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(56) References cited:
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GB-A- 2 269 485
US-A- 3 523 156

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Description

The present invention relates to the provision of environmental protection around wires, optical fibres or other elongate substrates.

It is often necessary to seal wires at their points of entry into housings in order to protect connectors or electronic components within the housing from moisture or other contaminants that might otherwise enter the housing through the opening provided for the wire. This problem frequently occurs in telecommunications networks where devices for connection, electrical protection or isolation, are positioned outside buildings and are expected to have a long life-time under unfavourable weather conditions.

The invention is therefore particularly concerned with a device comprising some form of housing which has means for sealing wires at or adjacent their points of entry.

US-A-3 523 156 (Phillips, Jr.) discloses a housing with cable entry apertures of generally U-shaped profile, each of which is provided with a moisture barrier of sponge rubber or the like. The barrier has a conductor passage linked by a slit to a flat surface at the open end of the U. A cable is placed against this surface and is manually displaced laterally into the barrier material to lodge in the conductor passage. A compression member is then tightened against the flat surface to put the barrier material under pressure.

GB-A-2 269 485 (MK Electric Ltd.) discloses a housing with a body portion and a lid having slots which, in the closed position, cooperate to define a cable passage. The body portion and lid are respectively provided with lower and upper gel sealing members which deform and flow around the cable when the lid is closed. In one embodiment the sealing members have a stepped profile and the cable may be completely surrounded by one or the other member.

US 4859809 (Jervis) discloses a splice case for sealing connectors joining small pair count telecommunications cables. First and second half-shells contain a gel sealing material and are held together by springs that function also to deform surfaces of the half-shells to put the sealing material therein under compression. The conductors enter the half-shells at their ends and lie between two layers of gel.

A two part closure for sealing wire connectors is also disclosed in US 4849580 (Reuter). Again, each part contains a sealing material.

Reference may also be made to US 4963700 (Olsen), US 3879775 (Dobbin et al), US 4610738 (Jervis), US 3757031 (Israel and DE G9004689.2 (3M). These documents confirm the common practice of providing sealing material in each of two half-shells that are brought together around the conductor to be sealed.

We have discovered that, particularly with careful choice of sealing material, a more economical sealing device can be produced.

Surprisingly a single layer of sealing material can be caused to fold, or wrap, around a conductor to be sealed by lateral displacement of the conductor into the sealing material. This preferably occurs as parts of a sealing device are closed around the conductor. Thus, the invention provides a device for forming a seal around an elongate member which comprises:

(a) a sealing material having a surface onto which the elongate member can be placed;

(b) means for displacing the elongate member substantially laterally away into the sealing material; and

(c) means for applying a force to said surface after displacement of the elongate member, thereby putting the sealing material under pressure.

Displacement of the elongate member into the sealing material will, in general, cause the sealing material to fold or wrap around the elongate member so that it forms a seal around its entire periphery. It is preferably the displacement itself which produces this result without any other displacement of the sealing material being required.

The man skilled in the art, after reading the specification, will be able to select sealing materials having the properties necessary to produce this result. The material is preferably sufficiently soft that the elongate member can be displaced laterally into it without damage to the elongate member. Where the elongate member is a wire typically used in a telecommunications network, we prefer that the sealing material have a Stevens Voland hardness of less than 60 g, preferably less than 45 g, more preferably less than 40 g, and especially less than 35 g. In order that the material have sufficient stability during its service life we prefer that its Stevens Voland hardness be greater than 10 g, preferably greater than 15 g. Stevens Voland hardness is measured on a Stevens LFRA Texture Analyser having a stainless steel circular spindle of diameter of about 0.64 cm, rotating in slow mode at 0.2 mm/second and in fast mode at 2 mm/second, the measurement being taken at a penetration of 4 mm. The material preferably has a certain elasticity and in particular preferably has an elongation to break of at least 100%, preferably at least 200%, more preferably at least 300%.

We prefer that, after displacement of the wire, not only that first and second parts of the surface of the sealing material contact one another around the wire, but also that the interface between those first and second parts disappears. It may disappear substantially immediately, or it may disappear gradually over time after the sealing material has been put under pressure. We prefer therefore that the sealing material has this property of eliminating an interface and this will generally mean that...
the sealing material is capable of, as it were, wetting itself.

A preferred class of materials that has this desirable property is that of liquid-extended polymers, in particular oil-extended polymers. Preferred materials may be classified as gels, as disclosed in US 4634207 (Debbaut). That specification discloses encapsulation of electrical contacts through the use of gels which have been preformed in the absence of the contact; the preformed gel and the contact being pressed against each other thus deforming the gel into close and conforming contact with the contact. In general the contact is pushed longitudinally into the gel, and there is no disclosure of a wire being displaced laterally as required by the present invention. US 4634207 discloses gels having a cone penetration value of at least 100, preferably 100-350, according to ASTM D217-68 at 21°C on an undisturbed sample using a standard 1:1 scale cone (cone weight 102.5 g, shaft weight 47.5 g), the penetration being measured after 5 seconds.

The gels disclosed also have an elongation of at least 200%, elongation being measured according to ASTM D638-80 at 21°C using a type 4 die to cut the sample and at a speed of 50 cm/minute. Suitable materials for the gel can be made by gelling a curable polyurethane, a silicone or a suitable block copolymer in the presence of substantial quantities of a mineral oil, a vegetable oil or a plasticizer. In the present invention any of these materials can be used, particularly those at the softer end of the above ranges. We particularly prefer a gel that comprises a styrene-ethylene/propylene-styrene (SBS) or a styrene-ethylene/propylene-styrene or a styrene-ethylene/propylene/ethylene/propylene-styrene block copolymer extended by a mineral oil. Suitable block copolymers of these types are marketed under the trademarks Kraton and Septon. The amount of block copolymer, relative to the amount of oil, can be varied to achieve the desired softness. Preferred Kraton-based gels may contain between 5 and 10% by weight of Kraton block copolymer.

In some instances other materials such as soft rubbers may be used as alternatives to gels.

The device of the invention preferably has first and second housing parts that can be brought together to form a substantially enclosed space. The sealing material is preferably provided substantially solely in the first part, and the means for displacing the wire and/or the means for applying the force is preferably provided in the second part. As a result, movement of the first and second parts together may directly result in displacement of the wire into the gel and/or in application of the force putting the gel under pressure. Thus, a single relative movement of the parts to close the housing will form the desired seal.

The sealing material may appear over a significant proportion of the surface of one of the housing parts. We prefer, however, that it be provided, or at least be exposed, merely at or around a periphery of one of the parts, for example in the form of a sealing bead.

The sealing material may be present as a single, uniform, flat layer or it may be shaped to improve the quality of the seal and/or to facilitate installation. In particular we prefer that the sealing material have a groove therein for receipt of the elongate member. The width of the groove is preferably from 0.25 - 0.75, especially about 0.5, times the width of the elongate member which the device is intended to seal. Devices of the type with which we are concerned are usually specialized products produced for installation in a particular network, and it will therefore usually be clear with what gauge wire or fibre etc the device is expected to be used. Furthermore, the device may include means for making an electrical connection etc. suitable only for conductors or fibres etc. of a particular gauge. Other means for terminating other elongate members, may be provided.

The device will usually include a housing containing the sealing material and having an inlet through which the conductor will pass. We prefer that this inlet comprise a slot, along the depth of which the conductor can be displaced as the seal is made.

One part of the device preferably has a first surface that abuts the conductor and causes the displacement when the first and second parts of the device are brought together. That part preferably also has a second surface that abuts the surface of the sealing material, and causes application of the force, when the first and second parts are brought further together. These first and second surfaces may comprise mutually adjacent steps.

The quality of the seal may be enhanced as a result of the surface of means (c) for applying the force being concave. Preferably means (c) surrounds at least 30% of the periphery of the conductor after the force has been applied. Also, an improved seal may be achieved if the means (c) is capable of providing a resiliently biased force. To this end, a metallic or other spring may be provided to bias together a part of the device carrying the sealing material and a part comprising means (c).

The device of the invention may serve merely to seal conductor splices, or it may serve to house an electronic component such as overcurrent protection, over-voltage protection, disconnection means and/or testing means.

The invention is further illustrated with reference to the accompanying drawings, in which:

Figure 1 shows a housing having a lid in the closed position;

Figure 2 shows the housing of figure 1 with the lid open;

Figures 3 and 4 show cross-sectional views of a two-part housing;

Figures 5A to 5D show lateral insertion of a wire into a sealing material;
Figures 6A to 6E show a preferred embodiment in which the sealing material and the means (c) are shaped;

Figures 7A and 7B show closure of a device of the invention around a wire;

Figure 8 shows a plan view of a part of a device of the invention; and

Figures 9A to 9C show sections through a device of the invention.

Figures 1 and 2 show by way of example a device for housing an electronic component such as an electrical-protector in a telecommunications network. Conductors may enter the device for example through holes such as those shown in the upper right-hand surface and will require sealing in order that the electronic component be protected from the environment. The device comprises a base 1 which may be attached to an external wall, and a semi-permanently attached first cover 2 and a removable second cover 3. The cover 3 has fixing means 4 which allow it to be slid or rotated with respect to the first cover 2. For example means 4 may slide within a channel 5. Means 4 may protect screw holes 6 by means of which the base may be secured to the wall.

Cross-sections through such a device are shown in figures 3 and 4 which show a printed circuit board supported within base 1 and overlying a sealing material. A bead of the sealing material is exposed around the printed circuit board. In the device of the invention a wire entering into the device for connection to the printed circuit board may overlie that bead of sealing material and be sealed in the way described above when the cover 2 and base 1 are brought together.

Figure 5A shows a wire or other elongate member 8 on a surface 10 of sealing material 9. In figure 5B means (b), identified by arrow 11, has begun to displace the member 8 laterally into the sealing material. First and second parts 16, 17 of the surface 10 of the sealing material 9 can be seen to be moving together around the member 8. Further displacement of the member 8 as shown in figure 5C has resulted in the first and second parts 16, 17 of the surface of the sealing material contacting one another. In time, the interface between the first and second parts 16, 17 will preferably disappear. In figure 5D means (c) 12 for applying a force has been applied to surface 10.

In figure 6A the surface 10 of the sealing material has a groove 10A for receipt of the member 8. The width of the groove is preferably about half of the diameter of the member 8, the depth of the groove, shown as distance x, is preferably equal to at least the diameter of the member 8 and the depth to which the member 8 is displaced, shown as distance y, is preferably from 1.5 to 2.5 times the depth of the groove.

Figure 6B shows the situation after full displacement of the member 8. Figure 6C shows a part 12 of a cover of the device acting as means (c). The dotted line shows the position of a slot in a base of the device that carries the sealing material 9 and along the depth of which the member 8 can be displaced. In figure 6D the part 12 has been advanced slightly into the sealing material 9 causing the sealing material to be put under pressure. This pressure ensures a good seal around the member 8, and preferably can compensate for creep of the sealing material during its service life. In figure 6E part 12 that provides means (c) has a concave surface 19. The concave surface can at least partially surround the member 8 thereby applying forces in preferred directions and/or providing at least some containment for the sealing material 9.

Figure 7A and 7B show in section a part of a base and cover of a housing such as that shown in figures 1 to 4. Base 13 has a slot 20 through which wire 8 extends and along the depth of which the wire can be displaced. The base 13 contains sealing material 9 along a surface of which the wire 8 extends. A cover 14 is provided with means 11 for displacing the wire into the sealing material 9, and means 12 for applying a force to the surface of the sealing material after displacement of the wire. The means 11 and 12 can be seen to comprise mutually adjacent steps. Figure 7A shows the parts before the base and cover have been closed together, and figure 7B shows the parts after closing.

Figure 8 shows a plan view of the base 13 of figures 7A and 7B. The base 13 contains a printed circuit board 15 surrounded by sealing material 9.

Figures 9A, 9B and 9C show sections of a particular design of housing. Sealing material 9 and slots 20 for location of an ingoing conductor are illustrated.

Claims

1. A device for forming a seal around an elongate member which comprises:

   (a) a sealing material (9) having a surface (10) onto which the elongate member (8) can be placed;

   (b) means (11) for displacing the elongate member substantially laterally into the sealing material; and

   (c) means (12) for applying a force to said surface after displacement of the elongate member thereby putting the sealing material under pressure.

2. A device according to claim 1, which has first (13) and second (14) housing parts that can be brought together to form a substantially enclosed space, the sealing material (9) being provided in the first part,
and the means (b) and/or the means (c) being provided by the second part.

3. A device according to claim 2, in which movement of the first and second parts together results in the displacement and/or in application of the force.

4. A device according to claim 2 or 3, in which a single relative movement of parts of the device results first in the displacement and subsequently in at least application of the force.

5. A device according to any preceding claim, in which means (c) applies a force by advancing in a direction substantially parallel to the direction of the displacement.

6. A device according to any preceding claim, in which the displacement itself results in the sealing material entirely surrounding the elongate object.

7. A device according to any preceding claim, in which, after the displacement, first and second parts of the surface (16, 17) contact one another around the elongate member (8).

8. A device according to claim 7, in which the sealing material is capable of wetting itself such that the first and second parts seal to one another on contact.

9. A device according to any preceding claim, including a housing which has a slot (20) through which the elongate member can enter and along the depth of which the member can be displaced.

10. A device according to claim 2, in which the second part has a first surface that abuts the elongate member and causes the displacement when the first and second parts are brought together at a first extent; and a second surface that abuts the surface of the sealing material and causes application of the force when the first and second parts are brought together to a greater extent.

11. A device according to claim 10, in which the first and second surfaces comprise mutually adjacent steps.

12. A device according to any preceding claim, in which the surface of the sealing material has a groove (10A) therein for receipt of the elongate member.

13. A device according to claim 12, in which the width of the groove is from 0.25 to 0.75 times the width of the elongate member which the device is intended to seal.

14. A device according to any preceding claim, having means for termination of the elongate member.

15. A device according to claim 2, in which the sealing material is exposed substantially only at a periphery of the first part.

16. A device according to any preceding claim, in which a surface of means (c) that applies the force is concave.

17. A device according to claim 16, in which means (c) surrounds at least 30% of the periphery of the elongate member after the force has been applied.

18. A device according to any preceding claim, in which the sealing material has a Stevens Voland hardness of less than 60 g.

19. A device according to claim 18, in which the sealing material has a Stevens Voland hardness of from 10 to 45 g.

20. A device according to any preceding claim, in which the sealing material comprises a gel.

21. A device according to any preceding claim, in which means (c) is capable of providing a resiliently biased force.

22. A device according to any preceding claim, having means for electrical protection or for disconnection or for testing to which the elongate member is to be connected.

**Patentansprüche**

1. Vorrichtung zum Herstellen einer Abdichtung um ein langgestrecktes Element herum, wobei die Vorrichtung folgendes aufweist:

   (a) ein Dichtmaterial (9), das eine Oberfläche (10) hat, auf der das langgestreckte Element (8) plaziert werden kann;

   (b) eine Einrichtung (11), um das langgestreckte Element im wesentlichen quer in das Dichtmaterial zu verlagern; und

   (c) eine Einrichtung (12), um nach der Verlagerung des langgestreckten Elements eine Kraft auf die genannte Oberfläche aufzubringen, so daß das Dichtmaterial unter Druck gesetzt wird.

2. Vorrichtung nach Anspruch 1, die ein erstes (13) und ein zweites (14) Gehäuseteil aufweist, die zusammengebracht werden können, um einen im wesentlichen umschlossenen Raum zu bilden, wobei das Dichtmaterial (9) in dem ersten Teil vorgesehen ist, und wobei die Einrichtung (b)
und/oder die Einrichtung (c) von dem zweiten Teil vorgesehen werden.


5. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Einrichtung (c) durch ein Vorwärtsbewegen in einer Richtung, die im wesentlichen parallel zu der Richtung der Verlagerung ist, eine Kraft aufbringt.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Verlagerung selbst dazu führt, daß das Dichtmaterial den langgestreckten Gegenstand vollständig umgibt.

7. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei, nach der Verlagerung, ein erster und ein zweiter Teil der Oberfläche (16, 17) um das langgestreckte Element (8) herum miteinander in Kontakt stehen.

8. Vorrichtung nach Anspruch 7, wobei das Dichtmaterial fähig ist, sich selbst zu bilden, so daß der erste und der zweite Teil bei einem Kontakt einander abdichten.

9. Vorrichtung nach einem der vorhergehenden Ansprüche, die ein Gehäuse aufweist, das einen Schlitze (20) aufweist, durch den das langgestreckte Element eintreten kann und entlang dessen Tiefe das Element verlagert werden kann.

10. Vorrichtung nach Anspruch 2, wobei das zweite Teil eine erste Oberfläche hat, die an dem langgestreckten Element anliegt und die Verlagerung bewirkt, wenn das erste und das zweite Teil in einem ersten Ausmaß zusammengebracht werden, sowie eine zweite Oberfläche hat, die an der Oberfläche des Dichtmaterials anliegt und das Aufbringen der Kraft bewirkt, wenn das erste und das zweite Teil in einem größeren Ausmaß zusammengebracht werden.

11. Vorrichtung nach Anspruch 10, wobei die erste und die zweite Oberfläche gegene

seitig benachbarte Stufen aufweisen.

12. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Oberfläche des Dichtmaterials eine darin ausgebildete Nut (10A) zur Aufnahme des langgestreckten Elements hat.

13. Vorrichtung nach Anspruch 12, wobei die Breite der Nut das 0,25 bis 0,75fache der Breite des langgestreckten Elements ausmacht, das die Vorrichtung abdichten soll.


15. Vorrichtung nach Anspruch 2, wobei das Dichtmaterial im wesentlichen nur an einem Umfang des ersten Teils freiliegt.

16. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei eine Oberfläche der Einrichtung (c), die die Kraft aufbringt, konkav ist.

17. Vorrichtung nach Anspruch 16, wobei die Einrichtung (c) wenigstens 30 % des Umfangs des langgestreckten Elements umgibt, nachdem die Kraft aufgebracht worden ist.

18. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das Dichtmaterial eine Stevens-Voland-Härte von weniger als 60 g hat.

19. Vorrichtung nach Anspruch 18, wobei das Dichtmaterial eine Stevens-Voland-Härte von 10 bis 45 g hat.

20. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das Dichtmaterial ein Gel aufweist.

21. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Einrichtung (c) fähig ist, eine elastisch vorgespannte Kraft bereitzustellen.

22. Vorrichtung nach einem der vorhergehenden Ansprüche, die eine Einrichtung zum elektrischen Schutz oder zum Trennen oder zum Prüfen hat, mit der das langgestreckte Element zu verbinden ist.

**Revisions**

1. Dispositif pour former un scellement étanche autour
d'un élément allongé, qui comporte :

(a) une matière de scellement (9) ayant une surface (10) sur laquelle l'élément allongé (8) peut être placé ;
(b) des moyens (11) destinés à déplacer l'élément allongé sensiblement latéralement pour l'enfoncer dans la matière de scellement ; et
(c) des moyens (12) pour appliquer une force à ladite surface après le déplacement de l'élément allongé, plaçant ainsi la matière de scellement sous pression.

2. Dispositif selon la revendication 1, qui comporte des première (13) et seconde (14) parties de boîtier qui peuvent être approchées l'une de l'autre pour former un espace sensiblement fermé, la matière de scellement (9) étant placée dans la première partie, et les moyens (b) et/ou les moyens (c) étant présentés par la seconde partie.

3. Dispositif selon la revendication 2, dans lequel un mouvement de rapprochement des première et seconde parties a pour résultat le déplacement et/ou l'application de la force.

4. Dispositif selon la revendication 2 ou 3, dans lequel un mouvement relatif unique des parties du dispositif a pour résultat d'abord le déplacement puis au moins l'application de force.

5. Dispositif selon l'une quelconque des revendications précédentes, dans lequel les moyens (c) appliquent une force en avançant dans une direction sensiblement parallèle à la direction du déplacement.

6. Dispositif selon l'une quelconque des revendications, dans lequel le déplacement lui-même a pour résultat d'amener la matière de scellement à entourer entièrement l'objet allongé.

7. Dispositif selon l'une quelconque des revendications précédentes, dans lequel, après le déplacement, des première et seconde parties de la surface (16, 17) entrent en contact l'une avec l'autre autour de l'élément allongé (8).

8. Dispositif selon la revendication 7, dans lequel la matière de scellement est capable d'être auto-moulante de telle sorte que les première et seconde parties soient scellées l'une à l'autre par contact.

9. Dispositif de scellement selon l'une quelconque des revendications précédentes, comprenant un boîtier qui présente une encoche (20) à travers laquelle l'élément allongé peut entrer et le long de la profondeur de laquelle l'élément peut être déplacé.

10. Dispositif selon la revendication 2, dans lequel la seconde partie présente une première surface qui s'applique contre l'élément allongé et provoque le déplacement lorsque les première et seconde parties sont approchées l'une de l'autre à un premier degré ; et une seconde surface qui s'applique contre la surface de la matière de scellement et provoque l'application de la force lorsque les première et seconde parties sont approchées l'une de l'autre à un plus grand degré.

11. Dispositif selon la revendication 10, dans lequel les première et seconde surfaces comportent des épaulements mutuellement adjacents.

12. Dispositif selon l'une quelconque des revendications précédentes, dans lequel la surface de la matière de scellement présente une gorge (10A) destinée à recevoir l'élément allongé.

13. Dispositif selon la revendication 12, dans lequel la largeur de la gorge est comprise entre 0,25 et 0,75 fois la largeur de l'élément allongé que le dispositif doit sceller.


15. Dispositif selon la revendication 2, dans lequel la matière de scellement n'est à découvrir sensiblement qu'à une périphérie de la première partie.

16. Dispositif selon l'une quelconque des revendications précédentes, dans lequel une surface des moyens (c) qui applique la force est concave.

17. Dispositif selon la revendication 16, dans lequel des moyens (c) entourent au moins 30 % de la périphérie de l'élément allongé après que la force a été appliquée.

18. Dispositif selon l'une quelconque des revendications précédentes, dans lequel la matière de scellement présente une dureté Stevens Voland inférieure à 60 g.

19. Dispositif selon la revendication 18, dans lequel la matière de scellement présente une dureté Stevens Voland de 10 à 45 g.

20. Dispositif selon l'une quelconque des revendications précédentes, dans lequel la matière de scellement comprend un gel.

21. Dispositif selon l'une quelconque des revendications précédentes, dans lequel les moyens (c) sont capables de produire une force sollicitée élastique-
22. Dispositif selon l'une quelconque des revendications précédentes, comportant des moyens pour une protection électrique ou pour une déconnexion ou pour un essai, auxquels l'élément allongé doit être connecté.