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(54) **ANTI-ELECTRIC-SHOCK GARMENT**

KLEIDUNGSSTÜCK ZUM SCHUTZ VOR STROMSCHLÄGEN

VÊTEMENT ANTI-ÉLECTROCUTION

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(56) References cited:

**EP-B- 0 758 479 DE-A1- 3 300 158
DE-A1- 19 500 254 DE-A1- 19 743 389
US-A- 3 164 840**

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Description

[0001] The present invention relates to an anti-electric-shock garment according to the preamble of claim 1.

[0002] Such a garment is known, for example, as a protective garment for technicians who carry out maintenance operations on uncovered high-voltage cables.

[0003] When the high-voltage cables are damaged, it is necessary to proceed to repair them in order to prevent them from breaking and causing considerable damage, both to the structures and in terms of a break in the supply of the service.

[0004] Obviously, the activity of the technicians is aimed at minimising the risks of discharge (or short circuit) between two different phases of the high voltage, which may reach potential differences on the order of 800 kV AC or 600 kV DC.

[0005] Clearly it is desirable to have garments capable of providing protection even if a short circuit is created in spite of the precautions taken.

[0006] A known solution is disclosed in DE 19743389; wherein a protective suit is described. The suit comprises individual layers disposed separately one from each other by including air gaps and formed by an intermediate layer, that is a conductive layer, which is disposed between two outside layers. The intermediate layer requiring at least one connection with the high voltage potential for potential equalization of the suit.

[0007] The garments known hitherto in the prior art are made of steel wire braided with cotton thread; however, they exhibit a number of disadvantages: their electrical resistance, measured between any two points, is relatively high; they must be 'activated' before each use by means of a strong electrical discharge in order to restore their original electrical conductivity; finally, because of its rigidity, the steel wire gives rise to rigid and uncomfortable garments that hamper the movements of the operators, with a consequent further decrease in the operative margins of safety.

[0008] A protective garment according to the preamble of claim 1 is known from US 3164840A.

[0009] For this reason, a European Standard, IEC 60895: 2002, was approved recently that defines some parameters that must be measured to characterise garments that are suitable for these purposes, among them:

- resistance to abrasion and to wear;
- flame-retardant properties;
- low electrical resistance;
- capacity to conduct capacitive currents;
- protection and shielding capacity;
- resistance to cleaning cycles;
- protection against sparks.

[0010] Besides these parameters, the Standard defines other parameters specific to garments that protect only some parts of the body: for gloves, boots, socks, and footwear the maximum resistance measure is de-

fined; for garments that shield the head and the face, the efficiency of protection of the face is also defined.

[0011] The necessity for safety garments that are ever more effective and simple to use in this field is continually underlined by the too frequent accidents recorded almost daily all over the world.

[0012] The present invention is therefore aimed at satisfying specifically the needs of operators who carry out maintenance work on high-voltage electrical lines.

[0013] An other solution to a protective suit having a protective effect in particular against highfrequency electromagnetic fields, is disclosed in DE3300158. The effect is achieved by a multilayer laminate of planar structures made of a three-layers composite material. The composite material comprising a textile water-vapor permeable outer layer, an intermediate layer of a metallised textile sheet-like structure having good screen damping against highfrequency electromagnetic fields and an inner layer of water-vapour skin-compatible material.

[0014] Moreover, US 3,164,840 discloses a protective garment to be worn by a person working in a region immersed in, or irradiated by, an electromagnetic field of very high frequency, wherein the protective garment comprises a fabric having a layer or lamination of metal mesh that is disposed between two layers of cloth.

[0015] Also, DE 19500254 discloses an Electromagnetic Compatibility full-body protective clothing to protect the person wearing it against electromagnetic fields, in which the protective suit comprises a multilayer laminate (L), with an intermediate metallized fabric layer (M), and a water and water vapour-permeable material outer layer, and an air gap that is arranged between the multilayer laminate and the outer layer.

[0016] EP 0758479 discloses a protective clothing material for shielding people from high-frequency electromagnetic fields, wherein the fabric is formed by a polyamide yarn, which is coated by a silver layer, the silver layer being sealed by a polymer layer.

[0017] In view of the prior art described, the object of the present invention is to obtain a protective garment that allows technicians to work with greater safety during operations on uncovered high-voltage cables, with the efficiency of the garment being measured according to the parameters defined by the Standard indicated above.

[0018] According to the present invention, this object is achieved by means of a garment in accordance with claim 1.

[0019] The features and the advantages of the present invention will become evident from the following detailed description of a practical form of embodiment given as a non-limiting example with reference to the attached drawings in which:

- figure 1 shows a view of a preferred embodiment of a garment according to the present invention;
- figure 2 shows a schematic view of one of the components of the present invention.

[0020] According to the invention, the garment 1 comprises at least one first electrically conductive layer whose extent substantially coincides with the extent of the garment 1 itself. This first layer includes a conductive yarn 2; advantageously, it is composed exclusively of this conductive yarn 2.

[0021] This means that the garment 1 is composed of a substantially complete electrically conductive layer on which can be superimposed other different layers, even partial layers, however without there being substantial portions of the garment 1 where this first electrically conductive layer is absent.

[0022] The first layer is a textile product in which the spaces between two adjacent threads need not be considered as areas of substantial discontinuity for the purposes of the present invention.

[0023] The conductive yarn 2 visible in figure 2 contain silver; it has a core 3 covered by a layer 4 of silver, for example by means of spraying.

[0024] The core 3 is a polymer, for example composed of polyamide strands. In a preferred embodiment, about 80% of the mass of the yarn 2 is silver.

[0025] Using the silver as a conductor, advantageously a garment 1 is obtained that is also endowed with anti-bacterial and bacteriostatic properties.

[0026] The conductive yarn 2 can also be one of those described in the international patent application with the title 'CONDUCTIVE TEXTILE YARN', filed on 22 March 2007 in the name of the holder of the present application, for example produced by braiding a polyamide filament covered with silver with an aramide thread, or twisting together polyamide fibres covered with silver and aramide fibres.

[0027] Preferably the garment 1 is overalls 5 capable of covering the legs, the arms, and the torso of the operator. In a preferred embodiment, the garment 1 also comprises a hood 6 and/or a visor 7 and/or one or more loop fastenings 8, to cover also the nape of the neck and part of the face of the operator. Advantageously, all these elements are integrated together.

[0028] Furthermore, the garment 1 can cover also the feet and/or the hands, for example by means of boots 9 and/or gloves 10 integrated with the overalls 5 or that can be connected thereto.

[0029] In this way it is possible to obtain a continuous covering that produces an almost perfect Faraday cage, allowing the garment 1 to satisfy the requirements relating to electrical properties, established by the Standard cited above.

[0030] The conductive textile product is a knit, for example made with a loom 30 inches in diameter, of fineness 28, with 'interlock' weave, and with a weight of 200 g/sqm ($\pm 5\%$) after removal from the machine.

[0031] Clearly, these values refer to the best embodiment, but suitable products can also be obtained with circular or straight knitting machines. Similarly, the diameter, the fineness, and the weight after removal from the machine can vary.

[0032] The garment 1 comprises, connected in a stable manner to the first layer, at least one second layer that provides the garment 1 with the properties of mechanical and/or chemical and/or flame resistance, as prescribed by the Standard cited initially. Preferably a single layer provides all these properties.

[0033] Both layers are produced in the form of a knit and are connected to one another in a stable manner.

[0034] The second layer is composed of a second textile product, that is obtained from a second yarn with anti-flame or flame-retardant properties, such as for example a fibre selected from the group comprising aramide fibres, meta-aramide fibres, treated natural fibres, flame-retardant fibres, flame-retardant viscose, flame-retardant cotton, Lenzing FR[®].

[0035] The two layers can be coupled together in a stable manner by means of quilting or, more advantageously, by means of coupling (chemical or mechanical) over the entire extent of their contact surfaces.

[0036] The coupling can be achieved both chemically, that is by placing a resin between the two yarns, for example a flameproof and preferably polyurethane resin, that acts as an adhesive without compromising the elastic properties of the knits, and mechanically, that is by weaving at least one conductive thread for the first layer and at least one thread for the second layer at the same time, but separated, on the same weaving machine.

[0037] In order to contribute to keeping the electrical resistance of the garment 1 low, at least some of the internal stitches between two fabric parts (for example undersleeve, oversleeve), advantageously all the stitches, are top stitches and double and/or overlocked.

[0038] The garment 1 can include, on the breast, a metal frame covered by a flap 11. The flap 11 can be closed on the breast of the garment 1 by means of a number of press studs 12, for example alternating with strips of Velcro 13, arranged on the free edge of the flap 11 itself.

[0039] Corresponding to the zones subjected to higher mechanical forces, the garment 1 comprises reinforcing padding, advantageously made of woven/nonwoven material. For example, such reinforcements are present in the vicinity of the closure studs 12 or in the vicinity of the Velcro 13.

[0040] The hood 6 of the garment 1 can include one or more loop fastenings 8 to protect the neck and the face respectively; to protect the eyes, it has proved to be sufficient to produce a substantially rigid visor 7, for example reinforced with woven/nonwoven material. To ensure a greater shielding of the eyes and the nose, the visor 7 is sewn to the hood 6 by means of a slanting stitch, preferably slanting in the upwards direction, in such a way that the visor 7 is slanted and pushed to rotate downwards.

[0041] In this manner the use of a shield for the eyes becomes superfluous. The garment 1 according to the present invention thus does not need to include a transparent shield to protect the eyes, which allows an even

greater comfort in use.

[0042] As is evident, with the present invention an extremely conductive protective garment 1 has been produced, a garment that is greatly more elastic than the overalls currently available commercially, thus obtaining a garment 1 capable of increasing the safety of the operators both by means of the protection against the external agents properly speaking (electricity, aggressive chemical and/or mechanical agents, flames), and because it is much more comfortable than the garments known hitherto.

[0043] This garment 1 is the only one up to now capable of satisfying the Standard IEC 60895:2002.

[0044] In particular, the garment 1 according to the present invention, after being subjected to various tests laid down by this Standard, has shown the following results:

- a maximum resistance of less than 10 ohm, more precisely less than 3 ohm, even more precisely less than 1 ohm, for the electrical resistance test;
- a measured resistance of less than 5 ohm, more precisely less than 2 ohm, even more precisely less than 0.5 ohm, for the test of electrical resistance on samples of fabric;
- a shielding efficiency greater than 40 dB, more precisely greater than 60 dB, even more precisely greater than 70 dB, better if greater than 75 dB, for example greater than 79 dB on new samples and greater than 78.8 dB on washed samples.

[0045] Obviously one skilled in the art, for the purpose of satisfying contingent and specific needs, will be able to introduce numerous modifications and variants to the configurations described above, but all contained within the scope of protection of the invention as defined by the following claims.

Claims

1. Protective garment (1) for operations on uncovered high-voltage cables, comprising:
 - a first electrically conductive layer having the surface area that is substantially equal to the surface area of the said garment (1), said first electrically conductive layer being a textile product which is obtained from a conductive yarn (2) comprising a polymeric core (3) covered by a layer (4) of silver, said textile product being obtained in order that the space between two adjacent threads defines an area of continuity,
 - at least one second layer that is obtained from a second yarn **characterized in that** the second yarn has flame-retardant properties and is obtained from a polyaramide fibre;

said first and second layers being produced in the form of knit and being coupled together in a stable manner over the entire extent of the surfaces of mutual contact of the said first and second layer.

2. Garment (1) according to claim 1, wherein the shielding efficiency, measured according to Standard IEC 60895:2002, is greater than 20 dB, preferably greater than 70 dB.
3. Garment (1) according to any one of the preceding claims, comprising trousers, a covering for the abdomen, and sleeves, produced without a break in continuity between them.
4. Garment (1) According to any one of the preceding claims, comprising boots (9) and/or gloves (10), each capable of being joined to the said garment (1) by means of at least two press studs (11) having a diameter of not less than 10 mm.
5. Garment (1) according to the preceding claim, re-folded in correspondence with these press studs (11), in such a way that the said conductive layer is present with continuity also to the inside of the said garment (1), in such a way as to form an electrical contact both with the external portion and with the internal portion of the said press studs.
6. Garment (1) according to any one of the preceding claims that comprises double or overlooked stitches.
7. Garment (1) according to any one of the preceding claims that comprises a hood (6) capable of being arranged around the head of the user, the said hood (6) being such as to leave only the face uncovered.
8. Garment (1) according to the preceding claim wherein the said hood (6) is equipped with one or more loop fastenings (8) capable of being arranged around the face in such a way as to leave uncovered only the eyes of the user.
9. Garment (1) according to any one of claims 7 or 8 wherein the said hood (6) comprises a rigid visor (7).
10. Garment (1) according to the preceding claim wherein the said rigid visor (7) is sewn to the said hood (6) by means of a stitch slanting in the upwards direction, in such a way as to impart to the said visor (7) a torque that tends to rotate it towards the face of the user.

Patentansprüche

1. Schutzbekleidung (1) für Arbeiten an unbedeckten Hochspannungskabeln, umfassend:

- eine erste elektrisch leitfähige Schicht mit dem Oberflächenbereich, welcher im Wesentlichen gleich dem Oberflächenbereich der besagten Bekleidung (1) ist, wobei die besagte erste elektrisch leitfähige Schicht ein Textilprodukt ist, das aus einem leitfähigen Garn (2) erhalten wird, das einen polymerischen Kern (3) bedeckt mit einer Schicht (4) aus Silber umfasst, wobei das besagte Textilprodukt erhalten wird damit der Raum zwischen zwei benachbarten Fäden einen Bereich der Kontinuität definiert,
- mindestens eine zweite Schicht, die aus einem zweiten Garn erhalten wird, **dadurch gekennzeichnet, dass** das zweite Garn einen flammenabweisende Eigenschaften hat und aus einer Polyaramidfaser erhalten wird;
- die besagten ersten und zweiten Schichten werden in der Form eines Gewirks produziert und über das gesamte Ausmaß der Flächen gemeinsamen Kontakts zwischen der ersten und zweiten Schicht miteinander in einer stabilen Weise verbunden.
2. Bekleidung (1) gemäß Anspruch 1, wobei die Abschirmeffektivität, gemessen nach Standard IEC 60895:2002, größer ist als 20 dB, bevorzugt größer als 70 dB.
3. Bekleidung (1) gemäß einem der vorhergehenden Ansprüche, umfassend eine Hose, eine Abdeckung für den Abdomen, und Ärmel, produziert ohne Unterbrechung der Kontinuität dazwischen.
4. Bekleidung (1) gemäß einem der vorhergehenden Ansprüche, umfassend Schuhe (9) und/oder Handschuhe (10), jedes davon geeignet mit besagter Bekleidung (1) verbunden zu werden durch mindestens zwei Druckknöpfe (11), die einen Durchmesser von nicht weniger als 10 mm haben.
5. Bekleidung (1) gemäß dem vorhergehenden Anspruch, zurückgefaltet in Korrespondenz mit diesen Druckknöpfen (11), in einer Weise, dass die besagte leitfähige Schicht auch kontinuierlich auf der Innenseite der besagten Bekleidung (1) vorhanden ist, in einer Weise, um einen elektrischen Kontakt mit beidem dem äußeren Abschnitt und mit dem inneren Abschnitt der besagten Druckknöpfe zu formen.
6. Bekleidung (1) gemäß einem der vorhergehenden Ansprüche, die doppelte oder Überwindlingsstiche umfasst.
7. Bekleidung (1) gemäß einem der vorhergehenden Ansprüche, die eine Kapuze (6) umfasst, die geeignet ist um den Kopf des Anwenders herum angeordnet zu werden, wobei die besagte Kapuze (6) derart ist, dass sie nur das Gesicht unbedeckt lässt.
8. Bekleidung (1) gemäß dem vorhergehenden Anspruch, wobei die besagte Kapuze (6) ausgestattet ist mit einer oder mehreren Schlaufenbefestigungen (8), die geeignet sind um das Gesicht herum angeordnet zu werden, in einer Weise, um nur die Augen des Anwenders unbedeckt zu lassen.
9. Bekleidung (1) gemäß einem der Ansprüche 7 oder 8, wobei die besagte Kapuze (6) ein starres Visier (7) umfasst.
10. Bekleidung (1) gemäß dem vorhergehenden Anspruch, wobei das besagte starre Visier (7) an die besagte Kapuze (6) angenäht ist durch einen Stich, der aufwärts gerichtet geneigt ist in einer Weise, um ein Drehmoment auf das besagte Visier (7) zu vermitteln, so dass es dazu tendiert auf das Gesicht des Anwenders zu rotieren.

Revendications

1. Vêtement protecteur (1) pour opérations sur des câbles de haute tension nus, comprenant :

- une première couche conductrice de l'électricité dont la surface est sensiblement égale à la surface dudit vêtement (1), ladite première couche conductrice de l'électricité étant un produit textile qui est obtenu à partir d'un fil conducteur (2) comprenant une âme polymère (3) revêtue d'une couche (4) d'argent, ledit produit textile étant obtenu de sorte que l'espace compris entre deux fils adjacents définisse une zone de continuité,

- au moins une seconde couche qui est obtenue à partir d'un second fil, **caractérisé en ce que** le second fil a des propriétés retardatrices de flamme et est obtenu à partir d'une fibre de polyaramide ;

lesdites première et seconde couches étant produites sous la forme d'un tricot et étant couplées l'une à l'autre de manière stable sur la totalité de l'extension des surfaces de contact mutuel desdites première et seconde couches.

2. Vêtement (1) selon la revendication 1, dans lequel l'efficacité de la protection mesurée selon le standard IEC 60895:2002 est supérieure à 20 dB, de préférence supérieure à 70 dB.
3. Vêtement (1) selon l'une quelconque des revendications précédentes, comprenant un pantalon, un revêtement pour l'abdomen et des manches produits sans rupture de continuité entre eux.
4. Vêtement (1) selon l'une quelconque des revendi-

cations précédentes, comprenant des bottes (9) et/ou des gants (10), chacun ou chacune étant à même d'être joint(e) audit vêtement (1) au moyen d'au moins deux boutons pression (11) ayant un diamètre qui n'est pas inférieur à 10 mm.

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5. Vêtement (1) selon la revendication précédente, rempli en correspondance avec ces boutons pression (11) de manière que ladite couche conductrice soit présente avec une certaine continuité également avec l'intérieur dudit vêtement (1) en sorte de former un contact électrique à la fois avec la partie externe et avec la partie interne desdits boutons pression. 10
6. Vêtement (1) selon l'une quelconque des revendications précédentes, qui comprend des points doubles ou de type overlock. 15
7. Vêtement (1) selon l'une quelconque des revendications précédentes, qui comprend un capuchon (6) qui est à même d'être aménagé autour de la tête de l'utilisateur, ledit capuchon (6) étant tel qu'il ne laisse que le visage découvert. 20
8. Vêtement (1) selon la revendication précédente, dans lequel ledit capuchon (6) est équipé d'une ou plusieurs fermetures en boucle (8) qui sont à même d'être aménagées autour du visage de manière à ne laisser découverts que les yeux de l'utilisateur. 25
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9. Vêtement (1) selon l'une quelconque des revendications 7 ou 8, dans lequel ledit capuchon (6) comprend une visière rigide (7).
10. Vêtement (1) selon la revendication précédente, dans lequel ladite visière rigide (7) est cousue audit capuchon (6) au moyen d'une couture oblique dans la direction ascendante de manière à communiquer à ladite visière (7) un couple de torsion qui tend à la faire tourner vers le visage de l'utilisateur. 35
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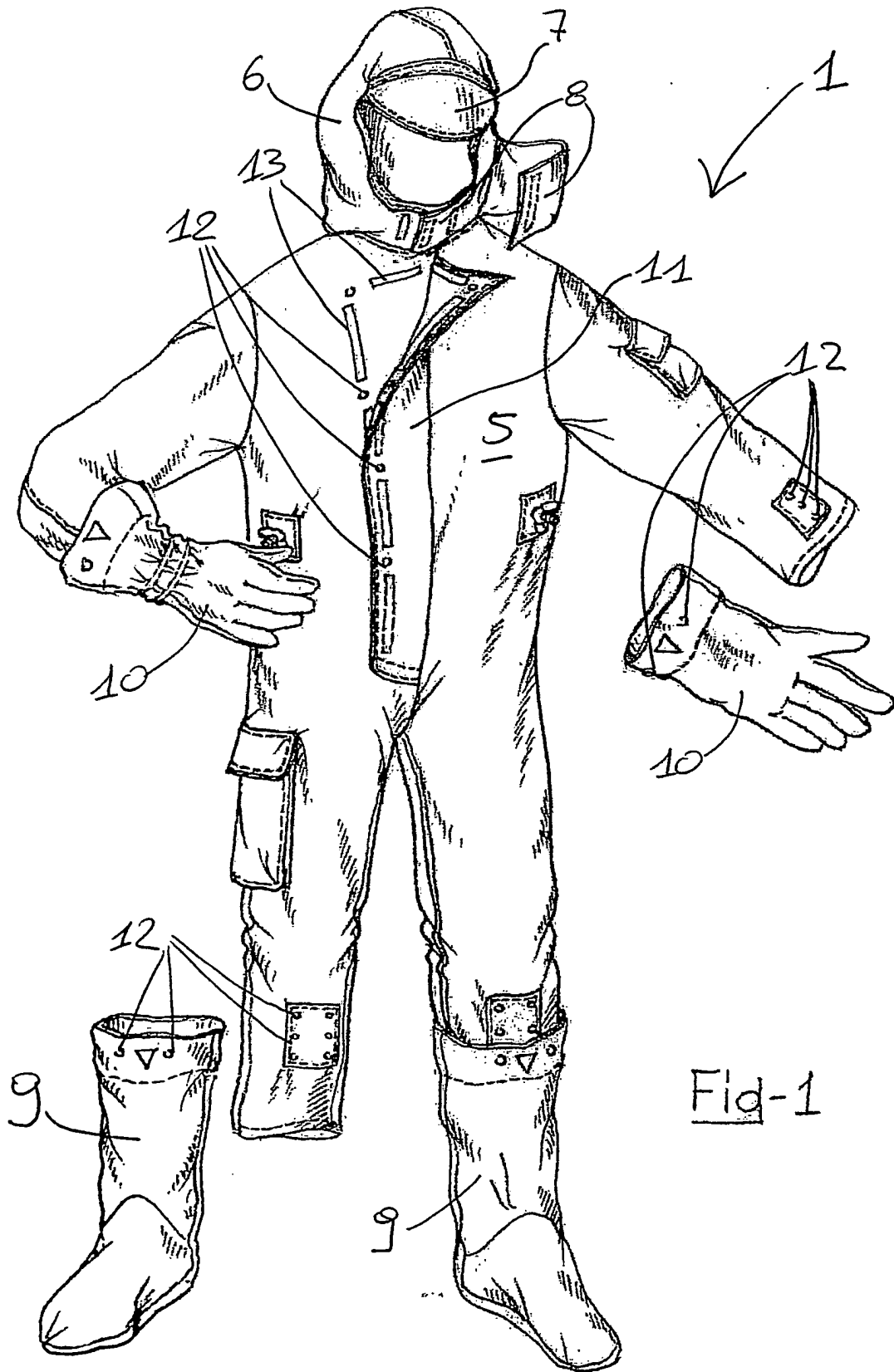


Fig-1

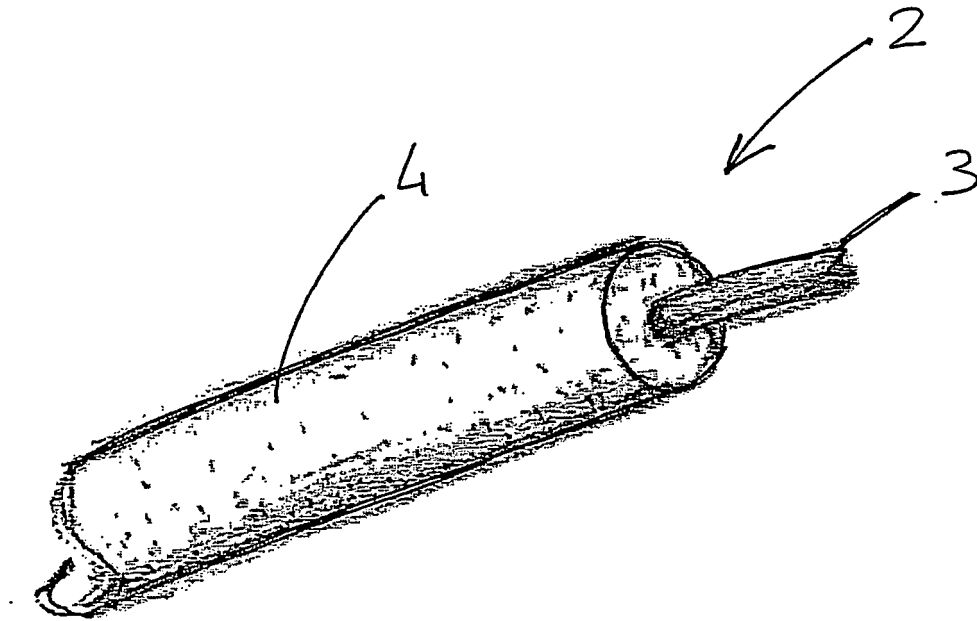


Fig-2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 19743389 [0006]
- US 3164840 A [0008] [0014]
- DE 3300158 [0013]
- DE 19500254 [0015]
- EP 0758479 A [0016]