Title: A THERMAL DUAL-LAYER UNDERGARMENT FOR A DRY DIVING SUIT

Abstract: A thermal insulating garment for an underwater diving suit has an inner insulating layer or thermal core and an outer elastomeric layer. The inner thermal core layer is larger than the outer layer. The inner thermal core thermal layer is temporarily fixed to the outer elastomeric layer by fastening means such as a hook and loop system. A zipper may be disposed between the two shoulders of the garment and across the chest of the garment to permit the top portion of the garment to be removed and permit diver entry and egress into the dry suit. There is a lamination seal at the ankles, wrists and collar of the garment.

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant’s entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant’s entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

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Description

Title of Invention: A THERMAL DUAL-LAYER UNDERGARMENT FOR A DRY DIVING SUIT

Technical Field

This invention relates to underwater diving equipment and more particularly to dry diving suits worn by professional and sports divers for warmth and protection while diving, and specifically a new thermal two-layer undergarment for a dry diving suit.

Background Art

Underwater diving in cold water requires a dry diving suit that is capable of insulating the diver from the temperature of the ambient water and its deleterious effects. A dry suit provides physical protection against water and obstacles that a diver may encounter. However, in cold water dives it is necessary for the diver to wear additional garments underneath the dry suit to keep warm. Wet suits, on the other hand, permit water to enter the suit forming a layer of water trapped between the diver's body and the suit. Once the water is trapped it is heated by the diver's body and provides a layer of insulation around the diver. Each of these systems has deficiencies.

Wet suits are unsuitable for cold water dives primarily because they allow water to come into contact the diver. Dry suits can be very cumbersome and stiff and so restrict the movement of the diver underwater. Furthermore, dry suits require water tight seals around ankles, wrists and the neck in order to prevent water from entering the dry suit and contacting the diver's body.

There have been a number of attempts to provide solutions to the problems of adequately insulating a diver in a dry suit from cold in a cold water dive. One such attempt is set out in US Patent 5,960,469 entitled LIQUID-INSULATED GARMENT FOR COLD WATER DIVING issued to Nuckolas et al. on Oct. 5, 1999. There is described a liquid insulated garment that supplements the internal thermal protection of traditional diving suit. The invention comprises bladders having insulating liquids which maybe heated. Such a device requires additional equipment for the diver to carry during a dive and may increase the cumbersome nature of the diving suit. Furthermore, the bladders may make ingress and egress from a dry suit more difficult for the diver.

Therefore, there is an ongoing requirement for an easily worn insulating garment for divers to wear during cold water dives under a dry suit which is easy to put on, easy to take off and does not restrict diver movement inside the suit. There is a further need for an insulating garment that can be used in fewer sizes to fit a wider range of end users thereby reducing inventory requirements and associated costs for retailers and distributors.
Disclosure of Invention

Technical Problem


[7] It is an object of the present invention to provide a two-layered dry diving suit undergarment that is capable of insulating a diver during a cold water dive. The insulating garment would include an inner thermal dry core which can be a stretch or non-stretch fabric and an outer garment that comprises an elastomeric fabric.

[8] In one embodiment of the invention, the inner thermal core is a non-stretch fabric such as PRIMALOFT® insulating material. In another embodiment the inner thermal core can be an insulating mesh or a fleece.

[9] In another embodiment of the invention the inner thermal core layer is over-sized and has a larger surface area than the outer stretch layer. Therefore the inner thermal core layer is not required to stretch. The outer stretch layer pulls in the internal non-stretch layer resulting in a highly mobile streamlined fit. It further expels excess air that may be trapped in the looser fitting inner thermal core layer. This increases mobility of the diver and aids in the control of buoyancy.

[10] It is a further object of the invention to provide an insulating undergarment that is streamlined to the contours of the diver's body thereby permitting a wide range of movement within a dry suit.

[11] In another embodiment of the invention, the outer stretch layer pulls in the oversized inner insulating layer, placing the bulky inner layer insulating materials snug in the armpits and crotch of the diver. This also allows the diver maximum mobility.

[12] In another embodiment of the invention the outer stretch layer can be made with high stretch fleece offering additional thermal protection in combination with an oversized inner thermal core.

[13] Another advantage of the invention is that it provides for an undergarment for insulation which can be manufactured in a limited number of sizes to suit all body sizes of divers in order to save on manufacturing costs and inventory. The result is that only about half the number of sizes typically stocked will be required to fit the same number of body types.

[14] In another embodiment of the invention the insulating undergarment may comprise a fleece inner layer and a Lycra® outer layer.

[15] In yet another embodiment of the invention the outer layer can be any high stretch material such as a thin super stretch neoprene, a non-insulating stretch mesh, or insulating like a super stretch fleece.

[16] In one of the embodiments of the invention, the insulating undergarment inner layer
maybe sewn into the outer layer.  

In a further embodiment, the inner insulating layer may be attached to the outer layer by means such as a hook and loop system. In other embodiments, buttons, magnets and, sticky adhesive may be used.

In yet another embodiment of the invention the layers of the garment are not attached and just placed one over the other.

Another advantage of the present invention is that it allows use of technical thermal fabrics that traditionally would have resulted in a very bulky low mobility garment.

Yet another advantage of the invention is that by adding the secondary form fitting stretch outer layer over an oversized inner thermal core, maximum mobility is achieved while using non stretch, or low stretch bulky thermal fabrics.

**Advantageous Effects**

**Description of Drawings**

Figure 1 shows a diver wearing a dual-layer dry suit insulating garment of one embodiment of the invention.

Figure 2 shows an arm of the invention illustrating the wrist cuff lamination.

Figures 3A-3C illustrate another embodiment of the invention where in adhesive sites are placed on the exterior of the insulating layer in order to fasten to the inside surface of the elastomeric layer.

**Best Mode**

Referring to Figure 1, the invention 10 is a dual-layered insulating garment for covering a wearer's 22 torso, arms and legs in order to provide thermal protection for the wearer during a cold water dive. The invention is worn under a dry suit. The dual-layered insulating garment 10 comprises an inner thermal insulating layer 12 showing in solid line, an elastomeric outer layer 14 shown in broken line. The outer layer can be an insulating or a non-insulating layer. The garment further comprises a torso portion 13 for covering the wearer's torso, a left 15 and right 17 arm portion attached to the torso portion and for receiving the wearer's left and right arms up to their respective wrists, a left 19 and right 21 leg portion attached to the torso portion for receiving the wearer's left and right leg up to their respective ankles and a neck portion 23 attached to the torso portion including a neck receiving portion 25. The garment also comprises an entry system 27 for entry and exit. The inner layer 12 is internally secured to the elastomeric outer layer 14 as further explained below. The elastomeric outer layer 14 comprises a stretch fabric such as Lycra®, high stretch thin neoprene, high stretch
[27] Still referring to Figure 1 and Figure 2 the inner layer 12 is secured to the elastomeric outer layer 14 at the ankles, wrists and neck receiving portion by respective ankle 18, wrist 16 and neck 20 seals. Figure 2 shows an enlarged diagram of a wrist seal 16. The respective ankle, wrist and neck seals are laminated seals formed from alternating inner layer material and elastomeric outer layer material. At the ankle the lamination seal 18 connects the bottom ankle cuff of the insulating layer and the outer layer. In other embodiments of the invention socks, gloves and hoods can be made in a similar fashion from similar materials and used as accessories to the diving suit. Therefore, rather than terminating at an ankle or wrist laminated seal, the garment would join a boot or a glove connected to the garment by a laminated seal formed between the garment and the boot or glove. As illustrated in Figure 2, at the wrists the lamination seal 16 connects the insulating thermal inner layer 12 with the outer stretch material 14. Referring to Figure 1, the neck lamination seal 20 connects the insulating thermal core layer 12 and the outer elastomeric layer 14. Figure 2 shows, for one embodiment of the invention, a drawing of one of the diver’s 22 arms 15 inside the insulating thermal core inner layer 12 covered by elastomeric layer 14. The wrist 16 lamination forms a seal around the wrist of the diver. As shown in Figure 1, the wrist lamination seal 16 may also attach to a glove or mitt 31. Referring to Figure 1, a similar configuration can exist for the leg 19/21 of the insulation garment with the ankle 18 lamination forming a seal around the ankle of the diver. This seal may be joined to a boot 33.

[28] Still referring to Figure 1, the torso portion 13, the left and right arm portions 15 and 17 and the left and right leg portions 19 and 21 of the inner layer 12 have at least one pleat 24. The at least one pleat comprises at least one fold of inner layer material. When the dual-layered garment is worn by the wearer, the at least one pleat 24 is operative to create a sufficient amount of tension in the torso portion, the left and right arm portion and the left and right leg portion of the inner layer to urge the inner layer material to conform to the wearer’s body over a range of wearer sizes. It is anticipated that a minimum of five sizes will be needed to fit all customers. This will significantly reduce inventory costs for retailers and distributors. Furthermore when the dual-layered garment is worn by the wearer under a dry suit and in the water, the at least one pleat is operative to accommodate the movements of the wearer without causing movement restrictions. To further improve mobility of the garment when the dual-layered garment is worn by the wearer, the elastomeric outer layer is operative to compress the inner layer material to further conform to the wearer’s movements and expel any air pockets trapped between the wearer’s body and the garment. This will greatly improve buoyancy control of the diver.
In one embodiment of the invention, the inner layer is an insulating layer 12 and the elastomeric outer layer 14 is a protective non-insulating layer. In another embodiment of the invention the inner layer 12 is an insulating layer and the elastomeric outer layer is also an insulating layer 14.

Referring now to Figures 3A to 3C, in one embodiment of the invention there are temporary internal connecting sites 30 between the inner layer 12 and the elastomeric outer layer 14. These sites permit the elastomeric outer layer to lie in a flattened manner proximate to the inner layer. The result is that the garment fits snuggly against the form of the wearer permitting maximum mobility of the wearer. The plurality of temporary connecting sites may be disposed over the torso portion, the left and right arm portion and the left and right leg portion of the inner layer and the outer layer so that the connecting sides on both layers align. For example, the rump of insulating garment may have connecting sites so that this area of the garment is snug fitting. In one embodiment of the invention the plurality of temporary connecting sites comprise one of adhesive sites, hook and loop connection sites, magnetic connector sites and snap button sites.

Referring back to Figure 1, the dual-layered garment entry system 27 is disposed between the neck portion 23 and the torso portion 13. The entry system 27 comprises a shoulder to opposite shoulder closable opening 26 descending downwards from a first shoulder then arcing across wearer's chest and then rising to an opposite shoulder. In one embodiment of the invention the closable opening is a zipper. At the closable opening the inner layer and the elastomeric outer layer are sealed by a laminate seal 28. Entry zippers can be run in both directions and so this embodiment is not to be limiting. There could also be an embodiment with no zipper where closure is achieved by overlapping flaps. The inner insulating layer and the outer elastomeric layer are jointed at the zipper lamination 26. In other embodiments of the invention the inner and out layers may utilize different closure systems. For example, the inner thermal core layer may use a zipper system and the outer stretch layer may user another closure system such as a hook and loop system. The inner thermal core layer and outer stretch layer may both use zippers that run in opposite directions.

In one embodiment of the invention, when the zipper connects both the inner thermal core layer and the outer stretch layer, and when the zipper is opened the top neck portion 23 of the garment is separated from the torso portion 13 along the lamination line 26. The top neck portion 23 can then be folded back. This permits the wearer to enter garment in a feet-first fashion. The wearer pulls the garment over legs, torso and arms. If boots/socks and gloves/mits are fixed to the ankle and wrist seals of the garment then the wearer will insert feet and hands into them. The garment is pulled up over the torso 13. The neck portion 23 of the insulating garment unzipped will be
hanging over the back of the diver 22. The neck portion 23 is then flipped forward over the head of the diver and the neck cuff 25 is pulled down over the head of the wearer and so that it sits on the shoulder portion of the wearer. The wearer will then close the zipper 28 there by closing the insulating garment. The neck cuff 25 is sealed by lamination seal 20. The wearer is then free to put on the dry suit.

Although the above description is specific, it should not be considered as a limitation on the scope of the invention, but only as an example of the preferred embodiment. Many variations are possible within the teachings of the invention. For example, the garment can be made in a variety of fabric type materials. It can be made of a variety of sizes. The relative positions and shapes of the elements can vary. It may be provided with surface indicia, such as crests, logos, emblems, etc. Therefore, the scope of the invention should be determined by the appended claims and their legal equivalents, not by the examples given.

**Industrial Applicability**

**Sequence List Text**
Claims

[Claim 1] A dual-layered insulating garment for covering a wearer's torso, arms and legs in order to provide thermal protection for said wearer during a cold water dive, said dual-layered insulating garment comprising:
   a. an inner thermal core layer for thermal protection;
   b. an elastomeric outer layer so that said inner thermal core is snug against the wearer;
   c. a torso portion for covering the wearer's torso, a left and right arm portion attached to said torso portion for receiving the wearer's left and right arms up to their respective wrists, a left and right leg portion attached to the torso portion for receiving the wearer's left and right leg up to their respective ankles and a neck portion attached to the torso portion including a neck receiving portion; and,
   d. an entry system for wearer entry and exit into the garment; wherein said dual-layered insulating garment is worn beneath a dry-suit.

[Claim 2] The dual-layered insulating garment according to claim 1 wherein the inner thermal core layer is internally secured to the elastomeric outer layer.

[Claim 3] The dual-layered insulating garment according to claim 2 wherein the inner thermal core layer is secured to the elastomeric outer layer at said ankles, said wrists and said neck receiving portion by respective ankle, wrist and neck seals.

[Claim 4] The dual-layered insulating garment according to claim 3 wherein said respective ankle, wrist and neck seals are laminated seals formed from alternating inner thermal core layer material and elastomeric outer layer material.

[Claim 5] The dual-layered garment according to claim 1 wherein the torso portion, said left and right arm portion and said left and right leg portion of the inner layer have at least one pleat.

[Claim 6] The dual-layered garment according to claim 5 wherein said at least one pleat comprises at least one fold of inner thermal core layer material.

[Claim 7] The dual-layered garment according to claim 6 wherein when the dual-layered garment is worn by the wearer, said at least one pleat is operative to create a sufficient amount of tension in the torso portion, the left and right arm portion and the left and right leg portion of the
inner thermal core layer to urge the inner thermal core layer material to conform to the wearer over a range of wearer sizes.

[Claim 8] The dual-layered garment according to claim 7 wherein when the dual-layered garment is worn by the wearer and the at least one pleat is operative to accommodate the movements of the wearer.

[Claim 9] The dual-layered garment according to claim 8 wherein when the dual-layered garment is worn by the wearer, the elastomeric outer layer is operative to compress the inner thermal core layer material snuggly against the wearer to further facilitate the wearer’s movements.

[Claim 10] The dual-layered garment according to claim 1 wherein the elastomeric outer layer is a protective non-insulating layer.

[Claim 11] The dual-layered garment according to claim 1 wherein the elastomeric outer layer is an insulating layer.

[Claim 12] The dual-layered garment according to claim 1 further comprising a plurality of temporary connecting sites between the inner thermal core layer and the elastomeric outer layer, so that the elastomeric outer layer lies in a flattened manner proximate to the inner thermal core layer and so that the dual-layered garment form fits the wearer permitting maximum mobility of the wearer.

[Claim 13] The dual-layered garment according to claim 12 wherein said plurality of temporary connecting sites facilitates the expulsion of a volume of excess air from within the dual-layered garment thereby improving buoyancy control of said dry suit.

[Claim 14] The dual-layered garment according to claim 13 wherein the plurality of temporary connecting sites are disposed in complementary adjacent pairs over an inside surface and an outside surface of the torso portion, the left and right arm portion and the left and right leg portion of the elastomeric outer layer and the inner thermal core layer respectively.

[Claim 15] The dual-layered garment according to claim 14 wherein the plurality of temporary connecting sites comprise one of adhesive sites, hook and loop connection sites, magnetic connector sites and snap button sites.

[Claim 16] The dual-layered garment according to claim 1 wherein said entry system is disposed between the neck portion and the torso portion.

[Claim 17] The dual-layered garment according to claim 16 wherein the entry system comprises a shoulder to opposite shoulder closable opening descending downwards from a first shoulder then arcing across wearer’s chest in and then rising to an opposite shoulder.

[Claim 18] The dual-layered garment according to claim 17 wherein said shoulder
opposite shoulder closure is a zipper.

[Claim 19] The dual-layered garment according to claim 18 wherein the inner thermal core layer and the elastomeric outer layer are joined and sealed by a laminate seal at said zipper.

[Claim 20] The dual-layered garment according to claim 1 wherein the inner thermal core layer has a first surface area and the elastomeric outer layer comprises a smaller second surface area so that when the garment is worn by a wearer the elastomeric outer layer compresses the inner thermal core layer over the wearer and forces inner thermal core layer material into an arm pit area and a crotch area of the wearer thereby eliminating inner layer bulk, expelling excess air and permitting improved mobility of the wearer while wearing a dry suit.
INTERNATIONAL SEARCH REPORT

International application No. PCT/IB2011/052802

A. CLASSIFICATION OF SUBJECT MATTER
IPC: A41D 13/012 (2006.01), A41D 13/002 (2006.01), B63C 11/04 (2006.01)
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)
IPC(2006.01): A41D, A41D 13/012, A41D 13/002, B63B 11/04 USPC: 2/2.16, 2/2.15

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

Electronic database(s) consulted during the international search (name of database(s) and, where practical, search terms used)
Canadian Patent Database (CPD), EPoque (Epopdoc), Google Patent, Google, Canadian Industrial Design Database

Keywords: dive, protect, diving, insulate, insulation, thermal, layer, elastomeric, stretch, elastic, underwear, undergarment, undersuit,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>CA 2,632,739 A1 (MYERSCOUGH, R. K.) 23 August 2007 (23-08-2007) <em>Whole Document</em></td>
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[X] See patent family annex.

[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

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<td>US3404406A</td>
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