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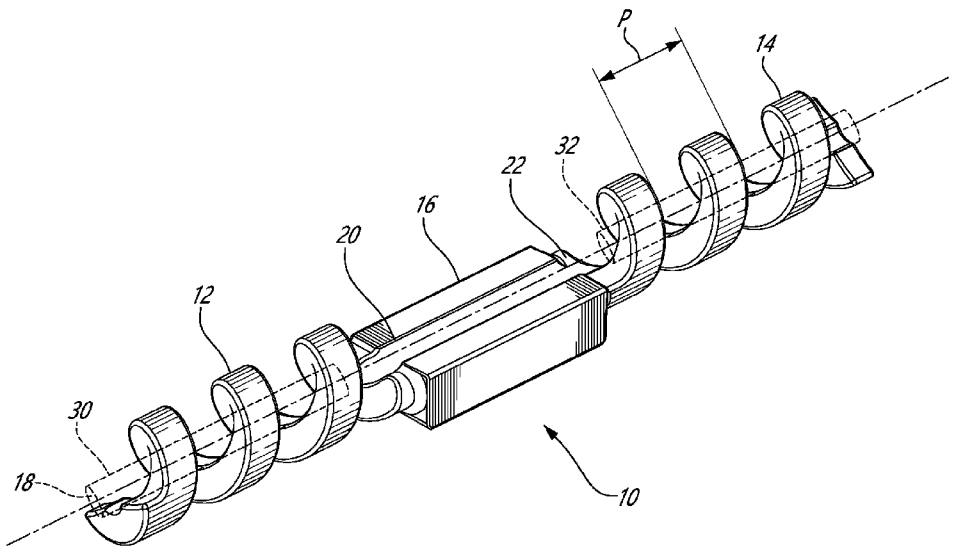

Fig. 3

(57) Abstract: The attachment device can have a first helix defined around an axis, the first helix having a first internal profile surrounding a first volume and operable to engagingly surround the cable when the cable is positioned in the first volume; a second helix defined around the axis, the second helix having a second internal profile and operable to engagingly surround the cable when the cable is positioned in the second volume; and a utility segment extending axially, relative to the axis, from a first end of the utility segment to a second end of the utility segment, the first helix connecting the utility segment, the second helix connecting the utility segment, the utility segment positioned alongside the cable when the cable is positioned in the first volume and in the second volume.

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ATTACHMENT DEVICE FOR CABLE

BACKGROUND

[0001] Fig. 1 presents an example of an installation having a large number of cables. Comparable installations may have cables of various types such as electrical cables or optical fiber cables for instance. Cables may be used to convey signals carrying data from one point to another. In some cases, a malfunction may be detected which may imply one or more cable. There may be a serious maintenance burden associated to determining things such as determining which two cable ends correspond to a same cable, and in the case of some cables, the question may be further complexified when cables have more than two connectors, such as the example optical cable presented in Fig. 2 for instance which has one connector at one end, and four connectors at the second end. There always remains room for improvement, such as room to alleviate such maintenance burden, particularly in an era where maintenance personnel costs are high.

SUMMARY

[0002] It was found that such maintenance burden can be addressed or alleviated in some embodiments by providing attachment devices for cables. Such attachment devices may include a utility segment, which can bear an identifier for the cable for instance, a first helix protruding from a first end of the utility segment, and a second helix protruding from a second end of the utility segment. The first and second helix may be placed into a configuration where they engagingly surround the cable, such that the utility segment be held alongside the cable.

[0003] In some cases, this may be achieved by using helices which are made of elastic material, such as a flexible plastic for instance, which may be deformed to be wrapped around corresponding portions of the cable. In other cases, this may be achieved using rigid helices, but with a flexible cable which may be elastically deformed to be engaged with the helices.

[0004] While the attachment device was developed while thinking of the afore-mentioned maintenance burden, and thus with cables in mind, it was found that such attachment devices may be used for attachment to other structures which may have a similar geometry to that of a cable, such as tubular conduits (e.g., tubes or hoses). Moreover, while the attachment device was initially developed as a way to integrate an identifier to the utility segment, it was found

that the utility segment could alternately be used for other reasons. For instance, in some embodiments, the utility segment may be used to bear a sensor, such as a temperature sensor for instance, or be used as a fastening portion for attachment to yet another structure than the cable. Moreover, while some embodiments include two helices, protruding from opposite ends of the utility segment, it was found that in some embodiments, using only a single helix rather than two could be satisfactory.

[0005] In accordance with one aspect, there is provided an attachment device for a cable, the attachment device comprising : a first helix defined around an axis, the first helix having a first internal profile surrounding a first volume, the first internal profile matching an external diameter of the cable in a manner for the first internal profile to engagingly surround the cable when the cable is positioned in the first volume; a second helix defined around the axis, the second helix having a second internal profile surrounding a second volume, the second internal profile matching the external diameter of the cable in a manner for the second internal profile to engagingly surround the cable when the cable is positioned in the second volume; and a utility segment extending axially, relative to the axis, from a first end of the utility segment to a second end of the utility segment, the first helix connecting the utility segment and protruding from the first end in a first direction of the axial orientation, the second helix connecting the utility segment and protruding from the second end in a second direction of the axial orientation, opposite the first direction, the utility segment positioned alongside the cable when the cable is positioned in the first volume and in the second volume.

[0006] In accordance with another aspect, there is provided an electronic device for attachment to an elongated structure, the electronic device comprising : a helix defined around an axis, the helix having an internal profile surrounding an volume, the internal profile matching an external diameter of the elongated structure in a manner for the internal profile to engagingly surround the elongated structure when the elongated structure is positioned in the volume; a utility segment extending axially, relative to the axis, from a first end of the utility segment to a second end of the utility segment, the helix connecting the utility segment and protruding from the first end in the axial orientation, the utility segment positioned alongside the elongated structure when the elongated structure is positioned in the first volume with an internal profile of the utility segment facing the elongated structure; and an antenna secured

to the utility segment and separated from the internal profile of the utility segment by a thickness of a material of the utility segment, the material of the utility segment having an electrical conductivity below 1 S/m, a relative permittivity above 1.5, and the thickness has at least 0.5 mm.

[0007] In accordance with another aspect, there is provided a method of moving a device along an elongated structure, the device having a first helix defined around an axis and wrapped around a first longitudinal portion of the elongated structure, a second helix defined around the axis and wrapped around a second longitudinal portion of the elongated structure, and a utility segment extending alongside the elongated structure and connecting the first helix to the second helix, the method comprising :compressing the first helix in the orientation of the axis, thereby increasing an internal diameter of the first helix and releasing the first helix from the cable-like structure; while maintaining said compressing of the first helix, sliding the device along a length of the elongated structure, from a first location to a second location; and at the second location, releasing said compressing of the first helix, thereby engaging the first helix with the cable-like structure.

[0008] In accordance with another aspect, there is provided a device for attachment to a cable comprising: a spiral portion for wrapping around a predetermined portion of the cable; and a portion having an end coupled to an end of the spiral portion.

[0009] In accordance with another aspect, there is provided a device comprising: a first spiral element; a second spiral element; and a central element coupled to one end of the first spiral element and to one end of the second spiral element; wherein an axis of the first spiral element, another axis of the second spiral element and a further axis of the central element all define an axial geometry.

[0010] In accordance with another aspect, there is provided a device comprising: a body comprising a first portion on an upper side of the device and a second portion on the lower side of the device; wherein the first portion comprises a surface around which are disposed one or more edge portions and one or more end portions to form one or more grooves dimensioned to accept one or more edges of a wireless identification tag; the second portion is dimensioned and profiled to encompass a predetermined portion at least one element

selected from the group comprising a cable, a cable element, a signal carrying cable element and a conduit

[0011] Many further features and combinations thereof concerning the present improvements will appear to those skilled in the art following a reading of the instant disclosure.

DESCRIPTION OF THE FIGURES

[0012] In the figures,

[0013] Fig. 1 is a view of an example of an example installation having numerous cables;

[0014] Fig. 2 is a view of an example of an optical cable having multiple connectors;

[0015] Fig. 3 is an oblique view of an example of an attachment device;

[0016] Fig. 4 is an oblique view of an example of an attachment device secured to a cable;

[0017] Fig. 5 is an oblique view of another example of an attachment device;

[0018] Fig. 6A is a cross-sectional view of the attachment device of Fig. 5;

[0019] Fig. 6B is a cross-sectional view of one of many possible alternatives to the attachment device of Fig. 6A;

[0020] Fig. 7 is an oblique view of another example of an attachment device;

[0021] Fig. 8 is an enlarged view of a portion of the attachment device of Fig. 7; and

[0022] Fig. 9 is an oblique view of another example of an attachment device embodied as an electronic device.

DETAILED DESCRIPTION

[0023] Fig. 1 shows an example of an attachment device 10 which can be used to attach to a cable or other similar structure. The attachment device 10 has two helices which will arbitrarily labeled the first helix 12 and the second helix 14 for ease of reference, and a utility segment 16 structurally connected therebetween. The expression helix involves a structure which turns

around an axis 18 while advancing along the axis 18. In the illustrated embodiment, the first helix 12 protrudes from a first end 20 of the utility segment 16, in a first axial direction, and the second helix 14 protrudes from a second end 22 of the utility segment 16, axially opposite the first end 20, in the second axial direction.

[0024] The extent to which the helix structure advances along the axis 18 for a given turn is referred to as pitch P. In the embodiment shown in Fig. 1, the first helix 12 and the second helix 14 are regular, circular helices, having a constant radius and a constant pitch P, but it will be understood that other types of helices may be used in alternate embodiments. In the illustrated embodiment, the first helix 12 and the second helix 14 both have more than one turn, and have more specifically three turns, though in alternate embodiments, the number of turns may vary. In an example context of use, the first helix 12 may be engaged with a first portion 26 of a cable 24 and the second helix 14 may be engaged with a second portion 28 of a cable 24, such as suggested by the embodiment shown in Fig. 4. In the latter configuration, the utility segment 16 can be positioned alongside the cable 24. The first helix 12 and the second helix 14 can be coaxial.

[0025] Referring back to Fig. 3, depending on the embodiment, the attachment device 10 may be arranged in a manner for the helices 12, 14 to engagingly surround the cable via elastically stretching and deforming the helices 12, 14, via elastically stretching and deforming the cable 24, or both. In the illustrated embodiment, the helices 12, 14 were made of an elastic material and act as helical springs, and can be deformed in a manner to wrap around the cable.

[0026] A first volume 30 may be defined relative the first helix 12, and a second volume 32 may be defined relative the second helix 14. More specifically, relative the axis 18 around which the first helix 12 and/or the second helix 14 are defined, a radially inner surface of the first helix 12 can be referred to as a first internal profile, and a radially inner surface of the second helix 14 may be referred to as a second internal profile. The first internal profile and the second internal profile can match the external diameter of the cable, in a manner to achieve a snug fit when the cable 24 is engagingly surrounded by the helices 12, 14.

[0027] More specifically, the first volume 30 and the second volume 32 may be defined, in this embodiment, by a virtual cylindrical projection of the first internal profile and of the second internal profile, respectively. The first volume 30 and the second volume 32 can have a diameter which matches to the diameter of the cable 24. Here, “matches” does not involve a mathematically exact match, as some amount of play may be tolerated or even desired. In some embodiments, the matching can be, for instance, equal to or within 2 or 5 % of the diameter of the cable. In some cases, an interference fit, which may be referred to herein as a “pinch”, may be preferred. For instance, the cross-sectional dimension of the first volume may be of between 85 and 95% of the diameter of the cable. In such cases, the attachment device may need to be stretched and deformed to be engaged with the cable, but may then more firmly hold in place on the cable, with elastic tension in the helices constricting the cable. An appropriately elastic material may be selected to achieve this elastic deformability, such as some plastics, though in some cases some metals could alternately be used. Examples of material of which the first helix 12, second helix 14 and/or utility segment 16 can be made of in some embodiments can include a polymer, a polyester, a thermoplastic, an aramid, a silicone and an elastomer. Examples of material of which the first helix 12, second helix 14 and/or utility segment 16 can be made of in some embodiments can include a metal and a ceramic.

[0028] In the embodiment presented in Fig. 1, the pitch P of the first helix 12 and of the second helix 14 is greater than a diameter of the cable 24. It was found that this feature could help in achieving a good hold between the attachment device 10 and the cable 24.

[0029] In the embodiment presented in Fig. 1, the utility segment 16 has a flat face which can bear various types of devices. For instance, in one embodiment, the flat face can bear a hand-written label, or a printed label bearing, for example, words and/or numbers and/or a machine-readable code such as a barcode or QR code, adhered or otherwise engaged thereto. In another embodiment, the flat face can bear an antenna. Indeed, an electronic device such as an electronic identifier or a sensor connected to an antenna may be adhered to or otherwise engaged with the utility segment. In some embodiments, such as exemplified in Fig. 6A, an electronic device 40 may be partially or fully embedded within a thickness T of material of the utility segment. This may be achieved at production by over moulding for instance. In some

other embodiments, such as exemplified in Fig. 6B, an electronic device 40 may be placed atop a thickness T of material of the utility segment (i.e., on a face thereof opposite the cable).

[0030] In some embodiments, it may be relevant for the electronic device 40 to remain held at a certain distance from the cable 24 when the attachment device 10 is engaged with the cable 24. Indeed, in the case of an electrical cable for instance, it was found that placing an antenna too close to the electrical cable could lead to difficulties in interfacing with the antenna with an external electronic device (e.g., electronic antenna reader, sometimes referred to as a scanner). Having a thickness T of material between the antenna and the cable can help, particularly if the material is has a relatively high relative permittivity (e.g., above 1.5 – relative permittivity was formerly referred to as dielectric constant). Indeed, it may be desired for the Q factor of the antenna to exceed a combined absorption of the thickness of the material of the utility segment and of the underlying cable. Typically, materials which have low electrical conductivity, such as electrical conductivity below 1 S/m, have relatively high relative permittivity.

[0031] It will be noted that various parameters may vary in alternate embodiments. For instance, in some embodiments, the attachment device 10 may have one helix instead of two helices, or two helices which have different shapes from one another, such as different diameters. Various alternate examples will be presented below. The exact construction may be affected by the way in which the attachment device 10 is to be manufactured. The embodiment presented above in relation with Fig. 3, may be particularly well adapted to manufacturing using an additive manufacturing process, e.g., 3D printing technology, whereas other embodiments may be better suited to other manufacturing techniques. In the embodiment presented above in Fig. 3, the first helix 12, second helix 14 and utility segment 16 are made of a same material which extends continuously and monolithically from one component to the next, but alternate embodiments may use different materials for different components.

[0032] Identifying specific cables at installation together with subsequent servicing / reorganization / expansion activities etc. is important to facilitate these activities either by reducing the time they take or removing errors and subsequent time / effort for correcting these errors. It can thus be beneficial to provide manufacturers, construction crews, installers,

managers, engineers and service technicians, with cable markers that are quick and easy to apply initially or subsequently remove for re-use such as removal from a failed cable and attachment to a replacement cable.

[0033] Fig. 2 presents an example optical breakout cable. For example, an installer may be using a number of these breakout cables at an installation. If these are pre-tagged then the installer must find the right break-out cable at each point in the installation. However, it can be preferable for the installer to simply retrieve the next breakout cable, tag it and install it afterwards or install it and tag it later. This is particularly important with service personnel. For example 5 tags according to embodiments of the tag would be used on a 1x4 breakout cable comprised of a common trunk a furcation unit and four break out legs, with a first tag on the trunk and one tag on each of the four legs wherein each tag present information and/or supports mounting of its respective cable with the furcation unit unmounted. Alternatively, a tool as an embodiment may be used to mount the bifurcation unit and 5 tags to identify the different cable legs and/or trunk.

[0034] Cable tags may be available in multiple colors but may not be practical to use cable markers for purpose of both color-coding and labeling each leg of a break-out cable, notwithstanding that it may be extremely beneficial to do so to facilitate the tasks of the installers and subsequent troubleshooting.

[0035] Referring to Fig. 2 there is depicted an optical breakout cable to which embodiments of attachment devices may be applied. In some embodiments, the attachment device may be referred to as a tag. A single tag may be applied to the cable to denote the breakout assembly identity or the input cable for example or multiple tags may be applied to denote the output cables discretely or in combination with tags on the input cable and/or breakout housing. Whilst an optical breakout cable is depicted tag(s) may alternately be applied to electrical cables, electrical cable harnesses, RF cables, RF cable assemblies, or hybrid optical-electrical assemblies etc.

[0036] Now referring to Fig. 1 there is depicted cable management within server racks. A significant number of cables may be co-located with respect to an item of equipment or multiple items of equipment such that identification of the correct cable becomes increasingly important

and significant. For example, Fig. 1 depicts cable management within four server racks of an installation. At a data center the number of 1U servers may be a hundred thousand or more, potentially a million or more in major data centers. As such the tagging / labelling of cables in such installations can give rise to particular challenges.

[0037] Referring to Fig. 5 there is depicted an attachment device which can be used as a tag 300 according to an embodiment. As depicted the tag 300 comprises a first end 310 (which can alternately be referred to as a first end abutment), first spiral element 320 (which can alternately be referred to as a first helix), central portion 330 (which can alternately be referred to as a utility segment), second spiral element 340 (which can alternately be referred to as a second helix) and second end 350 (which can alternately be referred to as a second end abutment). Accordingly, the first and second spiral elements 320 and 340 are wound onto the cable wherein the first end 310, second end 350 and central portion 330 lie along the cable. The first spiral element 320 and the second spiral element 340 each have a helix of material this embodiment.

[0038] Optionally, the lateral dimensions of the tag 300 may be established in dependence upon an outer diameter of the cable. Optionally, the length of the first and second spiral elements 320 and 340 may be defined in dependence upon a number of turns around the cable and the outer diameter of the cable.

[0039] One of the benefits of the tag is that it can be manufactured to enforce a minimum bend radius and not to provoke too hard of a bend radius transition for the cable or conduit at the entrance or exit to the first end 310 and/or second end 350. Accordingly, the tag can be manufactured according to define a minimum bend radius of a cable or conduit coil radius rather than straight such as to provide a smooth entry and exit into the tag 300.

[0040] Optionally, the pitch between the turns of each of the first and second spiral elements 320 and 340, which can correspond to the height of one complete helix turn, measured parallel to the axis of the helix, can provide a spacing which more or less matches the outer diameter of the cable or slightly exceeds the outer diameter of the cable. The helical pitch of the tag 300 supports and enables easy winding of the tag 300 around the cable and/or winding of the cable into the tag 300, capitalizing on the flexibility of the cable, and of the tag 300, to work

hand in hand to facilitate the winding of the cable and the tag 300 onto one another. For instance, a tag 300 may be rigid and difficult to bend, whilst the cable be flexible, and it would be the cable being wound into the tag 300, more than the tag 300 being wound around the cable. Alternatively, the tag 300 may be flexible and easy to bend, whilst the cable is rigid, and it would be the tag 300 being wound around the cable. Alternatively, the tag 300 and cable may be flexible and the tag 300 and cable are each winding around the other.

[0041] The inside diameter tag 300 can be mathematically defined as the inside diameter of the circle as seen from the tag 300 helix as projected onto a surface perpendicular to it and which applicable to the tag looks like the hole in the middle of a cross-section of a tube given that the thickness of the walls of the helix. The inner diameter of the tag 300 may be sized to match the diameter of the cable or conduit upon which the tag 300 is to be wound around. Within other embodiments of the tag, the inner diameter of the tag 300 may be dimensioned to support a number of cables of defined diameter according to a packing pattern, e.g., hexagonally packed.

[0042] In the embodiment presented in Fig. 5, the first 310 and the second end 350 bear abutment faces which, in this embodiment, are arcuate in shape. Optionally, a tag 300 may be formed without first end 310 and/or second end 320 such that the end or ends of the tag 300 are the end or ends of the first spiral element 320 and second spiral element 340 respectively.

[0043] As perhaps best seen in Fig. 6A, central portion 300, which may serve as a utility segment, can have a flat region. The flat region 360 can be adapted to provide a better surface for affixing a label printed using a device like a portable label maker. Indeed, after some time, the glue of a portable label maker (P-Touch) may dry out leaving labels falling from the cables. This may be more likely to occur when labels are adhered onto a round surface of a PVC sheath which may be dirty or greasy from manipulation by dirty fingers. Optionally, in embodiments such as ones where the tag 300 is manufactured with an additive manufacturing process a flat region may integrally include some form of identification, such as by introduction of material of a different color, embossing, etc.

[0044] Now referring to Fig. 6A there is depicted a cross-sectional view of the tag 300 wherein the cross-section 710 of the central portion 330 allows the different profiles of the inner and outer surfaces of the central portion 330 to be seen where the cross-section in Fig. 6A is through that portion of the central portion 330 with flat region 360. As depicted in Fig. 6A the cross-section of central portion 330 is depicted as area 710.

[0045] As can be observed from Fig. 6A, whilst flat region 360 is on the outside of the central portion 330, such as to make it easy to affix a label onto it, or for other purposes, the other face of the central portion 330 of the tag 300 is curved to match the outer diameter of the cable or conduit, allowing the tag 300 to espouse the cable outer diameter or conduit. Such espousing of the cable outer diameter, minimizes locations where material can get caught on the underside of a label that would not espouse the outer diameter of the cable or conduit.

[0046] Optionally, the inner diameter 720 of the spiral portion, e.g. first spiral element 320 or second spiral element 340 of the tag 300, allowing for the tag wall thickness as defined by first and second dimensions 730 and 740 (where first dimension 730 is the rounded edge projected onto the view) can be calculated to be slightly smaller than the diameter of the cable or conduit, such as to force the tag 300 to slightly stretch when it is wound onto the cable or conduit. This can allow for the tag 300 to be “locked” or retained in place onto the cable providing some resistance to moving it out of place. Accordingly, the resulting mechanical spring loading of the first spiral element 320 or second spiral element 340 of the tag 300 can be achieved with the tag 300 formed within a material that does not exceed its elastic limit when “expanded” upon placement on the cable or conduit. It would be beneficial to form the tag 300 from a material that retains this spring loading force even if stretched (attached) for a long time, and even in the presence of temperature extremes in the deployment region (e.g. industrial deployments, within data centers, in winter / summer in outdoor deployments etc.). Optionally, the tag 300 may be formed from a glass filled plastic with the right parameters to achieve these properties.

[0047] The tag 300 inner diameter 720 can be dimensioned as such as to slightly pinch yet allow the first spiral element 320 and/or second spiral element 340 upon being compressed to increase the inner diameter 720 to become slightly bigger than the diameter of the cable, allowing the tag 300 to then freely to move up and down upon the cable.

[0048] This mechanical property of the spring-loaded feature of the tag 300 can be associated to benefits, namely allowing for the relocation of the tag 300 to be displaced to a set distance marker for instance. This mechanical property of the tag 300 can make it possible to push on the tags up to the head of a patch cable for storage yet allowing it to be pulled back temporarily to be visually consulted.

[0049] It may also be possible to pull back the tag 300 from one end of a patch cable all the way to the other end of a patch cable, making easier to be confident that one is manipulating the reciprocal end of the same cable, which may make it convenient to trace or disconnect one cable among a sea of cables in a dense patch panel.

[0050] Within other embodiments of the tag the identifier receiving region may have a different profile which is the same as or different to the outer profile of the central portion 330. Flat region 360 allowing marking of the tag 300 post-manufacture for example.

[0051] Within other embodiments the tag 300 may be employed with a set of cables, the set comprising two or more cables, such that the tag 300 “bundles” the cables together for ease of deployment, management etc. Within the embodiments of the tag depicted Figs 3 and 5 the inner region of the first and second spiral elements 320 and 340 can be circular in cross-section. However, in other embodiments the tag 300 may be employed with inner region geometries other than circular according to the cable, conduit, cables, or conduits being disposed with these portions. For example, these may have a rectangular geometry to match a 14/2 or 12/2 electrical cable with 3 conductors as commonly used in North American homes, allowing for the tag 300 to espouse the cross-section of such an electrical cable. In other embodiments the inner profile may be elliptical, square, a regular polygon, an irregular polygon or another geometry. In some embodiments, the cross-sectional profile of the first and/or second spiral elements 320 and/or 340 may be a discorectangle (also known as a stadium shape, pill shape or two-dimensional spherocylinder).

[0052] Within the embodiments of the tag the cross-sections of the first and second spiral elements 320 and spiral element 340 can be circular in cross-section. However, other embodiments the tag 300 may be employed with cross-sectional geometries for the first and second spiral elements 320 and 340 respectively other than circular according to the cable,

conduit, cables, or conduits being disposed with these portions, according to design rules, or other factors.

[0053] The tag 300 having a flat side within the first and/or second spiral elements 320 and/or 340 facing the cable works may increase the surface friction between the cable outer diameter and the inner diameter of the helical spiral, for example inner diameter 720 of the spiral portion, compared to a round geometry cross-section within the first and/or second spiral elements 320 and/or 340. A flat side within first and/or second spiral elements 320 and/or 340 facing outward works out to minimize the outer diameter of combined cable or conduit as augmented by the tag 300, allowing more cables or conduits to be tagged within a given volume.

[0054] An alternate embodiment of a tag is presented in Fig. 7. In this embodiment, the first helix and the second helix may be formed by a series of straight lines interconnected by relatively bends, rather than a purely circular path, projecting a square, a regular polygon, an irregular polygon or another geometry onto a surface perpendicular to the helix, rather than a circle. This may be particularly effective when mounting the tag onto a cable or conduit with a cross-section that is more elliptical, square or rectangular than round, such as that of a 14/2 electrical cable. Such a shape may also be more easy to manufacture using a molding technique for instance.

[0055] In some embodiments the tag may be manufactured with an identifier such as a unique identifier.

[0056] In some embodiments the tag may be modified post-manufacture to add an identifier such as a unique identifier. For example, the outer surface of the tag 300 may support marking with a pen, pencil, marker etc.

[0057] In some embodiments the tag may include a machine readable code, such as barcode, quick response (QR) code, or matrix barcode for example.

[0058] In some embodiments the tag may include a radio-frequency identification (RFID) tag or other tag interrogatable by an RF, wireless, magnetic or optical reader for example. The details of how a pocket configured or dimensioned to accommodate an identifier such as a RFID in a way preventing it from dropping out or be covered or protected can depend on the

embodiment. Optionally, the RFID chip may be embedded within the tag 300 during the manufacturing process.

[0059] In some embodiments the central portion may incorporate an interface coupled to a processor. Optionally, the processor may be coupled to one or more sensors disposed within the central portion or another part of the tag. The interface may support a wired interface and/or a wireless interface. A wireless interface may be optical or RF/microwave according to a wireless standard or other wireless format. A wired interface may be optical or electrical according to a wired standard or other format.

[0060] In some embodiments, the lateral dimensions of the tag may be established in dependence upon an outer diameter of the cable. Optionally, the length of the spiral element may be defined in dependence upon a number of turns around the cable and the outer diameter of the cable.

[0061] Referring to Fig. 7 there is depicted a perspective attachment device 1400, which can be used to attach a cable or conduit onto a support structure or another cable. The attachment device 1400 has a central section 1430 (which can alternately be referred to as a utility segment). The central section can espouse the cable or conduit outer diameter on the face touching the cable or conduit, providing the benefits of there being no residual gap. The central section 1430 can be used as a way to add a number of other attachment device stacked one atop another, or one beside another, rather than as a location for cable conduit tags.

[0062] Attachment devices may also be formed of a flat side within the first and/or second spiral elements 1410 and/or 1420 (which may alternately be referred to as a first helix and second helix) to increase the surface friction between the cable outer diameter and the inner diameter of the first and/or second spiral elements 1410 and/or 1420, compared to a round geometry cross-section within the first and/or second spiral elements 1410 and/or 1420. A flat side within first and/or second spiral elements 1410 and/or 1420 facing outward can minimize the outer diameter of combined cable or conduit as augmented by attachment device 1400, allowing more cables or conduits to be tagged within a given volume.

[0063] As depicted in Fig. 7 the utility segment can be apertured. In this specific example, one or both first and second mounting holes 1440A and 1440B respectively may be employed to attach the attachment device 1400 to another element. This element may include, for example, a chassis, a casing, a post, a frame or other element. Attaching the utility segment to another element may involve a fastener such as a screw, a bolt, a rivet, a tie wrap, etc. While a single mounting hole 1440A may be sufficient, use of both mounting holes 1440A and 1440B may be used to prevent the attachment device 1400 from swiveling about one mounting hole and provide a tangential support for a cable or a conduit. The attachment device may be attached via a screw, nut-and-bolt, cable tie, rope, string etc. or other attachment means.

[0064] The flange portion 1430 may include a single mounting hole or mounting means. In other embodiments, a flange portion 1430 may include three or more mounting holes or mounting means. In other embodiments, attachment device may be absent a mounting hole but formed such that a flange portion 1430 may be attached through a securing means around and/or through the flange portion 1430. For example, the flange portion 1430 may be formed from a plastic wherein a screw, for example, may be screwed through the flange portion 1430 in some deployments.

[0065] In some embodiments, dimensions of the first and second mounting holes 1440A and 1440B may be different to support different attachments. In some embodiments, first and second mounting holes 1440A and 1440B respectively may support different attachment means, e.g. one for a screw and one for a tie-wrap.

[0066] In some embodiments, the flange portion may act as a utility segment. The flange portion may incorporate an RFID tag or other tag interrogatable by an RF, wireless, magnetic or optical reader for example, or a barcode or other machine readable code.

[0067] In some embodiment a flange portion 1430 may incorporate an interface coupled to a processor. Optionally, the processor may be coupled to one or more sensors disposed within the flange portion 1430 or another part of the attachment device. The interface may support a wired interface and/or a wireless interface. A wireless interface may be optical or RF/microwave according to a wireless standard or other wireless format. A wired interface may be optical or electrical according to a wired standard or other format.

[0068] Depending on the embodiment, the pitch of the helix of a spiral element within each advancement of the rotational angle of the helix may be continuous or it may vary. Depending on the embodiment, the number of revolutions per unit of distance of the helix of a spiral element may impact an effective grip force of the spiral element onto the cable(s) around which the spiral element is wound. A helix of a spiral element can be configured to “ease in” and “ease out” such that it begins or ends co-linear to the axis of the cable. The helix of a spiral element can be right-handed or left-handed, providing benefits of single hand adaptative operation for right-handed or left-handed installers.

[0069] Referring to Fig. 7 there are depicted perspective views of an attachment device 1400 having a first helix 1410 and a second helix 1420 which are provided here in the form of square helices. A central portion 1430 is disposed between the first and second helices 1410 and 1420 respectively. In Fig. 7 central portion 1430 is now labelled as comprising first and second mounting means 1440A and 1440B respectively allowing the device 1400 to be attached to another element, e.g. another device 1400, a post, wall, etc. Optionally, first and second mounting means 1440A and 1440B are dimensioned and/or profiled for attachment with a nut-and-bolt, screw, cable tie, etc. or for “hooking” onto a screw, nail, hook etc. The second spiral element 1420 has an inner profile that is subsequentially square, though it may alternately be rectangular or have another polygonal cross-sectional shape.

[0070] Fig. 8 presents a portion of the square helix enlarged, which can be seen to include first element 1610 disposed parallel to a first axis perpendicular to the axis on a first side, a second element 1620 coupled at one end to an end of the first element 1610 disposed parallel to a second axis perpendicular to both the axis and the first axis on a second side, a third element 1630 coupled at one end to a distal end of second element 1620 disposed parallel to a third axis, that being along the axis, a fourth element 1640 coupled at one end to a distal end of the third element 1630 disposed parallel to the first axis on a third side, and a fifth element 1650 coupled at one end to a distal end of the fourth element 1640 disposed parallel to the second axis on a fourth side.

[0071] Accordingly, the distal end of the fifth element 1650 can be coupled to the first element 1610 of subsequent turn element. The number of such turn elements within a first spiral element 1410 or second spiral element 1420 of a device 1400, may be 1, 2, 3 or another

integer. However, an integer number of turn elements may be employed with a partial turn element at one end or with partial turn elements at either end. For example, the first spiral element 1410 may comprise integer N turn elements and the second spiral element 1420 may comprise integer M turn elements where N and M are positive integers. Alternatively, the first spiral element 1410 may comprise (N+1/R) turn elements and the second spiral element 1420 may comprise (M+1/S) turn elements where N, M, R and S are positive integers.

[0072] Whilst in the figure, different elements are depicted as being coupled to one another via small radius curved portions, in alternate embodiments, transitions may have an even smaller radius, e.g., be abrupt (i.e. zero radius), or have a greater radius than the one illustrated or another defined geometry.

[0073] In alternate embodiments to the embodiment presented in Fig. 7, the utility segment may have an elongated structure similar to the utility segment of figures 3 and 5, and may bear an identifier for instance, while still retaining the square helix geometry for the first helix and the second helix.

[0074] It will be noted that in some embodiments, the first helix may not be coaxial to the second helix. For instance, an axis extending through the first helix, along the utility segment, and through the second helix may be curvilinear rather than linear.

[0075] When the attachment device incorporates an electronic device and/or an antenna, the thickness of the material between the electronic device and/or antenna may be adjusted to provide a defined physical separation between the antenna and the underlying cable or conduit (not depicted) to which the device is attached to. Such cable or conduit may not be dielectric and may decrease the inductive or RF coupling of the antenna. For example, a separation of 5mm (0.2”) may be required for coupling to be possible where the attachment device may be attached to non-dielectric cables or conduits, or dielectric conduits that contain a liquid.

[0076] The attachment device may also comprise an RF absorber, for example a foam platform with a metal back. The attachment device may provide an RFID-on-metal tag

structure which provides a folded patch antenna for a wireless identification device (WID) to be attached to the utility segment.

[0077] An electronic device may provide data including, but not limited to, a unique identifier, an encrypted unique identifier, a product identifier, a manufacturer identity, a manufacturing location identifier, time data such as date of manufacture for example and installation data such as location of installation, identifier of installation location (e.g. rack within data center) etc. As a digital product passport, attachment device may store locally within the memory of the electronic device, and make openly readable using a smart phone using NFC or Bluetooth, end-user accessible cable or conduit manufacturing details related to the attachment device itself and/or cable or conduit manufacturing details such as plastic composition or metal composition attesting to the carbon footprint of the cable or conduit either at purchase or to inform disposal of the cable or conduit at the end of its service life. Where a unique identifier or encrypted unique identifier is returned this may be subsequently provided to a remote application upon a remote system from a reader and parsed by the remote application or another remote application to extract data relating to the product incorporating the electronic device. A unique identifier may take the form of a hash key stored in a block chain, either public or local.

[0078] Accordingly, the information either retrieved from the electronic device directly or by parsing the information retrieved electronic device can be used to verify the product, verify that the product is as manufactured (e.g. the retrieved or extracted information identifies a cable as being a 1m (3ft) RF cable with SMA connectors whilst the product it is attached to is a 2m (6ft) RF cable with SMC connectors), that the product is installed in the right location (e.g. Palo Alto Datacenter of Company X, Rack Y) etc.

[0079] In various embodiments, an attachment device have an antenna integrated in an engineered position relative the cable or conduit to enhance readability in environments which are noisy within the portion of the wireless spectrum the electronic device operates within and/or where accessibility to the attachment device within the equipment/system etc. is difficult. The thickness of the material underlying the antenna, and/or the planarity of the surface supporting the antenna may enhance readability, particularly in cases where the electronic device has an NFC wireless system or RFID wireless system.

[0080] Within embodiments described above, an antenna and/or electronic device can be embedded within an attachment device when manufactured. However, in other embodiments, it may be appropriate to provide an attachment device supports insertion of an antenna or electronic device subsequent to manufacture of the attachment device. This may allow, for example, for the antenna, label, or electronic device to be added at a different time to the attachment device, to be replaced and/or removed, such as for recycling. For example, the attachment device can include metallization (for the antenna) and a semiconductor circuit which may be preferred to be processed separately from the remainder of the supporting structure of the attachment device. The supporting structure of the attachment device may, for example, be formed from a plastic which is recycled by different processing or it may be formed from a biodegradable material such that it can be composted, placed into landfill etc.

[0081] Accordingly, referring to Fig. 9 an embodiment of an attachment device for use with a wireless identification (WID) tag or label is presented. In this embodiment, the attachment device 1000B has an upper planar surface 950, upon which a WID Tag, electronic device, and/or antenna can be disposed. In this embodiment, the attachment device 1000B has a lower channel 960, which is designed in this case to espouse a cable (or conduit). Disposed around the upper outer portions of the surface 950 are edge portion 920 and end portion 930 which in conjunction with the surface 950 provide grooves 940 into which the edges of the WID, antenna, label and/or electronic device (e.g. electronic device 1220 having an antenna and a chip and forming a radio-frequency identifier RFID) can be fitted to be retained in position.

[0082] The openings either side of the edge portion 920 allow for the electronic device 1220 to be pushed into place using an installers finger, thumb or a tool. However, in alternate embodiments, the edge portion 920 may extend completely around the periphery of the surface 950. Within other embodiments the edge portion 920 may be disposed along a different edge of the periphery. Similarly, multiple edge portions 920 may be disposed to allow eased insertion of the electronic device 1220 onto surface 950 and its edges inserted into the grooves 940.

[0083] The attachment device 1000B can further include, in addition to a central portion 1010, a first helix 1020 and a second helix 1030. The first and second helices 1020, 1030 can be

operable to "wrap" around the cable or conduit to which the attachment device is to be attached to.

[0084] Depending on the embodiment, the attachment device may incorporate a low power wireless transceiver, such as an ultra-low power ultra-wideband (UWB) transceiver for example, to transmit data.

[0085] Depending on the embodiment, the attachment device may incorporate a battery and/or an energy harvester (e.g. solar cell or photovoltaic cell for ambient light harvesting) to provide power to the battery.

[0086] Depending on the embodiment, the attachment device may incorporate one or more sensors which can provide data to one or more of a memory forming part of the attachment device, an active WID tag, a reading upon interrogation of a passive WID tag, etc.

[0087] Depending on the embodiment, the attachment device may incorporate a sensor which provides data to one or more of a memory forming part of the device, an active WID tag, a reading upon interrogation of a passive WID tag, etc. where the sensor reading is indicative of a property of a signal being carried by a cable for example.

[0088] As can be understood, the examples described above and illustrated are intended to be exemplary only. The scope is indicated by the appended claims.

WHAT IS CLAIMED IS:

1. An attachment device for a cable, the attachment device comprising :

a first helix defined around an axis, the first helix having a first internal profile surrounding a first volume, the first internal profile matching an external diameter of the cable in a manner for the first internal profile to engagingly surround the cable when the cable is positioned in the first volume;

a second helix defined around the axis, the second helix having a second internal profile surrounding a second volume, the second internal profile matching the external diameter of the cable in a manner for the second internal profile to engagingly surround the cable when the cable is positioned in the second volume; and

a utility segment extending axially, relative to the axis, from a first end of the utility segment to a second end of the utility segment, the first helix connecting the utility segment and protruding from the first end in a first direction of the axial orientation, the second helix connecting the utility segment and protruding from the second end in a second direction of the axial orientation, opposite the first direction, the utility segment positioned alongside the cable when the cable is positioned in the first volume and in the second volume.

2. The attachment device of claim 1 wherein the first helix and the second helix are made of an elastic material and are provided in the form of helical springs having a same pitch and a same internal diameter.

3. The attachment device of claim 1 or 2 wherein the first helix and the second helix have a pitch equal to or greater than the external diameter of the cable.

4. The attachment device of any one of claims 1 to 3 wherein the first internal profile and the second internal profile have a cross-sectional dimension, relative the axis, having between 85% and 95% of the external diameter of the cable when the cable is not in the first volume and in the second volume, and wherein the first helix and the second helix can elastically stretch to accommodate the external diameter of the cable when the cable is positioned in the first volume and in the second volume.

5. The attachment device of any one of claims 1 to 4 wherein the first helix and the second helix have circular helix geometries of a same, constant, diameter.

6. The attachment device of any one of claims 1 to 4 wherein the first helix and the second helix have square helix geometries.

7. The attachment device of any one of claims 1 to 6 wherein the utility segment bears an identifier of the cable.

8. The attachment device of claim 7 wherein the identifier is a label.

9. The attachment device of claim 7 wherein the identifier has an antenna.

10. The attachment device of any one of claims 1 to 8 wherein the utility segment has an internal surface, defined radially relative the axis, and the utility segment bears an antenna spaced apart from the internal surface by a material of the utility segment.

11. The attachment device of claim 10 wherein the material of the utility segment has a poor electrical conductivity and is a good dielectric.

12. The attachment device of claim 10 or 11 wherein the antenna has a Q factor which exceeds a combined absorption of the material of the utility segment and of the cable when the cable is when the cable is positioned in the first volume and in the second volume.

13. The attachment device of any one of claims 1 to 12 wherein the utility segment bears a sensor.

14. The attachment device of any one of claims 1 to 13 wherein the utility segment has a fastening portion.

15. The attachment device of claim 14 wherein the fastening portion is apertured.

16. The attachment device of any one of claims 1 to 15 wherein the first helix and the second helix have more than one turn.

17. The attachment device of claim 16 wherein the first helix and the second helix have between 1.5 and 4 turns.

18. An electronic device for attachment to an elongated structure, the electronic device comprising :

a helix defined around an axis, the helix having an internal profile surrounding an volume, the internal profile matching an external diameter of the elongated structure in a manner for the internal profile to engagingly surround the elongated structure when the elongated structure is positioned in the volume;

a utility segment extending axially, relative to the axis, from a first end of the utility segment to a second end of the utility segment, the helix connecting the utility segment and protruding from the first end in the axial orientation, the utility segment positioned alongside the elongated structure when the elongated structure is positioned in the first volume with an internal profile of the utility segment facing the elongated structure; and

an antenna secured to the utility segment and separated from the internal profile of the utility segment by a thickness of a material of the utility segment, the material of the utility segment having an electrical conductivity below 1 S/m, a relative permittivity above 1.5, and the thickness has at least 0.3 mm.

19. The electronic device of claim 18 further comprising a second helix defined around the axis, the second helix having a second internal profile surrounding a second volume, the second internal profile matching the external diameter of the cable in a manner for the second internal profile to engagingly surround the cable when the cable is positioned in the first volume and in the second volume.

20. A device for attachment to a cable comprising: a spiral portion for wrapping around a predetermined portion of the cable; and a portion having an end coupled to an end of the spiral portion.

21. The device according to claim 20, further comprising another spiral portion for wrapping around another predetermined portion of the cable; wherein an end of the another spiral is coupled to a distal end of the portion to that coupled to the spiral portion.

22. The device according to claim 20 or 21, wherein the portion has a first surface disposed towards a surface of the cable upon attachment of the device to the cable and a second surface disposed on another side of the portion to the first surface.

23. The device according to claim 22, wherein the first surface has a geometry matching an exterior geometry of the cable; and the second surface has a planar geometry.

24. The device according to claim 20 or 21, wherein the portion has a first surface disposed towards a surface of the cable upon attachment of the device to the cable and a projecting flange projecting away from the cable upon attachment of the device to the cable.

25. The device according to claim 24, wherein the projecting flange has one or more holes; and each hole of the one or more holes is compatible with one or more attachment mechanisms for attaching the device to another element.

26. The device according to claim 22 or 23, wherein the second surface comprises at least one of an identifier and a unique identifier.

27. The device according to claim 22 or 23, wherein the second surface comprises a machine readable code.

28. The device according to any one of claims 20 to 27, wherein the portion incorporates at least one of a machine readable tag and a radio frequency identification tag.

29. The device according to claim 24 or 25, wherein the projecting flange comprises a processor and at least one of a wireless interface and a wireless interface.

30. The device according to claim 24 or 25, wherein the projecting flange comprises a processor, one or more sensors and at least one of a wireless interface and a wireless interface.

31. The device according to any one of claim 20 to 31, wherein a cross-section of the spiral portion is a discorectangle.

32. A device comprising:

a first spiral element;

a second spiral element; and

a central element coupled to one end of the first spiral element and to one end of the second spiral element; wherein

an axis of the first spiral element, another axis of the second spiral element and a further axis of the central element all define an axial geometry.

33. The device according to claim 32, wherein the axial geometry is linear.

34. The device according to claim 32, wherein the axial geometry is a predetermined portion of a circle.

35. The device according to claim 32, wherein

the first spiral element comprises N square helix elements;

the second spiral element 1420 comprises M square helix elements;

N and M are positive integers greater than or equal to one; and

each square helix comprises:

a first element disposed parallel to a first axis perpendicular to a longitudinal axis of the device at that point on a first side of the device;

a second element coupled at one end to an end of the first element disposed parallel to a second axis perpendicular to both the longitudinal axis of the device and the first axis on a second side of the device;

a third element coupled at one end to a distal end of the second element disposed parallel to a third axis parallel to the longitudinal axis of the device;

a fourth element coupled at one end to a distal end of the third element disposed parallel to the first axis on a third side of the device; and

a fifth element coupled at one end to a distal end of the fourth element disposed parallel to the second axis on a fourth side of the device.

36. The device according to claim 32, wherein

the first spiral element comprises (N+1/R) square helix elements;

the second spiral element 1420 comprises (M+1/S) square helix elements;

N and M are positive integers greater than or equal to one;

R and S are positive integers greater than or equal to two; and

each square helix comprises:

a first element disposed parallel to a first axis perpendicular to a longitudinal axis of the device at that point on a first side of the device;

a second element coupled at one end to an end of the first element disposed parallel to a second axis perpendicular to both the longitudinal axis of the device and the first axis on a second side of the device;

a third element coupled at one end to a distal end of the second element disposed parallel to a third axis parallel to the longitudinal axis of the device;

a fourth element coupled at one end to a distal end of the third element disposed parallel to the first axis on a third side of the device; and

a fifth element coupled at one end to a distal end of the fourth element disposed parallel to the second axis on a fourth side of the device.

37. The device according to claim 32, wherein the central portion comprises a radio frequency identification device.

38. A device comprising:

a body comprising a first portion on an upper side of the device and a second portion on the lower side of the device; wherein

the first portion comprises a surface around which are disposed one or more edge portions and one or more end portions to form one or more grooves dimensioned to accept one or more edges of a wireless identification tag;

the second portion is dimensioned and profiled to encompass a predetermined portion at least one element selected from the group comprising a cable, a cable element, a signal carrying cable element and a conduit.

39. The device according to claim 38, wherein the second portion of the body is at least one of designed to be compliant to the element and manufactured from a material of defined elasticity; and the body when attached to the element is retained in position by the second portion of the body.

40. The device according to claim 38, further comprising a first helix with a helical structure disposed at one end of the device; wherein the first helix has a bore of a first diameter, an outer surface of a second diameter and the bore is aligned with an axis of the second portion; and the element is frictionally retained within the first helix.

41. The device according to claim 38, further comprising a first helix with a helical structure disposed at one end of the device; wherein the second portion of the body is at least one of designed to be compliant to the element and manufactured from a material of defined elasticity; the first helix has a bore of a first diameter, an outer surface of a second diameter and the bore is aligned with an axis of the second portion; and the body when attached to the element is retained in position by the second portion of the body and the element is frictionally retained within the first helix.

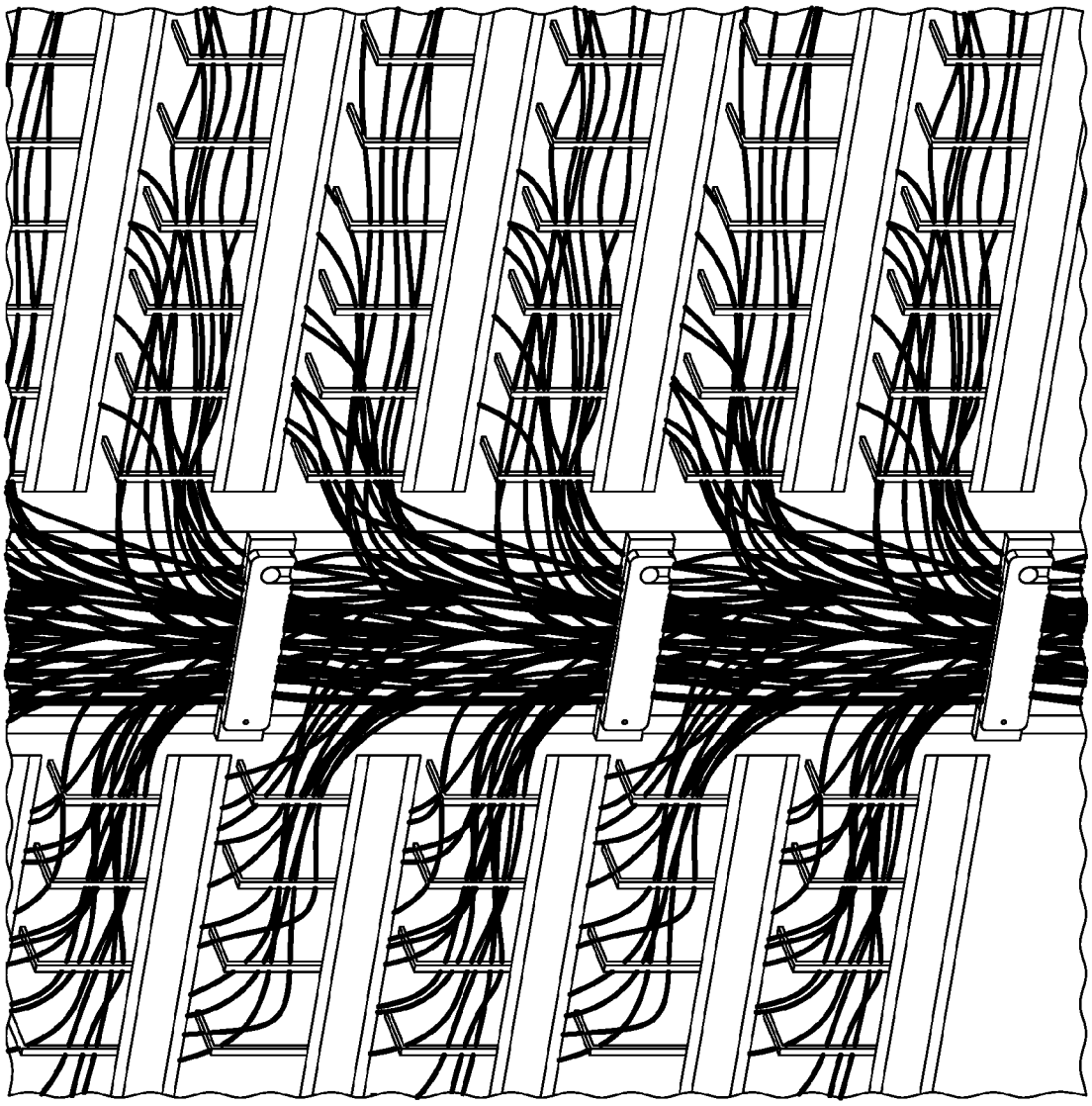

Fig. 1

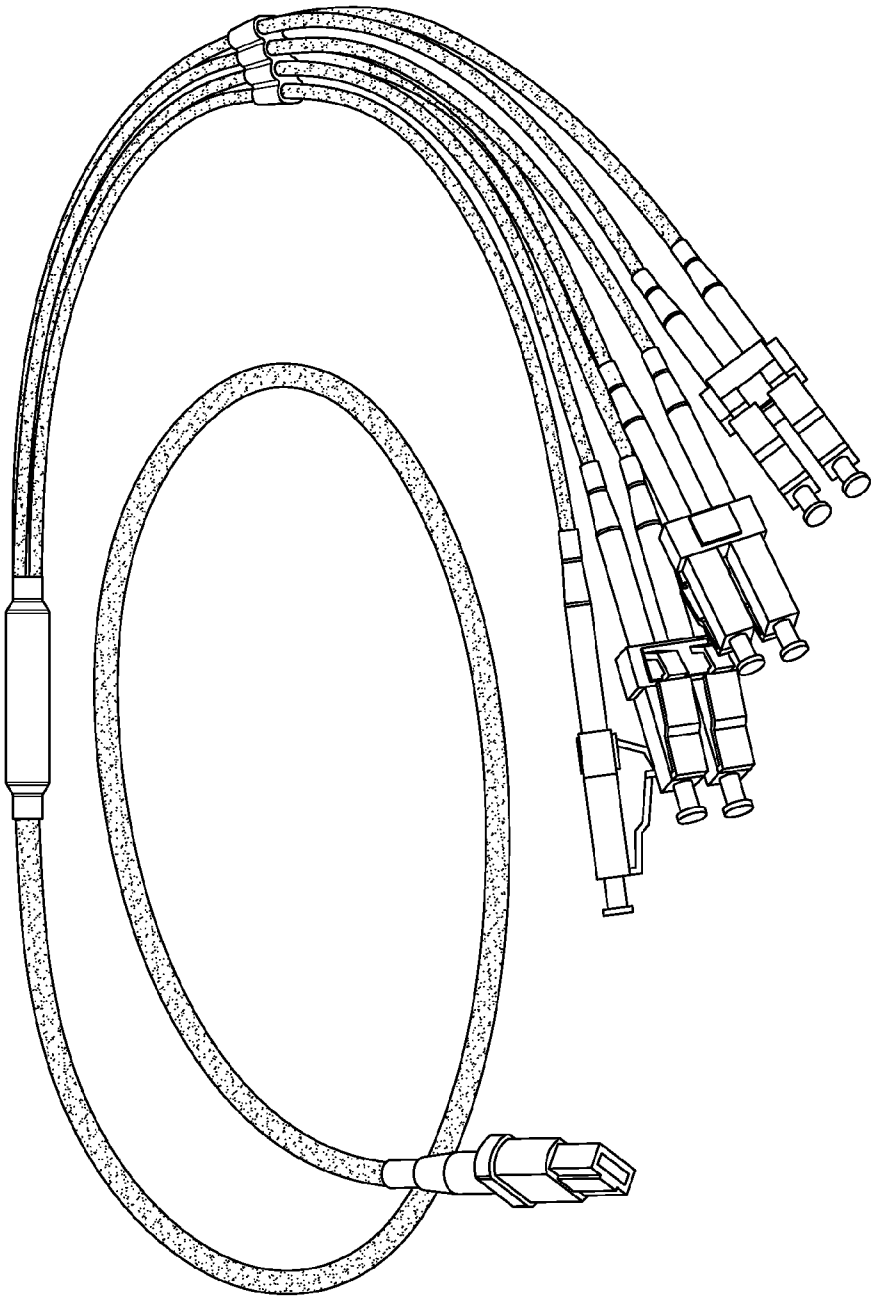

Fig. 2

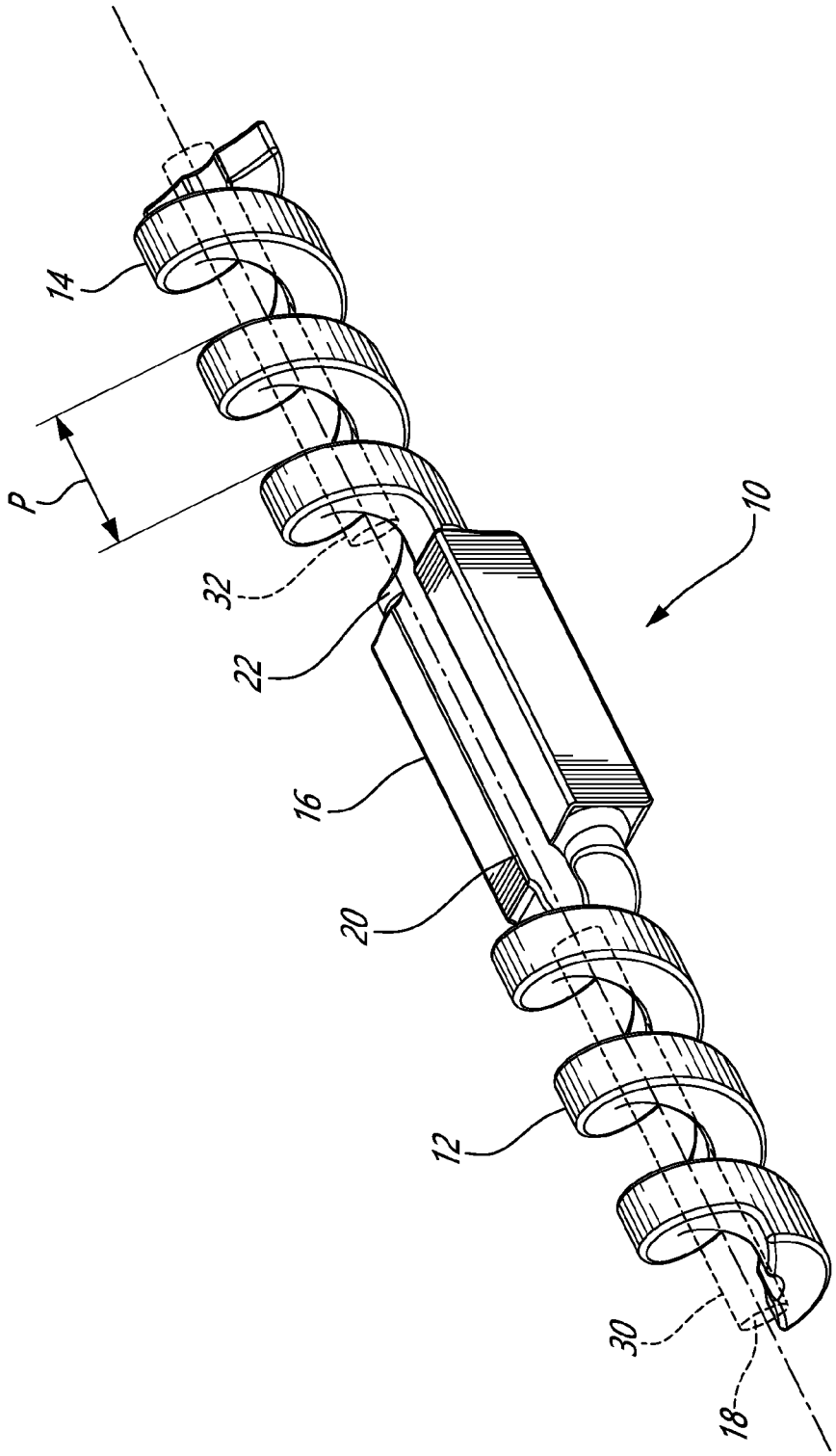

Fig. 3

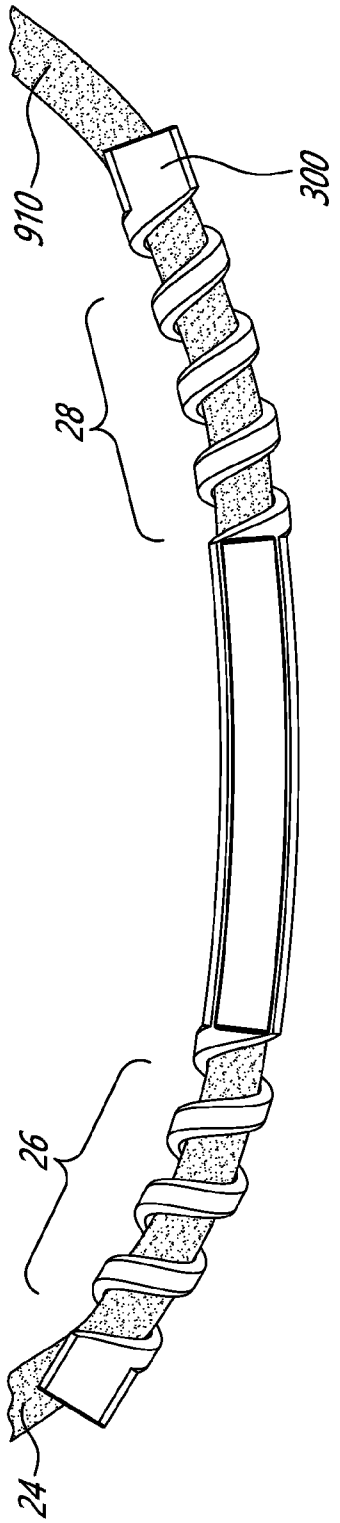

FIG. 4

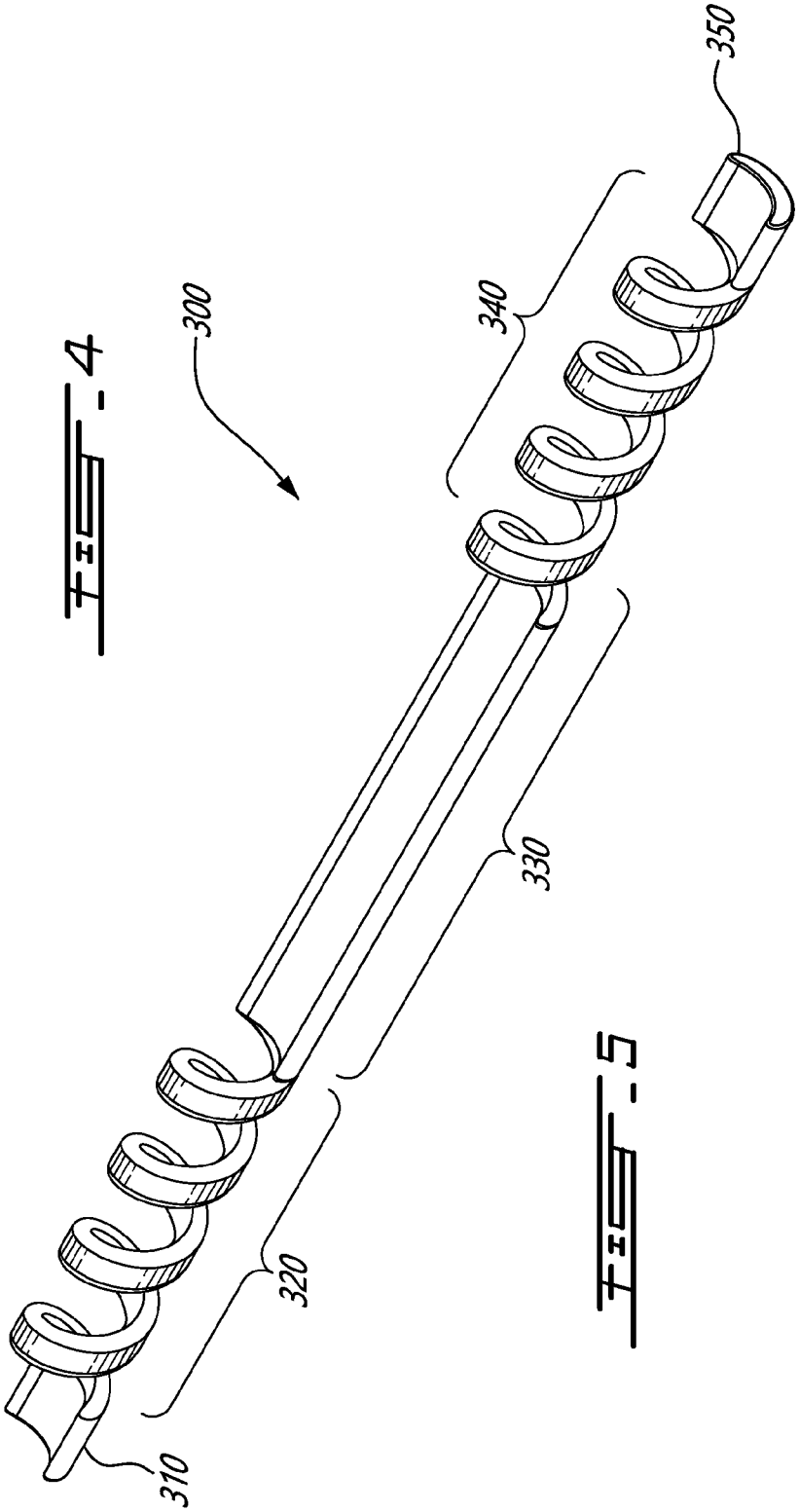

FIG. 5

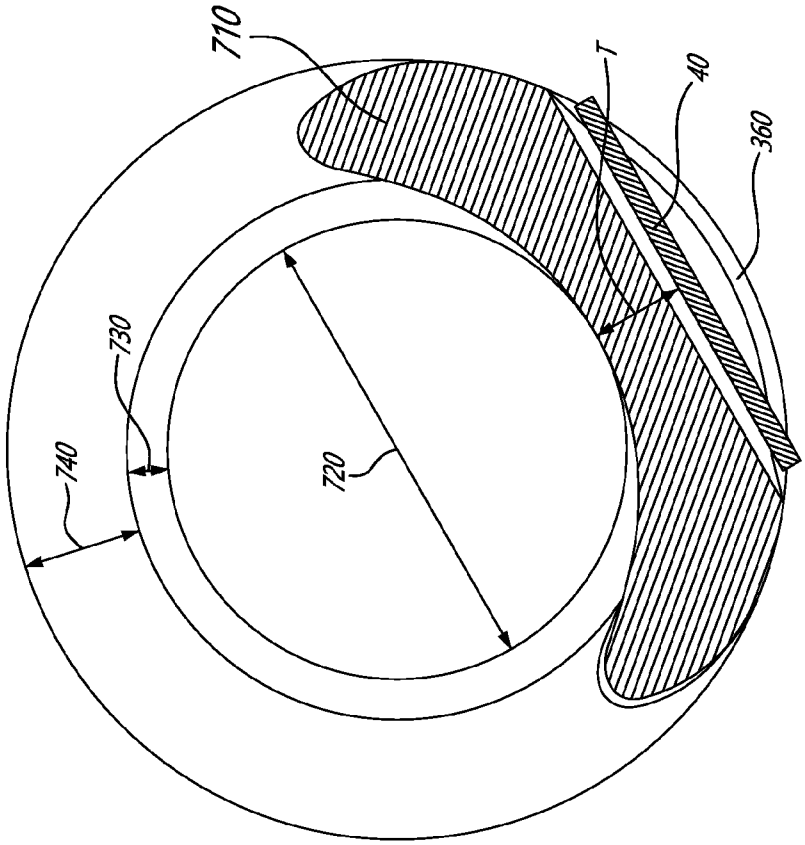

Fig - 6B

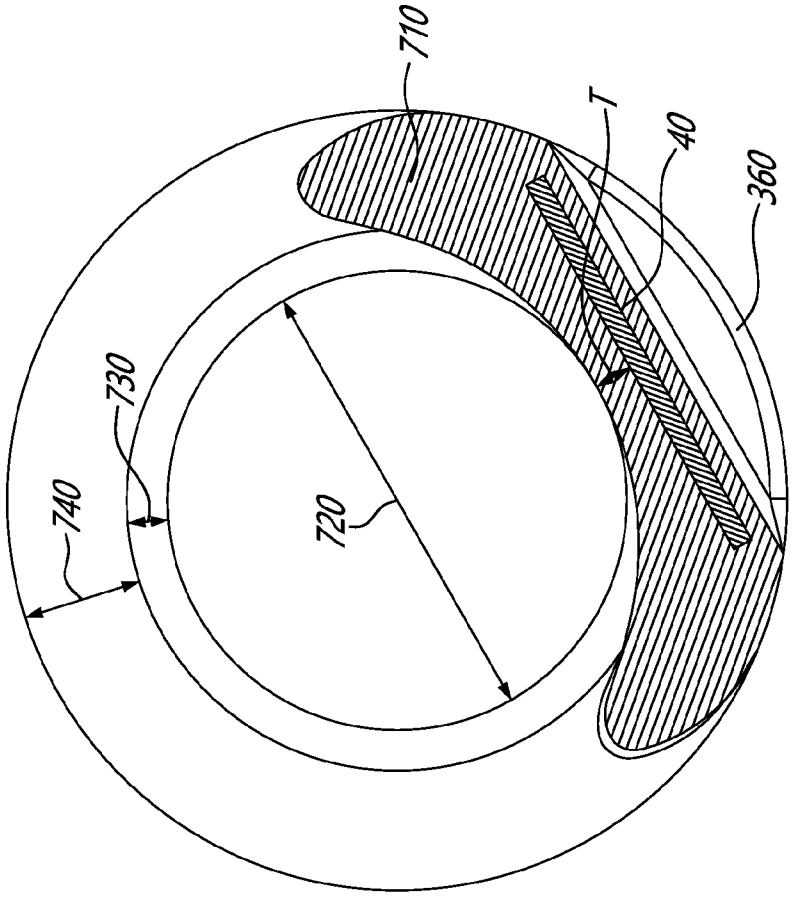

Fig - 6A

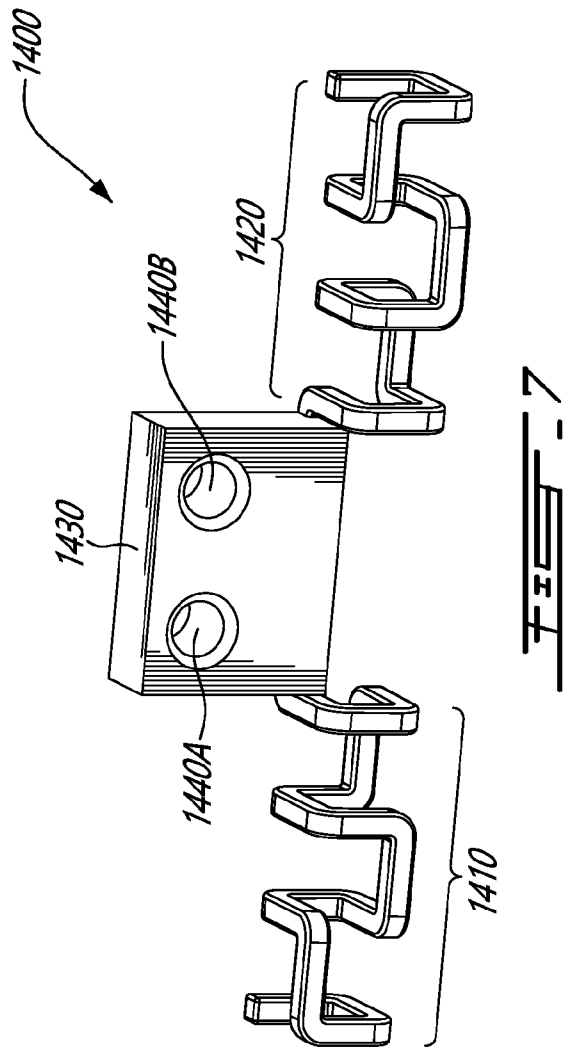

Fig. 7

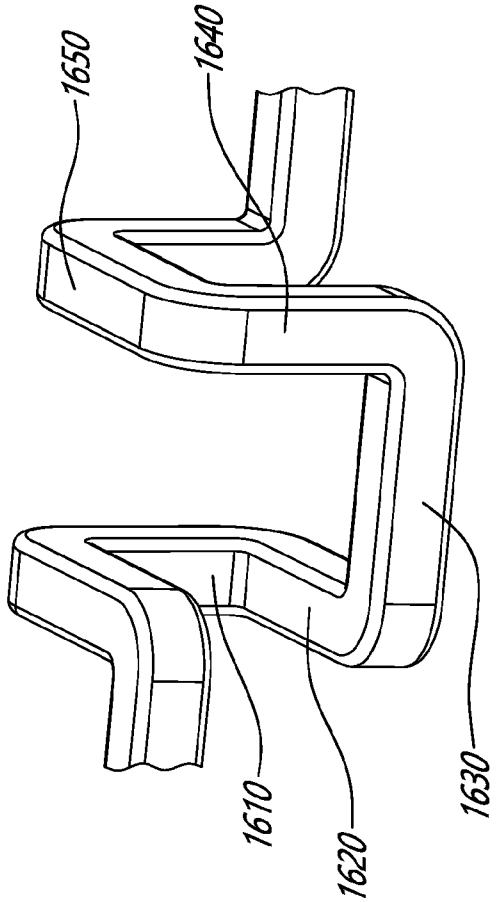

Fig. 8

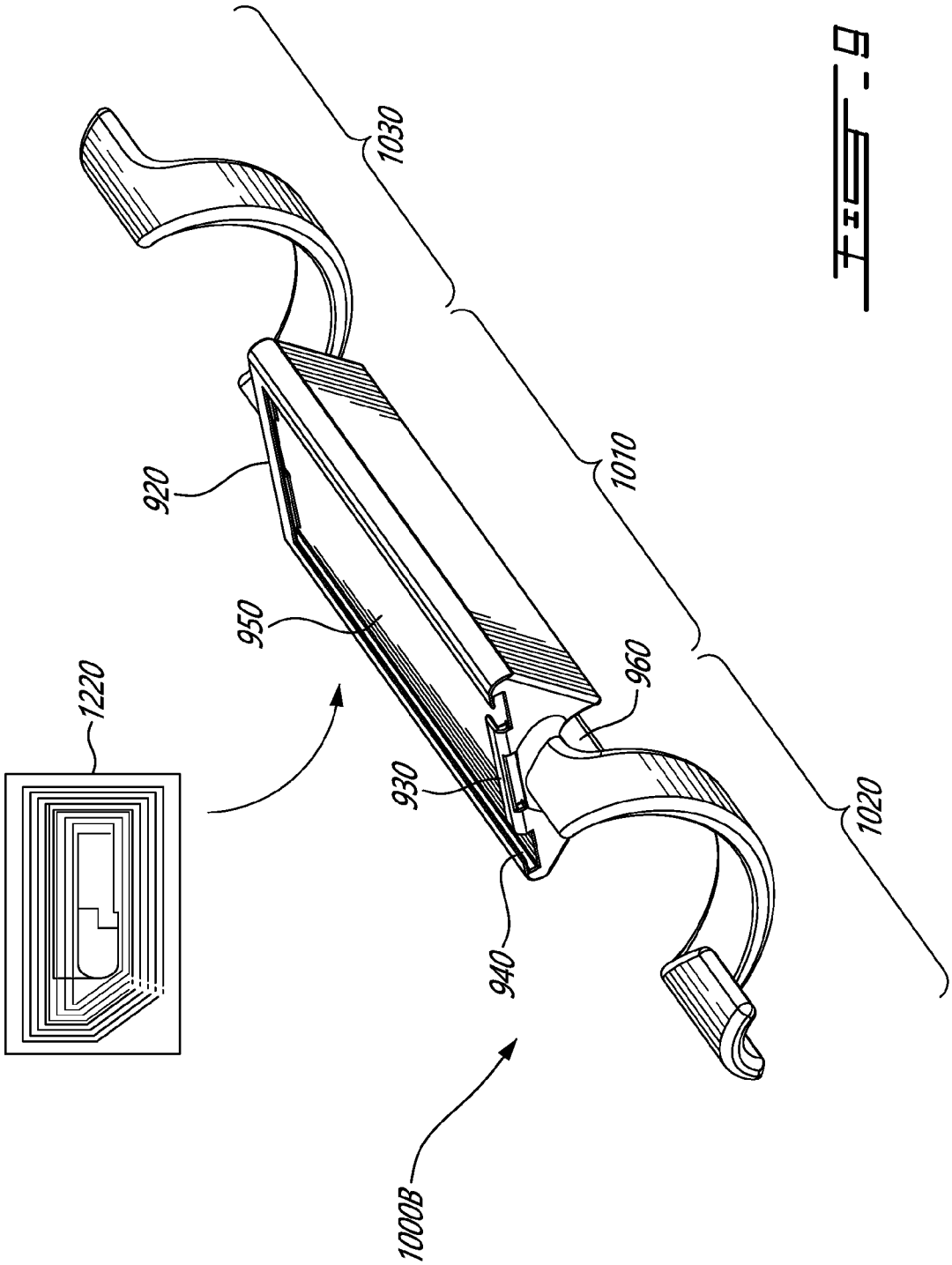

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2024/050805

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***F16L 3/137*** (2006.01), ***B65B 13/02*** (2006.01), ***B65D 63/10*** (2006.01), ***H02G 3/00*** (2006.01)

CPC: B65B 13/02 (2020.01), B65D 63/10 (2020.01), F16L 3/137 (2020.01), H02G 3/00 (2023.02)

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)
F16L 3/137 (2006.01), B65B 13/02 (2006.01), B65D 63/10 (2006.01), H02G 3/00 (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC: F16L3/1211, F16L3/12

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Questel Orbit (fampat); Keywords : helix, (wrap+ OR surround+ OR enclos+), (label, tag) (sensor, rfid), (cable+ OR wire+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB1474901 (BARNETT) 25 May 1977 (1977-05-25) *whole document*	1-5,14-17,20-22,24-25,32-33 6-13,18-19, 26-31,35-37, 40-41
X	GB257294 (MICKLETHWAITE) 07 October 1926 (07-10-1926) *whole document*	1-5,14, 16-17, 20-24, 32-34 6-13,18-19, 26-31,35-37, 40-41
X	US8740157 (JATZKE) 03 June 2014 (2014-06-03) *whole document*	20-23
X Y	KR10-2011-0080409 (KIM et al.) 13 July 2011 (2011-07-13) *whole document*	38-39 7-13, 18-19, 26-30, 37

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"D"	document cited by the applicant in the international application	"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
"E"	earlier application or patent but published on or after the international filing date	"&"	document member of the same patent family
"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		

Date of the actual completion of the international search 15 August 2024 (15-08-2024)	Date of mailing of the international search report 10 September 2024 (10-09-2024)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Jarret Diggins (819) 639-7846

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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