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(54) Cabling system with connectors for branching

(57) A cable clamp (70) for making electrical connections to a cable (40) including individually insulated and sheathed conductors (50) is disposed to include clamps (70) for mounting onto the insulated conductors (50) of the cable (40). The clamps (70) are adapted for making connections to the conductors (50), and the clamps (70) are housed within an outer casing (20). Moreover, the clamps (70) are provided with an electrical contact arrangement (160, 180) providing one or more contact points (180) onto associated conductors (50) of the cable (40) and multiple stages of sealing (290, 280, 250, 270) between an inner volume (60) of the outer casing (20) and locations whereat the one or more contact points (180) electrically contact onto their associated conductors (50).

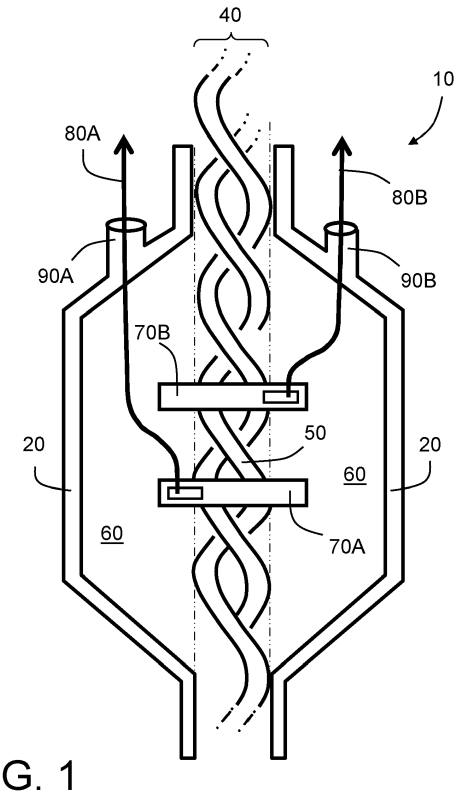

FIG. 1

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Description

Field of the invention

[0001] The present invention relates to power cable clamps, for example to power cable clamp arrangements adapted for making electrical connections to branch cables at arbitrary points along lengths of a main power cable which is susceptible to being exposed to wet and/or damp operating condition. Moreover, the present invention also concerns methods for making power cable branches, and for methods of preparing cables for coupling a branch cable to a main cable clamp arrangement. The main cable consists of individually insulated and sheathed conductors with a specific lay-up length, whereas the branch cable may be screened and may include a common sheath. Furthermore, the present invention relates to kits for making connections to cables using the cable clamp.

Background of the invention

[0002] In many power-consuming electrical installations comprising multiple spatially separate power consuming devices, for example lighting units disposed along a motorway, it is desirable to couple the devices to a single length of cable for reducing installation complexity and cost. An example of clamp system for making connections to a length of cable comprising multiple current carrying conductors is described in a published PCT patent application WO 99/66597 ("A T-joint Connector", Tappat Engineering Pty. Ltd., Australia). The system is adapted for interconnecting with a power cable. The power cable includes an outer insulating jacket encircling inner insulated sector conductors in mutually parallel disposition. Moreover, the system includes a clamping unit for clamping around the cable. A series of apertures are included in the apparatus. During installation, a cable cutting tool of the system is inserted into one or more of the apertures for removing portions of inner and outer insulating jackets of the cable spatially underneath the one or more apertures. Subsequently, a connection unit of the apparatus is then inserted into a corresponding aperture for piercing a corresponding inner conductor of the cable. Moreover, the clamping unit has inwardly projecting ribs for locating between edges of the inner insulated sector connectors for accurately aligning the one or more apertures against the inner sector conductors. Optionally, the outer jacket of the power cable is marked so as to indicate spatial orientation of the sector conductors within the outer jacket.

[0003] In the German utility model DE20004005435U1, a contact unit with axially movable electrical contact position, a spring loaded contact (SLC) is presented. Although this contact arrangement is intended for HF contacts, it may be used to advantage in LF high current applications as well. This utility model does not discuss sealing of the contact from moisture.

[0004] As aforementioned, a single cable is often installed, for example, along a length of a road or along a length of a tunnel, wherein electric power and/or signals are to be distributed along the length to distribute energy and/or signals to various devices along the length, for example to road lights or smoke fans. It is found in practice that the single cable is often installed in locations which have difficult access and/or are unsafe, for example within limited volumes. Moreover, there is a contemporary trend to employ cables including conductors with increasingly larger current-carrying conductor cross-sectional areas to cope with longer lengths and/or to supply progressively greater power consuming devices. Making connections to these contemporary cables is becoming increasingly difficult and time-consuming. A better solution is thus desirable.

[0005] A further issue arising when making connections to aforementioned cables is that they are typically operated at potentials of 110V, 230V, 400V, voltages in between and also at elevated voltages above this, for example 1 kV or more, for reducing a corresponding magnitude of current when supplying a total power consumed by the devices coupled along the length of the cable. Operating at these elevated potentials when the cable is exposed to wet and/or damp conditions requires that special care is taken to avoid any risk of electrical flashover which could disrupt operation of the cable along its entire length.

[0006] It is conventional practice that a single cable is installed along an entire length of a given electrical installation, wherein the single cable is cut and then connected directly at connections points along the single cable, for example at bases of road-light poles along a motorway. Moreover, the single cable is beneficially double-insulated or screened for personnel and equipment safety reasons; for example, such a single cable is manufactured for operation at 230 V potential or less or more, and includes Aluminium or copper conductors which may each have for example a 25 or 50 mm^2 cross-sectional area, and also includes an outer screen enclosed within an overall outer insulating sheath. The cross section chosen is often calculated based upon a maximum accepted voltage drop and not by the heat generated in use. The reasoning for this is that the total length of the main cable may have a length of some kilometres that might otherwise result in unacceptable voltage drops. Pursuant to conventional practice, at each connection point along the cable, the cable conventionally has to be dismantled and insulated conductors and screen wires brought to connection apparatus. Such conventional practice has many disadvantages associated therewith, for example corrosion, time consuming during installation, flashover and so forth.

Summary of the invention

[0007] The present invention seeks to provide improved cable branching which addresses one or more

aforementioned problems associated with known cable connection apparatus; the problems concern one or more of: time consuming cable connection, difficulty operating in wet and/or damp conditions, space restrictions for making connections.

[0008] According to a first aspect of the present invention, there is provided a power cable clamp for making electrical connection to an adapted main cable including one or more insulated and sheathed conductors, wherein the clamp is adapted for making connection to the one or more conductors,
characterized in that
the clamp is provided with an electrical contact arrangement providing at least one contact point onto an associated conductor of the cable and that the clamp is also provided with at least one layer of sealing around the contact arrangement.

[0009] The invention is of advantage in that the power cable clamp is capable of providing greater reliability in wet and/or damp conditions by using one or more contact points and multiple stages of sealing from external environment to the cable.

[0010] Optionally, for the cable clamp, the clamp is adapted to register angularly onto the conductor by way the clamp being provided with curved regions and cusp regions on its surface adapted for registering onto the conductor, such that the curved regions and cusp regions are adapted to conform to an outer surface presented the conductor towards the clamp.

[0011] Optionally, for the cable clamp, the clamp is fabricated in one element which is adapted to be attached via features for receiving cable ties, the clamp thereby being retained upon the insulated and sheathed conductors of the cable.

[0012] Optionally, for the cable clamp, the outer casing is fabricated from at least two portions which are adapted to be pivoted together for being retained on the cable and enclosing the one or more clamps.

[0013] Optionally, for the cable clamp the electrical contact arrangement encompasses a first flexible material of the flexible material region is adapted to be elastically and or plastically deformed when the one or more contact points are brought into forced contact with their associated conductor of the cable for sealing from ingress of moisture in operation of the one or more contact points. More optionally for the cable clamp arrangement, the electrical contact arrangement is provided with a second flexible material gasket region peripherally thereabout, and wherein the flexible material is adapted to be elastically and or plastically deformed when the one or more contact points are brought into forced contact with their associated conductor of the cable for sealing from ingress of moisture in operation of the one or more contact points and which is integrated in the curved region of the clamps around the connector block. More optionally for the cable clamp arrangement, the electrical contact arrangement is provided with a third flexible material region in which the one or more contact points are embedded, the flexible material of the third flexible material region is adapted to be elastically and or plastically deformed when the one or more contact points are brought into forced contact with their associated conductor of the cable for sealing from ingress of moisture in operation of the one or more contact points.

[0014] According to a second aspect of the invention, there is provided a preparation apparatus for preparing a cable for the cable clamp arrangement pursuant to the first aspect of the invention: there is provided a preparation apparatus for preparing a cable including one or more insulated conductors for receiving a cable clamp arrangement pursuant to the first aspect of the invention, wherein the preparation apparatus includes a housing including an inner surface adapted to conform to an outer surface presented by the one or more conductors for angularly registering the preparation apparatus to the one or more conductors, and wherein the preparation apparatus is provided with one or more guide holes for guiding a tool when milling, or otherwise producing, one or more holes onto or into the one or more conductors, preferably with flat bottom regions, to the one or more holes.

[0015] Optionally, for the preparation apparatus, the housing includes two pivotally coupled parts providing with a locking arrangement for securing the housing around one or more conductors for preparation thereof for subsequently receiving the cable clamp arrangement.

[0016] According to a third aspect of the invention, there is provided a method of installing at least one cable clamp pursuant to the first aspect of the invention: there is provided a method of installing a cable clamp pursuant to the first aspect of the invention, wherein the method includes:

(a) coupling a preparation apparatus to the cable for angularly registering the preparation apparatus to said insulated and sheathed conductors;
(b) producing, by milling or otherwise, one or more holes via one or more guide holes through the sheath and insulation material of said one or more conductors to expose electrically conductive metal of said one or more conductors;
(c) coupling at least one clamp of said cable clamp arrangement to said one or more conductors for making electrical connections to electrically conductive metal of said one or more conductors via said at least one clamp;
(d) tightening at least one tie around said at least one clamp and said one or more conductors so that, through the process of tightening, said flexible materials from their flexible insulating materials regions ooze, thereby improving the sealing for the one or more contact points from ingress of moisture in operation; and
(e) installing an outer casing of said cable clamp arrangement around said one or more clamps for protecting said one or more clamps.

[0017] Optionally, the method includes at least partially filling a region formed between an inner surface of the outer casing of the at least one cable clamp and the cable with at least one of: insulating filling material, anti-corrosion and/or anti-tracking material.

[0018] It will be appreciated that features of the invention are susceptible to being combined in any combination without departing from the scope of the invention as defined by the accompanying claims.

Description of the diagrams

[0019] Embodiments of the present invention will now be described, by way of example only, with reference to the following diagrams wherein:

FIG. 1 is a schematic illustration of an embodiment of a cable clamp arrangement pursuant to the present invention;

FIG. 2A is an illustration of a clamp element of a clamp of the apparatus of FIG. 1;

FIG. 2B is an illustration of a manner in which the clamp of FIG. 2A accommodates a cable;

FIG. 3 is a side view of a manner in which a connection is made to an individually insulated and sheathed conductor of a cable within the cable clamp arrangement of FIG. 1;

FIG.4 is an illustration of pre-cut holes in individually insulated and sheathed conductors of a cable in preparation for receiving the cable clamp arrangement of FIG. 1;

FIG. 5A is an illustration of a tool for use in preparing individually insulated and sheathed conductors of cables in preparation for receiving the cable clamp arrangement of FIG. 1; and

FIG. 5B is an illustration of cutting or milling bit for use with the tool of FIG. 5A to cut and or mill.

[0020] In the accompanying diagrams, an underlined number is employed to represent an item over which the underlined number is positioned or an item to which the underlined number is adjacent. A non-underlined number relates to an item identified by a line linking the non-underlined number to the item. When a number is non-underlined and accompanied by an associated arrow, the non-underlined number is used to identify a general item at which the arrow is pointing.

Description of embodiments of the invention

[0021] Referring to FIG. 1, there is shown a schematic illustration of a cable clamp arrangement pursuant to the present invention. The apparatus is indicated generally by **10** and includes an outer casing **20** for locating onto, and optionally sealing around. The outer casing **20** is beneficially manufactured from a robust insulating plastics material, for example from some polymer, polypropylene, polyethylene, polyurethane, nylon, rubber, and is optionally armoured with one or more rigid members for ensuring that the casing **20** is resistant to being collapsed or otherwise mechanically damaged in use. Moreover, the cable **40** includes one or more individually insulated and sheathed conductors **50**. The one or more insulated and sheathed conductors **50** are optionally in a straight parallel arrangement, or are disposed in a helical formation with an adapted lay-out length which is more compliant and tolerant to bending or longitudinal stress experienced by the cable **40** when in use. The outer casing **20** defines an inner volume **60** between itself and the cable **40** as illustrated. This inner volume **60** is capable of accommodating one or more clamp components **70A**, **70B** which are secured over a region of the cable **40**. This inner volume **60** may optionally be partly or completely filled with a compound in order to restrict water from penetrating into said volume **60**. The clamp components **70A**, **70B** are provided with corresponding cables **80A**, **80B** respectively which extend via one or more ports **90A**, **90B** included within a general form of the outer casing **20** to a external region remote from the inner volume **60**. The clamp components **70A**, **70B** are an important feature of the apparatus **10** pursuant to the present invention on account of:

(i) a manner in which they seals to insulation of their one or more conductors **50;**

(ii) a manner in which they makes an electrical connection to metal conducting portions of their one or more conductors **50;** and

(iii) a manner in which they angularly registers to a bundle of conductors **50** for ensuring reliable mechanical retention thereto.

It will be appreciated that the apparatus **10** optionally includes multiple clamp components **70** for coupling to various individually sheathed and insulated cores **50** present within the apparatus **10**.

[0022] The clamp components **70** will now be described in greater detail with reference to FIG. 2A and FIG. 2B. Each clamp component **70** comprises a part-circular element **100.** The part-circular element **100** does not necessary cover the whole of the circumference. The element **100** is formed to include curved regions **110** and cusp regions **120** designed to conform around the insulation and sheath of the conductors **50** to ensure that the element **100** is not prone to twisting around when clamped around the insulation and sheath of the conductors **50** in use. The curved regions **110** and the cusp regions **120** are beneficially adapted to conform to a spiral disposition of the conductors as illustrated in FIG. 1, FIG. 2A and FIG. 2B. Alternatively, the curved regions **110** and the cusp regions **120** are adapted to a configuration of straight parallel conductors **50**. Optionally, the element **100** includes one or more features **300**, **310** for receiving a "cable tie" or similar ratchet-binding component; such a cable tie is beneficially fabricated from metal strips,

plastics material or similar. The arrangement with such an element **100** is not necessary covering the whole of the circumference. As illustrated in FIG. 2A and FIG. 2B, the element **100** includes an elongate projection **130** into which the cable **80** is terminated onto a conductor block; the elongate projection **130** is conveniently referred to as being a "connector housing". The projection **130** houses an electrical contact arrangement, usually spring loaded contacts (SLC), in a conductor block **160**, an optional soft insulation material **270** such as u-butyl rubber or similar material around the conductor block **160**, and a plurality of pointed conductor pins (SLC) **180** embedded within the optional insulation material **270** and in electrical communication with the aforesaid conductor block **160**. The soft insulation material beneficially includes a peripheral projecting ring gasket feature adjacent to the conductor block **160** for providing an enhanced quality of hermetic sealing. Optionally, an additional sealing "O"-ring gasket or some elastic and plastic material, e.g. some mastic material, denoted by **280** in FIG. 3, is also provided around the conductor block **160**, or in substitution thereto, for providing a further hermetic seal of the electrical contact arrangement to the outer insulation of the conductor **50**. The gasket **280** may alternatively be produced with an initial outer profile formed along the outer surface of the conductor **50**. On the mid part of the curved region **110** in FIGS. 2A, 2B and 3, the curved region **110** where the hole is produced, an additional mastic material **290** may be adapted and which is compressible during the assembly of the clamps **70**. To summarize, this describes a threefold sealing of the contact area including the sealing elements of **290**, **280** and **270**. **250** is also a sealing element around the conductor block **160** and this is produced from the u-butyl rubber or similar material when the ties or strips get tightened and the material of sealing element **280** oozes and then comprises the sealing element **250**. Before this tightening, the sealing element **250** as indicated in FIG. 2A does not necessary exist.

[0023] Next, a method of installing the apparatus **10** illustrated in FIG. 1 onto a length of cable **40** will be described. The method is implemented to implement finally the apparatus **10** illustrated in FIG. 1. A result of the method is to ensure that the electrical contact arrangement couples the cable **80** to its corresponding insulated conductor **50** in a manner as depicted in FIG. 3. The conductor pins (SLC) **180** penetrate into metal of the insulated conductor **50** via a flat-bottomed hole which is pregrinded into through the insulation **260** of the conductor **50** and a short distance into metal of the conductor **50**, for example in an order of a 0,5 or 1 mm depth. Such penetration ensures that insulation material **270** individually may seal to the metal of the conductor **50** for each of its pins 180, namely each pin 180 is individually hermetically sealed. Moreover, the outer flexible material **250** provides an extra barrier of protection against ingress of moisture, thereby reducing a risk of corrosion occurring when the apparatus **10** is employed in wet and/or damp conditions. The present invention effectively employs in practice an electrical contact arrangement for making an electrical connection to a conductor of a cable, wherein the arrangement simultaneously penetrates the conductor at several spatial locations and synergistically also provides multiple stages of hermetic sealing to avoid ingress of moisture. Such multiple barriers not only protect against corrosion but also reduce a risk of flash-over occurring at elevated potentials, for example in excess of 1 kV, or even for elevated potentials in an order of 36 kV.

[0024] The method includes a series of steps which will now be described in more detail.

[0025] The main cable preferably consists of five conductors **50**, individually insulated and sheathed. The conductor itself is made of an electrically conductive material, such as aluminium or copper. To increase flexibility and elongation to break the conductors are annealed during or after the drawing process. The diameter of the conductors is made even and exact to fit the later cutting or milling process. To decrease the possibility of longitudinal ingress of water from an eventual hole/cut through the later applied insulation and sheath the conductors are made of solid metal.

[0026] The insulation is made of an electrically insulating material for example cross-linked Polyethylene/ XLPE. It is placed in one or more layers around the conductor with a specific thickness and in a way, by a specific extrusion technique, so that the insulation forms a continuous layer in the whole length of the core and with close contact with the conductor to decrease the possibility of longitudinal ingress of water from an eventual hole/cut through the later applied sheath and the insulation.

[0027] The individual sheath placed on top of the insulation is made of an electrically insulating material for example a specific PVC-compound or a so called halogen-free, flame retardant compound in one or more layers around the insulated conductor with a specific thickness and in a way, by a specific extrusion technique, so that the sheath forms a continuous layer in the whole length of the core and with close contact with the insulation to decrease the possibility of longitudinal ingress of water from an eventual hole/cut through the applied sheath and the insulation. To avoid long term deteriorating ageing effects between the insulation and sheath the sheath compound is made with specific components to avoid negative compatibility effects as reduced mechanical properties of the sheath and insulations materials and to avoid eventual migration of possible migrating components included in the recipe of the sheath and insulation compounds/materials and the connector base material.

[0028] The conductors are twisted together with a specific lay-up length to improve the cable flexibility and to fit the later used preparation apparatus for cutting or milling the holes in the sheath and insulation for connection of the electrical connectors at the right spot.

[0029] The branch cable is made with solid conductors or stranded conductors, typically made of Copper. The insulation material may be based on XLPE, PVC or so called halogen-free, flame retardant materials. The cable may have a common bedding or inner sheath, polymer compound placed above the insulated cores. The cable may have a common screen made of electrically conductive material. The cable has a common, protective sheath typically made based on PVC or a so called halogen-free, flame retardant compound. The cross-section of the conductor are of a size fitting the connection points inside the connector and to avoid long term deteriorating ageing effects between the insulation and the connector body the insulation compound is made with specific components to avoid negative compatibility effects, as reduced mechanical properties of the insulation and the connector body of the connector.

[0030] A first step optionally involves removing the individual sheath and insulation by cutting or milling a hole in them and in the same operation produce a flat surface on the outside of the solid metallic conductor to which the cable clamp arrangement **10** is to be installed in order to expose corresponding individually insulated and sheathed conductors **50**.

[0031] A second step involves clamping a preparation apparatus indicated generally by **400** in FIG. 5A onto the portion of the cable **40**, to ensure a fixed and defined positioning of the holes **350**. The preparation apparatus **400** comprises two half portions **410A**, **410B** pivotally coupled together by hinges **420** and secured together in a closed state by a closing mechanism **430** including user-operated handles **440**. Inside surfaces of the portions 410A, **410B** are machined or moulded to conform to an outer profile of the individually insulated and sheathed conductors **50** as illustrated in FIG. 5A. Such conformity ensures that the preparation apparatus **400** is automatically angularly registered to the individually insulated and sheathed conductors **50** of the cable **40** when the two portions **410A**, **410B** are pivoted and then secured together using the mechanism **430**. Holes **450** are included at various positions along one or more of the portions **410A**, **410B** for receiving a flat-bottomed milling bit **500** which can be rotated by use of a hand drill or similar applying torque onto a shank **530** of the milling bit **500** as illustrated in FIG. 5B. The milling bit **500** is beneficially provided with a collar **520** remote from its flat-bottom milling surface **540**, wherein the collar 520 abuts against an outer surface of the portions **410A**, **410B** as appropriate for preventing the milling bit **500** being advanced further than necessary into the metallic part of the conductor **50**. When holes **350** are correctly formed into the conductors **50** for receiving the aforementioned clamp components **70**, the holes **350** are shallow and flat-bottomed **360** for receiving ends of the one or more pins **180**. There exist other means than by milling for producing holes through the cable sheath and insulation and to produce beneficial surfaces on conductors, e.g. by drilling.

[0032] A third step of the method involves removal of the preparation apparatus **400** from the combined cable **40**.

[0033] A fourth step of the method involves attaching one or more clamp components **70** to the combined cable **40** by way of joining together the clamp components **70**, for example as illustrated in FIG. 2A, and FIG. 2B, so that electrical connections are made to the conductors **50** in a manner as depicted in FIG. 3. The element **100** of the clamp component **70** are placed in respect of their associated conductor **50** to which electrical connections are to be made, and then cable ties or similar are used to firmly attach the element **100** together with the bundle of conductors **50** to form the combined clamp component **70**. This step also results in the different gasket regions **290**, **280**, **270** of the combined clamp component **70** ooze and thus produces sealing including **250** which is produced from the material in region **280**.

[0034] A fifth step of the method involves optionally spraying the clamp components **70** and conductors **50** in the portion of the combined cable **40** with surface passivating material to reduce any tendency to flashover, corrosion or surface tracking. Thereafter, the method involves coupling together component parts of the outer casing **20** of the cable clamp arrangement **10** for completing installation of the cable clamp arrangement **10** to the combined cable **40**.

[0035] The cable clamp arrangement **10** is susceptible to being modified in various ways. For example, the outer casing **20** can be designed to be replaced or accept additional cables **80** in an event that the more connections subsequently are found to be necessary to the cable **40** after initial installation of the cable clamp arrangement **10**. Optionally, the method involves a further step of filling the inner volume **60** of the outer casing **20** with filling material, for example potting silicone rubber, after the clamp components **70** have been installed and the outer casing **20** has been located into position and/or is being located into position.

[0036] The cable clamp arrangement **10** is beneficially fabricated from moulded plastics materials, for example butyl rubber for flexible sealing components, and filled plastics materials for more rigid component parts of the apparatus **10**. Electrically connective parts of the apparatus **10** are beneficially fabricated from metal, for example aluminium, brass and/or copper. The metallic connectors may be electroplated with a thin layer of electrically conductive and corrosion resistant material. As aforementioned, although the apparatus **10** is described in the foregoing with cables **40** including a spiral configuration of insulated conductors **50**, the apparatus **10** can be adapted to enable electrical connections to cables **40** include their insulated conductors **50** in a parallel straight configuration. Although use of the cable clamp arrangement **10** is explicitly described in the foregoing in association with making electrical connections at lower regions of highway lamp units, the apparatus **10** can be used in numerous other contexts; for example, the apparatus **10** can be employed in underground street con-

duits for making connections to domestic premises, in tall building facilities such as tall skyscrapers, along railway tracks for feeding onto trackside transformers for conveying motive power, in agricultural facilities in the future wherein combine harvesters and similar equipment will be electrically propelled in a post-carbon World (post fossil fuel World), in airport facilities for conveying power to lights along runways, and so forth.

[0037] The preparation apparatus **400** and component parts of the cable clamp arrangement **10** are beneficially supplied as a kit for users to employ when implementing electrical connections to cables **40**. Optionally, the preparation apparatus **400** is provided with an insert for adapting to the insulated conductors **50** of the combined cable **40**, there being one type of insert for spiral insulated conductors **50** and another type of insert for straight insulated conductors 50, thereby rendering the kit ubiquitous for a plurality of different cable types and sizes. Optionally, the outer casing **20** of the apparatus **10** is fabricated from one ore more portions which can be attached and/or pivoted together to encompass the one or more clamp components **70** therein.

[0038] Branching of power cables with power cable clamps **70** has many uses outside the examples described above. Some examples of use can be branching of conductors for current to:

- Fans
- Sensors
- Rail points
- Lighting systems
- LED-based
- Emergency
- Direct current (DC) -distribution
- Battery charging depots

[0039] The power cable clamps **70**, preparation apparatus **400** and outer casing **20** must be adapted to required currents and voltages, specific lay-up lengths and other constructional details of the cables used, as well as the environment where the cables and branching is to be used. Cables may vary from cables with 2 conductors up to 5 conductors or even more. The cables may have various specific lay-up lengths or may even be straight.

[0040] Modifications to embodiments of the invention described in the foregoing are possible without departing from the scope of the invention as defined by the accompanying claims. Expressions such as "including", "comprising", "incorporating", "consisting of", "have", "is" used to describe and claim the present invention are intended to be construed in a non-exclusive manner, namely allowing for items, components or elements not explicitly described also to be present. Reference to the singular is also to be construed to relate to the plural. Numerals included within parentheses in the accompanying claims are intended to assist understanding of the claims and should not be construed in any way to limit subject matter claimed by these claims.

Claims

1. A power cable clamp (70) for making electrical connection to an adapted main cable (40) including one or more insulated and sheathed conductors (50), wherein said clamp (70) is adapted for making connection to the one or more conductors (50),
characterized in that
said clamp (70) is provided with an electrical contact arrangement (160, 180), providing at least one contact point (180) onto an associated conductor (50) of the cable (40) and said clamp (70) is also provided with at least one layer of sealing (290, 280, 250, 270) around said contact arrangement (160, 180).

2. A cable clamp (70) as claimed in claim 1, wherein said clamp (70) is adapted to register angularly onto said conductor (50) by way of said clamp (70) being provided with curved regions (110) and cusp regions (120) on its surfaces adapted for registering onto said conductor (50), such that the curved regions (110) and cusp regions (120) are adapted to conform to an outer surface presented by said conductor (50) towards said clamp (70).

3. A cable clamp (70) as claimed in claim 1 or 2, wherein said clamp (70) is fabricated one element (100) which is adapted to be attached via features (300, 310) for receiving cable ties, said clamp (70) thereby being retained upon said conductor (50) of the cable (40).

4. A cable clamp (70) as claimed in claim 1, 2 or 3, wherein the outer casing (20) is fabricated from two or more portions which are adapted to be pivoted together for being retained on the cable (40) and enclosing the one or more clamps (70).

5. A cable clamp (70) as claimed in any one of the preceding claims, wherein the electrical contact arrangement (160, 180) encompasses a first flexible material of the flexible material region (290) which is adapted to be elastically and or plastically deformed when the one or more contact points (180) are brought into forced contact with their associated conductor (50) of the cable (40) for sealing from ingress of moisture in operation of the one or more contact points (180).

6. A cable clamp (70) as claimed in claim 5, wherein the electrical contact arrangement (160, 180) is provided with a second flexible material gasket region (280) peripherally therearound, and wherein the flexible material of the second flexible material region (280) is adapted to be elastically and or plastically

deformed when the one or more contact points (180) are brought into forced contact with their associated conductor (50) of the cable (40) for sealing from ingress of moisture in operation of the one or more contact points (180) and which is integrated in the curved region of the clamps (70, 100) around the conductor block (160).

7. A cable clamp (70) as claimed in claim 5 or 6, wherein the electrical contact arrangement (160, 180) is provided with a third flexible material region (270) in which the one or more contact points (180) are embedded, wherein flexible material of the third flexible material region (270) is adapted to be elastically and or plastically deformed when the one or more contact points (180) are brought into forced contact with their associated conductor (50) of the cable (40) for sealing from ingress of moisture in operation of the one or more contact points (180).

8. A cable clamp (70) as claimed in claim 5, 6 or 7, wherein the said one or more contact points (180) are adapted to make contact to a flat-bottomed hole preformed into their associated conductor (50) of the cable (40).

9. A preparation apparatus (400) for preparing a combined cable (40) including one or more insulated conductors (50) for receiving a cable clamp (70) as claimed in any one of claims 1 to 7, wherein said preparation apparatus (400) includes a housing (410A, 410B) including an inner surface adapted to conform to an outer surface presented by said one or more conductors (50) for angularly registering said preparation apparatus (400) to said one or more conductors (50), and wherein said preparation apparatus (400) is provided with one or more guide holes (450) for guiding a grinding, or otherwise hole-producing tool (500).

10. A preparation apparatus (400) as claimed in claim 9, wherein said housing (410A, 410B) includes pivotally coupled parts (410A, 410B) providing with a locking arrangement (430, 440) for securing said housing around one or more conductors (50) for preparation thereof for subsequently receiving the cable clamp arrangement (10).

11. A method of installing at least one cable clamp (70) as claimed in any one of claims 1 to 8, wherein said method includes:

(a) coupling a preparation apparatus (400) to the cable (40) for angularly registering the preparation apparatus (400) to said insulated and sheathed conductors (50);
(b) producing, by milling or otherwise, one or more holes (350) via one or more guide holes (450) through the sheath and insulation material (255) of said one or more conductors (50) to expose electrically conductive metal of said one or more conductors (50);
(c) coupling at least one clamp (70) of said cable clamp arrangement (10) to said one or more conductors (50) for making electrical connections to electrically conductive metal of said one or more conductors (50) via said at least one clamp (70);
(d) tightening at least one tie around said at least one clamp (70) and said one or more conductors (50) so that, through the process of tightening, said flexible materials from their flexible insulating materials regions (290, 280, 270) ooze, thereby improving the sealing for the one or more contact points (180) from ingress of moisture in operation; and
(e) installing an outer casing (20) of said cable clamp arrangement (10) around said one or more clamps (70) and said cable (40) for protecting said one or more clamps (70).

12. A method as claimed in claim 11, including at least partially filling a region (60) formed between an inner surface of an outer casing (20) of said at least one cable clamp and said cable (40) with at least one of: insulating filling material, anti-corrosion and/or anti-tracking material.

Amended claims in accordance with Rule 137(2) EPC.

1. A power cable clamp (70) for making electrical connection to an adapted main cable (40) including one or more insulated and sheathed conductors (50), wherein said clamp (70) is adapted for making connection to the one or more conductors (50), said clamp (70) being provided with an electrical contact arrangement (160, 180), providing at least one contact point (180) onto an associated conductor (50) of the cable (40) and said clamp (70) being also provided with at least one layer of sealing (290, 280, 250, 270) around said contact arrangement (160, 180), **characterized in that** said clamp (70) is adapted to register angularly onto said conductor (50) by way of said clamp (70) being provided with curved regions (110) and cusp regions (120) on its surfaces adapted for registering onto said conductor (50), such that the curved regions (110) and cusp regions (120) are adapted to conform to an outer surface presented by said conductor (50) towards said clamp (70).

2. A cable clamp (70) as claimed in claim 1, wherein said clamp (70) is fabricated one element (100) which is adapted to be attached via features (300,

310) for receiving cable ties, said clamp (70) thereby being retained upon said conductor (50) of the cable (40).

3. A cable clamp (70) as claimed in claim 1 or 2, wherein the outer casing (20) is fabricated from two or more portions which are adapted to be pivoted together for being retained on the cable (40) and enclosing the one or more clamps (70).

4. A cable clamp (70) as claimed in any one of the preceding claims, wherein the electrical contact arrangement (160, 180) encompasses a first flexible material of the flexible material region (290) which is adapted to be elastically and or plastically deformed when the one or more contact points (180) are brought into forced contact with their associated conductor (50) of the cable (40) for sealing from ingress of moisture in operation of the one or more contact points (180).

5. A cable clamp (70) as claimed in claim 4, wherein the electrical contact arrangement (160, 180) is provided with a second flexible material gasket region (280) peripherally therearound, and wherein the flexible material of the second flexible material region (280) is adapted to be elastically and or plastically deformed when the one or more contact points (180) are brought into forced contact with their associated conductor (50) of the cable (40) for sealing from ingress of moisture in operation of the one or more contact points (180) and which is integrated in the curved region of the clamps (70, 100) around the conductor block (160).

6. A cable clamp (70) as claimed in claim 4 or 5, wherein the electrical contact arrangement (160, 180) is provided with a third flexible material region (270) in which the one or more contact points (180) are embedded, wherein flexible material of the third flexible material region (270) is adapted to be elastically and or plastically deformed when the one or more contact points (180) are brought into forced contact with their associated conductor (50) of the cable (40) for sealing from ingress of moisture in operation of the one or more contact points (180).

7. A cable clamp (70) as claimed in claim 4, 5 or 6, wherein the said one or more contact points (180) are adapted to make contact to a flat-bottomed hole preformed into their associated conductor (50) of the cable (40).

8. A preparation apparatus (400) for preparing a combined cable (40) including one or more insulated conductors (50) for receiving a cable clamp (70) as claimed in any one of claims 1 to 6, wherein said preparation apparatus (400) includes a housing (410A, 410B) including an inner surface adapted to conform to an outer surface presented by said one or more conductors (50) for angularly registering said preparation apparatus (400) to said one or more conductors (50), and wherein said preparation apparatus (400) is provided with one or more guide holes (450) for guiding a grinding, or otherwise hole-producing tool (500).

9. A preparation apparatus (400) as claimed in claim 8, wherein said housing (410A, 410B) includes pivotally coupled parts (410A, 410B) providing with a locking arrangement (430, 440) for securing said housing around one or more conductors (50) for preparation thereof for subsequently receiving the cable clamp arrangement (10).

10. A method of installing at least one cable clamp (70) as claimed in any one of claims 1 to 7, wherein said method includes:

(a) coupling a preparation apparatus (400) to the cable (40) for angularly registering the preparation apparatus (400) to said insulated and sheathed conductors (50);
(b) producing, by milling or otherwise, one or more holes (350) via one or more guide holes (450) through the sheath and insulation material (255) of said one or more conductors (50) to expose electrically conductive metal of said one or more conductors (50);
(c) coupling at least one clamp (70) of said cable clamp arrangement (10) to said one or more conductors (50) for making electrical connections to electrically conductive metal of said one or more conductors (50) via said at least one clamp (70);
(d) tightening at least one tie around said at least one clamp (70) and said one or more conductors (50) so that, through the process of tightening, said flexible materials from their flexible insulating materials regions (290, 280, 270) ooze, thereby improving the sealing for the one or more contact points (180) from ingress of moisture in operation; and
(e) installing an outer casing (20) of said cable clamp arrangement (10) around said one or more clamps (70) and said cable (40) for protecting said one or more clamps (70).

11. A method as claimed in claim 10, including at least partially filling a region (60) formed between an inner surface of an outer casing (20) of said at least one cable clamp and said cable (40) with at least one of: insulating filling material, anti-corrosion and/or anti-tracking material.

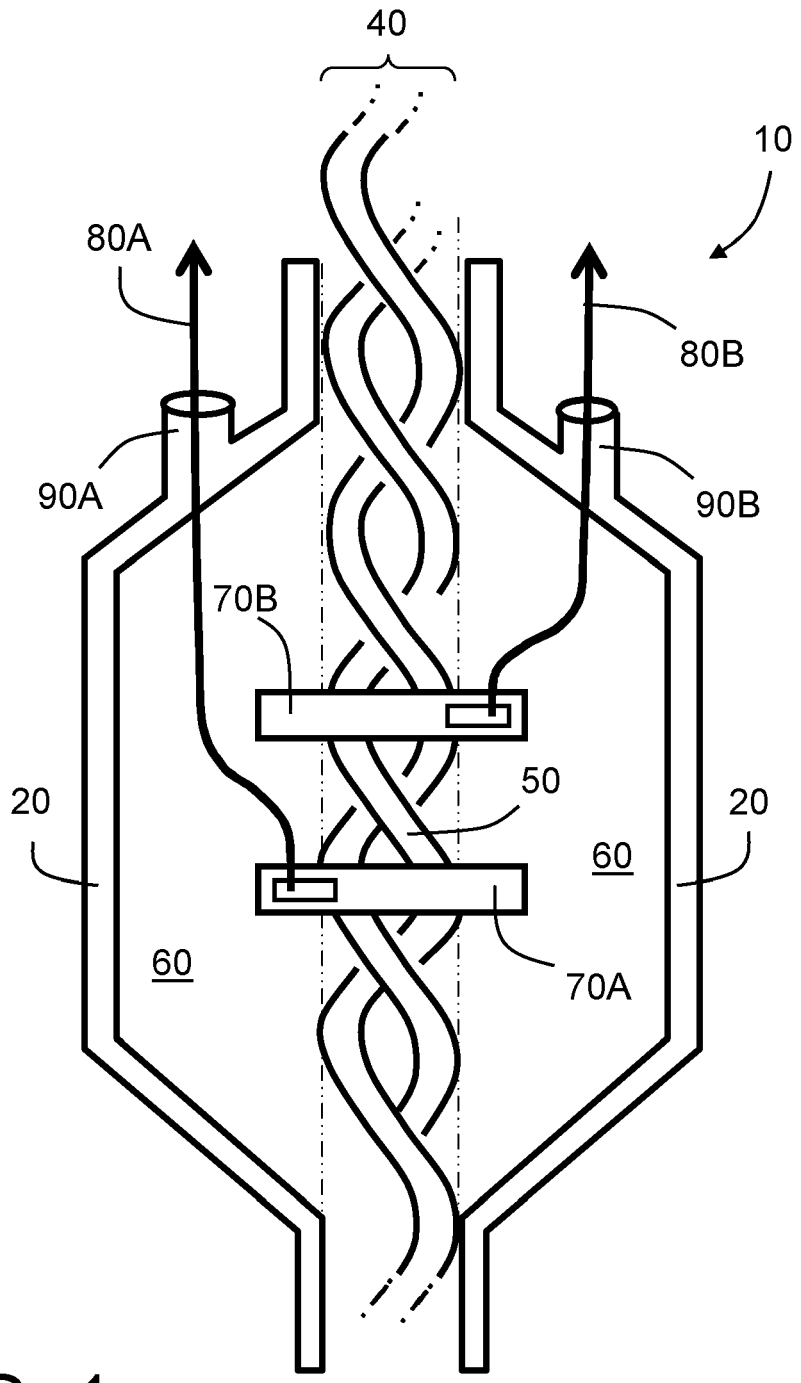

FIG. 1

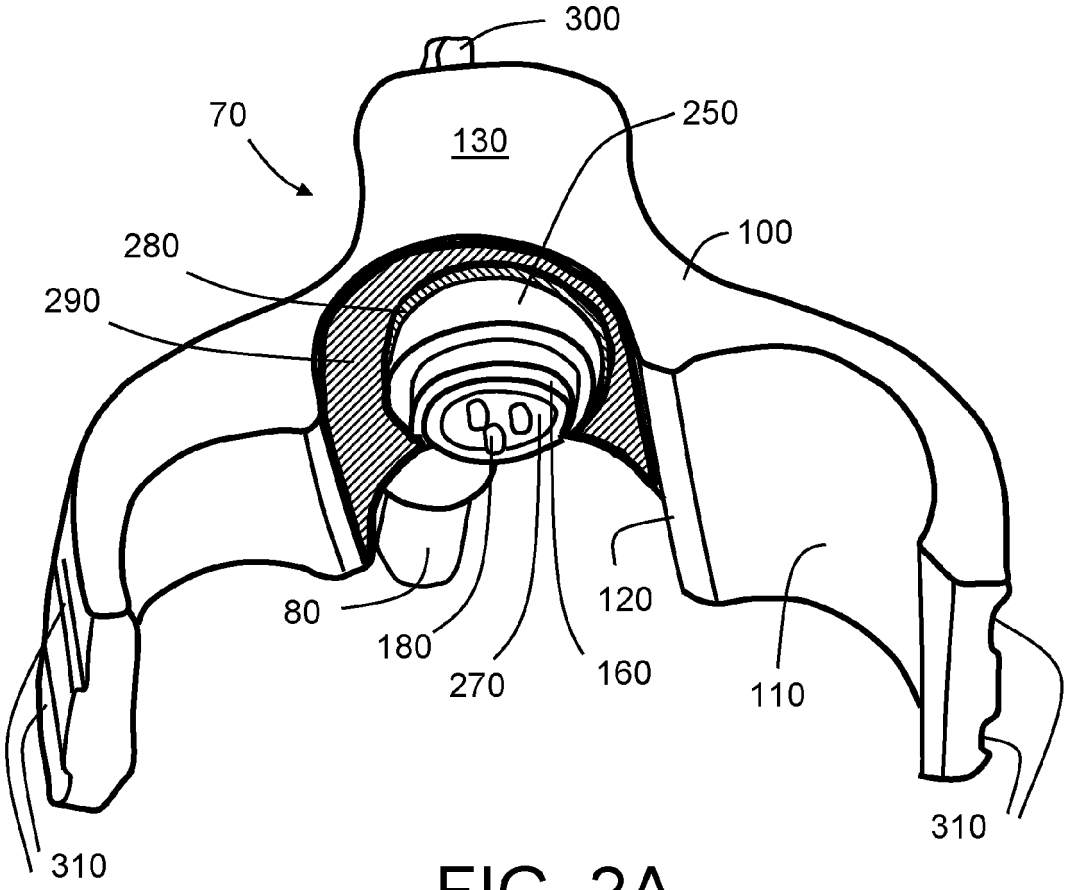
300
70
130
250
100
280
290
80
180
270
160
120
110
310
310

FIG. 2A

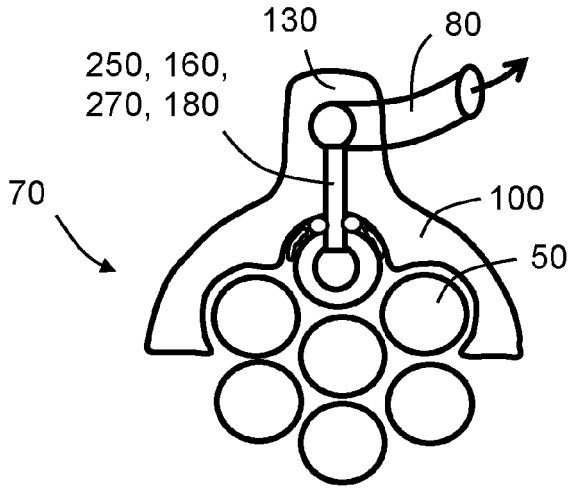
130
80
250, 160,
270, 180
70
100
50

FIG. 2B

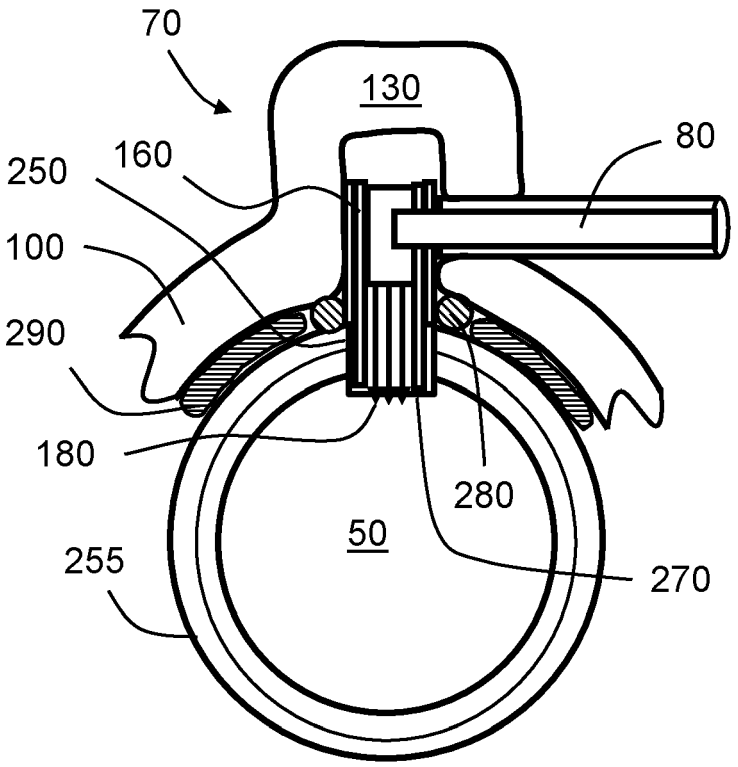

FIG. 3

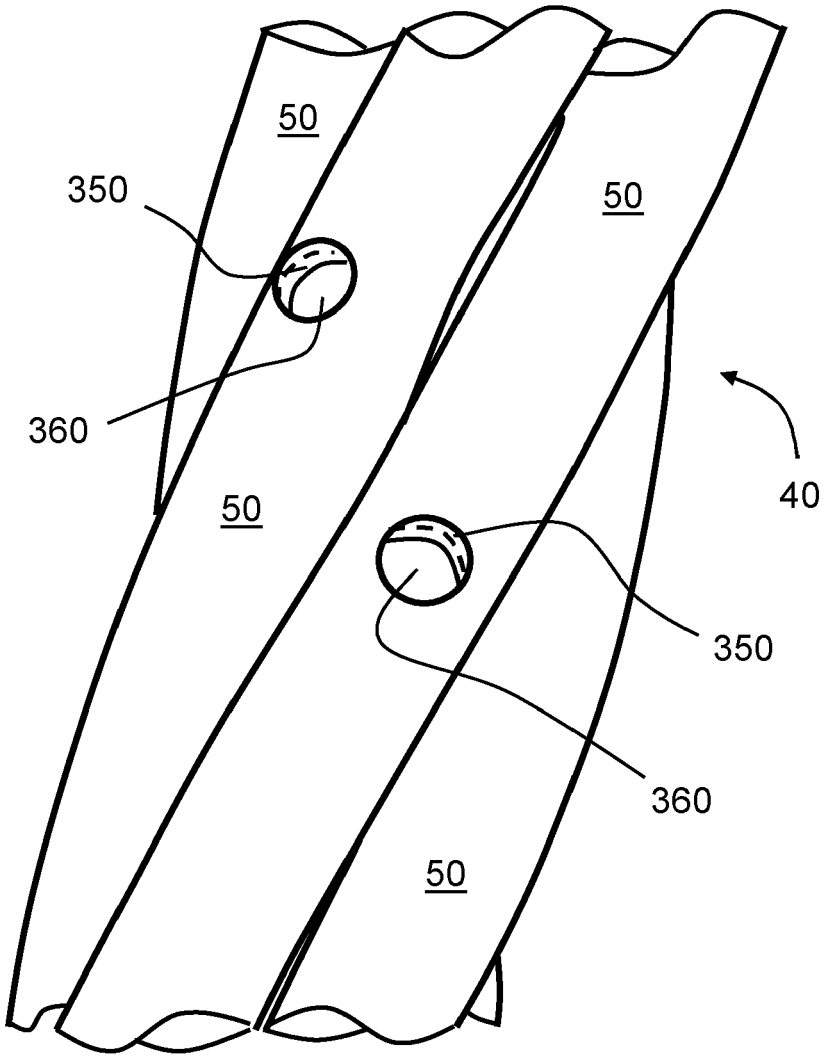

FIG. 4

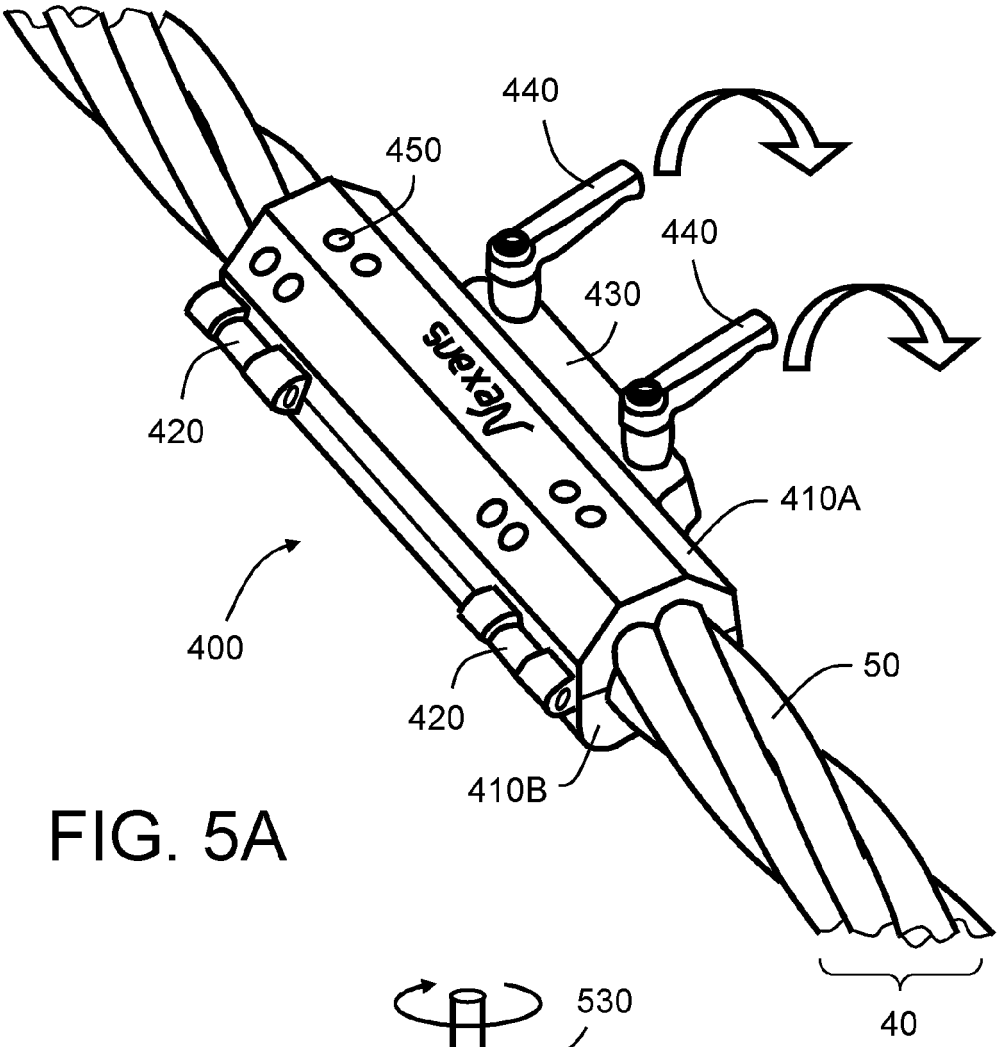

FIG. 5A

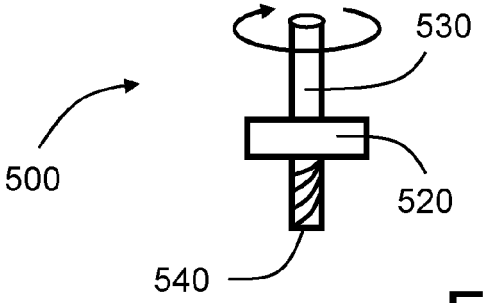

FIG. 5B

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EUROPEAN SEARCH REPORT

Application Number
EP 11 30 6549

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	WO 99/66597 A1 (TAPPAT ENGINEERING PTY LIMITED [AU]; DANNENBERG PATRICK PAUL [AU]) 23 December 1999 (1999-12-23)	1-7,9-12	INV. H01R9/03 H01R13/52
A	* figures 1-6 * * page 6, line 19 - page 9, line 34 *	8	ADD. H01R43/00
X	WO 01/15276 A1 (TAPPAT ENG PTY LTD [AU]; DANNENBERG PATRICK PAUL [AU]) 1 March 2001 (2001-03-01)	1-3,5-10	H01R43/28
A	* figures 2-6, 11-15 *	12	
A,D	DE 20 2004 005435 U1 (ROSENBERGER HOCHFREQUENZTECHNICK GMBH&CO [DE]) 9 June 2004 (2004-06-09) * figure 1 *	1	

TECHNICAL FIELDS SEARCHED (IPC)
H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 March 2012	Hugueny, Bertrand

CATEGORY OF CITED DOCUMENTS

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20-03-2012

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WO 9966597 A1	23-12-1999	NONE	
WO 0115276 A1	01-03-2001	NONE	
DE 202004005435 U1	09-06-2004	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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