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

(11) EP 1 359 238 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
05.11.2003 Bulletin 2003/45

(21) Application number: **02711434.7**

(22) Date of filing: **08.02.2002**

(51) Int Cl.[7]: **D04B 1/00**

(86) International application number:
PCT/JP02/01109

(87) International publication number:
WO 02/063082 (15.08.2002 Gazette 2002/33)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **08.02.2001 JP 2001031996**

(71) Applicant: **TEIJIN LIMITED**
Osaka-shi Osaka 541-0054 (JP)

(72) Inventor: **SOEDA, Tsuyoshi, C/O TEIJIN LIMITED**
Osaka-shi, Osaka 541-0054 (JP)

(74) Representative: **Hallybone, Huw George et al**
Carpmaels and Ransford,
43 Bloomsbury Square
London WC1A 2RA (GB)

(54) THREE-LAYER KNITTING FABRIC

(57) A knitted fabric having a triple knit ply structure, and is useful for underwear clothes which need high lightness and warmth, has a front surface knit ply having a yarn knit structure, a back surface knit ply having a yarn knit structure and a binding intermediate knit ply constituted from stitching yarns through which the front and back surface knit plies are tuck-stitched together, the stitching yarns are constituted from hollow fibers (for example, hollow filaments having a percentage of hollowness of 10 to 50%).

Fig.2

EP 1 359 238 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a knitted fabric having a triple knit ply structure. More particularly, the present invention relates to a knitted fabric having a the triple knit ply structure constituted from a front surface knit ply, a back surface knit ply and an intermediate knit ply arranged between the front and back surface knit plies and formed from hollow filament stitching yarns through which the front and back surface knit plies are tuck-stitched together. The knitted fabric having a triple knit ply structure of the present invention is appropriately used for underwear which a high lightness (light weight property) and must have a high warmth (warm-keeping property).

TECHNICAL BACKGROUND

[0002] Generally, it is known that a knitted fabric having a triple knit ply structure constituted by tuck-stitching front and back surface knit plies with stitching yarns, as disclosed by, for example, Japanese Unexamined Patent Publication No. 6-158483-A, has excellent bulkiness, warmth and a good appearance and thus is widely used for sport wear such as, for example, training wear, and casual clothes for children and women. In the case where the knitted fabric having a triple knit ply structure is used for underwear, it must have a further enhanced warmth and lightness.

[0003] Conventional knitted fabrics for underwear, which are produced from knitting yarns comprising natural fibers such as cotton fibers or a combination of natural fibers and synthetic fibers (for example, polyester or nylon fibers) or regenerated fibers (for example, rayon fibers) or semisynthetic fibers (for example, cellulose triacetate fibers), are widely used. In the conventional knitted fabric for underwear as mentioned above, in the case where a further enhancement of the warmth is required, the front or back surface of the knitted fabric is nap-raised or, for knitting yarns, functional fibers, containing a substance capable of absorbing far infrared rays and/or near infrared rays and mixed into a fiber-forming polymer, or other functional fibers capable of generating heat by absorbing moisture in the ambient air, are used, to realize an enhancement of the warmth of the knitted fabric. However, when a nap-raising procedure is applied, the thickness of the knitted fabric may significantly increase. Also, when the above-mentioned functional fibers are utilized, a disadvantage that the enhancement in the warm-keeping property of the knitted fabric is unsatisfactory, such that it becomes necessary to increase the thickness of the knitted fabric and therefore the mass of the resultant knitted fabric becomes too large, may occur.

SUMMARY OF THE INVENTION

[0004] An object of the present invention is to provide a knitted fabric having a triple knit ply structure, exhibiting high lightness and warmth and useful for knitted clothes.

[0005] The above-mentioned object can be attained by the knitted fabric having a triple knit ply structure of the present invention.

[0006] The knitted fabric having a triple knit ply structure of the present invention comprises a front surface knit ply having a yarn knit structure, a back surface knit ply having a yarn knit structure and a binding intermediate knit ply formed from stitching yarns through which the yarn knit structure of the front surface knit ply and the yarn knit structure of the back surface knit ply are tuck-stitched together,

the stitching yarns being constituted from hollow fibers.

[0007] In the knitted fabric having a triple knit ply structure of the present invention, the stitching yarns are preferably polyester multifilament yarns having a thickness of 20 to 170 dtex, and a thickness of individual filaments of 1 to 10 dtex, the individual filaments preferably having a percentage of hollowness of 10 to 55%.

[0008] The knitted fabric having a triple knit ply structure of the present invention, preferably has a thickness of 0.5 to 1.5 mm and a basis mass of 80 to 200 g/m^2.

[0009] In the knitted fabric having a triple knit ply structure of the present invention, the binding intermediate knit ply preferably has a basis mass of 25 to 60 g/m^2.

[0010] The knitted fabric having a triple knit ply structure of the present invention preferably has a heat-insulation efficiency (α) of 18% or more.

[0011] In the knitted fabric having a triple knit ply structure of the present invention, the yarns from which the front surface knit ply is formed are preferably bulky polyester multifilament yarns having a thickness of 20 to 17 dtex, and a thickness of individual filaments of 0.1 to 20 dtex.

[0012] In the knitted fabric having a triple knit ply structure of the present invention, the yarns from which the back surface knit ply is formed are preferably constituted from at least one type of fibers selected from natural fibers, synthetic fibers, regenerated fibers and semisynthetic fibers.

[0013] The knitted fabric having a triple knit ply structure of the present invention, preferably has a tubular knit struc-

ture.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 shows an explanatory cross-sectional profile of an embodiment of the knitted fabric having a triple knit ply structure,
Fig. 2 is a photographic of a cross-section of an embodiment of the knitted fabric having a triple knit ply structure of the present invention,
Fig. 3 is a diagram showing a knit design of an embodiment of the knitted fabric having a triple knit ply structure of the present invention, and
Fig. 4 shows an explanatory cross-sectional view of a dry-contact heating apparatus for the measurement of the heat-insulation efficiency α of the knitted fabric having a triple knit ply structure of the present invention.

BEST MODE OF CARRYING OUT THE INVENTION

[0015] The knitted fabric having a triple knit ply structure is constituted from front and back surface knit plies formed from yarns knitted into knit ply structures and a binding intermediate knit ply formed from stitching yarns through which the yarn knit structure of the front surface knit ply and the yarn knit structure of the back surface knit ply are tuck-stitched together, and the stitching yarn from which the binding intermediate knit ply is formed are constituted from hollow fibers.

[0016] In the present invention, each of the hollow fibers comprises a peripheral shell portion extending along the longitudinal axis of the hollow fiber and having an annular cross-sectional profile and a hollow space surrounded by the peripheral shell and extending along the longitudinal axis of the hollow fiber.

[0017] In the case where the knitted fabric having a triple knit ply structure is formed into an underwear cloth, the resultant knitted underwear cloth having the triple knit ply structure is used in the manner such that the back surface knit ply faces the skin surface and the front surface knit ply is exposed to the ambient air atmosphere. In this case, the back surface knit ply, in most cases, comes into contact with the skin of the user, and thus must have a good warmth and a high absorption of perspiration and moisture and must exhibit a good touch and hand; the front surface knit ply must exhibit a good appearance, and an appropriate sliding property on a coat superimposed on the underwear cloth; and the binding intermediate knit ply must have a firm tuck-stitching property, a good form-retaining property resistance to compression, and a high warmth.

[0018] Referring to Fig. 1, the knitted fabric 1 having a triple knit ply structure is constituted from

(a) a front surface knit ply 2 constituted from yarns 2a knitted into a knit structure,
(b) a back surface knit ply 3 constituted from yarns 3a knitted into a knit structure, and
(c) a binding intermediate knit ply 4 constituted from stitching hollow fiber yarns 4a which are tuck-stitched with the yarns 2a and 3a from which the knit structures of the front and back surface knit plies 2 and 3 are formed, to bind the front and back surface knit plies together through the intermediate knit ply 4.

[0019] Fig. 2 shows a photograph of a cross-section of an embodiment of the knitted fabric having a triple knit ply structure of the present invention. In Fig. 2, yarns 2a, from which the knit structure of the front surface knit ply 2 is constituted and yarns 3a from which the knit structured the back surface knit ply 3 is constituted, are tuck stitched by stitching yarns 4a of the binding intermediate knit ply 4. In Fig. 2, the stitching yarn 4a constituted from filaments. The filaments are hollow filaments of which the hollow cross-sectional profiles clearly appears in Fig. 2.

[0020] Fig. 3 shows a knit design of an embodiment of the knitted fabric having a triple knit ply structure of the present invention. Fig. 3, the knit designs (1) and (4) are of a front surface knit ply, the knit designs (2) and (5) are of a back surface knit ply, and the knit designs (3) and (6) are of a binding intermediate knit ply.

[0021] In the knitted fabric having a triple knit ply structure of the present invention, there is no limitation to the type of the stitching yarns usable for the binding intermediate knit ply. For example, the stitching yarns are preferably hollow multi-filament yarns. In this case, preferably, the hollow multifilament yarns have a thickness of 20 to 170 dtex, more preferably 20 to 100 dtex; the individual filaments have a thickness of 1 to 10 dtex, more preferably 2 to 5 dtex, and a percentage of hollowness of 10 to 50%, more preferably 30 to 55%. The percentage of hollowness of the hollow filaments refers to a percentage of the cross-sectional area of hollow portion of an individual hollow filament on the basis of the whole cross-sectional area of the individual hollow filament. The stitching yarns may be spun yarns comprising hollow staple fibers (preferably having a thickness of 1 to 10 dtex and a percentage of hollowness of 10 to 55%) and preferably having a thickness of 20 to 170 dtex.

[0022] There is no specific limitation to the type of the hollow fibers for constituting the stitching yarns. Usually, the hollow fibers are preferably selected from organic fibers for clothes, for example, hollow polyester filaments, hollow nylon filaments, hollow polyester staple fibers, hollow nylon staple fibers and composite fibers of these polymers. Among them, hollow polyester filaments are preferably used for the present invention.

[0023] In the knitted fabric having a triple knit ply structure of the present invention, the binding intermediate knit ply preferably has a basis mass of 25 to 60 g/m^2, more preferably 30 to 50 g/m^2. When the basis mass is within the above-mentioned range, the resultant knitted fabric having a triple knit ply structure of the present invention exhibits high warmth and lightness.

[0024] The front surface knit ply of the knitted fabric having a triple knit ply structure of the present invention is preferably formed from bulky yarns, for example, false twist-textured yarns, spun yarns, air jet-interlaced filament yarns and yarns comprising two or more types of fibers or filaments different in shrinkage from each other. In this case, the resultant knitted fabric exhibit a high warmth. Also, to improve the hand of the knitted fabric, and to prevent undesirable projections of stitching yarns from the outermost surface of the front surface knit ply when the stitching yarns tuck-stitch with the yarns from which the front surface knit ply is formed, to form the binding intermediate knit ply, the yarns for forming the front surface knit ply preferably have a thickness of 20 to 170 dtex, more preferably 50 to 150 dtex, and the individual fibers for the yarns preferably have a thickness of 0.1 to 20 dtex, more preferably 2 to 5 dtex. There is no limitation to the type of the fibers from which the front surface knit ply is formed. For example, fibers of polyesters, nylons, cellulose acetates, acrylic resins, rayon, cotton, wool and/or silk or composite fibers thereof may be used for the front surface knit ply. Among them, the polyester fibers are preferably employed. The fiber yarns as mentioned above are preferably selected from false twist-textured multifilament yarns, more preferably false twist-textured polyester multifilament yarns. The front surface knit ply preferably has a basis mass of 20 to 60 g/m^2, more preferably 30 to 50 g/m^2.

[0025] In the knitted fabric having a triple knit ply structure of the present invention, the yarns from which the knit structure of the back surface knit ply is formed preferably comprises at least one type of fibers selected from natural fibers (for example, wool and silk fibers), synthetic fibers (for example, polyester, nylon and acrylic fibers), regenerated fibers (for example, rayon and cupra fibers), and semisynthetic fibers (for example, cellulose triacetate fibers). In the case where the knitted fabric having a triple knit ply structure of the present invention is used for clothes, the fiber yarns for the back surface knit ply are preferably selected from those exhibiting high comfort when the cloth is worn by a user, for example, cotton, rayon, polyester, and nylon yarns and composite yarns of the above-mentioned yarns. The yarns for the back surface knit ply may be selected from multifilament yarns and spun yarns. The multifilament yarns may be texturized bulky multifilament yarns. The yarns for the back surface knit ply preferably have a thickness of 40 to 300 dtex (130 to 20 yarn number count), more preferably 70 to 200 dtex. The back surface knit ply preferably has a basis mass of 30 to 100 g/m^2, more preferably 40 to 70 g/m^2.

[0026] There are no limitations to the thickness and the basis mass of the knitted fabric having a triple knit ply structure of the present invention. Usually, to realize both the high warmth and lightness, the knitted fabric having a triple knit ply structure preferably has a thickness of 0.5 to 1.5 mm, more preferably 0.6 to 0.8 mm, and a basis mass of 80 to 200 g/m^2, more preferably 110 to 150 g/m^2.

[0027] The knitted fabric having a triple knit ply structure of the present invention preferably exhibits a heat-insulation efficiency of 18% or more, more preferably 20% or more, determined by the following measurement.

[0028] In the measurement, referring to Fig. 4, a heating device 5 (large size BT-box, made by KATOTEC K.K., model: THERMOLABO II) is placed in air controlled to a uniform temperature of 20°C, in which device only a heating surface (dimensions: 10 cm $\times$ 10 cm) is exposed to the atmosphere and other surface are heat-insulated, and the temperature of the heating surface is maintained at a uniform temperature of 65°C. A sample of a knitted fabric b having dimensions of 10 cm $\times$ 10 cm is placed on the heating surface. Then, an electric power consumption W, in W needed to maintain the temperature of the heating surface at 65°C for one minute is measured. For the purpose of comparison, an electric power consumption W_0 needed to maintain the temperature of the heating surface, on which no knitted fabric sample is placed, at 65°C for one minute is measured.

[0029] The heat-insulation efficiency α of the knitted fabric sample is calculated in accordance with the following equation.

$$\alpha(\%) = [(w_0 - w_1)/w_0] \times 100$$

[0030] In the production of the knitted fabric having a triple knit ply structure of the present invention, for example, a circular knitting machine is used, yarns for forming the knit structure of the front surface knit ply and yarns for forming the knit structure of the back surface knit ply are respectively supplied into the circular knitting machine through a cylinder side and a dial side of the machine and knitted into, for example, knit structures, as shown in Fig. 3 and, simultaneously, the knit structures of the front and back surface knit plies are tuck-stitched with stitching yarns, to form

a binding intermediate knit ply.

EXAMPLES

[0031] The knitted fabric having a triple knit ply structure of the present invention will be further illustrated by the following examples, which are not intended to limit the scope of the present invention in any way.

Example 1

[0032] A 23G double circular knitting machine was employed to produce a knitted fabric having a triple knit ply structure of the present invention.

[0033] The front surface knit ply was formed from false twist-textured polyethylene terephthalate filament yarns having a yarn count of 56 dtex/36 filaments, and the back surface knit ply was formed from spun cotton yarns having a thickness of 98 dtex (60 yarn number count). The binding intermediate knit ply was formed from stitching yarns consisting of hollow polyethylene terephthalate filament yarns having a percentage of hollow of hollow filaments of 35% and a yarn count of 40 dtex/12 filaments. The knit structures of the front and back surface knit piles are tuck-stitched by the stitching hollow filament yarns. A knitted fabric having a triple knit ply structure as shown in Fig. 3 was obtained. Table 1 shows the thickness, basis mass and heat-insulation efficiency α of the resultant knitted fabric.

[0034] The resultant knitted fabric exhibited lightness, an excellent warmth and a soft surface touch. No projection or exposure of the stitching yarns of the binding intermediate layer to the outside of the front surface knit ply were found. Thus the resultant knitted fabric exhibited a good appearance and dignity.

Comparative Example 1

[0035] A knitted fabric having a triple knit ply structure as shown in Fig. 3 was produced by using the same 23G double circular knitting machine as in Example 1, from false twist-textured polyethylene terephthalate filament yarns having a yarn count of 56 dtex/36 filaments for the front surface knit ply, spun cotton yarns having a thickness of 98 dtex (60 yarn number count) for the back surface knit ply and non-hollow polyethylene terephthalate filament yarns, having a yarn count of 56 dtex/24 filaments as stitching yarns for the binding intermediate knit ply. Table 1 shows the thickness, basis mass and heat-insulation efficiency of the resultant knitted fabric.

[0036] The knitted fabric having a triple knit ply structure of Comparative example 1 had similar appearance, elegance, thickness and basis mass to that of the Example 1, but had an insufficient heat-insulation efficiency α.

Comparative Example 2

[0037] A knitted fabric having a circular rib knit structure was produced from spun cotton yarns having a thickness of 147 dtex (40 yarn number count) by using a circular knitting machine. Table 1 shows the thickness, basis mass and heat-insulation efficiency α of the resultant knitted fabric.

[0038] The resultant knitted fabric exhibited a significantly poor heat insulation efficiency α, while the thickness and the basis weight of the resultant knitted fabric were higher than those of Example 1.

Table 1

Item / Example No.		Thickness (mm)	Basis mass (g/m^2)	Heat-insulation efficiency α (%)
Example 1		0.68	149.3	22.7
Comparative Example	1	0.72	153.7	15.6
	2	0.75	178.0	7.9

INDUSTRIAL APPLICABILITY OF THE INVENTION

[0039] The knitted fabric having a triple knit ply structure of the present invention exhibits an excellent warmth in relation to the thickness and basis mass thereof, an excellent lightness in relation to the thickness and the warmth

thereof and thus is an appropriate textile material for the use in underwear which need high lightness and warmth.

Claims

1. A knitted fabric having a triple knit ply structure, comprising a front surface knit ply having a yarn knit structure, a back surface knit ply having a yarn knit structure and a binding intermediate knit ply formed from stitching yarns through which the yarn knit structure of the front surface knit ply and the yarn knit structure of the back surface knit ply are tuck-stitched together,
   the stitching yarns being constituted from hollow fibers.

2. The knitted fabric having a triple knit ply structure as claimed in claim 1, wherein the stitching yarns are polyester multifilament yarns having a thickness of 20 to 170 dtex, and a thickness of individual filaments of 1 to 10 dtex, the individual filaments having a percentage of hollowness of 10 to 55%.

3. The knitted fabric having a triple knit ply structure as claimed in claim 1, having a thickness of 0.5 to 1.5 mm and a basis mass of 80 to 200 g/m^2.

4. The knitted fabric having a triple knit ply structure as claimed in claim 1, wherein the binding intermediate knit ply has a basis mass of 25 to 60 g/m^2.

5. The knitted fabric having a triple knit ply structure as claimed in claim 1, having a heat-insulation efficiency (α) of 18% or more.

6. The knitted fabric having a triple knit ply structure as claimed in claim 1, wherein the yarns from which the front surface knit ply is formed are bulky polyester multifilament yarns having a thickness of 20 to 17 dtex, and a thickness of individual filaments of 0.1 to 20 dtex.

7. The knitted fabric having a triple knit ply structure as claimed in claim 1, wherein the yarns from which the back surface knit ply is formed are constituted from at least one type of fibers selected from natural fibers, synthetic fibers, a regenerated fibers and semisynthetic fibers.

8. The knitted fabric having a triple knit ply structure as claimed in claim 1, having a tubular knit structure.

Fig.1

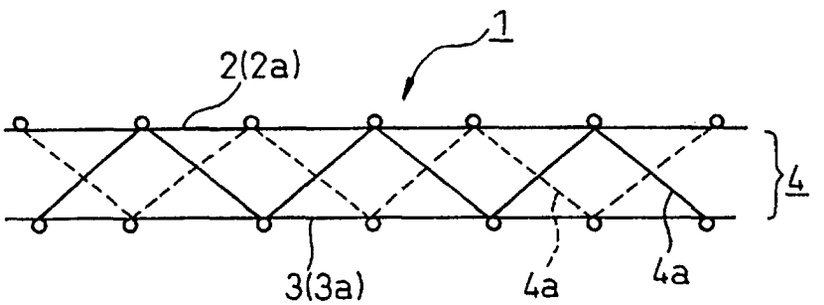


Fig.2

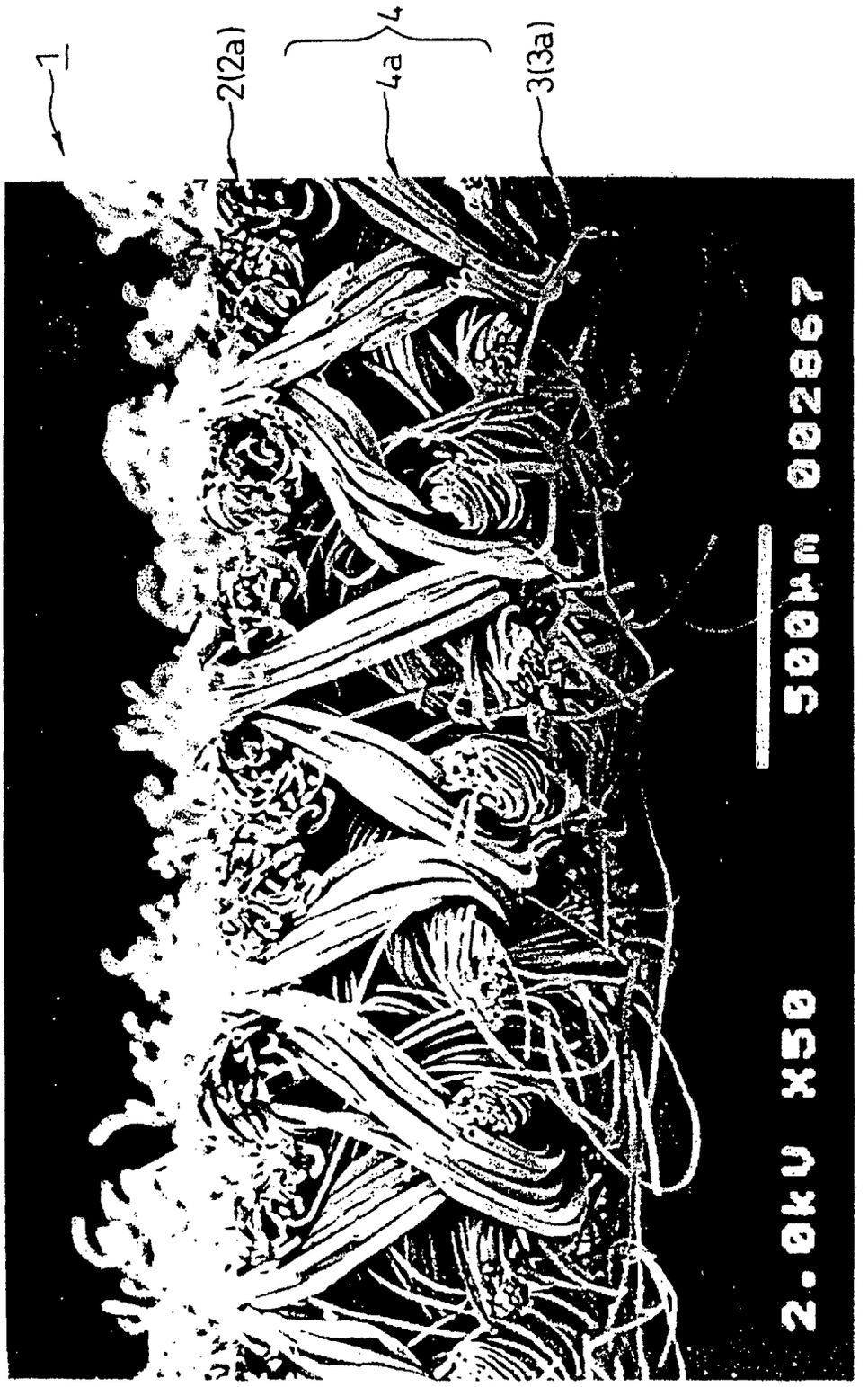


Fig.3

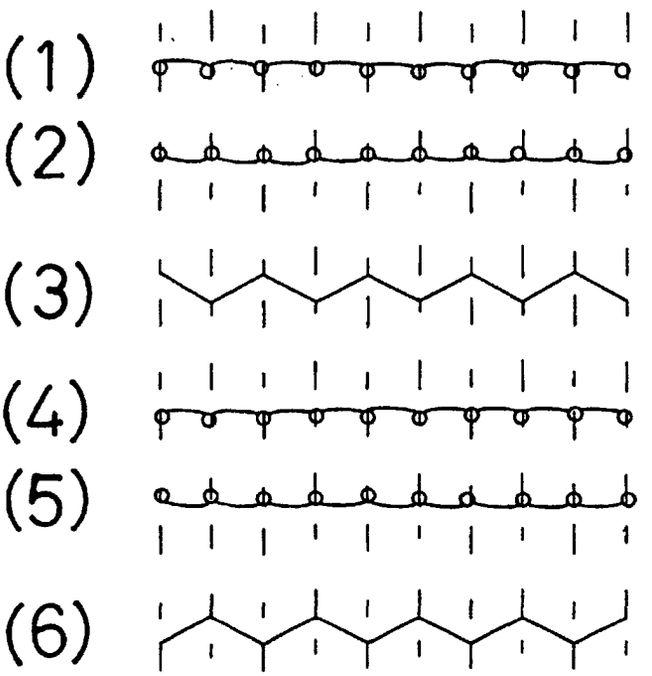
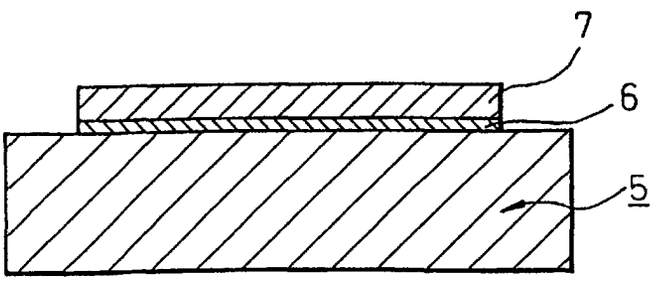


Fig.4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/01109

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] D04B1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] D04B1/00, 21/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Jitsuyo Shinan Toroku Koho	1996-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 43606/1987 (Laid-open No. 149983/1988) (Unitika Ltd.), 03 October, 1988 (03.10.88), (Family: none)	1-8
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 62755/1983 (Laid-open No. 169386/1984) (Toyobo Co., Ltd.), 13 November, 1984 (13.11.84), (Family: none)	3,4
A	JP 62-53454 A (Teijin Ltd.), 09 March, 1987 (09.03.87), Full text (Family: none)	3

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 May, 2002 (07.05.02)	21 May, 2002 (21.05.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/01109

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 5-148746 A (Unitika Ltd.), 15 June, 1993 (15.06.93), Full text (Family: none)	1-8
A	JP 10-1854 A (Asahi Chemical Industry Co., Ltd.), 06 January, 1998 (06.01.98), Full text (Family: none)	1-8

Form PCT/ISA/210 (continuation of second sheet) (July 1998)