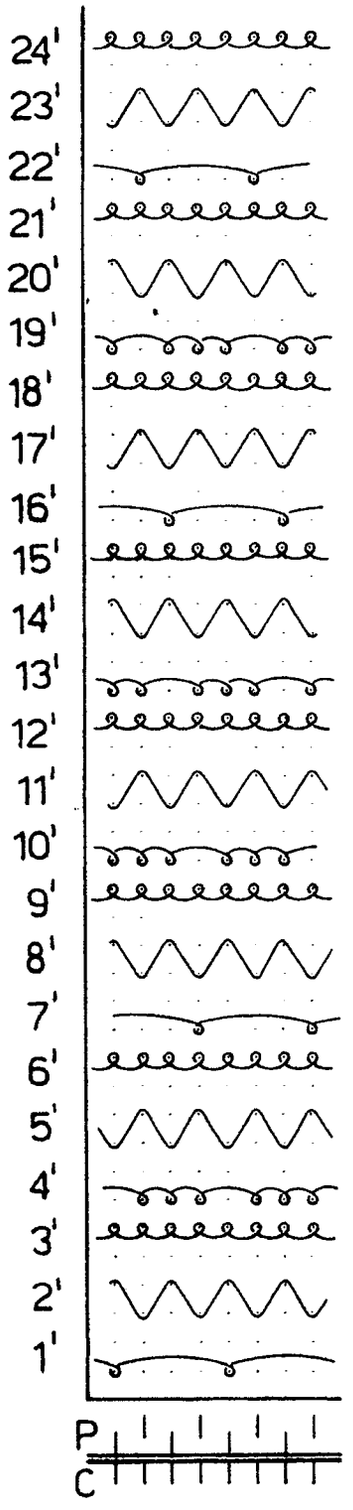


FIG. 4

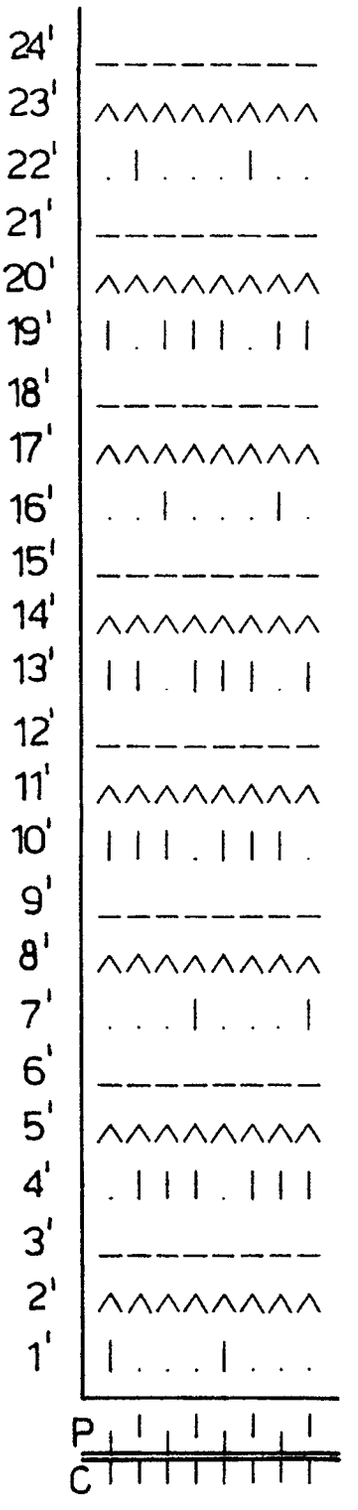


FIG. 5

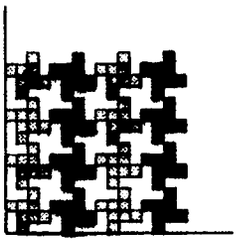


FIG. 13

FIG. 14

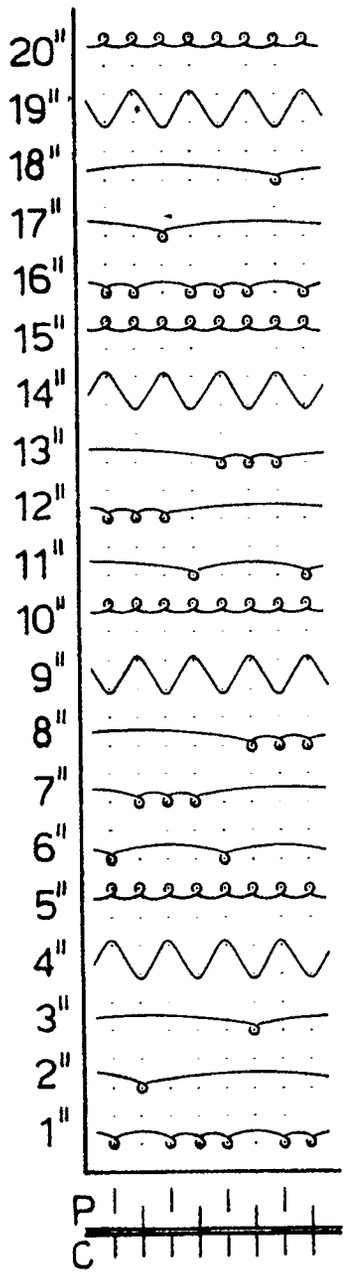
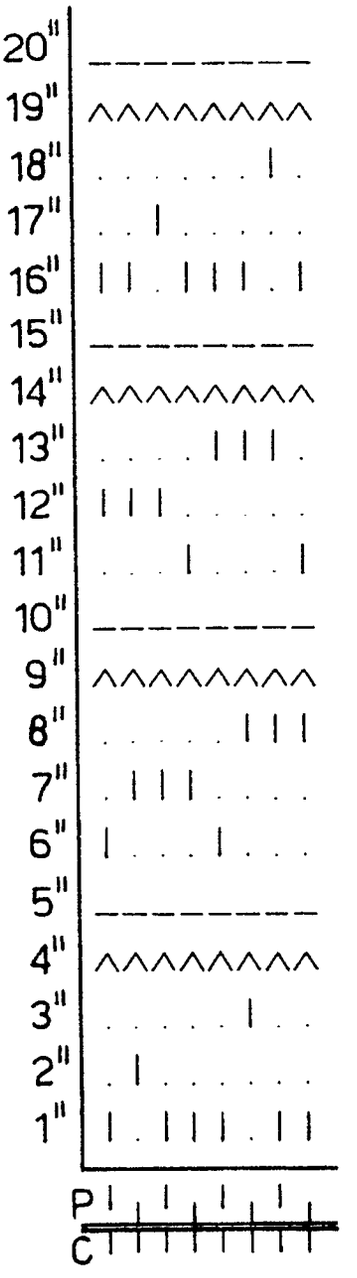


FIG. 15



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 83 0429

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	FR-A-2570935 (VYZKUMNY USTAV PLETARSKY SUJANOVO NAMESTY 3) * page 6, line 28 - page 7, line 2; figure 2 *	1, 2	D04B1/00
A	DE-A-2618316 (OTTO STECK MASCHINENBAUTEILE) * page 3, line 30 - page 4, line 17; figure 1 *	1, 2, 6	
A	FR-A-2493358 (PAUL HEURTEFEU ET CIE)		
A	DE-A-2530806 (ERICH MAK SPORTBEKLEIDUNGSFABRIK)		
A	US-A-1407343 (WALTER)		
A	FR-A-1290328 (MARCHAND)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 JUNE 1990	VAN GELDER P.A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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