Oct. 16, 1962 N. O. GUGEN 3,058,187

SEALING MEANS FOR AN APERTURE IN AN ARTICLE COMPRISED OF FLEXIBLE SHEET MATERIAL

Filed Dec. 12, 1958 2 Sheets-Sheet 1

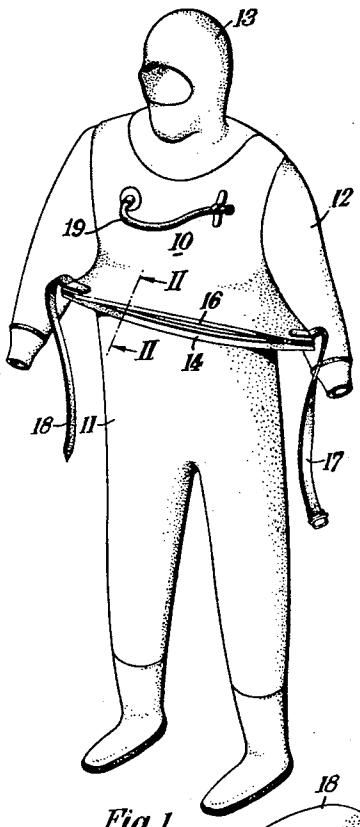


Fig. 1.

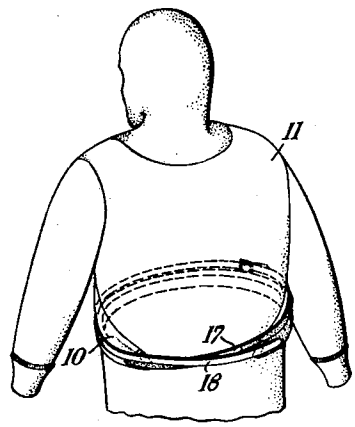


Fig. 4.

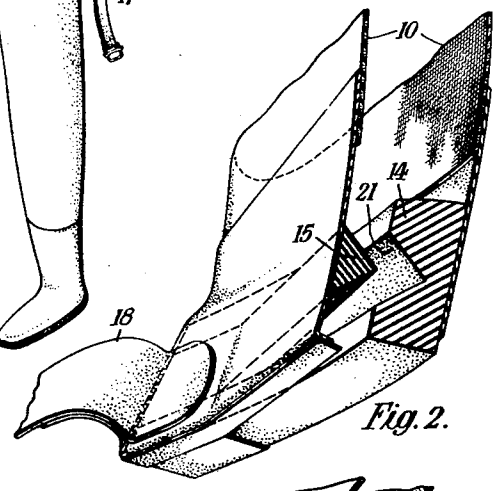


Fig. 2.

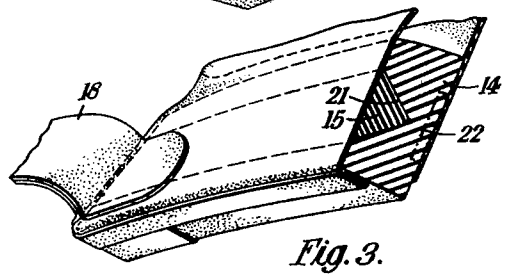


Fig. 3.

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SEALING MEANS FOR AN APERTURE IN AN ARTICLE COMPRISED OF FLEXIBLE SHEET MATERIAL

Filed Dec. 12, 1958 2 Sheets-Sheet 2

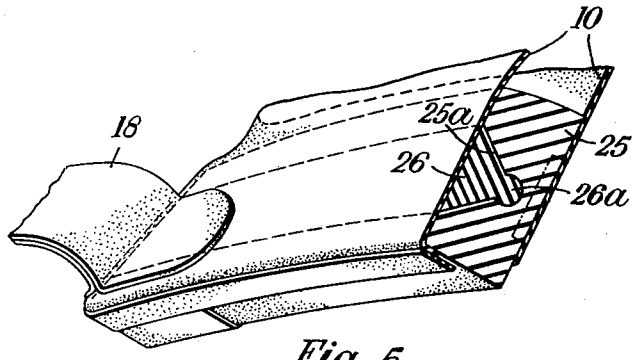


Fig. 5.

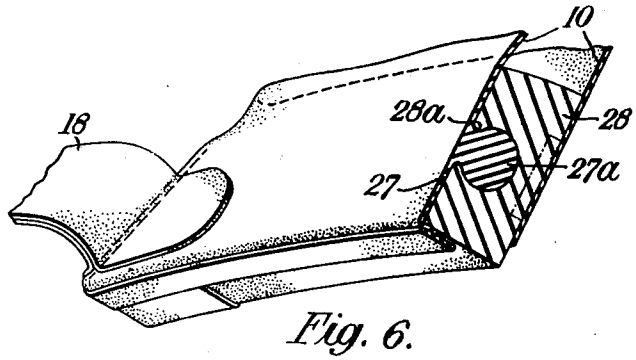


Fig. 6.

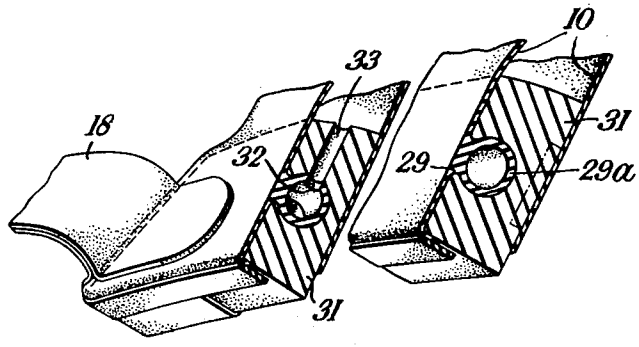


Fig. 7.

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3,058,187

SEALING MEANS FOR AN APERTURE IN AN ARTICLE COMPRISED OF FLEXIBLE SHEET MATERIAL

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5 Claims. (Cl. 24—201)

The invention relates to improved sealing means for an aperture in an article comprised of flexible sheet material and is particularly suitable for sealing the entry sleeve of a diving suit. Diving suits are known which have a sleeve mounted on the chest part of the suit, through which the diver may enter the suit. The aperture of said sleeve needs to be sealed against the ingress of water and one object of the present invention is to provide a simple and effective sealing means therefor.

According to the invention means for sealing an aperture in an article of flexible sheet material comprises two strips of material to which the entire edge of said aperture can be sealed, said strips being of unequal length and flexibility and being sealed together at their respective ends, the shorter strip being of sufficiently elastic material to enable it to be stretched over the entire length of the longer strip, the longer strip having sufficient stiffness to be capable of being maintained in a bowed condition over its entire length when the shorter strip is stretched thereover to effect a substantially fluid-tight seal.

In order that the invention may be more readily understood reference will be made to the accompanying drawings which illustrate by way of example a preferred embodiment thereof applied to the entry sleeve of a diving suit.

In the drawings:

FIG. 1 is a perspective view of a diving suit having an entry sleeve to which the improved sealing means are fitted, the aperture to the sleeve being shown in the open and unsealed condition,

FIG. 2 is a sectional perspective view of the sleeve on the line II—II of FIG. 1 showing the sealing means on an enlarged scale,

FIG. 3 is likewise a sectional perspective view of the same part of the sleeve as FIG. 2 but showing the aperture to the sleeve in the sealed condition,

FIG. 4 is a rear view of the upper part of the diving suit shown in FIG. 1 showing the entry sleeve secured in the sealed condition,

FIG. 5 is a sectional view of a modified form of sealing means suitable for a suit such as an airman's suit which may be subjected to fluid pressure from within,

FIGS. 6 and 7 are sectional views of alternative forms of sealing means for use with suits and the like which are subjected to fluid pressure from within.

In the embodiment illustrated in the drawings the entry sleeve **10** is mounted on the chest part of a diving suit **11**. Such suits are usually known as front entry suits and in entering the suit the diver steps through the sleeve **10** whilst the suit is laid out on the ground, he then places one leg after the other into the leg and boot parts of the suit and draws the suit up above the waist. Thereafter first one and then the other arm is worked into the respective arm sleeves **12**, the hands being pushed through the elastic wrist seals. Next the entry sleeve **10** is raised above the head, the head is pushed through the neck of the suit and the entry sleeve **10** folded down over the chest into the position shown in FIG. 1.

The mouth or aperture of the entry sleeve **10** is sealed by means of two co-operating strips **14** and **15** of flexible waterproof material to which the entire edge **16** of the aperture of the sleeve is sealed. The strips **14** and **15**

which are clearly shown in FIGS. 2 and 3, and which together correspond in length to the periphery of the sleeve aperture, are of unequal length and flexibility and are sealed together at their ends. The longer strip **14** which is the inner strip in relation to the body when the suit is worn, is slightly longer than half the periphery of the sleeve aperture and is sufficiently stiff to form a bow curved towards the shorter and outer strip **15** when the aperture to the entry sleeve is open as shown in FIG. 2. The shorter strip **15** is of sufficiently elastic material to enable it to be stretched over the entire length of the longer strip **14** when required.

When it is required to seal the aperture to the entry sleeve **10** the said longer strip **14** is flexed from the position shown in FIGS. 1 and 2 so as to curve round the body of the diver as shown in FIGS. 3 and 4, that is, the direction in which the strip **14** is bowed is reversed. This reversal has the effect of stretching the shorter and outer strip **15** so that it bears tightly against the inner strip **14** as shown in FIG. 3, around the entire periphery of its curve and effectively seals the aperture. The two strips **14** and **15** may be held in the aforesaid curved and sealed condition by means of straps **17** and **18** attached to the respective ends of the strips and arranged to be secured together at the back of the waist of the diver as shown in FIG. 4. Any excess of air which is entrapped in the suit may be allowed to escape through the vent pipe **19** which is provided with a valve for the purpose. Alternatively the diver may blow air into the suit through the pipe **19**.

In order that the shorter strip **15** shall not slip off the longer strip **14** when the aperture in the sleeve is sealed, the strip **15** in the embodiment illustrated, is arranged to engage with a groove **21** in the outer surface of the strip **14**. Conveniently the strip **15** is of triangular cross section and the groove **21** is correspondingly shaped to receive it. This arrangement not only serves to locate the strip **15** along the strip **14**, but increases the surface areas of the two strips in contact and improves the seal. In alternative arrangements strips having other sections which respectively co-operate with each other, can of course be used and it may be desirable to provide them each with a series of grooves and ridges which respectively mate with each other. On the other hand a seal may be formed between two flat strips which are maintained in position one upon the other by means of surface friction. The strips are preferably formed of rubber, but may also be formed of synthetic resinous material.

In the case of divers with a large waist the curve of the strips near the ends, when the sleeve is secured, may be insufficient to ensure that the shorter strip **15** bears on the longer strip **21** with sufficient pressure. In order to overcome this disadvantage the ends of the two strips may be permanently curved by means of a metal stiffening strip which may be carried in a recess on the inner side of the strip **14** as shown in chain lines **22** in FIG. 3.

In an alternative arrangement not illustrated the diving suit may be provided with a rear entry, thus instead of the sleeve **10** being mounted on the chest part of the suit, it is mounted on the back. The sleeve is used and sealed in the same manner as described above except that in the sealed condition the sleeve **10** is folded down over the back of the diver and the sealing strips are curved round the divers waist at the rear and secured by straps led round to the front of the suit.

In the case of a diving suit the fluid pressure is applied to the outside of the suit and the sealing strips are pressed against the body of the diver. In the case of suits intended for airmen and certain industrial uses, which may be subjected to pressure from within, there is unlike a diving suit, no solid support for the sealing strips corresponding to that offered by the body of the wearer. Ex-

cept in the case of very low pressures therefore, suits which may be pressurised from within require a modified form of sealing strip. Examples of such modified forms of sealing means are illustrated in FIGS. 5, 6 and 7.

In FIG. 5 sealing strips **25** and **26** are shown mated together in the sealed condition. The sealing strips **25** and **26** operate in the same manner as the strips **14** and **15** described with reference to FIGS. 1 to 4, but the outer strip **26** is provided with a bead **26***a* and the inner strip **25** is provided with a correspondingly shaped groove **25***a*. Owing to the elasticity of the material of the strips the bead **26***a* can be pushed into the recess at the bottom of the groove **25***a* where by reason of its interlocking engagement it provides a more efficient seal against fluid under pressure within the sleeve **10**.

FIG. 6 shows another form of interlocking engagement between the sealing strips. In this case the outer strip **27** is formed with a bead **27***a* of part circular cross section which can be forced into a groove of corresponding cross section in the inner strip **28**, the elasticity of the material of the respective sealing strips being such as to enable the bead **27***a* to be pushed through the neck **28***a* of the inner strip **28**.

FIG. 7 shows a similar arrangement to FIG. 6 except that the outer sealing strip **29** is provided with a bead **29***a* of tubular form, the said bead being arranged to engage in a correspondingly shaped groove in the inner strip **31**. In order to improve the seal between the inner and outer strips **29** and **31** when fluid under pressure is applied to the seal from the inside of the sleeve **10**, the tubular bead **29***a* is connected with the interior of the sleeve **10** through passages **32** and **33** in the outer and inner strips respectively, as shown in the broken-away section of one end of the sealing strips to the left of FIG. 7. With this arrangement the greater the pressure within the sleeve the greater will be the pressure forcing the tubular bead **29***a* into contact with the groove in the inner strip **31**. This arrangement is suitable for suits in which a comparatively high pressure, for example, of four pounds per square inch or more, must be maintained within the suit.

Although the preferred embodiment of the invention has been specifically described with reference to sealing means for a diving or airman's suit, the sealing means has a number of other applications, such as the sealing of entries to tents, inflatable life rafts and the like. Moreover, although both strips have been specifically described as flexible, the longer strip may be formed as a rigid bow curved away from the shorter strip and over which the shorter strip may be drawn.

What I claim as my invention and desire to secure by Letters Patent is:

1. Means for closing in a fluid-tight manner, an aperture in an article of waterproof material, comprising two juxtaposed closure strips to which the entire edge of said aperture can be sealed, said strips being of unequal length and flexibility and being joined together at their respective ends, the shorter strip serving in its position of rest, to bow the longer strip into an arc in which the two strips are separated to form an entrance aperture, said shorter strip being sufficiently elastic to enable it to be stretched over the longer strip to effect a substantially fluid-tight seal therewith when said longer strip is bowed in the reverse direction said longer strip having a groove extending from end to end thereof on the side opposed to the shorter strip and having sufficient stiffness to be capable of being maintained in a bowed condition over its entire length when the shorter strip is stretched thereover to engage in said groove with a fluid tight fit.

2. Means as in claim 1 wherein the shorter strip has a cross section corresponding to that of said groove so as to fit closely therein.

3. Means as in claim 1 wherein the shorter strip has a cross section corresponding to that of said groove so as to fit closely therein, said groove being of triangular cross section.

4. Means as in claim 1 wherein the shorter strip has a cross section corresponding to that of said groove so as to fit closely therein, and wherein said groove and said shorter strip each have a cross section such that the two strips interlock when mated together, at least one of said strips being deformable to permit one to be mated with the other.

5. Means as in claim 1 wherein the shorter strip has a cross section corresponding to that of said groove so as to fit closely therein and wherein the shorter strip is provided with a tubular bead adapted to interlock with a correspondingly shaped groove in the longer strip, the said bead being closed at its ends but having a port adapted to communicate through a port in the longer strip with the interior of the article to be sealed.

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