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(11) **EP 1 330 963 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.07.2003 Bulletin 2003/31

(51) Int Cl.7: **A41D 13/012, B63C 11/04**

(21) Application number: **03250388.0**

(22) Date of filing: **22.01.2003**

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

(30) Priority: **25.01.2002 GB 0201714**

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(54) **Clothing for use in, under or above water activities**

(57) A garments is described which is typically manufactured smaller than the correct size for its intended wearer, the material from which said suit is made being stretchable so that the suit is a snug fit on the wearer. The suit is constructed from a plurality of panels (10,14,30,32) woven from synthetic or naturally occurring fibres joined to one another along their respective edges, usually along seams which are effectively sealed so that the resulting suit covers the entire body of the wearer excepting extremities and extends across the various joints of the wearer which would commonly be expected to flex during diving. The garment is additionally provided with at least one panel (30,32) in the region of one or more joints of the wearer which is of the same woven material as the remaining materials, but is a panel which is cut from the material on the bias as opposed to parallel to the warp or weft of the weave of that material. In this manner, an exceedingly elastic suit, at least in the region of the joints of the wearer when the suit is correctly worn, can be achieved.

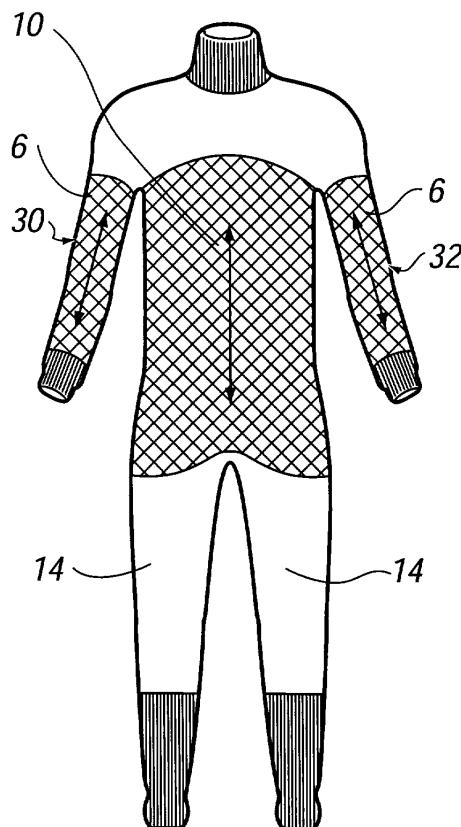


FIG. 2

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Description

[0001] This invention relates to clothing for use in activities which typically involve water, and more specifically the invention relates to dry or wet suits and the improvement in their construction.

[0002] Although the following description is almost exclusively concerned with the manufacture and provision of an improved dry suit for underwater diving, those skilled in the art will instantly appreciate that the invention may equally be applied to other types of suit which are required to be relatively close fitting and made normally in a woven or non-stretch material where toughness and resistance to abrasion and puncture is a prerequisite, in particular so called dry suits, and furthermore that the particular activity, pastime or sport for which such clothing may be used is to be generally disregarded in assessing the scope of protection provided hereby. The only proviso offered in this regard is that the activity performed in such clothing will generally involve some body movement and therefore the clothing worn must permit this.

[0003] Divers membrane drysuits have traditionally been layered in construction with one or more of the layers being manufactured using impermeable composite materials. For the most part the composite material is of a construction comprising outer layer(s) of square woven polyester, nylon or other synthetic woven textile materials adhered to one or both sides of an impermeable layer film or membrane. The outer woven textiles are resistant to sea water or other alternate environment in which the suit is likely to be used. The membrane layer may be constructed of butyl rubber, polyurethane, polyester or similar impermeable compound or material and is traditionally secured to the outer textile lining(s) by coating, gluing or other any other means suitable to give satisfactory adhesion.

[0004] It is possible to manufacture the composite material in the form of a two-layer composite wherein the outer lining is attached to only one face of the impermeable layer or as a three layer composite wherein an outer lining of woven synthetic textile material is attached to both faces of the impermeable layer. It is however to be mentioned that the invention is not to be considered limited to the use of only two or three layer composite fabric materials. Additional layers may be included for the purposes of making the composite material more thermally efficient or thermally reflective, increasing chemical and/or heat resistance, for making the respective surfaces of the material more receptive or suitable for the various different seaming methods which may be employed during suit manufacture, or for rendering the respective material surfaces more suitable for the fitting of attachments to the suit or for bonding further layers of different materials thereto.

[0005] The purpose of the textile layer(s) affixed to one or both sides of the impermeable membrane is to protect the impermeable layer from puncture and/or

damage by abrasion. Should the membrane become damaged and/or punctured to the extent that the composite material leaked; then the drysuit would be rendered dysfunctional and could more importantly endanger the life of the diver in certain situations.

[0006] Typically the weight of the layers of a composite material adapted for use in the manufacture of diving suits are within the following ranges, but it is to be mentioned that these in no way restrict the scope of the invention, as will be understood hereinafter: -

- A woven textile of 80 to 200 grams per square metre, one surface of which provides the external surface of the divers drysuit composite material and which would be subject to the rigours of the activity being undertaken in the suit;
- A woven textile of 40 to 150 grams per square metre which is sandwiched between the inner impermeable membrane and the abovementioned outer layer, and
- An impermeable membrane or film of 50 to 250 grams per square metre.

[0007] The importance of protecting the impermeable layer from damage and thus maintaining the impermeable characteristics of the drysuit as a whole is of the utmost importance. In circumstances where the impermeable membrane is punctured, ruptured or otherwise damaged, the suit will allow fluid to seep through the leak and the ability of the suit to withstand the pressure of the fluid externally of the suit is compromised. In cases where the drysuit is being used in deep water where fluid pressure is large, the result is at least a loss in the buoyancy provided by virtue of the encapsulation of the diver by the suit, which in turn could lead to uncontrolled ascent or descent. In severe circumstances, the diver may be injured, or more importantly may be drowned, suffer Nitrogen Narcosis, or experience decompression sickness more commonly known as the "Bends". A further danger of wearing a leaking dry suit during underwater activity, particularly in cooler and cold waters, is the almost total loss of thermal protection enabled or provided by the suit. This can lead to hypothermia and other low temperature exposure risks.

[0008] It is a commonly preferred to use "woven" textiles as opposed to "Knitted" textiles for the protective layers disposed to the outside of impermeable inner membrane, as such enhance puncture strength and abrasion resistance for the following reasons:

- Stronger non-elastic yarns can be used;
- Tighter weaves can be used offering better puncture resistance and strength;
- More cost effective in manufacture than knitted textiles.

[0009] The disadvantage of using "woven" textiles is the resistance to stretch along the warp and weft of the

material. Thus a divers membrane drysuit is normally required to be designed and manufactured with the following allowances:

- extra length in the body to facilitate bending forward of the body, sitting and crouching;
- extra length in the front of the knee and shin to allow the diver to bend their knees and crouch;
- extra length in the back of the arm in order to bend the arm at the elbow and to bring the arms forward without undue restriction across the shoulders of the suit.

[0010] The extra length in the design of the suit results in a "baggy" and "cumbersome" product that can hamper the movement of the diver or user and reduce comfort and impair safety. A further disadvantage is the fact that large pockets of air can be prevalent in a suit that is oversize leading to poor control of the buoyancy by the diver resulting in impaired safety as discussed above.

[0011] A yet further disadvantage, particularly when the need of drysuits to be snug and tight fitting is concerned, is such suits tend to involve considerable exertion on the part of the wearer as they attempt to climb inside the suit. This problem has heretofore been considered inextricable on account of the inability of the fabric to stretch as mentioned above.

[0012] It is an object of this invention to provide a suit consisting substantially of a woven synthetic or naturally occurring fibre and an impermeable membrane which is capable of stretching.

[0013] It is a further object of the invention to provide a stretchable garment being substantially of a woven synthetic or naturally occurring fibre construction and which fits a wide variety of differently sized and shaped individuals snugly and comfortably without appearing misshapen, baggy or otherwise deformed after a wearer has donned the garment.

[0014] According to the present invention there is provided a garment which consists of a plurality of panels woven from synthetic or naturally occurring fibres joined to one another along their respective edges, said garment being tailored so as to be a snug fit on the wearer, characterised in that the garment is of a shape, size and length so as to extend across one or more joints of the wearer which would commonly be expected to flex during wear, and in that the garment is provided with at least one panel in the region of the joint of said wearer which is cut on a bias as opposed to parallel to the warp or weft of the weave of that material.

[0015] Typically the garment is for use as an activity garment.

[0016] Most preferably, the garment is a diving wet or dry suit, consisting of a plurality of panels cut from a large piece of material in the conventional manner i.e. parallel to the warp or weft, and joined together in sealing manner along seams, and a plurality of bias cut pan-

els of the same material also incorporated into the garment in like manner to the conventional cut panel along seams, said bias cut panels being located orientated and disposed with the garment in the strategically chosen locations so as to permit the ultimate wearer of the garment to flex his joints easily without significant resistance on account of the capability of the bias cut panels to stretch.

[0017] Most preferably the orientation of the bias cut panels within the garment is arranged so that the direction of elongation or stretch which is experienced by those panels bisects the warp and the weft of the yarns in the panel.

[0018] Most preferably the garment is a wet or dry suit consisting of a plurality of conventionally cut panels and a plurality of bias cut panels seamingly and sealingly joined together, said garment having front and rear leg portions, front and rear torso portions, and front and rear arm portions which together define a cavity within the garment, said rear torso portion including a zip or other fastener to allow a wearer to don and remove the garment.

[0019] It is further preferable that one or more of the panels which constitute the front leg portions of the suit, particularly in the region where the shin, knee and front thigh of the wearer would be disposed when the suit is being worn, is bias cut.

[0020] Preferably one or more of the panels which constitute the rear arm portions of the suit, particularly in the region where the elbows of the wearer would be disposed when the suit is being worn, is bias cut.

[0021] Preferably one or more of the panels which constitute the rear torso portion of the suit, particularly in the region above where the buttocks of the wearer would be disposed when the suit is being worn, is bias cut.

[0022] It is currently well known that a property however of woven textile materials is that they will stretch along the bias (diagonal) of the weave, typically within a range of 30 to 60 degrees to the weft or warp.

[0023] The present invention takes advantage of this feature and by careful cutting of the composite material comprising woven material and impermeable membrane, and strategic orientation and positioning of the resulting bias cut panels, a suit can be provided which can expand or stretch in these panels where stretch as required by the motion of the wearer during the activity undertaken. Equally importantly, the capability of the bias cut panels to elastically recover to their original shape and size after having been stretched allows the suit as a whole to recover its original shape and thus continue to remain a snug fit on the wearer.

[0024] Typically said bias cut panel or panels are formed of the same woven material as the other material panels of the garment. The garment is dimensioned so as to be worn by wearers of defined size and typically a garment for a particular wearer size is of smaller dimensions than would a non stretching garment for the same

wearer size.

[0025] In a further aspect of the invention there is provided a method of forming a garment of clothing from a series of panels of material of synthetic or naturally occurring fibres, said panels joined together along their common edges to form seams of the garment and the garment itself and characterised in that at least one of the panels of the material is at least one of said panels is arranged and formed such that it is cut on a bias as opposed to parallel to the warp or weft of the weave of the material.

[0026] Typically the said panel or panels are located on the garment so as to lie adjacent a joint of the wearer of the garment when worn. Typically the method includes the step of positioning and joining a panel which is cut at a bias to the weft or warp of the material of the panel to lie adjacent each of the body joints of the wearer which lie within the garment when worn.

[0027] Depending upon the actual activity being undertaken by the user of the suit it may be more advantageous to locate the bias cut panels in different areas. By these means the suit can be made to offer the user a much better and closer fit without restricting body movement of the user. The cutting of the material on the bias can improve the stretch in the order of 700% as opposed to the material being cut directly along the alignment of the weft and/or warp.

[0028] The invention will be better understood with reference to the accompanying specific embodiment which is provided by way of example with reference to the following diagrams:

Figure 1 shows schematically a front elevation of a diving wet of dry suit, and

Figure 2 shows a rear elevation of the diving suit of Figure 1.

[0029] Referring to the Figures, a diving suit is provided with front and rear arm portions, 4, 6, front and rear torso portions 8, 10, and front and rear leg portions 12, 14 respectively. Each of these portions may consist of a plurality of separate panels of composite laminate material comprising at least a woven synthetic or naturally occurring fibre (but most likely a synthetic yarn of polymer or plastics material), and an impermeable membrane sealingly and securely adhered thereto. Each of the panels which constitute a particular portion are sealingly secured to one another along their edges and also to the edges of other panels which constitute the different portions of the suit. The manner in which the panels are joined to one another, and the particular disposition and orientation of panels and their seams is part of the current state of the art and therefore not discussed here or shown in the diagrams.

[0030] It can be seen from the figures that elasticated cuffs 16, ankle portions 18 and neck portions 20 are provided to ensure that the body of a wearer is encapsulat-

ed therein to enhance his buoyancy when underneath the water as mentioned above.

[0031] In accordance with the invention, certain of the plurality of panels which are used in the manufacture of the suit are bias cut as opposed to warp/weft cut, and furthermore the location and orientation of these bias cut panels within the suit is chosen so as to allow a significant degree of stretch in those portions of the suit which are most typically stretched by virtue of the movement of the wearer, depending on the activity pursued.

[0032] For example, when the wearer of the suit wishes to kneel or bend his knees towards his chest, the front leg portions of the suit, particularly in the region of the knees and perhaps less so the shins and lower thighs, are stretched, and in a conventional suit where all the panel from which its construction are warp/weft cut, such extension is generally impossible. Accordingly, the movement of the wearer is immediately restricted unless additional material is included in these panels to permit the movement. In the normal upright posture, or when the wearer's knees are not bent, this additional material is manifested by the suit being baggy and appearing not to fit the wearer in this region.

[0033] In Figure 1, the suit according to the invention is thus provided with bias cut composite material panels in the region of the shins and knees of the wearer as shown at 22, 24 in the hatched region. The direction of extension capable by these panels is shown by arrows 26, 28.

[0034] It will also be appreciated that in bending the elbows, the wearer of the suit will exert a force which tends to stretch the panels of material between the elbows and the wrists, and possibly also between the elbows and the shoulders. Accordingly, bias cut fabric panels 30, 32 may be used in the construction of the rear arm portions 6 of the suit.

[0035] Finally, when the wearer bends forward from the waist, the panels constituting the rear back portion 10 of the suit are likely to be stretched, and therefore again it is useful to include bias cut panels in this region.

Claims

1. A garment which consists of a plurality of panels woven from synthetic or naturally occurring fibres joined to one another along their respective edges, said garment being tailored so as to be a snug fit on the wearer, **characterised in that** the garment is of a shape, size and length so as to extend across one or more joints of the wearer which would commonly be expected to flex during wear, and **in that** the garment is provided with at least one panel in the region of the joint of said wearer which is cut on a bias as opposed to parallel to the warp or weft of the weave of that material.

2. A garment according to claim 1 **characterised in**

that the garment is a diving wet or dry suit, consisting of a plurality of panels cut from a large piece of material in the conventional manner i.e. parallel to the warp or weft, and joined together in sealing manner along seams, and a plurality of bias cut panels of the same material also incorporated into the garment in like manner to the conventional cut panel along seams, said bias cut panels being located orientated and disposed with the garment so as to permit the wearer of the garment to flex joints on account of the relative capability of the bias cut panels to stretch.

3. A garment according to claim 1 **characterised in that** all the woven fibre panels from which the suit is constructed are cut on the bias.

4. A garment according to claim 1 **characterised in that** the orientation of the bias cut panels within the garment is arranged so that the direction of elongation or stretch of said panels bisects the warp and the weft of the yarns in the panel.

5. A garment according to claim 1 **characterised in that** the garment is a wet or dry suit for use in water consisting of a plurality of conventionally cut panels and a plurality of bias cut panels sealingly joined together, said garment having front and rear leg portions, front and rear torso portions, and front and rear arm portions which together define a cavity for the wearer within the garment, said rear torso portion including a zip or other fastener to allow the wearer to don and remove the garment.

6. A garment according to claim 5 **characterised in that** one or more of the panels which constitute the front leg portions of the suit, particularly in the region where the shin, knee and front thigh of the wearer would be disposed when the suit is being worn, is/are bias cut.

7. A garment according to claim 5 **characterised in that** one or more of the panels which constitute the rear arm portions of the suit, particularly in the region where the elbows of the wearer would be disposed when the suit is being worn, is/are bias cut.

8. A garment according to claim 5, **characterised in that** one or more of the panels which constitute the rear torso portion of the suit, particularly in the region above where the buttocks of the wearer would be disposed when the suit is being worn, is/are bias cut.

9. A garment according to claim 1 **characterised in that** the angle of the bias cut is in the range of 30 to 60 degrees to the weft or warp.

10. A garment according to claim 9 **characterised in that** said panel or panels are formed of the same woven material as the other material panels of the garment.

11. A garment according to claim 1 **characterised in that** the garment is dimensioned so as to be worn by wearers of defined size.

12. A garment according to claim 11 **characterised in that** the garment for a particular wearer size is dimension smaller than would a non stretching garment for the same wearer size.

13. A method of forming a garment of clothing from a series of panels of material of synthetic or naturally occurring fibres, said panels joined together along their common edges to form seams of the garment and the garment itself and **characterised in that** at least one of the panels of the material is at least one of said panels is arranged and formed such that it is cut on a bias as opposed to parallel to the warp or weft of the weave of the material.

14. A method according to claim 13 **characterised in that** the said panel is located on the garment so as to lie adjacent a joint of the wearer of the garment when worn.

15. A method according to claim 13 **characterised in that** the method includes the step of positioning and joining a panel which is cut at a bias to the weft or warp of the material of the panel to lie adjacent each of the body joints of the wearer which lie within the garment when worn.

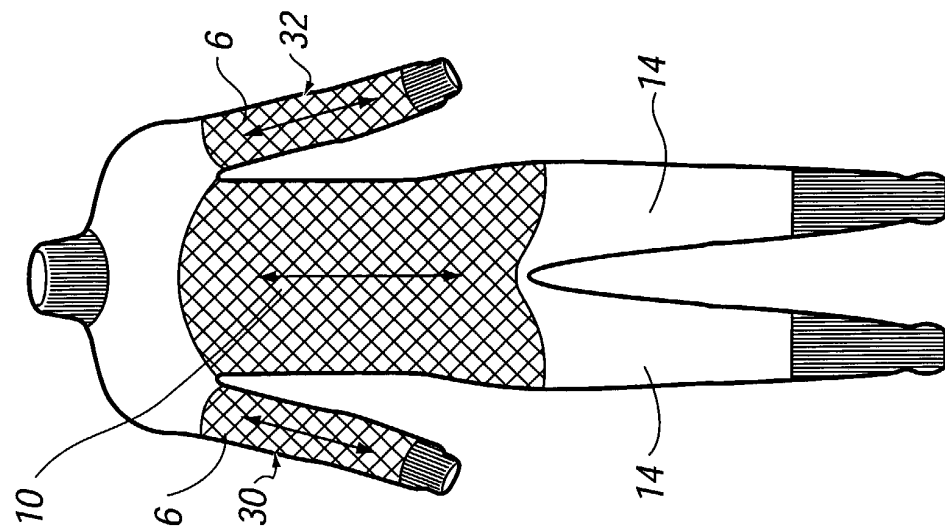


FIG. 2

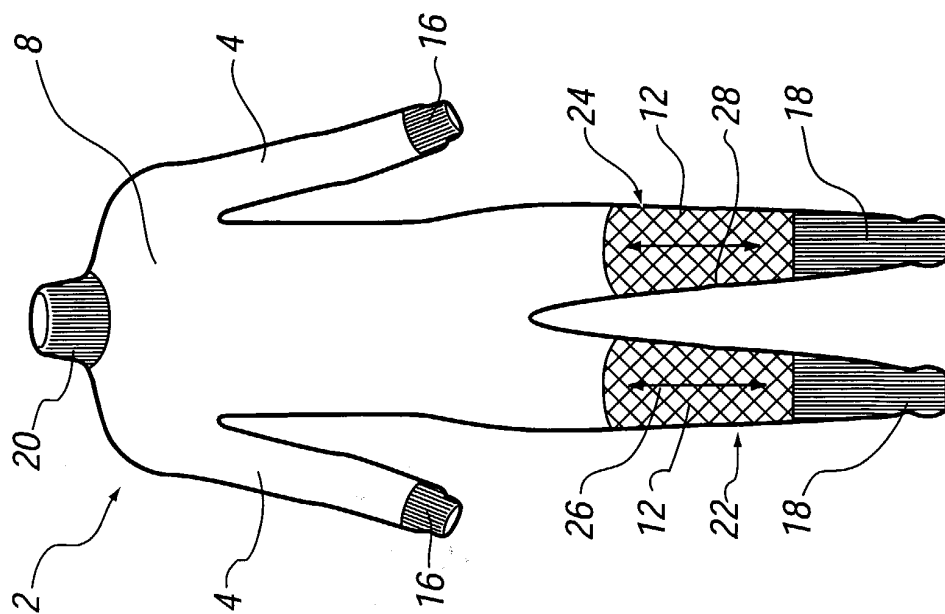


FIG. 1



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 03 25 0388

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X	US 5 768 703 A (MACHADO MARK R ET AL) 23 June 1998 (1998-06-23)	1,2, 11-13,15	A41D13/012 B63C11/04
Y	* column 3, line 62 - column 4, line 54 * * column 8, line 16 - line 20; figures 1,2 *	5-8	
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X	--- DE 197 03 481 A (INTERLOGISTIK LOTHAR MEYER HAN) 6 August 1998 (1998-08-06) * column 2, line 12 - line 31 * * column 3, line 14 * * column 3, line 42 - line 48 * * column 4, line 68 - column 5, line 3; claims 1,7,8,24,28; figures 1,3 *	1,4,13, 14	
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
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The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 1 April 2003	Examiner Uhlig, R
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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