(54) Title: A ROLL SEAL ASSEMBLY

(57) Abstract: A roll seal assembly for use on a dry suit for diving and other applications where water-tight sealing of garments is demanded. The seal joins a first tubular body to a second tubular body. The first tubular body has an extension comprising a third tubular body. The second tubular body has an extension comprising a fourth tubular body. The roll seal is formed by connecting the open ends of the third and fourth extensions using a fastener and then rolling the fastened ends over a stiff but pliable band.

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Description

Title of Invention: A ROLL SEAL ASSEMBLY

Technical Field

This invention relates to apparel and particularly to all dry suits and garment closures and specifically to a roll seal assembly for joining two pieces of a diving suit together in a water-tight relationship. The roll seal assembly of the present invention permits replacement of seals on dry suits in order to change their size or replace worn out or torn seals.

Background Art

Dry suits are used in a variety of applications including underwater sports such as diving, water surface sports such as windsurfing and cold water survival suits. In order for a dry suit to function correctly it is imperative that joints between various portions of the suit are water tight able to retain a water seal under pressure and movement of the wearer. Examples of where such seals may be found on a dry suit include glove and wrist seals, ankle and boot seals and hood seals. A variety of solutions have been proposed. One example is US Patent #5090057 for a "Combined Boots/Turnout Pant" issued to Aldridge et al on February 25, 1992. This invention describes a combination pant and boot joined by a first and second corrugated connection on the cuffs of the pant and boot. Such a seal is not suited to a dry suit used in underwater applications where ambient pressures are much higher. Additionally, the body movement of an underwater diver is different and involves a continuous movement of the legs and feet which may stress the type of seal disclosed by Aldridge et al. A second example is US Patent # 7062786 "Garment with releasable water-tight seal for neck and limbs" issued to Stinton et al on June 20, 2006. Sinton et al discloses a seal system used in a diving suit around the wrist, ankles and neck comprising a first and second annular interlocking seal members. The Stinton design is similar to the Aldridge design but uses a compression seal. The Stinton seal has disadvantages relating to the ability of the seal to withstand axial forces between the two joined garments. The Stinton seal may pull apart under axial loads. Therefore, there is a continued requirement for a releasable seal for a dry suit or similar garment that is water tight, pressure resistant and resistant to diver motion which may cause axial loads sufficient to pull the seal apart.

Disclosure of Invention

Technical Problem

Technical Solution

A roll seal assembly for joining a first tubular body open end to a second tubular
body open end comprises a third tubular body fixed to the first tubular body open end and a fourth tubular body fixed to the second tubular body open end. The third tubular body comprises an outside surface and an inside surface, a first open end fixed in a fluid-sealed relationship to the first tubular body open end, a second free open end adapted for roll sealing, a first band of first fastening means disposed around the outside surface of the first open end, a second band of first fastening means disposed around the outside surface of the second free open end. The fourth tubular body comprises an outside surface and an inside surface, a first free open end adapted for roll sealing, a second open end fixed in said fluid-sealed relationship to the second tubular body open end, a first band of second fastening means disposed around the outside surface of the second open end, a second band of second fastening means disposed around the inside surface of the first free open end. The first band of first fastening means is adapted to join the first band of second fastening means. The second band of first fastening means is adapted to join the second band of second fastening means. A sealing band disposed within the free open end of the third tubular body and fixed to the inside surface thereof. The first band of the second fastening means is disposed over the second band of the first fastening means in a press-fit relationship forming a first releasable joint between the free end of the fourth tubular body and the free end of the third tubular body. The releasable joint is disposed over the sealing band. A first turn of the sealing band is made towards the first tubular body. A second turn of the sealing band is made towards the first tubular body thereby placing the second band of second fastening means proximate to the first band of first fastening means. The second band of second fastening means is disposed over the first band of first fastening means in a press-fit relationship forming a second releasable joint between the first tubular body and the second tubular body. The third tubular body and the fourth tubular body are made from an elastic waterproof material such as latex, PVC or silicone. The first fastening means and the second fastening means comprise a hook and loop fastening system. In another embodiment of the invention the hook and loop system can be replaced by zippers, adhesive tape, magnets and snap fasteners.

**Advantageous Effects**

[5] Objectives and Advantages of the Invention

[6] It is one object of the present invention to provide a seal that is watertight under pressure caused by deep water emersion such as experienced by a dry suit for diving.

[7] It is another object of the invention to provide a seal that is suitable for joining two tubular bodies together.

[8] It is a further object of the invention to provide a seal that will resist axial loading.

[9] Another object of the present invention is to provide a seal that is seamless.

[10] Yet another object of the present invention is to provide a seal that is pliable and
Still another object of the invention is to provide a seal that can joint two garments together.

One advantage of the present invention is that it can be used in other applications such as closures for water-tight bags and for joining conduits that carry compressible or non-compressible fluids.

Another advantage of the present invention is that it can be use to join two flexible conduits together such as a hose or ducting.

Another advantage of the present invention is that the roll seals can be easily replaced on a garment such as a dry suit if the seals are damaged or if the seals need to be increased in size to improve the fit of the garment.

Another advantage of the invention is that the roll seal can be used to replace zipper fasteners used on dry suits.

**Description of Drawings**

Figure 1 is a drawing of a diver in a dry suit illustrating potential locations of the roll seals of one embodiment of the present invention.

Figure 2 is a view of a diver's arm with diving mitt and a roll seal of one embodiment of the present invention.

Figures 3A to 3E shows a sequence of steps used to create a roll seal between two garment pieces.

Figure 4 is a cross section of one embodiment of a roll seal of the present invention.

Figure 5 is a view of a dry suit having an entry portal sealed by one embodiment of the present invention.

**Best Mode**

The invention is best explained with reference to a single example of its application. Therefore, the example used is a dry suit garment and the attachment of a glove or boot to the dry suit. As previously noted and claimed herein, the invention can be used to close and seal in a water-tight relationship a variety of tubular bodies.

Referring now to Figure 1 there is shown a diver 10 wearing a dry suit 12. The dry suit generally has connecting garments which require sealing at the neck 14, wrist 16 and ankle 18. These garments can comprise gloves, mitts, boots and hoods. Referring to Figure 2, there is shown, as an example, the sleeve of a dry suit 12 connected to a mitt at the wrist 16 using the roll seal 22 of the present invention.

Figure 3A and Figure 3B illustrate how a wrist roll seal 22 is assembled.

Referring to Figure 3A there is shown the roll seal disassembled into a cuff portion 31 and a sleeve portion 33. The sleeve portion 33 is fixed to the end of arm 35 of the diving garment 12 by water proof stitching. The attachment point would be inside the
distal end of sleeve 35 around the base 37 of the sleeve portion 33 of the roll seal assembly 22. In this manner, should the sleeve portion 33 of the seal become damaged or worn it can be easily replaced and sewn back onto the sleeve 35. Furthermore, the seal can be replaced to suit a desired size change, that is, a larger or smaller seal. The sleeve portion 33 comprises a first band of fastening hooks 34 disposed around the outside of the sleeve portion 33 just above the base 37 of the sleeve portion where it joins the end of the arm 35 of the diving garment 12. A second band of fastening hooks 40 is disposed around the outside of the sleeve portion at the distal end 42 of the sleeve portion 33. There is further disposed a sealing band 30 of resilient material around the inside surface of the distal end 42 of the sleeve portion 33. The sealing band is of necessity harder than the material used for the rolled sections as described below in order to form a base for the rolled seal. Sealing band 30 retains the distal end 42 of the sleeve portion 33 open and in a generally circular shape and facilitates rolling the seal as more fully explained below. The sealing band must have some stiffness but remain flexible as well. The sleeve 35 of the dry suit 12 may terminate in a latex (or PVC or silicone) sleeve extension 47. An extended latex section 28 can be attached by stitching 36 so that there is sufficient rolling material between the first band of fastening hooks 34 and the second band of fastening hooks 40. The cuff portion 31 comprises a wrist sealing section 26 which comprises a section of latex shaped in the form of a truncated cone. The distal end 44 of the wrist sealing section 26 fits around the wrist in a water tight compression seal. Around the base of the wrist sealing section 26 there is a first band of loop fasteners 32. A second section of latex 37 is located between the first band of loop fasteners 32 and the base 41 of the cuff portion. A second band of loop fasteners 39 is disposed on the inside surface of the base 41 of the cuff portion 31. It is to be understood that zipper fasteners, can be used instead of hook and loop fasteners.

Referring now to Figure 3B, the first step in creating the roll seal is to join the cuff portion 31 to the sleeve portion 33 of the roll seal assembly 22. The band of fastening loops 39 is brought into overlapping contact with the second band of fastening hooks 40. The hooks and loops interact to form a joint at line 46 to hold the two portions together in a stable configuration while the seal is rolled into formation. Sealing band 30 is disposed beneath the hook and loop joint to prevent the now joined first and second latex extensions from collapsing.

Referring to Figure 3C, the second step in forming the roll seal is to roll the first band of loop fasteners 32 towards the sleeve 35. In this step the sealing band 30 is rolled a first time over second latex section 37 as shown in Figure 3C and then a second time as shown in Figure 3D.

Referring to Figure 3E, after the second roll, it is possible to bring the first band of fastening loop 32 into contact with the first band of fastening hooks to form a cover
over the rolled seal. The loop and hook fastener will absorb any axial stress between the sleeve 12 of the dry suit and the seal assembly 22. In other embodiments of the invention the loop and hook fasteners can be replaced by adhesive tape, a zipper fastener, magnetic fasteners and snap fasteners. As illustrated in Figure 1 and Figure 2 a boot, glove or hood can be attached to the cuff portion 31 of the seal assembly to provide a water-tight seal between the dry suit sleeve and the boot, glove or hood.

Referring to Figure 4 there is shown a cross-section of the completed roll seal assembly 22 which forms a water-tight, seamless and continuous seal between the sleeve 35 of the dry suit 12 and the garment attached over the wrist sealing section 26. It can be seen from Figure 4 that the resilient sealing band 30 forms the core of the seal. The hook and loop fastener combinations (39 and 40) and (32 and 34) resist any axial forces between the sleeve of the dry suit and the attached garment. The rolled latex (or PVC or silicone) extension 28 wrapped around the sealing band provides a water-tight seal.

Referring to Figure 5 there is shown a view of a dry suit having an entry portal 90 that is sealed by a roll seal 92. The roll seal could replace the use of a dry zipper seal as shown in Figure 1.

These and other objects, features, and characteristics of my invention will be more apparent upon consideration of the following detailed description and appended claims with reference to the accompanying drawings, wherein like reference numerals designate corresponding parts in the various figures.

**Mode for Invention**

**Industrial Applicability**

**Sequence List Text**
Claims

[Claim 1] A roll seal assembly for joining a first tubular body open end to a second tubular body open end, said roll seal assembly comprises a third tubular body fixed to said first tubular body open end and a fourth tubular body fixed to said second tubular body open end, wherein: (1) said third tubular body comprises: (i.) an outside surface and an inside surface; (ii.) a first open end fixed in a fluid-sealed relationship to the first tubular body open end; (iii.) a second free open end adapted for roll sealing; (iv.) a first band of first fastening means disposed around said outside surface of said first open end; (v.) a second band of first fastening means disposed around the outside surface of said second free open end; and wherein, (2.) said fourth tubular body comprises: (i.) an outside surface and an inside surface; (ii.) a first free open end adapted for roll sealing; (iii.) a second open end fixed in said fluid-sealed relationship to the second tubular body open end; (iv.) a first band of second fastening means disposed around said outside surface of said second open end; (v.) a second band of second fastening means disposed around said inside surface of said first free open end; and wherein, (3.) said first band of first fastening means is adapted to join said first band of second fastening means, and wherein, (4.) said second band of first fastening means is adapted to joint said second band of second fastening means.

[Claim 2] The roll seal of claim 1 further comprising a resilient sealing band disposed within the free open end of the third tubular body and fixed to said inside surface thereof.

[Claim 3] The roll seal of claim 2 wherein the first band of the second fastening means is disposed over the second band of the first fastening means in a press-fit relationship forming a first releasable joint between the free end of the fourth tubular body and the free end of the third tubular body.

[Claim 4] The roll seal of claim 3 wherein said releasable joint is disposed over said sealing band.

[Claim 5] The roll seal of claim 4 further comprising a first turn of the sealing band towards the first tubular body.

[Claim 6] The roll seal of claim 5 further comprising a second turn of the sealing
band towards the first tubular body thereby placing the second band of second fastening means proximate to said first band of first fastening means.

[Claim 7] The roll seal of claim 6 wherein the second band of second fastening means is disposed over the first band of first fastening means in a press-fit relationship forming a second releasable joint between the first tubular body and the second tubular body.

[Claim 8] The roll seal of claim 7 wherein the third tubular body and the fourth tubular body are made from an elastic waterproof material.

[Claim 9] The roll seal of claim 8 wherein the third tubular body and the fourth tubular body are made from one of latex, PVC and silicone.

[Claim 10] The roll seal of claim 9 wherein the first fastening means comprises a plurality of loop fasteners of a hook and loop fastening system.

[Claim 11] The roll seal of claim 10 wherein the second fastening means comprises a plurality of hook fasteners of said hook and loop fastening system.

[Claim 12] The roll seal of claim 11 wherein the first tubular body comprises one of the sleeve, the leg and the neck of a garment.

[Claim 13] The roll seal of claim 12 wherein the second tubular body comprises a garment attachment.

[Claim 14] The roll seal of claim 13 wherein said garment attachment comprises one of a glove, a boot and a hood.

[Claim 15] The roll seal of claim 11 wherein said garment is a dry suit.

[Claim 16] The roll seal of claim 11 wherein the garment is a survival suit.

[Claim 17] The roll seal of claim 11 wherein the garment is a pair of fish waders.

[Claim 18] The roll seal of claim 11 wherein the garment is a dry suit jacket having interchangeable neck and wrist seals.

[Claim 19] The roll seal of claim 10 wherein the first tubular body and the second tubular body comprise a conduit for a non-compressible fluid.

[Claim 20] The roll seal of claim 10 wherein the first tubular body and the second tubular body comprise a conduit for a compressible fluid.

[Claim 21] The roll seal of claim 10 wherein the first tubular body is a tubular container having a first open end and a second closed end.

[Claim 22] The roll seal of claim 21 wherein the second tubular body is a tubular cover for said tubular container, wherein said tubular cover has a first open end for closing over said tubular container first open end and a second closed end.

[Claim 23] The roll seal of claim 10 wherein the first tubular body comprises a jacket of a jacket and a pants set.
[Claim 24] The roll seal of claim 23 wherein the second tubular body comprises said pants of said jacket and pants set and further wherein the roll seal is a torso seal.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC: B63C 11/04 (2006.01) . B63C 9/087 (2006.01) (more IPCs on the last page)
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: B63C 11/04 (2006.01) . B63C 9/087 (2006.01) (more IPCs on the last page)

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 practicable, search terms used)
Canadian Patents Database, EPDOC, English FullText
Keywords : roll, seal, tube, press/fit dry suit, wet suit, diving

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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GB2166039A

Publication Date: 30 April 1986 (30-04-1986) | EP0181717A1, GB842870S0D0, GB8427088D0 |


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