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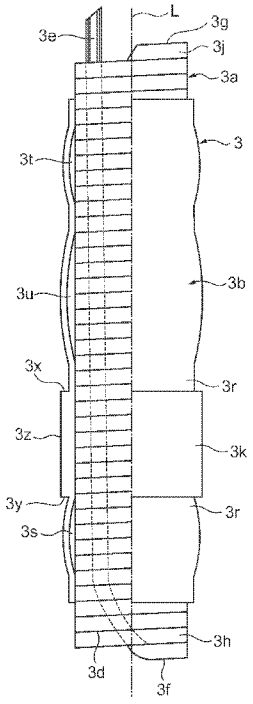


FIG. 2

(57) Abstract: To provide a cover processing tool capable of enhancing cable holding functionality and increasing cable work uniformity. The present invention includes a tube-like hollow core member 3a that can be pulled out and an elastic tube-like member 3b expanded on an outer circumferential side of the core member 3a, the core member 3a being pulled out in a state in which a power cable has been passed through an inner side of the elastic tube-like member 3b, thereby allowing the elastic tube-like member 3b to constrict and cover the power cable. The elastic tube-like member 3b includes a thick portion 3k arranged along an axis L direction of the core member 3a and capable of covering a border section B of a cable shielding layer 2e and a cable sheath 2g for a power cable 2A; and a normal portion 3r that is contiguous to the thick portion 3k, is arranged along the axis L direction, and has a lower elasticity than the thick portion 3k.

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COVER PROCESSING TOOL, POWER CABLE CONNECTION STRUCTURE, POWER CABLE CONNECTION STRUCTURE ASSEMBLY METHOD AND TERMINAL PROCESSING METHOD

The present invention relates to a cover processing tool, a power cable connection structure, a power cable connection structure assembly method, and a terminal processing method.

Related Art

There are various types of well-known power cable connection structures, such as terminating connection parts provided with a power cable terminal portion and a connection portion body (see Patent Document 1). In such terminating connection parts, the connection portion body includes a terminal, a porcelain bushing, an insulation compound and a stress cone. A conductor of the power cable terminal portion is compressed or crimped within a proximal end portion of the terminal that is attached to a distal end portion of the porcelain bushing, thereby connecting the terminal and the power cable terminal portion. Further, a strip-like machined portion is formed on the stress cone, and binding tape is wound onto a distal end portion of the stress cone, an outer circumference of the strip-like machined portion of the stress cone, and an outer circumference of a cable sheath of the power cable terminal portion.

Background Documents

Patent Documents

Japanese Unexamined Patent Application Publication No. 2011-83144

Disclosure of the Invention

In the above-described terminating connection part, the binding tape is wound on the outer circumference of the cable sheath where the strip-like machined portion is provided and works to increase friction resisting movement between the strip-like machined portion and the cable sheath, thereby enhancing the cable holding function of the terminating connection part. However, when the binding tape is wound, it must be sufficiently stretched and wound under high tension to ensure that enough friction is generated between the strip-like machined portion and the cable sheath. Since it is necessary to wind the tape while stretching it in this way, the operation to wind the tape requires time and effort. A further problem is unevenness which can result from variation in the tape tension during the winding in the tape winding operation.

The present invention was conceived to solve the above-described problems, and an object thereof is to provide a cover processing tool, power cable connection structure, power cable connection structure assembly method and terminal processing method capable of enhancing cable holding function while increasing the uniformity of the connection operation.

A cover processing tool according to a first embodiment of the present invention is a cover processing tool including a tube-like hollow diameter expansion holding member that can be pulled out and an elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member, the elastic tube-like member being constricted by pulling out the diameter expansion holding member in a state in which a power cable has been passed through an inner side of the diameter expansion holding member, and the power cable being covered by the constricted elastic tube-like member, wherein the elastic tube-like member includes a first section arranged along an axial direction of the diameter expansion holding member and capable of covering a border section between a cable shielding layer and a cable sheath of the power cable, and a second section that is contiguous to the first section, is arranged along the axial direction of the diameter expansion holding member, and has a lower elasticity than the first section.

According to this embodiment, when the tube-like hollow diameter expansion holding member is pulled out in a state in which the power cable has been passed through the diameter expansion holding member, the elastic tube-like member that was held in the expanded state on the outer circumferential side of the diameter expansion holding member constricts so that the power cable is covered by the constricted elastic tube-like member. In the cover processing tool, the elastic tube-like member includes the first section that is more resistant to deformation than the second section. The first section is arranged along the axial direction of the diameter expansion holding member and is capable of covering the border section of the cable shielding layer and the cable sheath of the power cable. When the elastic tube-like member constricts, the first section straddles the border section of the power cable, fastening it tightly in place. As a result, the cable sheath is prevented from moving in the longitudinal direction of the power cable.

In a cover processing tool according to another embodiment, the first section may be a thick portion that is thicker than surrounding portions.

In a cover processing tool according to another embodiment, the cover processing tool may further include a waterproofing member held between the diameter expansion holding member and the elastic tube-like member, wherein a position of the waterproofing member is shifted with respect to the first section in an axial direction of the diameter expansion holding member.

In a cover processing tool according to another embodiment, an electric field mitigating portion may be provided held between the diameter expansion holding member and the elastic tube-like member or integrated with the elastic tube-like member.

A power cable connection structure according to a first embodiment of the present invention is provided with an elastic tube-like member covering a power cable processed so that a cable shielding layer and a cable sheath are exposed in the stated order from a terminating end side, the power cable connection structure also including: a first section formed from the elastic tube-like member, arranged along a longitudinal direction of the

power cable, and capable of covering a border section of the cable shielding layer and the cable sheath; and a second section contiguous with the first section, arranged along the longitudinal direction of the power cable and having a lower elasticity than the first section.

In the above-described embodiment, the cable shielding layer and the cable sheath are exposed in the stated order from the terminating end side, and thus the length in the radial direction of the cable shielding layer and the length in the radial direction of the cable sheath will differ. Hence, a step will be formed at the border section of the cable shielding layer and the cable sheath, and this step can cause a problem because when the power cable is covered by the elastic tube-like member, the part of the elastic tube-like member positioned over the border section is easily stretched. However, in above-described power cable connection structure, the first section of the elastic tube-like member is arranged along the longitudinal direction of the power cable and is capable of covering the border section, and the first section resists deformation of the elastic tube-like member positioned at the border section, and consequently the above-described problem is prevented from occurring.

In a power cable connection structure according to another embodiment, the first section and the second section may be formed by a single elastic tube-like member.

In a power cable connection structure according to another embodiment, at least the first section may be formed from a plurality of elastic tube-like members.

A power cable connection structure according to another embodiment may further include a waterproofing member arranged on the cable sheath.

In a power cable connection structure according to another embodiment, the waterproofing member may be positioned a fixed distance further towards a proximal end side of the power cable than the border section, and a position of the waterproofing member may be shifted with respect to the first section in a longitudinal direction of the

power cable.

A power cable connection structure assembly method according to a first embodiment of the present invention is a power cable connection structure assembly method for covering a power cable using a cover processing tool including a tube-like hollow diameter expansion holding member that can be pulled out, and an elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member, the power cable connection structure assembly method including a step of processing the power cable to expose the cable shielding layer and cable sheath in the stated order from a terminating end side; a step of mounting the diameter expansion holding member on the power cable so as to cover a border section between the cable shielding layer and the cable sheath; and a step of constricting the elastic tube-like member by pulling out the diameter expansion holding member to cover the power cable with the constricted elastic tube-like member and form a first section that is arranged along a longitudinal direction of the power cable and capable of covering a border section between the cable shielding layer and the cable sheath, and a second section that is contiguous to the first section, is arranged along a longitudinal direction of the power cable, and has a lower elasticity than the first section.

According to this embodiment, when the tube-like hollow diameter expansion holding member is pulled out in a state in which the power cable has been passed through the diameter expansion holding member, the elastic tube-like member that was held in the expanded state on the outer circumferential side of the diameter expansion holding member constricts so that the power cable is covered by the constricted elastic tube-like member. The elastic tube-like member covers the power cable, thereby forming a first section that is more resistant to deformation than the second section. The first section is arranged along the axial direction of the diameter expansion holding member and covers the border section of the cable shielding layer and the cable sheath of the power cable. When the elastic tube-like member contracts, the first section straddles the border section of the power cable, fastening it tightly in place. As a result, the cable sheath is prevented from moving in the longitudinal direction of the power cable. Also, since the first section

is arranged along the axial direction of the diameter expansion holding member and is capable of covering the border section of the cable shielding layer and the cable sheath, the elastic tube-like member positioned at the border section is resistant to deformation.

A terminal processing method according to an embodiment of the present invention is a terminal processing method for covering a second elastic tube-like member in a power cable connection structure including a first elastic tube-like member that covers a power cable processed so as to expose a cable shielding layer and a cable sheath in the stated order from a terminating end side, the terminal processing method comprising: a step of mounting the diameter expansion holding member on the first elastic tube-like member so as to cover a position corresponding to a border section of the cable shielding layer and the cable sheath through use of a cover processing tool including a tube-like hollow diameter expansion holding member that can be pulled out and a second elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member; a step of constricting the second elastic tube-like member by pulling the diameter expansion holding member to cover the power cable with the constricted second elastic tube-like member via the first elastic tube-like member; wherein, in the covering step, the first elastic tube-like member and the second elastic tube-like member form a first section arranged along a longitudinal direction of the power cable and capable of covering a border section of the cable shielding layer and the cable sheath, and one of either the first elastic tube-like member or the second elastic tube-like member forms a second section that is contiguous to the first section, is arranged along a longitudinal direction of the power cable, and has a lower elasticity than the first section.

According to this embodiment, when the tube-like hollow diameter expansion holding member is pulled out in a state in which the power cable covered by the first elastic tube-like member has been passed through the diameter expansion holding member, the second elastic tube-like member that had been held in the expanded state on the outer circumferential side of the diameter expansion holding member contracts so as to cover the power cable via a first elastic tube-like member. The second elastic tube-like member also covers the power cable, forming a first section that is more resistant to

deformation than the second section. The first section is arranged along the axial direction of the diameter expansion holding member and covers the border section of the cable shielding layer and the cable sheath of the power cable with the first elastic tube-like member and the second elastic tube-like member, and when the second elastic tube-like member contracts, the first section straddles the border section of the power cable, fastening it tightly in place. As a result, the cable sheath is prevented from moving in the longitudinal direction of the power cable. Also, since the first section is arranged along the axial direction of the diameter expansion holding member and is capable of covering the border section of the cable shielding layer and the cable sheath, the elastic tube-like member positioned at the border section is resistant to deformation. Further, it is possible to use the cover processing tool again on the installed power cable connection structure to suppress the shrink back phenomenon.

The terminal processing method according to a first embodiment of present invention is a terminal processing method for further covering a second elastic tube-like member in a power cable connection structure including a first elastic tube-like member covering a power cable processed so as to expose a cable shielding layer and a cable sheath in that order from a terminating end side, the terminal processing method including: a step of mounting the diameter expansion holding member on the first elastic tube-like member so as to cover a position corresponding to a border section between the cable shielding layer and the cable sheath through use of a cover processing tool including a tube-like hollow diameter expansion holding member that can be pulled out and a second elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member; and a step of constricting the second elastic tube-like member by pulling out the diameter expansion holding member, and then covering the power cable with the constricted second elastic tube-like member via the first elastic tube-like member, wherein, in the covering step, the first elastic tube-like member and the second elastic tube-like member form a section arranged along a longitudinal direction of the power cable, and capable of covering the border section of the cable shielding layer and the cable sheath.

According to this embodiment, when the tube-like hollow diameter expansion holding member is pulled out in a state in which the power cable covered by the first elastic tube-like member has been passed through the diameter expansion holding member, the second elastic tube-like member that had been held in the expanded state on the outer circumferential side of the diameter expansion holding member contracts so as to cover the power cable via a first elastic tube-like member. The first elastic tube-like member and the second elastic tube-like member are arranged along the axial direction of the diameter expansion holding member and cover the border section between the cable shielding layer and the cable sheath of the power cable. When the second elastic tube-like member contracts, the first elastic tube-like member and the second elastic tube-like member straddle the border section of the power cable, fastening it tightly in place. As a result, the cable sheath is prevented from moving in the longitudinal direction of the power cable. Further, it is possible to use the cover processing tool again on the installed power cable connection structure to suppress the shrinkback phenomenon.

According this aspect of the present invention, it is possible to provide a cover processing tool, power cable connection structure, power cable connection structure assembly method and terminal processing method capable of enhancing the cable holding function and increasing the uniformity of cable connection work.

Brief Description of the Drawings

FIG. 1 is a view illustrating a power cable connection structure according to the present embodiment.

FIG. 2 is a view illustrating a cover processing tool according to the present embodiment.

FIG. 3 is a view illustrating a state in which the cover processing tool is mounted on the power cable.

FIG. 4 is a view for explaining a cover processing method for covering a terminating end of the power cable using the cover processing tool.

FIG. 5 is a view for explaining a cover processing method for covering the

terminating end of the power cable using the cover processing tool.

FIG. 6 is a view for explaining a cover processing method for covering the terminating end of the power cable using the cover processing tool.

FIG. 7 is a view for explaining a cover processing method for covering the terminating end of the power cable using the cover processing tool.

FIG. 8 is a view illustrating a modified example of a first section.

FIG. 9 is view for explaining a terminal processing method according to a modified example.

FIG. 10 is a view illustrating a state in which the cover processing tool is mounted on the power cable according to a modified example.

FIG. 11 is a view illustrating a state in which the cover processing tool is mounted on the power cable according to a modified example.

An embodiment of the present invention will now be described with reference to the drawings.

FIG. 1 is a view illustrating a connection structure 1 of a power cable 2A according to the present embodiment.FIG. 2 is a view illustrating a cover processing tool 3 according to the present embodiment.FIG. 3 is a view illustrating a state in which the cover processing tool 3 is mounted on the power cable 2A of FIG. 2.In FIGS. 1 to 3, a portion (left of the axis L) of the elastic tube-like member 3b has been peeled away so as reveal the interior of the elastic tube-like member 3b of the cover processing tool 3.The power cable 2A illustrated in FIG. 1 is, for instance, a cable for connecting an electrical room of a large apartment complex or other building to an outside electric utility pole. The connection structure 1 of the power cable 2A is provided in the electrical room or on the electric utility pole.

In the following, the location at which the terminal of the power cable 2A is attached is called a terminating connection location. Further, in the embodiment, the phrase "power cable" is also used to mean "electrical cable". Further, in the following, a portion covered by the elastic tube-like member 3b of the power cable 2A and a portion

where a terminal 2a is provided are sometimes referred to as a power cable terminating structure 2, and an upper side (terminal 2a side) of the drawing of FIG. 1 is referred to as a terminating end side, while a lower side (opposite side to terminal 2a) of FIG. 1 is referred to as a proximal end side.

The cover processing tool 3 can be used for both indoor and outdoor applications, but the present embodiment is described with reference to drawings for indoor use. As illustrated in FIG. 2, the cover processing tool 3 is used for implementing cover processing on the power cable terminating structure 2 to protect the power cable terminating structure 2.The cover processing tool 3 is configured to include a core member (diameter expansion holding member) 3a that can be pulled out and is formed in a tube shape, an elastic tube-like member 3b held in an expanded state on the outer circumference of the core member 3a, a waterproofing member 3s, a second waterproofing member 3t, and an electric field mitigating portion 3u.

The core member 3a is a cylindrical, tube-like hollow member having unravel lines formed on a wall surface along an entire length thereof. The unravel lines are provided so as to progressively proceed in the axis L direction of the core member 3a while circling around the axis L in one direction or circling around the axis L in the one direction and then reversing. In the present embodiment, a continuous spiral groove 3d is provided. The continuous spiral groove 3d is formed so as to progressively proceed along the axis L direction (axial direction of the diameter expansion holding member) while circling around the axis L of the core member 3a.In the following, the "unravel line" is described as the continuous spiral groove 3d.For the material of the core member 3a, a resin such as polyethylene or polypropylene is used. It is possible to pull out a core ribbon 3e, which is a cord-like body running along the continuous spiral groove 3d of the core member 3a.The portion where the continuous spiral groove 3d is formed is less thick than the area surrounding the continuous spiral groove 3d, and is therefore easily broken. Note that the unravel line is not limited to a spiral form of the type exemplified by continuous spiral groove 3d and can take an S or Z form, or any other form which allows pulling out.

Hence, when the core ribbon 3e is pulled, the core member 3a ruptures progressively at the portion of the continuous spiral groove 3d and is continuously pulled out as new core ribbon 3e.Since the continuous spiral groove 3d is formed with a fixed pitch, the core ribbon 3e being pulled out has uniform width. Note, however, that the core ribbon does not have to be of uniform width. The continuous spiral groove 3d may be formed on the inner circumferential surface of the core member 3a only, or it may be formed on the outer circumferential surface only, or it may be formed on both the inner circumferential surface and the outer circumferential surface. To manufacture the core member 3a having the continuous spiral groove 3d, for example, when the core ribbon 3e is wound in a spiral, adjacent core ribbons 3 may be adhered, fused, or linked, or joined using some combination of these methods. Alternatively, the continuous spiral groove 3d may be directly formed on a cylindrical member. The hollow tubular diameter expansion holding member that can be pulled out may be of the type described above whereby the diameter expansion holding member has a ribbon form and is unraveled in such a way that the elastic tube-like member 3b progressively constricts, or may be of a type whereby the diameter expansion holding member is pulled out from the elastic tube-like member and removed by sliding with respect to the elastic tube-like member.

The core member 3a includes a first end portion 3f at the end where the pulling out of the core ribbon 3e begins, and a second end portion 3g forming a terminating end side at which the pulling out of the core ribbon 3e ends. In proximity to the first end portion 3f, an exposed portion 3h is formed at which the elastic tube-like member 3b is not wound and the outer circumferential surface of the core member 3a is exposed, and in proximity to the second end portion 3g as well, an exposed portion 3 j is formed at which the elastic tube-like member 3b is not wound, and the outer circumferential side of the core member 3b is exposed.

The core ribbon 3e that is unraveled from the first end portion 3f passes through the inside of the core member 3a and is pulled from the second end portion 3g.When the core ribbon 3e is pulled at the second end portion 3g side, the core member 3a progressively unravels starting from the first end portion 3f and moving towards the

second end portion 3g.In the present embodiment, the continuous spiral groove 3d is formed over the entire length of the core member 3a, and thus the core member 3a can unravel over the entire length between the first end portion 3f and the second end portion 3g.Note, however, that it is sufficient for the continuous spiral groove to be formed at least at the portion of the core member 3a that holds the elastic tube-like member 3b in an expanded state. For example, there may be a portion in a predetermined range of the second end portion 3g where the spiral groove is not formed.

The elastic tube-like member 3b is held in an expanded state on the outer circumference of the core member 3a and forms the outer cover that covers the power cable terminating structure 2.The elastic tube-like member 3b is a room-temperature constriction tube formed from a rubber that contracts at room temperature and has excellent elastic properties. For the material of the elastic tube-like member 3b, ethylene propylene rubber, silicone rubber, or the like may be used. The elastic tube-like member 3b is held on the core member 3a in an expanded state, but when the core ribbon 3e of the core member 3a is pulled out, and the core member 3a progressively unravels, the hold provided by the core member 3a at the unraveled portion progressively disappears. The elastic tube-like member 3b in the corresponding portion contracts and shrinks in diameter, thereby covering the power cable terminating structure 2.

The elastic tube-like member 3b has formed therein a thick portion (first section) 3k that is thicker than the surrounding area. The thick portion 3k is a portion provided to suppress stretching of the elastic tube-like member 3b.Here, the elastic tube-like member 3b is configured from a normal portion (second section) 3r that has normal thickness and is arranged to be contiguous to the thick portion 3k, and the thick portion 3k that is thicker than the normal portion 3r.Specifically, the elastic tube-like member 3b includes the thick portion 3k arranged along an axis L direction of the core member 3a and capable of covering a border section B (see FIG. 1) of a cable shielding layer 2e and a cable sheath 2g for a power cable 2A, and the normal portion 3r that is contiguous to the thick portion 3k, is arranged along the axis L direction and has a lower elasticity than the thick portion 3k.

The axis L direction length of the thick portion 3k is a length that is sufficient to cover the border section B. Specifically, the axis L direction length of the thick portion 3k is set to be long enough so that even if the elastic tube-like member 3b is shifted in the axis L direction with respect to the power cable 2A, the thick portion 3k is positioned on an outer diameter side of the border section B. Further, the thick portion 3k extends in a circumferential direction of the elastic tube-like member 3b at a portion part-way along the axis L direction of the elastic tube-like member 3b, and is formed so as to surround the elastic tube-like member 3b in the circumferential direction. The thick portion 3k has a rectangular form when viewed in a cross-section along the axis L of the elastic tube-like member 3b.Further, the thick portion 3k includes a first surface 3x and a second surface 3y that extend in a flat shape in a plane perpendicular to the axis L, and a third surface 3z that extends in the axis L direction and a circumferential direction of the elastic tube-like member 3b between the first and second surfaces 3x and 3y.

The first and second waterproofing members 3s and 3t are held between the core member 3a and the elastic tube-like member 3b.The first and second waterproofing members 3s and 3t are, for example, putty filled between the core member 3a and the elastic tube-like member 3b. The first and second waterproofing members 3s and 3t are provided to prevent water permeating into the power cable 2A.For the material of first and second waterproofing members 3s and 3t, a silicone rubber compound, butyl rubber compound, or the like can be used.

Besides a putty, a rubber-like molded product, or a waterproof tape can also be used for the first waterproofing member. The first waterproofing member can be also be implemented separately when assembling the cable connection structure.

The electric field mitigating portion 3u is held between the core member 3a and the elastic tube-like member 3b.The electric field mitigating portion 3u is, for example, putty filled between the core member 3a and the elastic tube-like member 3b, and is provided to weaken the electric field concentration and reduce potential gradients in the power cable 2A.For the material of the electric field mitigating portion 3u, epichlorohydrin rubber,

nitrile butadiene rubber, or the like may be used for example.

The first and second waterproofing members 3s and 3t and the electric field mitigating portion 3u each extend in the circumferential direction of the elastic tube-like member 3b so as to surround the core member 3a.The portions holding the first and second waterproofing members 3s and 3t and the electric field mitigating portion 3u in the elastic tube-like member 3b have a bulging curved form due to the presence of the first and second waterproofing members 3s and 3t and the electric field mitigating portion 3u.The first waterproofing member 3s is positioned further toward the proximal end side of the elastic tube-like member than the thick portion 3k.The second waterproofing member 3t and the electric field mitigating portion 3u are positioned further toward the terminating end side than the thick portion 3k, and the second waterproofing member 3t is positioned further toward the terminating end side than the electric field mitigating portion 3u. Thus, the position of the first waterproofing member 3s, the position of the thick portion 3k of the elastic tube-like member 3b, the position of the electric field mitigating portion 3u and the position of the second waterproofing member 3t are staggered relative to each other in the axis L direction (longitudinal direction of the power cable 2A).

Besides being a putty, the electric field mitigating portion may be formed as an integrated body or separate body from the elastic tube-like member, or may be formed by combining a putty and an elastic tube-like member. Further, the electric field mitigating portion may be formed by winding an electric field mitigating tape or a sheet with a layer of putty on one side.

The following describes the power cable terminating structure 2 that is processed using the cover processing tool 3. Here, the power cable terminating structure 2 refers to a structure having a terminal 2a connected to a conductor 2b by compression, crimping, or the like at the terminating end side of the power cable 2A. As illustrated in FIG. 1, the power cable 2A is provided with a conductor 2b, an insulator 2c, a semiconductor layer 2d, a cable shielding layer 2e, a cable sheath 2g and a ground wire 2j.The insulator 2c is a portion configured with an insulating resin and the like, and covers an outer

circumferential surface of the insulator 2c.

The semiconductor layer 2d is a layer having semiconductor properties, and may be formed using a fabric or paper impregnated with a conductive substance such as carbon or the like. The semiconductor layer 2d is arranged on an inner circumferential side of the cable shielding layer 2e, and has the effect of enhancing insulation of the power cable 2A by making uniform the portions with high local electric fields caused by overlapping between the cable shielding layer 2e or the like.

The cable shielding layer 2e is a tape-like layer provided to prevent electric shock and allow leakage currents of the power cable 2A to flow. The cable shielding layer 2e material may be copper, for example, and in this case, the cable shielding layer 2e is also called shielding copper tape. The cable shielding layer 2e covers an outer circumference of the semiconductor layer 2d.The cable sheath 2g is constructed from, for example, polyvinyl chloride or polyethylene. The cable sheath 2g covers an outer circumference of the cable shielding layer 2e.The cable sheath 2g is not fixed to the outer circumference of the cable shielding layer 2e using an adhesive or the like, and thus the cable shielding layer 2e can be moved in the axis L direction with respect to the cable sheath 2g.

Before the power cable terminating structure 2 is covered using the cover processing tool 3, the insulator 2c, the semiconductor layer 2d, the cable shielding layer 2e and the cable sheath 2g are peeled off to expose, in order from the terminating end side, the conductor 2b, the insulator 2c, the semiconductor layer 2d and the cable shielding layer 2e. Further, on an outer circumferential surface of the exposed cable shielding layer 2e, a conductive ground wire extraction body 5 is attached. The ground wire extraction body 5 is connected to the ground wire 2j, and the ground wire 2j is extended to the proximal end side of the power cable 2A.

Note that the configuration of the above-described power cable terminating structure 2 is one example of the terminating connection location, and other configurations may be used. For example, paper-like binding tape may be wound on the outer

circumference of the cable shielding layer 2e.Alternatively, an inner semiconductor layer may be disposed on the outer circumference of the conductor 2b to cover the outer circumference of the conductor 2b.When an inner semiconductor layer is arranged on an outer circumference of the conductor 2b in this manner, electric fields locally concentrated in the outer circumference region of the conductor 2b can be stabilized, which contributes to making the electric field uniform.

As illustrated in FIG. 3, when the power cable terminating structure 2 is covered using the cover processing tool 3, the cover processing tool 3 is mounted on the power cable terminating structure 2 with the first waterproofing member 3s being orientated towards the proximal end side of the power cable 2A and the second waterproofing member 3t being orientated towards the terminating end side of the power cable 2A. The cover processing tool 3 is positioned with respect to the power cable 2A such that a proximal end section 3m of the elastic tube-like member 3bpositioned at the proximal end side of the cover processing tool 3 overlaps a terminating section 4A of a positioning tape 4 (see FIG. 6(b)) wound on the cable sheath 2g.

The positioning tape 4 is used to enable the identification of individual power cables 2A among a plurality of power cables 2A, and may, for example, differ in color for each power cable 2A.Note that the position of the positioning tape 4 is not limited to that in the above-described example, and may be determined as appropriate for each type of power cable. When the core member 3a is pulled out after fixing the position of the cover processing tool in the manner described above, the elastic tube-like member 3b contracts and shrinks in diameter and attaches tightly to the power cable 2A, and the power cable 2A is then covered by the elastic tube-like member 3b, thereby completing the connection structure 1.

Here, as illustrated in FIG. 1 and FIG. 3, in the connection structure 1 of the power cable 2A, the border section B between the cable shielding layer 2e and the cable sheath 2g is covered by the thick portion 3k of the elastic tube-like member 3b.The first waterproofing member 3s is positioned further toward the proximal end side than the

border section B with a distance D1 from the border section B to a terminating end section of the first waterproofing member 3s being, for example, 20 mm. The thick portion 3k covers the proximal end side of the cable shielding layer 2e and the ground wire extraction body 5.A distance D2 from the border section B to the terminating end section of the thick portion 3k is, for example 20 mm, and a length D3 from the border section B to the terminating end section of the cable shielding layer 2e in the axis L direction is, for example, 30 mm.

The electric field mitigating portion 3u covers a portion of the proximal end side of the semiconductor layer 2d and the insulator 2c, and a length D4 from the border section B to the semiconductor layer 2d in the axis L direction is, for example, 10 mm. The second waterproofing member 3t covers a portion of the terminating end side of the insulator 2c, the conductor 2b, and a portion of the proximal end side of the terminal 2a.A distance D5 from the border section B to the terminating end section of the insulator 2c is, for example, at least 130 mm. Note that the above-described distances D1, D2 and D5 and lengths D3 and D4 can be changed as appropriate according to the type of the power cable. Note, however, that if a waterproofing member is positioned in proximity to the border section B, a drop in viscosity of the waterproofing member under application of heat or the like may occur, resulting in movement of the cable sheath with respect to the cable shielding layer. For this reason, the first waterproofing member 3s must be separated by a fixed distance from the border section B, and thus it is preferable that distance D1 is set to at least 20 mm.

Next, an assembly method for the connection structure 1 of the power cable 2A for covering the power cable 2A using the above-described cover processing tool 3 is described with reference to FIGS. 4 to 7.In the following, work at the stage prior to covering the power cable 2A in the power cable terminating structure 2 is also described. Also, although the following describes an example in which the power cable 2A is a triplex (3 strand) cable, as illustrated in FIG. 4(a) and FIG. 7(d), the assembly method of the present embodiment may also be applied to cables other than triplex cables.

First, as illustrated in FIG. 4(a), a plurality of power cables 2A is fixed further to the proximal end side than the terminating end by a multicore bracket 6, and for example, the terminating ends of the power cables 2A are cut, and the power cable terminating structure 2 is formed such that the terminating ends are aligned along a single line. As illustrated in FIG. 4(b), the terminal hole depth F is measured for the terminals 2a that are attached to the power cables 2A.

As illustrated in FIG. 4(c), the cable shielding layer 2e is exposed by peeling off only a predetermined length of the cable sheath 2g.Here, the above-described predetermined length is determined according to the nominal conductor cross-sectional area, terminal type, and terminal hole depth F.As illustrated in FIG. 4(d), a tin-coated annealed copper wire 2h is attached at a predetermined position, and the cable shielding layer 2e is cut away along the tin-coated annealed copper wire to expose the semiconductor layer 2d, and the terminating end side of the semiconductor layer 2d is also removed to expose the insulator 2c.

As illustrated in FIG. 5(a), the terminating end side of the insulator 2c is peeled off to expose the conductor 2b.At this point, the dimension in the longitudinal direction of the insulator 2c that is peeled off is determined according to the nominal conductor cross-sectional area, terminal type and terminal hole depth F. As illustrated in FIG. 5(b), the cable sheath 2g over a range extending from the cut (border section B) in the cable sheath 2g to a proximal end side approximately 300 mm away is wiped clean using a cable cleaning material or the like.

As illustrated in FIG. 5(c), positioning tape 4 is wound at a position approximately 40 mm away from the border section B of the cable sheath 2g and the cable shielding layer 2e to a position at the cable sheath 2g side (proximal end side). Here, different colored positioning tape 4 is used for each of the power cables 2A so that the power cables 2 can be identified.

Since the position covered by the elastic tube-like member 3b is determined by the

position where the positioning tape 4 is wound, the operation to wind the positioning tape 4 must be performed with accuracy. Next, as illustrated in FIG. 5(d), the ground wire extraction body 5 is fitted at the location where the cable shielding layer 2e is wound in a position as near as possible to the cable sheath 2g.At this time, the ground wire 2j is installed so as to contact the ground wire extraction body 5 and so as to extend from the ground wire extraction body 5 to the proximal end side.

As illustrated in FIG. 6(a), the surface of the insulator 2c is wiped clean using a cable cleaning material or the like. At this point, it is preferable to wipe the insulator 2c by moving the cable cleaning material or the like from the semiconductor layer 2d side (proximal end side) to the conductor 2b side (terminating end side).Then, as illustrated in FIG. 6(b), the cover processing tool 3 is mounted on the power cable 2A.At this time, the direction in which the core ribbon 3e is pulled out is orientated towards the conductor 2b side (terminating end side). Next, the cover processing tool 3 is positioned with respect to the positioning tape 4 so that the proximal end section 3m of the elastic tube-like member 3b overlaps the terminating end section 4A of the positioning tape 4.

Next, the core ribbon 3e is pulled out from the terminating end side to progressively unravel the core member 3a from the first end portion 3f.Note that before and after the operation of winding the positioning tape 4 illustrated in FIG. 5(c), marks or the like for aligning the first end portion 3f and the second end portion 3g of the core member 3a may be added to the power cable 2A.In this case, addition of the marks or the like can make the alignment operation illustrated in FIG. 6(b) significantly easier.

As illustrated in FIG. 7(a), the core member 3a is progressively unraveled from the first end portion 3f as the core ribbon 3e is pulled out at the terminating end side, and the power cable 2A is gradually covered from the proximal end side by the elastic tube-like member 3b.Note that the core ribbon is pulled out completely. Then, as illustrated in FIG. 7(b), the terminal 2a is attached to the conductor 2b using a predetermined tool. Thereafter, as illustrated in FIG. 7(c), adhesive polyethylene tape 7 is wound onto the proximal end side of the terminal 2a, the conductor 2b, and the terminating end side of the

elastic tube-like member 3b. Then, if grounding is necessary, grounding is performed, thereby completing the assembly operation for the connection structure 1 of the power cables 2A as illustrated in FIG. 7(d).

Next, the effects of the cover processing tool 3, the connection structure 1 of the power cable 2A, and the assembly method of the connection structure 1 of the power cable 2A according to the present embodiment are described.

With conventional power cable connection structures, the cable sheath shrinks as a result of internal stresses during cable manufacture, especially if the cable is installed for long periods outside. Due to the contraction of the cable sheath in this way, the shrinkback phenomenon occurs, thereby exposing the cable shielding layer. When the shrinkback phenomenon occurs, water can then permeate easily into the cable, and there is then a risk of problems such as insulation breakdown occurring.

With the cover processing tool 3 of the present embodiment, the elastic tube-like member 3b includes a thick portion 3k that is more resistant to deformation than surrounding portions (normal portion 3r), and when the elastic tube-like member 3b contracts, the thick portion 3k tightly holds the border section B of the power cable 2A.As a result, the cable sheath 2g is prevented from moving in the longitudinal direction of the power cable 2A.Further, the first and second waterproofing members 3s and 3t are provided between the core member 3a and the elastic tube-like member 3b. The first and second waterproofing members 3s and 3t are arranged at positions displaced along the axis L direction with respect to the thick portion 3k.

For waterproof members of the type of the first and second waterproofing members 3s and 3t, it is common practice to use putty-like substances with flowability. However, it has not been common practice to use slippery substances such as putty-like substances and the like as a countermeasures to shrinkback. Conventionally, one countermeasure to shrinkback was to wind tape having waterproofing properties onto the outer diameter of the cable.

On the other hand, in the present embodiment, movement of the cable sheath 2g is prevented by the thick portion (first section) 3k that is capable of covering the border section B, and the first and second waterproofing members 3s and 3t are provided at positions staggered in the axis L direction with the thick portion 3k between the core member (diameter expansion holding member) 3a and the elastic tube-like member 3b. Hence, it is possible to use the first and second waterproofing members 3s and 3t, which are a putty substance having flowability, as a countermeasure to shrinkback.

Further, from the perspective of effectively filling gaps, it is more preferable to fill them using a putty substance in the manner of the embodiment than to wind tape. Note also that in the present embodiment, the first and second waterproofing members 3s and 3t formed from the putty substance are provided inside the elastic tube-like member 3b rather than on the outer diameter side, and thus waterproofing performance can be greatly increased.

Also, with conventional processing methods in which a cable is inserted into the stress cone, the cable outer diameter and the stress cone inner diameter are approximately the same. Hence, the terminating structure is assembled by inserting the cable into the stress cone. In processing methods such as this that use insertion, grease (lubricant) is applied to an inner circumference of normal stress cones to make it easier to insert the cable, and the tip of the stress cone is a structure that covers the border section of the cable in order to ensure a waterproof design. With an insertion-type terminating structure of this type, the grease is expelled outwards when the cable is inserted, and if the expelled grease is not removed in an appropriate manner, problems such as a drop in the attachment forces can result. In contrast, with the power cable terminating structure 2 of the present embodiment, when the thick portion 3k straddles the border section B, it covers the border section B directly. Hence, the power cable terminating structure 2 is more effective in suppressing shrinkback than the prior art. Further, since there is no need for an operation to remove grease, problems of the type described above do not occur.

Moreover, since the waterproofing provided by the first and second waterproofing members 3s and 3t and the holding provided by the thick portion 3k are performed independently, the functions of waterproofing and holding the power cable 2A can be enhanced. Thus, because the cable sheath 2g is strongly pressed by the thick portion 3k, it is possible to avoid circumstances in which internal stresses introduced during the manufacture of the power cable 2A cause the cable sheath 2g to contract. Hence, it is possible to avoid the situation in which the cable shielding layer 2e is exposed and also to suppress the above-described shrinkback phenomenon.

Further, with cover processing tool 3, the thick portion 3k and the first and second waterproofing members 3s and 3t are provided, and thus there is no need to provided tape to increase the waterproofing and holding of the power cable 2A, and the power cable 2A can be easily covered by unraveling the core member 3a.Thus, it is possible to improve the uniformity of operations relating to covering the power cables 2A.In addition, since the thick portion 3k and the first and second waterproofing members 3s and 3t are provided in advance in predetermined positions of the cover processing tool 3, the risk of an operator installing the waterproof members in an unintended position is eliminated, and operability can be significantly improved.

With the cover processing tool 3, the first section that is more resistant to deformation than the surroundings (normal portion 3r) is provided by the thick portion 3k, and thus by extending the thick portion 3k appropriately towards the terminal 2a side (terminating end side) and incorporating the semiconductor layer into the thick portion 3k to form a stress cone integrated with the thick portion 3k, it is further possible to provide the thick portion 3k with an electric field mitigating function.

The putty-like electric field mitigating portion 3u held between the core member 3a and the elastic tube-like member 3b is provided on an opposing side of the core member 3a in the axis L direction with the thick portion 3k between the electric field mitigating portion 3u and the first waterproofing member 3s. Note that one way to provide the electric field mitigating portion on the opposing side of the core member 3a in the axis

L direction with the thick portion 3k interposed between the electric field mitigating portion 3u and the first waterproofing member 3s is to form a stress cone that is integrated with the elastic tube-like member 3b by incorporating a semiconductor layer in the thick portion 3k, thereby making it possible to exhibit an electric field mitigating function. Thus, in the present embodiment, the electric field mitigating portion 3u can be provided in a predetermined position in the cover processing tool 3, and thus the risk of an operator installing an electric field mitigating portion in an unintended position is eliminated, and operability can be significantly improved. Moreover, in comparison to the case in which electric field mitigating tape, which is tape that works to weaken electric fields, is used, the working process can be shortened because there is no need to wind any tape. Hence, operability can be enhanced.

In the power cable 2A, the cable shielding layer 2e and the cable sheath 2g are exposed in the stated order from the terminating end side, and thus the diameter direction length at the cable shielding layer 2e and the diameter direction length at the cable sheath are different. Hence, a step is formed at the border section B between the cable shielding layer 2e and the cable sheath 2g. This step can cause a problem because when the power cable 2A is covered by an elastic tube-like member without a thick portion, the part of the elastic tube-like member positioned over the border section B is easily stretched. However, in the connection structure 1 of the power cable 2A, the thick portion 3k covers the border section B, making the elastic tube-like member positioned at the border section B resistant to deformation. As a result, the above-described problem does not occur. Also, due to the elastic force of the elastic tube-like member 3b, the thick portion 3k tightly holds the border section B, and the power cable 2A can be firmly held.

The present invention is not limited to the above-described embodiments, and various modifications may be made without departing from the spirit of the present invention.

For example, while in the above-described embodiment the thick portion 3k is formed so as to surround the elastic tube-like member 3b in the circumferential direction,

the thick portion need not be formed so as to surround the elastic tube-like member in the circumferential direction, and may instead include a plurality of discontinuous thick portions. The thick portion 3k has a rectangular form when the elastic tube-like member 3b is viewed as a cross-section along the axis L. However, as illustrated in FIG. 8(a), in place of the thick portion 3k, a thick portion 13k having a trapezoidal form when the elastic tube-like member 3b is viewed as a cross-section along the axis L may be used. Further, the form of thick portion may also be a curving bulge, or it may be changed to another appropriate shape.

Also, the thick portion formed as the "first section", may be formed using another cover processing tool. In such a case, after shrinking so as to cover the border section with a first cover processing tool, the thick portion is formed by shrinking another cover processing tool so as to cover the first cover processing tool. Details of this method are described below with reference to FIG. 9.

Next, an assembly method for a connection structure that covers the power cable 2A using two cover processing tools is described. The step of processing the power cable 2A so that the cable shielding layer 2e and the cable sheath 2g are exposed in the stated order from the terminating end side is the same as in the above described embodiment. In this method, a cover processing tool 3A including a first elastic tube-like member 3Ab as illustrated in FIG. 9(a) and a cover processing tool 3B including a second elastic tube-like member 3Bb as illustrated in FIG. 9(b) are used. The first elastic tube-like member 3Ab is of a similar length to the elastic tube-like member 3b described in the above embodiment. The second elastic tube-like member 3Bb may be shorter than the first elastic tube-like member 3Ab as long as it can cover a portion of the region in proximity to the border section B. The assembly method includes: a step of mounting a core member 3Aa of the first cover processing tool 3A on the power cable 2A so as to cover the border section B of the cable shielding layer 2e and the cable sheath 2g and covering the power cable 2A with the first elastic tube-like member (see FIG. 9(c)); a step of mounting a core member 3Ba of the second cover processing tool 3B on the first elastic tube-like member 3Ab so as to cover a position corresponding to the border section B of the cable shielding layer 2e and

the cable sheath 2g (see FIG. 9(d)); and a step of covering the power cable 2A with the second elastic tube-like member 3Bb via the first elastic tube-like member 3Ab (see FIG. 9(e)). In the steps illustrated in FIG. 9, pulling out the core members 3Aa and 3Ba causes the elastic tube-like members 3Ab and 3Bb to contract and cover the power cable 2A with the contracted elastic tube-like members 3Ab and 3Bb. As a result, a first section 40A arranged along the longitudinal direction of the power cable 2A and capable of covering the border section B and a second section 40B that is contiguous to the first section 40A, is arranged along the longitudinal direction of the power cable 2A, and has a lower elasticity to the first section 40A are formed. In the present embodiment, the first section 40A is formed by a plurality (two) of elastic tube-like members, the first elastic tube-like member 3Ab on the inner side and the second elastic tube-like member 3Bb on the outer side. According to the above-described assembly method, it is not necessary to prepare a cover processing tool including a special elastic tube like member having a thick portion, and existing cover processing tools can be used.

Next, a terminal processing method for covering a connection structure, in which the power cable 2A has already been covered with a first elastic tube-like member 3Ab, using a second elastic tube-like member 3Bb is described. The terminal processing method includes: a step of mounting a second core member 3Ba on the first elastic tube-like member 3Ab so as to cover a position corresponding to the border section B of the connection structure already in the state of FIG. 9(c) (see FIG. 9(d)); and a step of covering the power cable 2A with the second elastic tube-like member 3Bb via the first elastic tube-like member 3Ab (see FIG. 9(e)).In the above-described steps, the first elastic tube-like member 3Ab and the second elastic tube-like member 3Bb enable the forming of the first section 40A arranged along the longitudinal direction of the power cable 2A and capable of covering the border section B. The first elastic tube-like member 3Ab enables the forming of the second section 40B that is contiguous to the first section 40A, is arranged along the longitudinal direction of the power cable 2A, and has a lower elasticity than the first section 40A.According to the above-described terminal processing method, it is possible to use a cover processing tool again on the installed connection structure of the power cable 2A to suppress the shrinkback phenomenon.

In the assembly method illustrated in FIG. 9, the second elastic tube-like member 3Bb may be used to cover the border section B first, and then the first elastic tube-like member 3Ab may be used to cover on top of this arrangement. Alternatively, both the first elastic tube-like member 3Ab and the second elastic tube-like member 3Bb may be held on a single cover processing tool (in other words, a core member), and the power cable 2A can be covered by the first elastic tube-like member 3Ab and the second elastic tube-like member 3Bb simultaneously. In this case, the second elastic tube-like member 3Bb may be held on an outer circumferential side of the first elastic tube-like member 3Ab held on the core member, or the first elastic tube-like member 3Ab may be held so as to cover the second elastic tube-like member 3Bb held on the core member from the outer circumferential side.

In the assembly method illustrated in FIG. 9, the first elastic tube-like member 3Ab may be used to cover the border section B first, and another first elastic tube-like member 3Ab may be used to cover on top of this arrangement. For instance, if the length of the elastic tube-like member implemented afterwards is equal in length to or longer than the elastic tube-like member implemented first, it is easy to position the later-implemented tube-like member with respect to the first-implemented elastic tube-like member, and there is no longer any need to provide markings (after implementation of the elastic tube-like member, markings are necessary because the border section has been covered and cannot be confirmed visually).

If a high dielectric constant material (EPDM, silicone rubber or the like) is used as the second elastic tube-like member arranged on the inner circumferential side of the first elastic tube-like member, the second elastic tube-like member for forming the first section 40A can function as an electric field mitigating member 36.

Specifically, as illustrated in FIG. 10, the electric field mitigating member 36 formed as the second elastic tube-like member and also including the electric field mitigating function may be used instead of the putty-like substance as the electric field

mitigating portion. Thus, the electric field mitigating member 36 itself also functions as the elastic tube-like member. Accordingly, the electric field mitigating member 36 may be extended near the region of the border section B and allowed to function as a portion of the constituent elements of the first section 40A.In such a case, the first section 40A is formed by a plurality of elastic tube-like members, namely the elastic tube-like member 3b and the electric field mitigating member 36 that functions as an elastic tube-like member. Note that, as illustrated in FIG. 10, the portion of the elastic tube-like member 3b corresponding to the first section 40A is formed with a greater thickness than surrounding portions. Note also that since the first section 40A is formed by combining the elastic tube-like member 3b and the electric field mitigating member 36, provided that the condition of the elasticity of the second section 40B being lower than that of the first section 40A is maintained, the thickness of the section of the elastic tube-like member 3b corresponding to the first section 40A may be the same as or smaller than the section corresponding to the second section 40B.Further, when the first section is formed by a plurality of elastic tube-like members, the thickness of the "thick portion" is the total thickness of the plurality of elastic tube-like members.

Also, in the present embodiment, a putty-like substance was used as the waterproof member. However, as the members with the waterproofing function used in the first and second waterproofing members 3s and 3t, waterproofing members having a cylindrical rubber-like molded body arranged so as to be capable of covering the border section B may be used. When the rubber-like molded body is installed, it can be fitted prior to fitting the ground wire extraction body 5 illustrated in FIG. 5(d), and one end of the rubber-like molded body can be arranged to align with the border section B. When a rubber-like molded body is used, it is possible to use a molded body with an inner diameter, outer diameter and length predetermined so as to provide reliable waterproofing of the cable to be used, and thus it is possible to promote uniformity in the waterproofing work. Further, the rubber-like molded body may be arranged so as to cover the border section B.

The following describes an example in which a rubber-like molded body is used as the first waterproofing member with reference to FIG. 11.In such a case, the first

waterproofing member 34, which is the rubber-like molded body itself, functions as an elastic tube-like member. Accordingly, the first waterproofing member 34 may be arranged in proximity to the border section B and be allowed to function as a portion of the first section 40A.In the state in which the first waterproofing member 34 is arranged in proximity to the border section B, the elastic tube-like member 3b is allowed to contract and cover the first waterproofing member 34 together with the power cable 2A.In such a case, the first section 40A is formed by plurality of elastic tube-like members, namely the elastic tube-like member 3b and the first waterproofing member 34 that functions as an elastic tube-like member. The first waterproofing member 34 is not displaced in the axial direction of the diameter expansion holding member with respect to the first section. Note that, as illustrated in FIG. 11, the portion of the elastic tube-like member 3b corresponding to the first section 40A is formed with a thick portion having a greater thickness than surrounding portions. Note also that since the first section 40A is formed by combining the elastic tube-like member 3b and the first waterproofing member 34, provided that the condition of the elasticity of the second section 40B being lower than that of the first section 40A is maintained, the thickness of the section of the elastic tube-like member 3b corresponding to the first section 40A may be the same as or smaller than the section corresponding to the second section 40B.Further, when the first section is formed by a plurality of elastic tube-like members, the thickness of the "thick portion" is the total thickness of the plurality of elastic tube-like members.

As described above, at least the first section 40A may be formed using a plurality of elastic tube-like members. With such a configuration, the elastic tube-like members can provide a shrinkback suppressing effect, and can simultaneously provide some other functionality (such a waterproofing or an electric field mitigating function).Further, a shrinkback suppressing effect can also be imparted for already assembled connection structures.

Note also that when the first section and the second section are formed by a single elastic tube-like member as illustrated in FIGS. 1 to 3, it is possible to provide shrinkback suppression functionality for the power cable 2A in a single process. As illustrated in FIG.

11, the waterproofing member may form part of the first section. However, as illustrated in FIGS. 1 to 3, there is an advantage when the waterproofing member 3s is positioned a set distance further towards the proximal end side of the power cable 2A than the border section B so that the position of the waterproofing member 3s and the first section are displaced relative to each other along the longitudinal direction of the power cable 2A, the advantage being that the positioning of the waterproofing member 3s and the elastic tube-like member 3b can be set uniformly.

In the above-described embodiment, the first section (portion of the first section) and the second section were separate bodies, but the second section may be configured using a separate member.

In the above-described embodiment, the first section that is more resistant to deformation than the surroundings was formed by the thick portion 3k. However, as illustrated in FIG. 8(b), for example, the first section may instead be formed by a high-hardness rubber 23k embedded within the elastic tube-like member 3b.Further, as illustrated in FIG. 8(c), the first section may be formed by an insulating wire 33k embedded in the elastic tube-like member 3b so as to extend in the axis L direction. In FIG. 8(c), six strands of the insulating wire 33k are embedded so as to be equally spaced in a circumferential direction of the elastic tube-like member 3b, but the number of strands and the hardness of the insulating wire 33k can be appropriately changed according to the strength (resistance to stretching) required in the first section. Moreover as illustrated in FIG. 8(d), ribs 43k projecting from the outer circumferential surface of the elastic tube-like member 3b and extending in the axis L direction can also be provided as the first section.

In the examples illustrated in FIG. 8(b) to FIG. 8(d), of the sections where the high-hardness rubber 23k is embedded, the section where the insulating wire 33k is embedded, and the section where the ribs 43 is formed, each section thereof is more resistant to deformation than the surroundings (normal portion 3r), and hence it is possible to achieve the same effects as in the above-described embodiment. Note also that the first

section can be realized using configurations other than the above. For the material of the high-hardness rubber 23k, silicone rubber, ethylene propylene rubber, or the like may be used, and for the materials of the insulating wire 33k, glass fiber, alumina fiber, carbon fiber or the like may be used.

In the above-described embodiment, the core member 3a was used as the tube-like hollow diameter expansion holding member that can come apart, but the structure of the core member 3a may be appropriately modified. A size and form of the core member 3a and the elastic tube-like member 3b can be appropriately modified in accordance with the type of the power cable. For example, for cover processing tools to be used outdoors, an elastic tube-like member provided with a shielding cover may be used. Further, although in the above-described embodiment, the core member 3a is unraveled by pulling the core ribbon 3e along the continuous spiral groove 3d as a string-like body, a diameter expansion holding member that can be pulled from the elastic tube-like member by sliding on the elastic tube-like member may be used.

Further although in the above-described embodiment, the cover processing tool 3 includes the electric field mitigating portion 3u, the electric field mitigating portion 3u may be omitted, and a high dielectric tape may be wound at the location where the electric field mitigating portion 3u would be positioned. For example, after wiping the surface of the insulator 2c, the high dielectric tape is wound beginning from an end of the terminating end side of the ground wire extraction body 5 to a terminating end side from an end portion of a terminating end side of the semiconductor layer 2d in a range of approximately 50 mm, as illustrated in FIG. 6(a).The high dielectric tape is, for example, wound so as to have a 1/2 overlap with a 2/3 width. Note that if the cable shielding layer 2e has been stripped, the stripped portion is replaced before winding the high dielectric tape.

Further, in the above described embodiments, although the thick portion 3k forming the first section for suppressing deformation of the elastic tube-like member 3b was provided, the function and purpose of the first section is not limited to the above-

described embodiment. Specifically, the first section can, for instance, be used in place of a stress cone to weaken electric field concentrations and reduce potential gradients.

Explanation of Reference Numerals

1: Connection structure
2: Power cable terminating structure,
2A: Power cable
2a: Terminal
2b: Conductor
2c: Insulator
2d: Semiconductor layer
2e: Cable shielding layer
2g: Cable sheath
2h: Tin-plated flexible silver wire
2j: Ground wire
3: Covering processing tool
3a: Core member (diameter expansion holding member)
3b: Elastic tube-like member
3d: Continuous spiral groove
3e: Core ribbon
3f: First end portion
3g: Second end portion
3h, 3j: Exposed portion
3k: Thick portion (first section)
3m: Proximal end portion
3r: Normal portion
3s: First waterproofing member (waterproofing member)
3t: Second waterproofing member
3u: Electric field mitigating portion
5: Ground wire extraction body
13k: Thick portion (first section)

23k: High-hardness rubber (first section)

33k: Insulation wire (first section)

43k: Rib (first section)

40A: First section

OB: Second section

Claims

1. A cover processing tool comprising:

a tube-like hollow diameter expansion holding member that can be pulled out and an elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member, the elastic tube-like member being constricted by pulling out the diameter expansion holding member in a state in which a power cable has been passed through an inner side of the diameter expansion holding member, and the power cable being covered by the constricted elastic tube-like member, wherein

the elastic tube-like member includes a first section arranged along an axial direction of the diameter expansion holding member and capable of covering a border section between a cable shielding layer and a cable sheath of the power cable, and a second section that is contiguous to the first section, is arranged along the axial direction of the diameter expansion holding member, and has a lower elasticity than the first section.

2. The cover processing tool according to claim 1, wherein the first section is a thick portion that is thicker than surrounding portions.

3. The cover processing tool according to claim 1 or 2, further comprising a waterproofing member held between the diameter expansion holding member and the elastic tube-like member, wherein

a position of the waterproofing member is shifted with respect to a position of the first section in an axial direction of the diameter expansion holding member.

4. The cover processing tool according to any one of claims 1 to 3, wherein an electric field mitigating portion is provided held between the diameter expansion holding member and the elastic tube-like member or integrated with the elastic tube-like member.

5. A power cable connection structure including an elastic tube-like member covering a power cable processed so that a cable shielding layer and a cable sheath are exposed in

the stated order from a terminating end side, the power cable connection structure comprising:

a first section formed from the elastic tube-like member, arranged along a longitudinal direction of the power cable and capable of covering a border section of the cable shielding layer and the cable sheath; and

a second section that is contiguous with the first section, is arranged along the longitudinal direction of the power cable, and has a lower elasticity than the first section.

6. The power cable connection structure according to claim 5, wherein the first section and the second section are formed by a single elastic tube-like member.

7. The power cable connection structure according to claim 5, wherein at least the first section is formed from a plurality of elastic tube-like members.

8. The power cable connection structure according to any one of claims of 5 to 7, further comprising a waterproofing member arranged on the cable sheath.

9. The power cable connection structure according to claim 8, wherein the waterproofing member is positioned a fixed distance further towards a proximal end side of the power cable than the border section, and a position of the waterproofing member is shifted with respect to a position of the first section in a longitudinal direction of the power cable.

10. A power cable connection structure assembly method for covering a power cable using a cover processing tool including a tube-like hollow diameter expansion holding member that can be pulled out, and an elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member, the power cable connection structure assembly method comprising:

a step of processing the power cable to expose the cable shielding layer and the cable sheath in the stated order from a terminating end side;

a step of mounting the diameter expansion holding member on the power cable so

as to cover a border section of the cable shielding layer and the cable sheath; and

a step of constricting the elastic tube-like member by pulling out the diameter expansion holding member to cover the power cable with the constricted elastic tube-like member and form a first section that is arranged along a longitudinal direction of the power cable and is capable of covering a border section of the cable shielding layer and the cable sheath, and a second section that is contiguous to the first section, is arranged along a longitudinal direction of the power cable, and has a lower elasticity than the first section.

11. A terminal processing method for further covering a second elastic tube-like member in a power cable connection structure including a first elastic tube-like member that covers a power cable processed so as to expose a cable shielding layer and a cable sheath in the stated order from a terminating end side, the terminal processing method comprising:

a step of mounting the diameter expansion holding member on the first elastic tube-like member so as to cover a position corresponding to a border section of the cable shielding layer and the cable sheath by using a cover processing tool including a tube-like hollow diameter expansion holding member that can be pulled out and the second elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member; and

a step of constricting the second elastic tube-like member by removing the diameter expansion holding member so as to cover the power cable with the constricted second elastic tube-like member via the first elastic tube-like member, wherein

in the covering step,

the first elastic tube-like member and the second elastic tube-like member form a first section that is arranged along a longitudinal direction of the power cable and is capable of covering a border section of the cable shielding layer and the cable sheath, and one of either the first elastic tube-like member or the second elastic tube-like member forms a second section that is contiguous to the first section, is arranged along a longitudinal direction of the power cable, and has a lower elasticity than the first section.

12. A terminal processing method for further covering a second elastic tube-like member in a power cable connection structure including a first elastic tube-like member that covers a power cable processed so as to expose a cable shielding layer and a cable sheath in the stated order from a terminating end side, the terminal processing method comprising:

a step of mounting the diameter expansion holding member on the first elastic tube-like member so as to cover a position corresponding to a border section of the cable shielding layer and the cable sheath by using a cover processing tool including a tube-like hollow diameter expansion holding member that can be pulled out and the second elastic tube-like member held in an expanded state on an outer circumferential side of the diameter expansion holding member; and

a step of constricting the second elastic tube-like member by removing the diameter expansion holding member so as to cover the power cable with the constricted second elastic tube-like member via the first elastic tube-like member, wherein in the covering step,

the first elastic tube-like member and the second elastic tube-like member form a section arranged along a longitudinal direction of the power cable and capable of covering a border section of the cable shielding layer and the cable sheath.

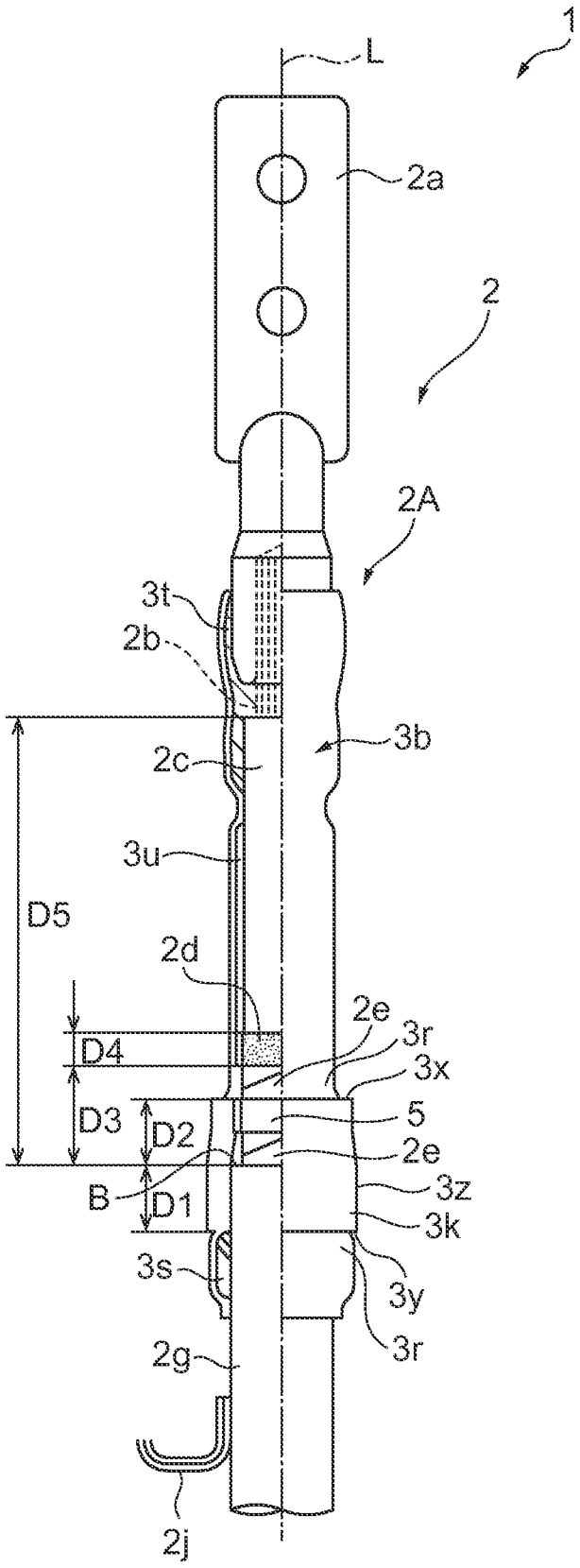

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FIG. 1

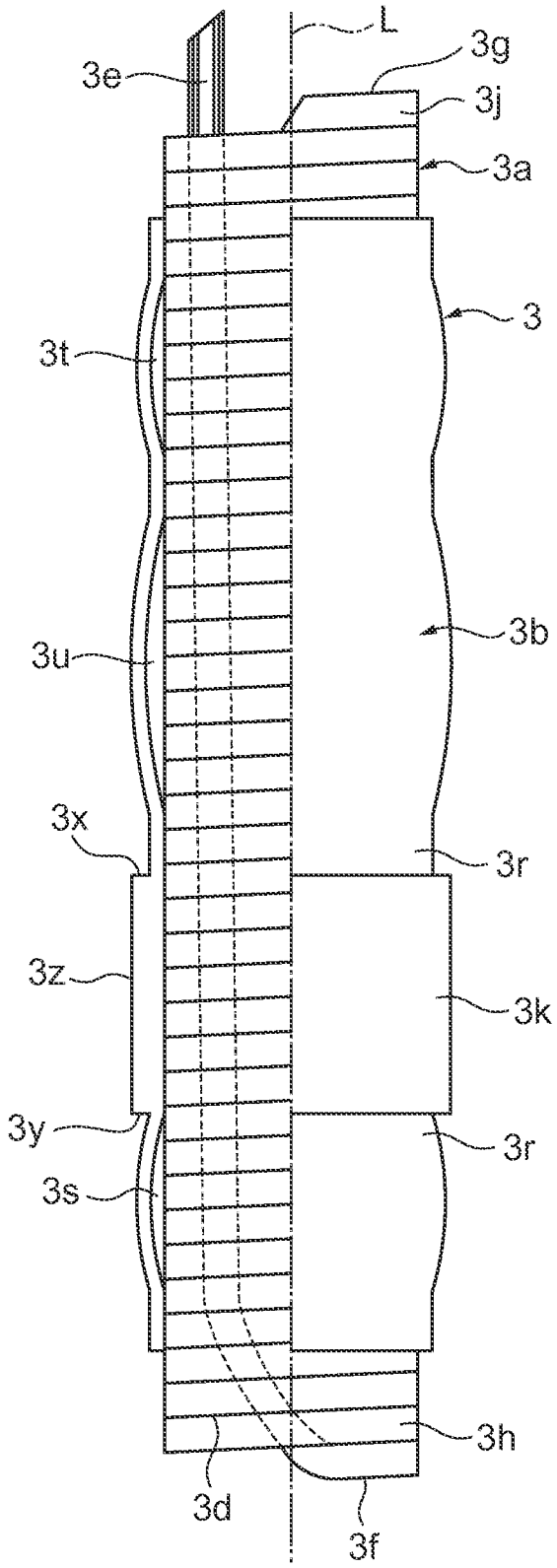


FIG. 2

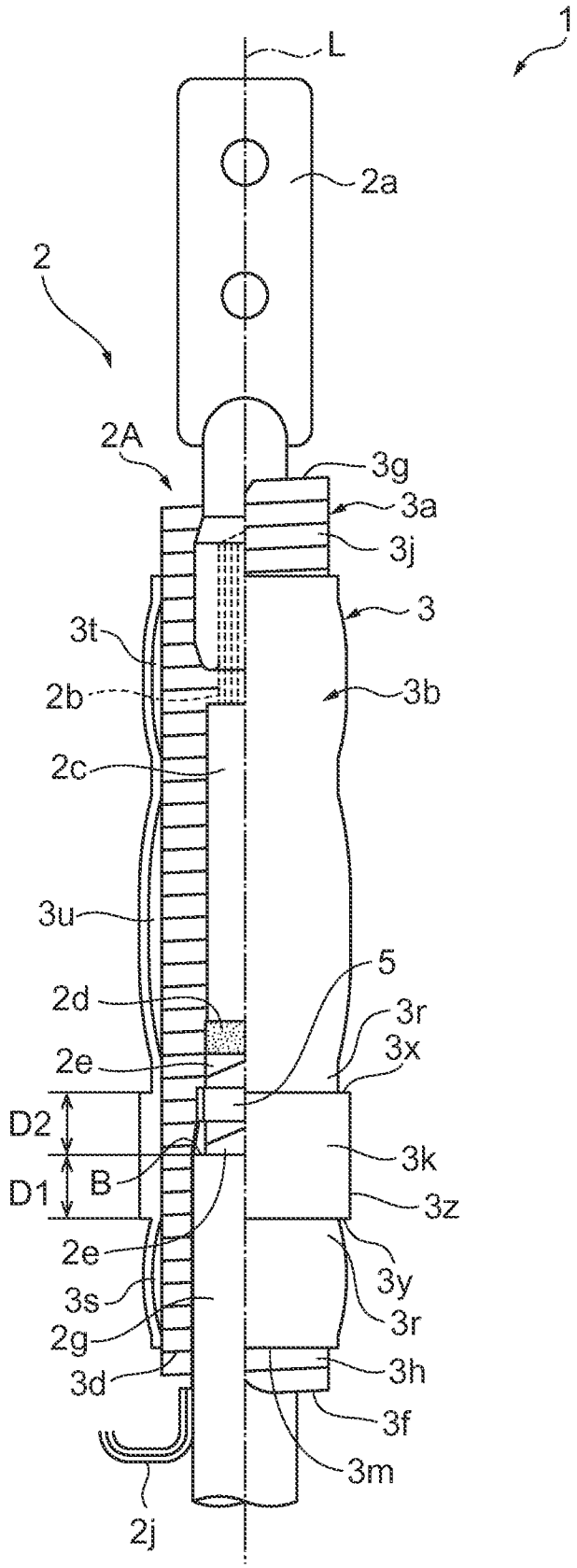

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FIG. 3

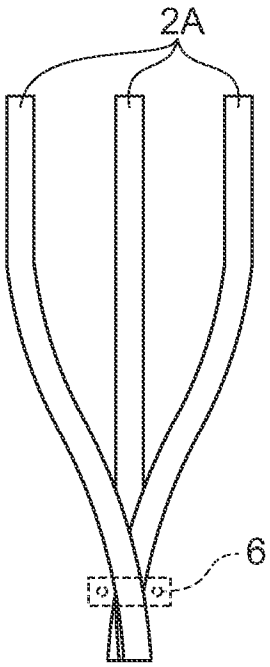


FIG. 4A

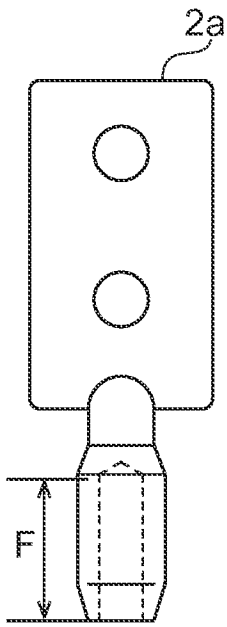


FIG. 4B

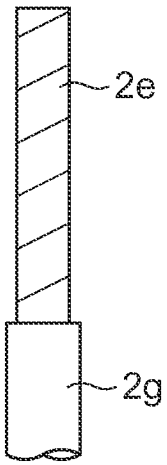


FIG. 4C

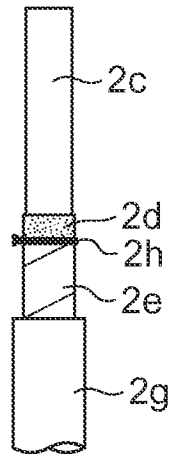


FIG. 4D

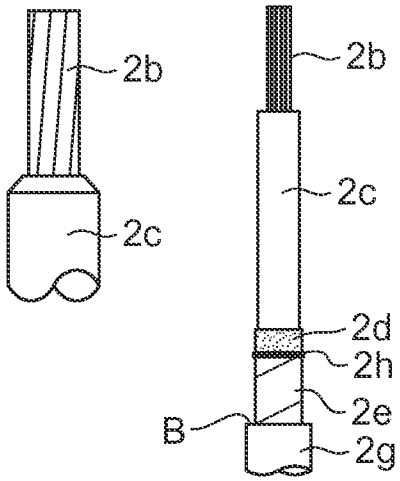


FIG. 5A

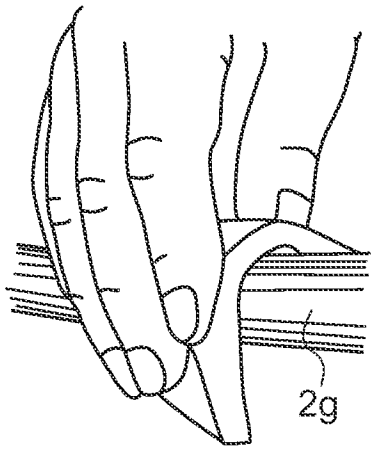


FIG. 5B

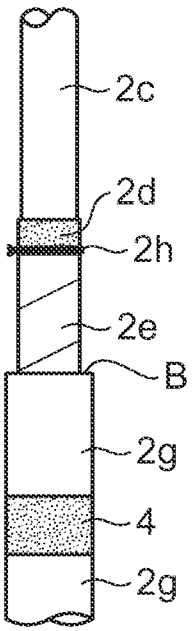


FIG. 5C

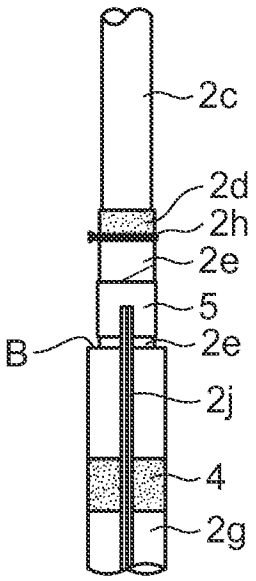


FIG. 5D

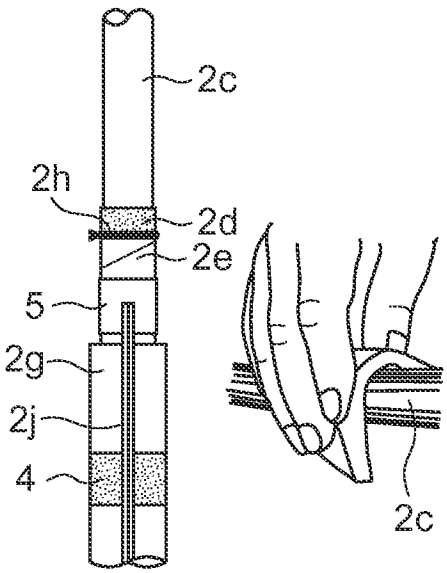


FIG. 6A

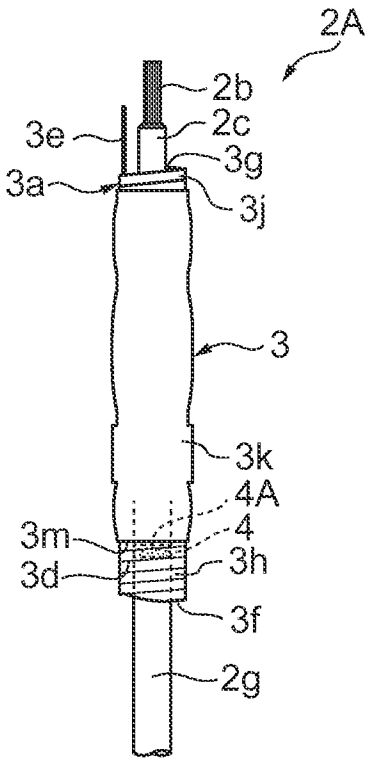


FIG. 6B

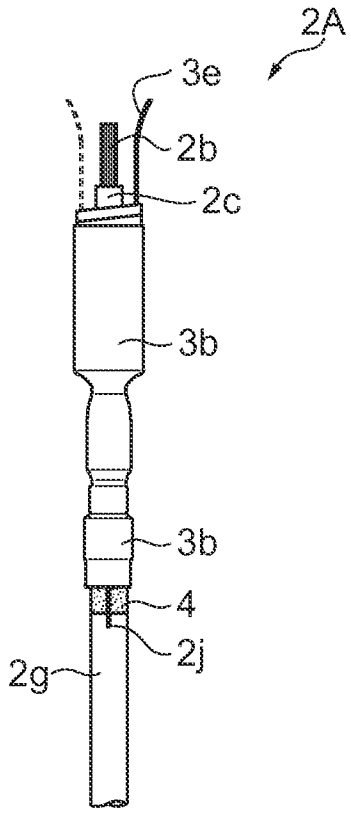


FIG. 7A

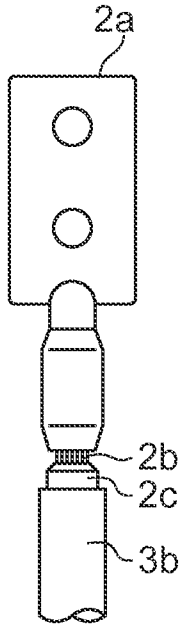


FIG. 7B

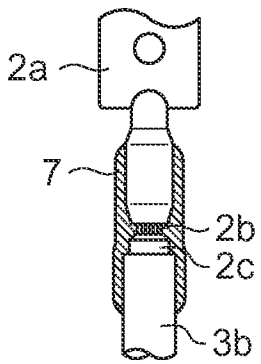


FIG. 7C

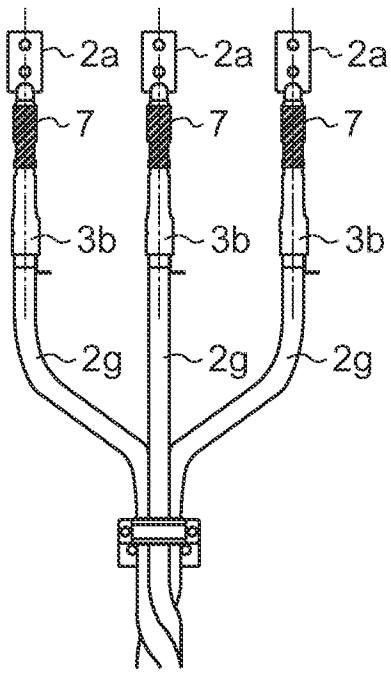


FIG. 7D

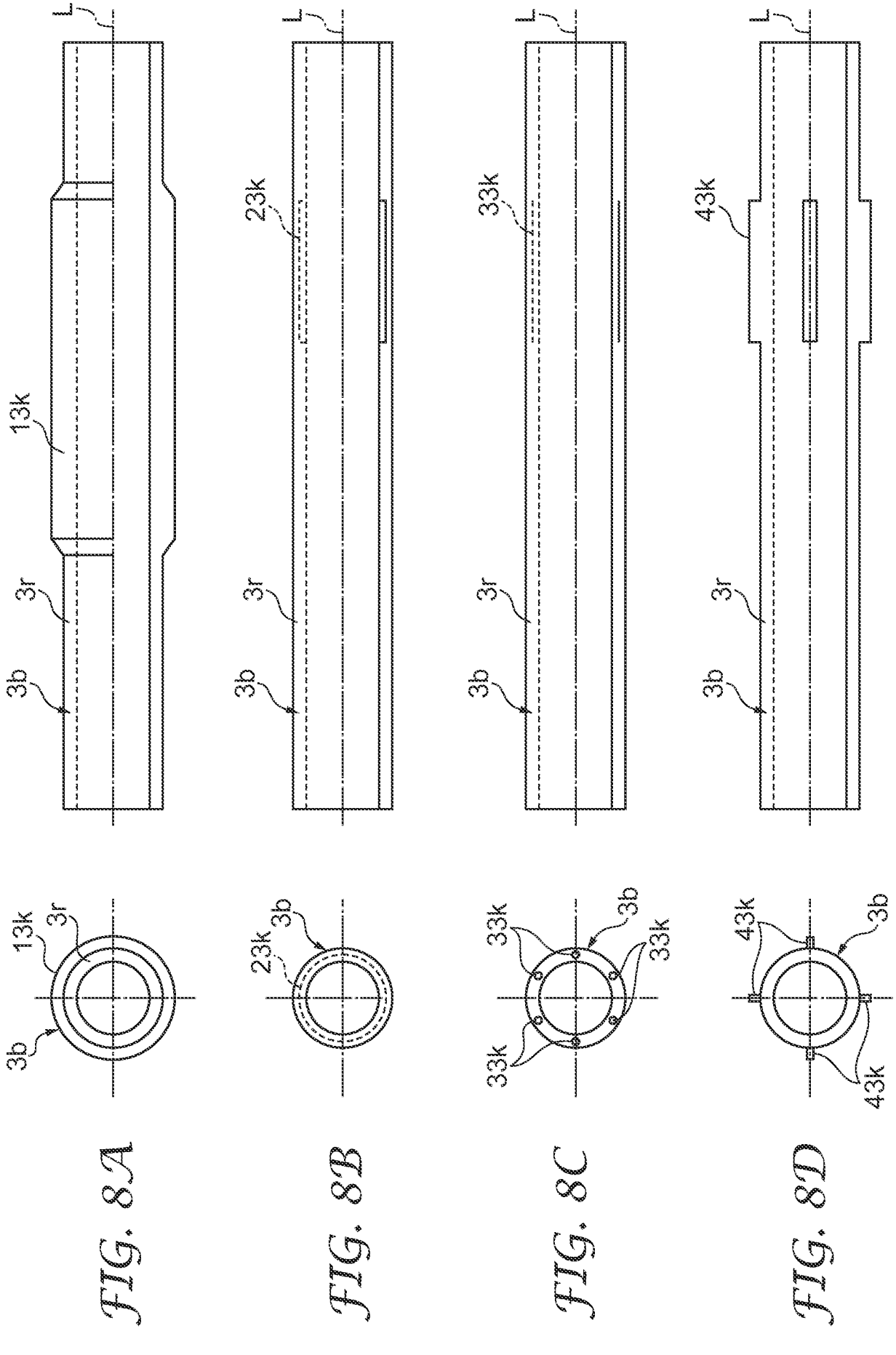


FIG. 8A

FIG. 8B

FIG. 8C

FIG. 8D

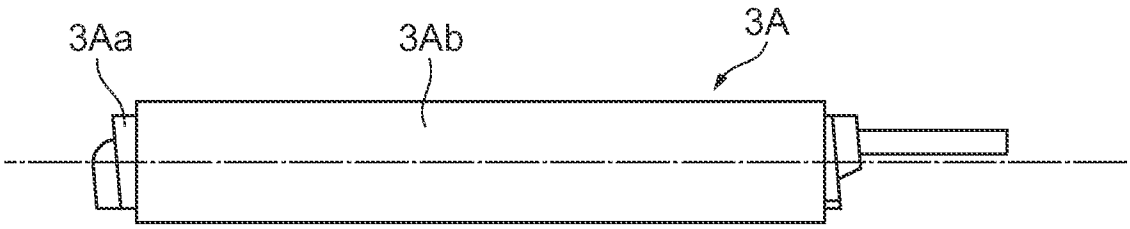


FIG. 9A

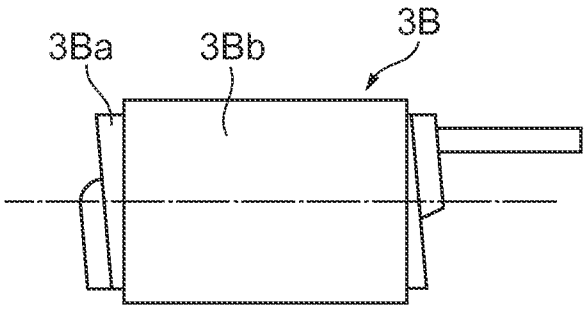


FIG. 9B

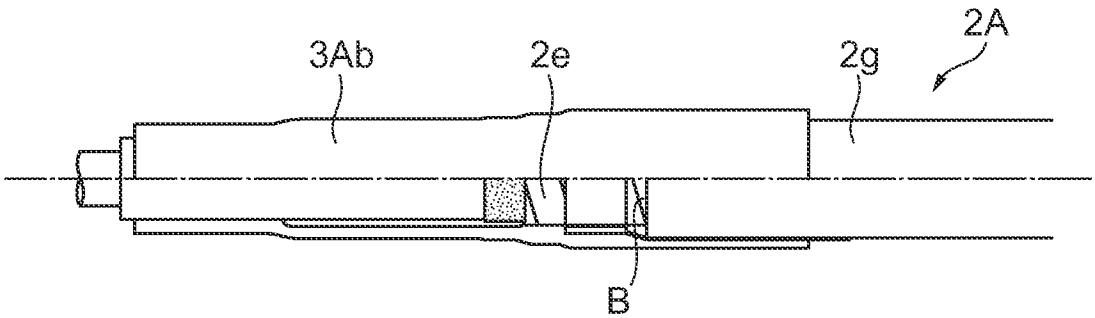


FIG. 9C

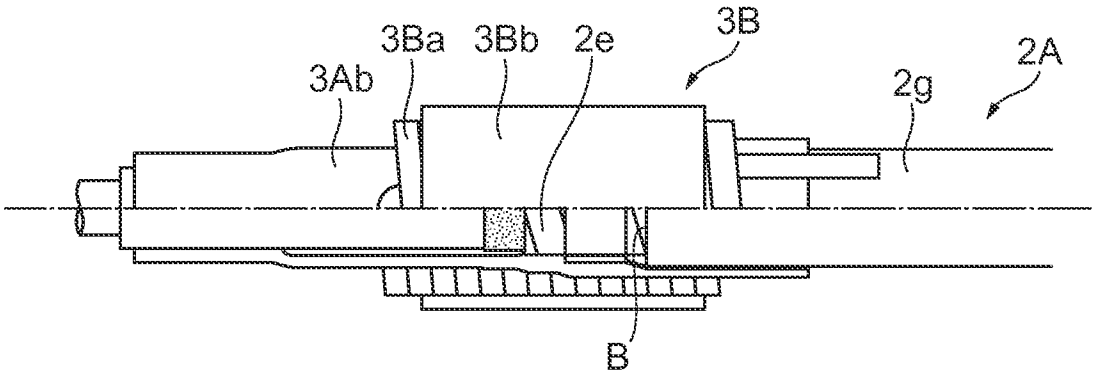


FIG. 9D

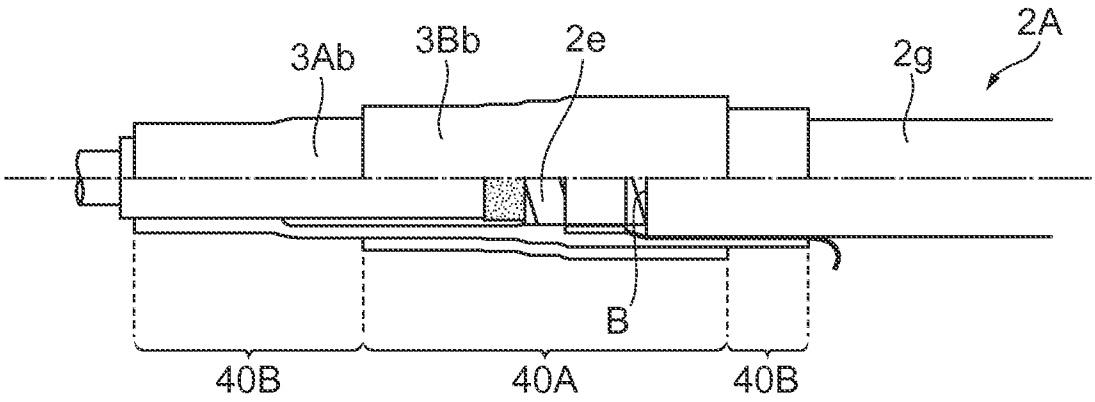


FIG. 9E

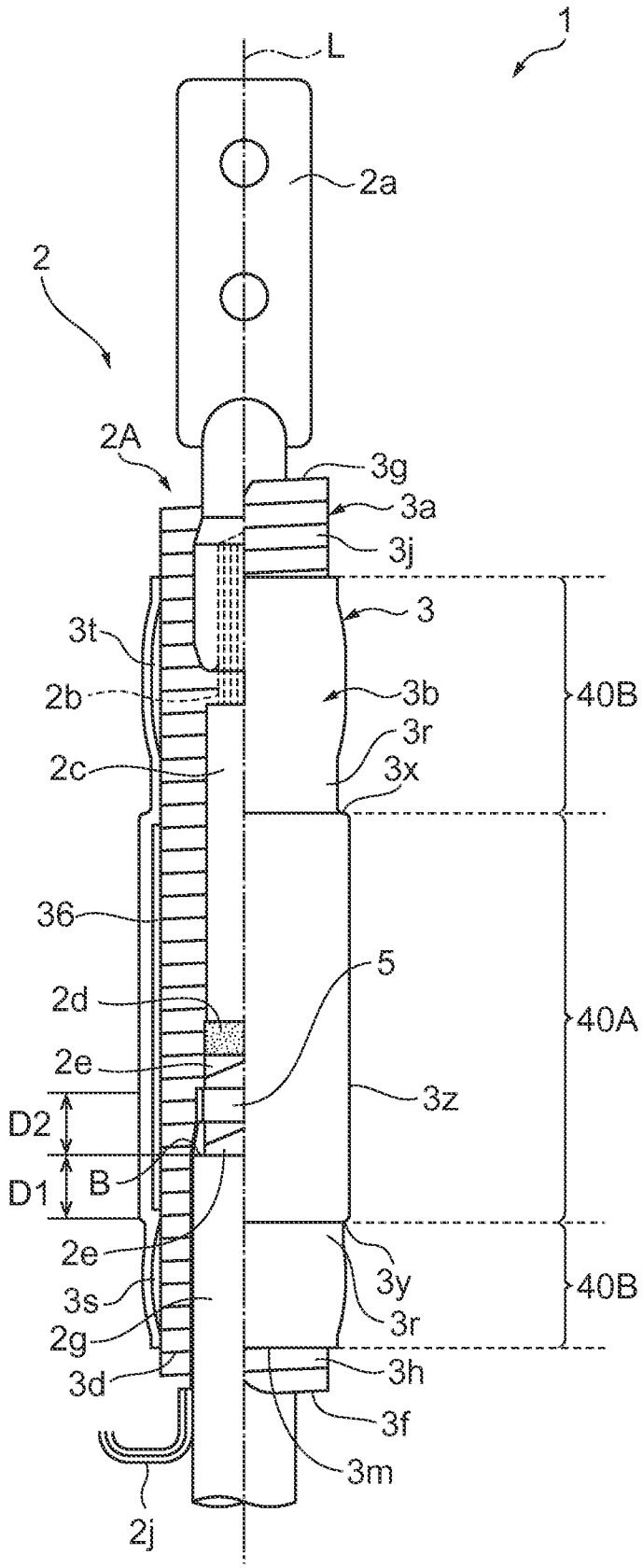

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FIG. 10

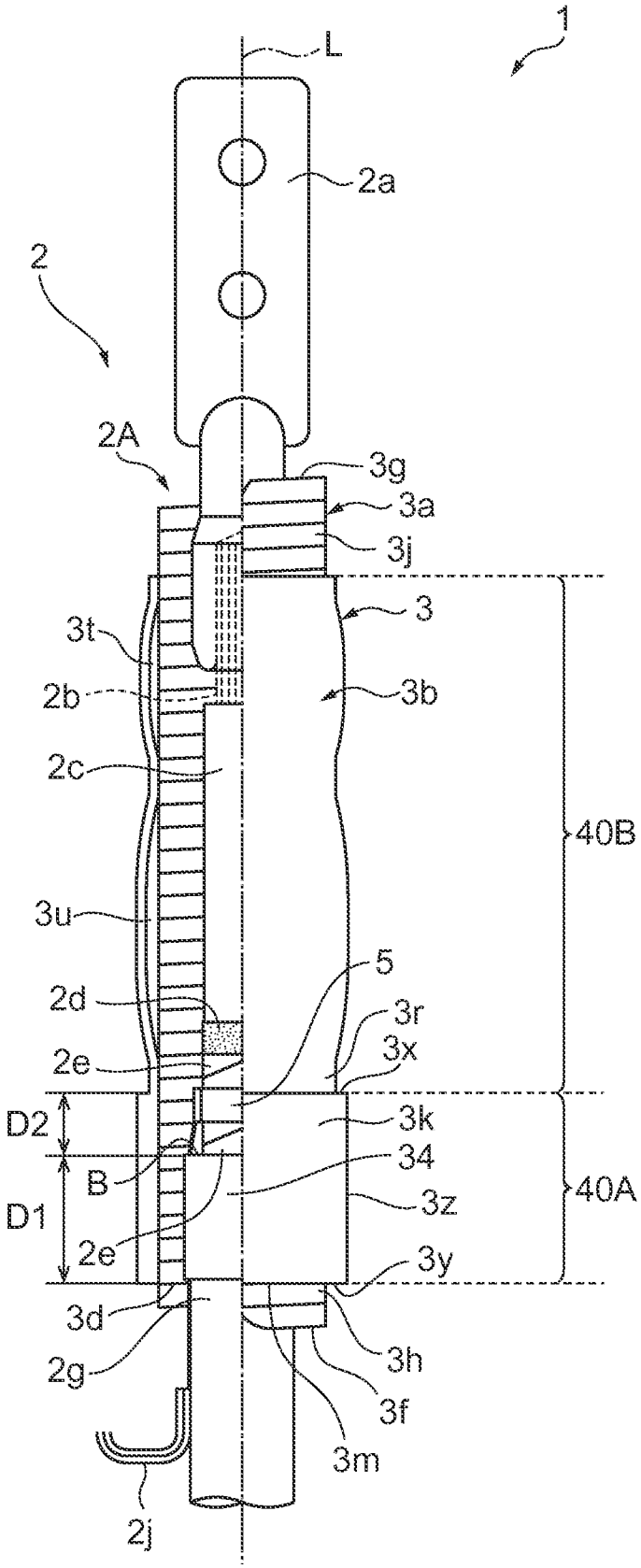

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FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/053645

A. CLASSIFICATION OF SUBJECT MATTER

H02G 15/02(2006.01)i, H01B 7/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02G 15/02; H02G 15/18; H02G 1/14; H02G 15/184; H01B 7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: elastic, tube, connection, cable, silicon, pull

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2013-096354 A1 (3M INNOVATIVE PROPERTIES COMPANY et al.) 27 June 2013 See column 3, lines 5-24, column 5, lines 30-35, column 5, lines 1-11, claims 1, 13 and figures 1, 2	12
A		1-11
Y	EP 0424090 A2 (MINNESOTA MINING AND MANUFACTURING COMPANY) 24 April 1991 See column 4, lines 34-42, claim 1 and figures 2, 6	12
A		1-11
A	JP 2012-050188 A (VISCAS CORP et al.) 08 March 2012 See paragraphs [0018]-[0032], claim 1 and figure 1.	1-12
A	JP 2010-011562 A (VISCAS CORP et al.) 14 January 2010 See paragraphs [0012]-[0021], claim 1 and figures 2-3.	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 December 2014 (16.12.2014)	**16 December 2014 (16.12.2014)**

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Facsimile No. +82-42-472-7140

Authorized officer
KIM, Soo Seob
Telephone No. +82-42-481-8500

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2014/053645

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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