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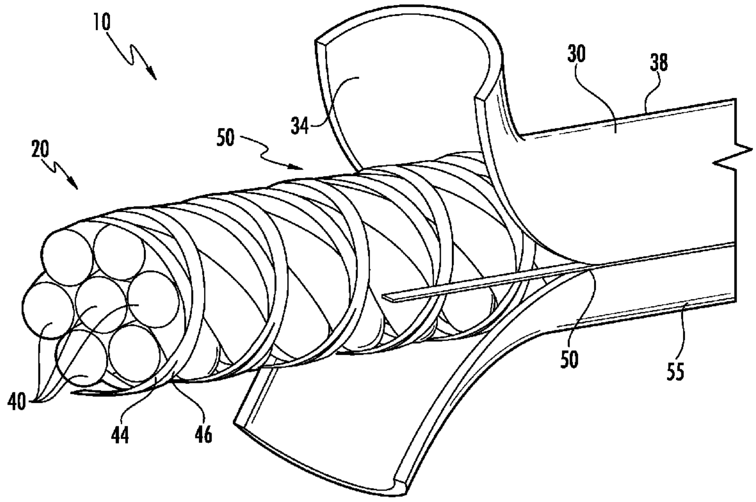

FIG. 1

(57) **Abstract**: Cables are constructed with discontinuities in the cable jacket that allow the jacket to be torn to provide access to the cable core. The discontinuities can be longitudinally extending strips of material in the cable jacket. The discontinuities allow a section of the cable jacket to be pulled away from a remainder of the jacket using a relatively low peel force.

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FIBER OPTIC CABLES WITH ACCESS FEATURES

PRIORITY APPLICATION

[0001] This application claims the benefit of priority under 35 U.S.C. § 119 of U.S. Provisional Application No. 61/416,684, filed on November 23, 2010, the content of which is relied upon and incorporated herein by reference in its entirety.

RELATED APPLICATIONS

[0002] This application is related to PCT/US11/34309, filed April 28, 2011, and to US Prov. App. No. 61/407,744, filed October 28, 2010.

BACKGROUND

Field of the Disclosure

[0003] A fiber optic cable is disclosed, specifically a fiber optic cable having access features for accessing a core of the fiber optic cable.

Technical Field

[0004] Fiber optic cables frequently require that the fibers inside are accessed mid-span rather than at an end of the cable. This often requires the cable jacket to be cut and a portion of the jacket to be removed, allowing access to the fibers inside the jacket. Conventional cutting tools, such as box cutters or custom cutting tools, can be cumbersome and dangerous, both to the operator and to the delicate fibers. Rip cords in a cable jacket can be used for cable access, but they add cost and require time and training in order for the craftsman to use them properly. In one conventional access process, a jacket is pierced using a first tool, and a second tool is used to "fish" out enough of the rip cord so that a third tool (e.g., pliers) can grasp the rip cord. A pull force must then be applied to the rip cord, tearing it through the jacket material. The jacket material is then peeled away from the cable core and removed. If the rip cord breaks, the cord must be "fished" out again.

SUMMARY

[0005] According to a first embodiment, a cable comprises a core including a plurality of optical fibers and a jacket surrounding the core. The jacket includes a main portion of a polymeric first extruded material, and at least a first and a second discontinuity of a second extruded material disposed in the main portion, each discontinuity having a bond with the main portion, with a section of the main portion located between the first and second discontinuities being separable from a remainder of the jacket by a peel force exerted on the section. The peel force may be relatively low to allow ease of access to the cable core. The peel force can be less than 80 Newtons, for example, and may fall in the range of 20-40 Newtons.

[0006] The at least one discontinuity may extend substantially along the entire length of the cable, or along a selected length of the cable to provide access to the core.

[0007] The first polymer may be a polyethylene and the second extruded material may be a polypropylene/polyethylene blend, the blend including from about 6% to about 20% by weight of the polyethylene.

[0008] The cable can include two discontinuities that are angularly spaced in the cable jacket. The discontinuities can be spaced at selected angles to provide varying degrees of required peel force.

[0009] It is to be understood that both the foregoing general description and the following detailed description are merely exemplary, and are intended to provide an overview or framework to understand the nature and character of the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] According to common practice, the various features of the drawings discussed below are not necessarily drawn to scale. Dimensions of various features and elements in the drawings may be expanded or reduced to more clearly illustrate the embodiments of the invention.

[0011] **FIG. 1** is a partial cutaway view of a fiber optic cable according to a first embodiment;

[0012] **FIG. 2** is a cross-section of the cable jacket illustrated in **FIG. 1**;

[0013] **FIG. 3** is an isolated cross-sectional view of one of the discontinuities in the cable jacket of **FIG. 2**;

[0014] **FIG. 4** is a cutaway view of a coextrusion apparatus used to manufacture cables with discontinuities;

[0015] **FIG. 5** is a cutaway view of the coextrusion apparatus of **FIG. 4** illustrating extrudate material flow;

[0016] **FIG. 6** illustrates a ring that can be used to modify conventional coextrusion devices to form discontinuities;

[0017] **FIG. 7** is a partial cutaway view of a fiber optic cable according to a second embodiment;

[0018] **FIGS. 8-11** are isolated cross-sectional views of alternate embodiments of the discontinuities in a cable jacket;

[0019] **FIGS. 12-15** are isolated cross-sectional views of further alternate embodiments of the discontinuities in a cable jacket;

[0020] **FIGS. 16A-16C** illustrate an alternate method of making a cable jacket with discontinuities in two extruded layers.

DETAILED DESCRIPTION

[0021] Reference is now made in detail to the present preferred embodiments of the disclosure, examples of which are illustrated in the accompanying drawings. Whenever possible, identical or similar reference numerals are used throughout the drawings to refer to identical or similar parts.

[0022] **FIG. 1** is a partial cutaway view of a fiber optic cable **10** according to a present embodiment. The cable **10** comprises a core **20** surrounded by a jacket **30**. The jacket **30** has an interior surface **34** that faces the core **20**, and an exterior surface **38**. The jacket **30** can be formed primarily from polymer materials, and can be generally referred to as "polymeric." In this specification, the terms "polymer" and "polymeric" indicate materials comprised primarily of extrudable polymer materials such as, for example, copolymers, but allows for the presence of non-polymer materials such as additives and fillers. The core **20** can be, for example, an assembly or arrangement having data-transmission and/or power-transmission capabilities. In the illustrated embodiment, the core **20** includes a bundle of optical fibers **40** bundled within contrahelically wound binders **44**, **46**, the optical fibers being capable of conveying optical data.

[0023] The jacket **30** includes a separation feature that facilitates access to the core **20**. In the exemplary embodiment, the separation feature is a pair of extruded discontinuities **50** that extend along the length of the cable **10**. In this specification, the term "discontinuity" indicates a portion of the jacket **30** of different material composition than the main portion of the jacket **30**, the main portion being indicated by reference number **55**. The main portion **55** can essentially be an annular hoop surrounding the core **20**, with the discontinuities **50** extending longitudinally through the main portion **55** along a selected length of the cable **10**. According to one aspect, the discontinuities **50** provide lines of weakness that allow the jacket **30** to be separated as shown in **FIG. 1**. The illustrated discontinuities **50** along the entire cable length, although shorter lengths may be used to provide access to the core **20**.

[0024] **FIG. 2** is a cross-section of the jacket **30** in isolation, taken on a plane perpendicular to a length of the cable **10**. In the exemplary embodiment, the discontinuities **50** are bonded to the main portion of the jacket **55** when the jacket **30** is extruded. The main portion **55** and the discontinuities **50** can be formed from extrudable polymers, so that as the extrudates used to form the main portion **55** and the discontinuities **50** cool and solidify, the extrudates become bonded to a desired degree at an interface **54** on each side of a discontinuity **50**. When the discontinuities **50** are formed while extruding in the same step as the main portion **55** of the jacket, the bond between discontinuity **50** and the remainder of the jacket **30** can be generally described as enabled by polymer chain entanglement as the jacket **30** solidifies. The jacket **30** accordingly comprises a cohesive composite polymer structure. In **FIG. 2** the interfaces **54** are shown as clear delineations, while in practice there may be a transition region between the materials of the main portion **55** and the discontinuities **50**. The curved “T” or “shark tooth” shapes of the discontinuities **50** in **FIG. 2** are a result of the extrusion process used to form the discontinuities, but other shapes are possible.

[0025] The discontinuities **50** can be strips that may each occupy up to, for example, 5% of the total jacket cross-sectional area **AJ**. In exemplary embodiments, discontinuities **50** can be relatively narrow strips in the jacket **30**, and may occupy relatively small portions of the jacket cross-sectional area AJ. For example, the discontinuities **50** can have cross-sectional areas AD that are less than 3% of AJ. In the illustrated embodiment, the discontinuities **50** each have cross-sectional areas **AD** that are less than 2% of **AJ**. In **FIGS. 1** and **2**, two discontinuities **50** are formed in the jacket **30** to facilitate opening of the jacket as shown in **FIG. 1**. Depending on the form that the core **20** takes, the number, spacing, shape, composition and other aspects of the discontinuities **50** can be varied. For example, a single discontinuity in the jacket **30** may be sufficient to allow the cable jacket **30** to be opened away from the core **20**.

[0026] **FIG. 3** is an isolated view of one of the discontinuities **50** in the jacket **30**. In the illustrated embodiments, the width of the discontinuity **50** is much greater near the exterior surface **38** of the jacket **30** than at the radially inward portion of the discontinuity **50**. The discontinuities **50** can accordingly form a small, visible portion of the exterior surface of the cable jacket **30**. This is due to the manufacturing process used to form the exemplary jacket, in which the extrudate used to form the discontinuity **50** is introduced from the direction **60** into the extrudate material used to form the main portion **55**. The discontinuities **50** are progressively narrower as they extend radially inwardly. The discontinuity extends a depth **D** into the jacket **30**, which has a thickness **T**. In exemplary embodiments, a discontinuity **50** may extend from the exterior surface **38** to the depth **D**, leaving a gap **56** that is contiguous with main portion **55**. Gap **56** may be from about 0.2 millimeter (mm) to about 0.4 mm, and in exemplary embodiments the gap **56** is about 0.3 mm. In other embodiments, discontinuity **50** may extend essentially from the exterior surface **38** to the interior surface **34** of the jacket **30**. The depth **D** need not equal the thickness **T**, however. For example, discontinuities having depths **D** of at least 80% of the thickness **T** may be effective in providing shear locations for tearing the jacket **30**. Discontinuities having depths **D** of at least 50% of the thickness **T** may also be effective in providing shear locations for tearing the jacket **30**.

[0027] The materials and processes used to form the main portion **55** and the discontinuities **50** can be selected so that the interfaces **54** allow for relatively easy access to the core **20** by tearing the jacket **30** as shown in **FIG. 1**. The cable **10** may be constructed to meet other requirements for robustness, such as requirements for the jacket **30** stay intact under tensile loads, twisting, in temperature variations, and when subjected to other known cable test criteria, such as, for example, ICEA 460, and GR20.

[0028] The cable jacket main portions **55** and the discontinuities **50** described in this specification may be made from various polymer materials. Either the main portion **55** or the discontinuities **50** may be made from polypropylene (PP), polyethylene (PE), or blends of materials such as a blend of PE and ethylene vinyl acetate (EVA), flame-retardant material such as flame-retardant polyethylene, flame-retardant polypropylene, polyvinyl chloride (PVC), or polyvinylidene fluoride (PVDF), filled materials such as polybutylene terephthalate (PBT), a polycarbonate and/or a polyethylene (PE) material and/or an ethylene vinyl acrylate (EVA) or other blends thereof having fillers like a chalk, talc, or the like, and other materials such as a UV-curable acrylates.

[0029] In the exemplary embodiments, the main portion can be extruded from a first material comprising at least 80% of a first polymer, polyethylene, by weight, and the discontinuities can be extruded from a second material comprising at least 70% of a second polymer, polypropylene, by weight and additionally at least 0.5% of the first polymer polyethylene by weight. Higher amounts by weight of the first polymer may be included in the second material, such as at least 1.0%, or at least 2%. Without being bound by theory, Applicants believe the bond between polypropylene and polyethylene may be caused by one or both of quantities of ethylene that are compounded in the polypropylene bonding with the polyethylene, and molecular entanglement between the PE and PP. According to this understanding, the amount of ethylene in the PP extrudate can be increased to increase the bond between the discontinuities and the remainder of the jacket. In one embodiment, the main portion **55** is made from a first polyethylene extruded material, such as a medium density polyethylene (MDPE). The discontinuities **50** are made from a second, polypropylene/polyethylene blend of extruded material, the blend including from 6% to 20% polyethylene, with the remainder of the blend being primarily a polypropylene material.

[0030] The cable **10** can be manufactured using existing coextrusion equipment subject to minor modifications. For example, extruders from the Davis-Standard line of wire and cable extruders can be used to form a cable jacket according to the present embodiments. For example, a 1-1/2 inch (40 mm) barrel diameter extruder and a larger barrel diameter extruder, such as a 3, 4, or 4-1/2 inch extruder available from Davis-Standard, can be screwed into a crosshead in a configuration that would conventionally be used to extrude a cable jacket with the larger extruder, and to extrude a stripe on the exterior of the cable jacket with the smaller extruder. In a conventional process, the stripe extrudate material is deposited on the surface of the jacket extrudate. According to the present embodiment, the flow of extrudate in the jacket extruder is diverted at the location or locations where the stripe extrudate material is introduced to the jacket extrudate. The diversion of the jacket extrudate creates a depression or trough in the flow of jacket extrudate, into which the extrudate material used to form a discontinuity is introduced. The jacket extrudate along with the discontinuities formed therein then contracts and solidifies around a fiber optic core advancing through the crosshead.

[0031] **FIG. 4** illustrates a cutaway section view of a coextrusion apparatus **100** that can be screwed into a crosshead and used to manufacture a cable according to the present embodiments. The arrows in **FIG. 4** illustrate the flow direction of extrudate. **FIG. 5** illustrates the coextrusion apparatus **100** including representations of the extrudate materials forming the jacket **30**. The apparatus **100** can generally be constructed from commercially available components used in a cable jacketing line with the capability to extrude stripes on a cable jacket, except for the modification described below. Referring to **FIGS. 4** and **5**, the apparatus **100** includes a first input port **110** that receives a first molten extrudate material **112** that is used to form the main portion **55** of the jacket **30**.

A second input port **120** allows introduction of a second molten extrudate material **122** used to form the discontinuities **50**. A cavity **130** houses a tip (not shown) that in part defines the shape of the extrusion cone **136**, and the ultimate form of the cable jacket.

[0032] **FIG. 6** illustrates a ring **150** that may be inserted in the apparatus **100** that enables formation of the discontinuities in the flow of the first extrudate material **112**. The ring **150** includes two projections **152** that act to divert the flow of the first extrudate **112**. The projections **152** divert the flow of the first extrudate **112** and create a trough or depression in the extrudate flow, into which the second extrudate material **122** flows.

[0033] Referring to **FIG. 5**, to form a fiber optic cable **10**, a cable core (not shown) is advanced along the centerline of the apparatus **100**. First extrudate material **112** is pumped into the first input port **110**, which then advances through channels in the apparatus **100** and travels over the tip (not shown). The projections **152** divert the flow of extrudate **112** and create troughs. At these locations, the second extrudate material **122** is introduced into the troughs. In exemplary embodiments, a space (not shown) between the innermost surfaces of projections **152** and the inner cone of apparatus **100** allows extrudate **112** to flow underneath projections **152**, creating a contiguous flow of extrudate **112** beside and beneath the second extrudate material **122**. The second extrudate material **122** therefore flows as a liquid in the flow of first extrudate material **112** as the jacket is extruded. The extrusion cone **136**, which is comprised of the first and second extrudate materials **112**, **122**, cools and solidifies around the core to form the jacket **30**.

[0034] **FIG. 7** is a partial cutaway view of a fiber optic cable **310** that can be constructed using the processes described herein, with relatively closely spaced discontinuities. The cable **310** has a core **320** surrounded by a jacket **330**, similar to the embodiment shown in **FIG. 1**. The jacket **330** includes a pair of discontinuities **350** that extend along the length of the cable **330**. In this embodiment, the discontinuities **350** are relatively close together so that a narrow strip of jacket **330** can be peeled away from the core **320**. The discontinuities **350** each occupy less than 5% of the total jacket area **AJ** of the cable **310**, and are separated by an angular distance of less than 60 degrees. For a relatively narrow strip providing easy tearing from the remainder of the cable, the angular separation can be less than 30 degrees.

[0035] According to the present embodiments, one or more discontinuities in a cable jacket can be arranged to provide relatively easy access to a cable core. The ease of access can be defined, for example, by the force required to pull, or peel away a section of the cable jacket at one or more discontinuities. The peel force can be measured as a direct force measurement, in Newtons, of the force a person must exert as the jacket section is peeled away from the cable core. It is understood that the jacket will not be perfectly uniform, and that a person or machine cannot exert a perfectly uniform force as the jacket is peeled, so "peel forces" described in this specification indicate an average force exerted as a distance of the jacket section is peeled back. It is also understood that peel forces according to the present embodiments are measured without any additional modifications to the cable jacket exterior, such as by scoring. The peel forces can be relatively low when compared to the forces required to access a cable without extruded discontinuities. For example, a peel force required to peel the narrow strip of jacket **330** shown in **FIG. 7** may be less than about 80 Newtons (N). In exemplary embodiments, the peel force required may be from about 10N to about 50N, and in yet further exemplary embodiments may be from about 20N to about 40N. Peel forces are defined herein to include any force great enough to cause the jacket material to rip, tear, or otherwise separate along the discontinuities **50, 350** for accessing the cable core. Spaced discontinuities, such as those shown in **FIGS. 2** and **7**, allow access at relatively low peel forces. Narrowly spaced discontinuities such as those shown in **FIG. 7** provide easy access at very low peel forces.

[0036] It is relatively easy to measure peel force. Using cable **10** (**FIG. 1**) as a reference, about 25 mm of jacket is cut away from one end of the cable **10**. The ends of the cable **10** are secured to a bench or other sturdy surface. A small hole is placed in the jacket proximal to the edge of the jacket where it was cut away from the core, and one end of an "S" hook is inserted into the hole in the jacket. If the cable includes a pair of spaced discontinuities, the hole is formed midway between the two discontinuities. A lanyard or wire is attached to the other end of the S hook. The lanyard is fixed to a force gauge, such as a Chatillon gauge available from Ametek Test and Calibration Instruments of Largo, Florida. The force gauge is pulled by hand or by some mechanical means, away from the cable at an angle of 45 degrees to the cable centerline, until the section of the jacket attached to the S hook peels away from the rest of the jacket. The jacket section is pulled for a distance of 250-500 mm away from the initial jacket removal location. The average peel can be calculated as the average force measured by the force gauge as the jacket section is pulled along the selected distance.

[0037] In an alternate method of measuring peel force, a force testing machine, such as those available from Instron®, pulls the section of cable away from the remainder of the cable at angle of 90 degrees to the remainder of the cable **10**. The cable is secured to a linear slide that translates the cable beneath the portion of the machine that is secured to the jacket section being peeled away. In this arrangement, the cable **10** slides beneath the force gauge that measures the tension on the section being removed, so that the section can be peeled away at a 90 degree angle. The tension in the removable section can be averaged over a desired distance to obtain the average peel force.

[0038] **FIGS. 8-11** are isolated cross-sectional views of exemplary alternate embodiments of discontinuities. In **FIG. 8**, the main portion **430** has discontinuity **450** disposed therein with a substantially serrated cross-section. In **FIG. 9**, the main portion **530** has an "hourglass" cross-section. Discontinuities **450** and **550**, for example, may extend from respective exterior surfaces to respective interior surfaces of respective main portions **430** and **530**. In **FIG. 10**, the main portion **630** has a generally rectangular shape discontinuity **650** that extends from the exterior surface of the main portion **630**. The discontinuity **650** extends only partially through the main portion **630** and leaves a gap **656**, similar to the gap **56** illustrated in **FIG. 3**. **FIG. 11** shows yet another example of a main portion **730** having a discontinuity **750** but having a substantially "I" shaped cross-section. The discontinuity **750** extends from the exterior surface of main portion **730** to the interior surface.

[0039] **FIGS. 12-15** are isolated cross-sectional views of further embodiments of discontinuities that are wholly encased or embedded in the main portion of the cable jackets, as opposed to extending to the cable exterior. **FIG. 12** illustrates a main portion **830** with a wholly embedded discontinuity **850** disposed therein having a substantially rectangular cross-section, with a diagonal axis of the rectangle generally aligned with a radius of the cable. **FIG. 13** illustrates a main portion **860** having a wholly embedded discontinuity **830** disposed therein with a substantially round cross-section. **FIG. 14** illustrates a main portion **830** having a pair of wholly embedded discontinuities **862** disposed therein, each having a substantially round cross-section. In **FIG. 14**, the two discontinuities **862** are arranged on a line that can coincide with a radius of the cable. **FIG. 15** illustrates a main portion **830** with a wholly embedded discontinuity **870** having a substantially ovoid shaped cross-section.

[0040] **FIGS. 16A-16C** illustrate an alternative method of forming a cable jacket in which an exterior jacket with one or more discontinuities in extruded over an inner jacket layer. Referring to **FIG. 16A**, a core **900** is advanced along a process direction in a cable jacketing line. The core **900** may include, for example, at least one optical fiber **40**, a plurality of optical fibers, buffered fibers, ribbon fibers, binders, and/or combinations thereof. The core **900** is passed through an extrusion apparatus having an extruder head, where a first, inner jacket layer **920** is extruded around core **900**, enclosing the core **900** as shown in **FIG. 16A**. The first jacket layer **900** can be formed from a first polymeric material such as a polyethylene. The first jacket layer **900** may be from about 0.1 mm to about 0.6 mm thick, and in exemplary embodiments in the range of 0.3-0.4 mm. The first jacket layer **920** has an exterior surface **922** and an interior surface **924**, the interior surface **924** being adjacent to and in some cases contacting the core **900**.

[0041] Referring to **FIG. 16B**, the core **900** and the first, inner jacket layer **920** are advanced to a second extrusion apparatus having a second extruder head, where a second jacket layer **930** is extruded over the first jacket layer **920**. The second jacket layer **930** can abut and, if desired, at least partially bond with the first, inner jacket layer **920**.

[0042] In exemplary embodiments, the second, outer jacket layer **930** may also be formed from the same material as the first, inner jacket layer **920**. The second jacket layer **930** may be from about 0.5 mm to about 1.0 mm thick, and in exemplary embodiments may be about 0.7 mm thick. The second jacket layer **930** can be formed using an apparatus similar to that shown in **FIGS. 4-6**, where one or more troughs are formed by a projection extending into the first extruded material flow path and a second extruded material is introduced into the trough to form a discontinuity **950** in second jacket layer **930**. The discontinuities **950** may extend radially up to 100% of the thickness of the second layer **930**. The first layer **920**, the second layer **930** and the discontinuities **950** draw down and cool around core **900**.

[0043] Referring to **FIG. 16C**, if the first jacket layer **920** and the second jacket layer **930** are made from substantially the same extrudate material, the two layers **920, 930** blend and form a bond that effectively eliminates, for example, any weld line, stitch line, inconsistency, or incongruence that may cause a likely high stress area between the respective layers **920, 930**. In other words, the first layer **920** and the second layer **930** form a uniform homogeneous layer of first extruded material, with one or more discontinuities formed **950** therein. The two layers **920, 930** and the discontinuities **950** thus form a unitary composite structure. **FIG. 16C** illustrates a cable embodiment **980** formed according to this method. A gap **956** of the first extrudate material, which corresponds to that portion of the first jacket layer **920**, can remain between each discontinuity **950** and the core **900**.

[0044] In general, the separation properties disclosed in this specification may be obtained by coextruding the discontinuities from a different material than the material used to form the main portion of the jacket. As an alternative method, the discontinuities may be made from the same material as the remainder of the jacket, but subjected to different curing conditions, for example.

What is claimed is:

1. A cable, comprising:

a core including a plurality of optical fibers; and

a jacket surrounding the core, the jacket comprising:

a main portion of a polymeric first extruded material; and

at least a first and a second discontinuity of a second extruded material disposed in the main portion, each discontinuity having a bond with the main portion, a section of the main portion located between the first and second discontinuities being separable from a remainder of the jacket by a peel force exerted on the section, wherein

the peel force is less than 80 Newtons (N).

2. The cable of claim 1, wherein the peel force is less than 50N.

3. The cable of claim 1, wherein the peel force is between 20N and 40N.

4. The cable of claim 1, the first and second discontinuities extending substantially along the entire length of the cable.

5. The cable of claims 1-4, the second extruded material being polymeric.

6. The cable of claims 1-5, wherein the first extruded material includes a first polymer and the second extruded material includes second polymer, the second extruded material further including between 1% to 20% by weight of the first polymer.

7. The cable of claims 1-6, the jacket having an interior surface and an exterior surface with a jacket thickness therebetween from 0.5 mm to 2.0 mm.

8. The cable of claims 1-7, wherein the jacket has an annular cross-section.

9. The cable of claims 1-8, the discontinuities being angularly spaced along the profile of the exterior surface from 1 degree to 180 degrees apart.

10. The cable of claims 1-9, the discontinuities being angularly spaced along the profile of the exterior surface from 5 degrees to 60 degrees apart.

11. The cable of claims 1-10, wherein a cross-sectional area of each discontinuity is less than 5% of a cross-sectional area of the jacket.

12. The cable of claims 1-11, wherein the first and second discontinuities are wholly embedded in the main portion.

13. A method of making a cable, comprising:

advancing a core in a first direction, the core being capable of conveying communication signals; and

extruding a jacket around the core, the extruding comprising:

introducing a first polymeric extrudate material into the extrusion apparatus;

introducing a first flow of a second polymeric extrudate material into the first polymeric extrudate material to form a first discontinuity in the first extrudate material;

introducing a second flow of the second polymeric extrudate material into the first polymeric extrudate material to form a second discontinuity in the first extrudate material; and

allowing the first and second extrudate materials to draw down and cool around the core, the first and second materials forming a jacket around the core, wherein

a section of the jacket located between the first and second discontinuities is separable from a remainder of the jacket by a peel force on the section of less than 80 Newtons (N).

14. The method of claim 13, wherein the first extrudate material includes a first polymer and the second extrudate material includes second polymer, the second extrudate material further including between 1% to 20% by weight of the first polymer.

15. The method of claims 13-14, the jacket having an annular cross-section with an interior surface and an exterior surface with a jacket thickness therebetween from 0.5 mm to 2.0 mm.

16. The method of claims 13-15, wherein the first and second flows have an angular spacing of between 5 and 60 degrees.

17. The method of claims 13-16, wherein a cross-sectional area of each discontinuity is less than 5% of a cross-sectional area of the jacket.

18. The method of claims 13-17, wherein the first and second discontinuities are wholly embedded in the main portion.

19. The method of claims 13-18, further comprising extruding an inner jacket layer over the core before extruding the jacket.

20. A method of making a cable, comprising:

advancing a core in a first direction;

extruding a first, inner jacket layer around the core;

extruding a second jacket layer around the inner jacket layer, the extruding comprising:

introducing a first extrudate material flow;

introducing at least one second extrudate material flow into the first extrudate material flow to form at least one discontinuity of the second extrudate material in a main portion of the second jacket layer formed from the first extrudate material flow; and

allowing the first jacket layer and the second jacket layer to draw down and cool around the core so that the first and second jacket layers at least partially bond together and form a cable jacket.

21. The method of claim 20, wherein the first, inner jacket layer is extruded from the same material as the first extrudate material flow.

22. The method of claim 20, wherein the main portion of the second jacket layer and the first jacket layer draw down and cool to form a uniform homogeneous layer of the first material.

23. The method of claims 20-22, wherein the first extrudate material includes a first polymer and the second extrudate material includes second polymer, the second extrudate material further including between 1% to 20% by weight of the first polymer.

24. The method of claims 20-23, the jacket having an annular cross-section with an interior surface and an exterior surface with a jacket thickness therebetween from 0.5 mm to 2.0 mm.

25. The method of claims 20-24, wherein introducing at least one second extrudate material flow comprises introducing a first and a second material flow of the second extrudate material, the first and second flows having an angular spacing of between 5 and 60 degrees.

26. The method of claims 20-25, wherein a cross-sectional area of each discontinuity is less than 5% of a cross-sectional area of the jacket.

27. The method of claims 20-26, wherein the first and second discontinuities are wholly embedded in first extrudate material.

28. The method of claims 20-27, wherein the first jacket layer is applied at a thickness in the range of 0.1-0.6 mm.

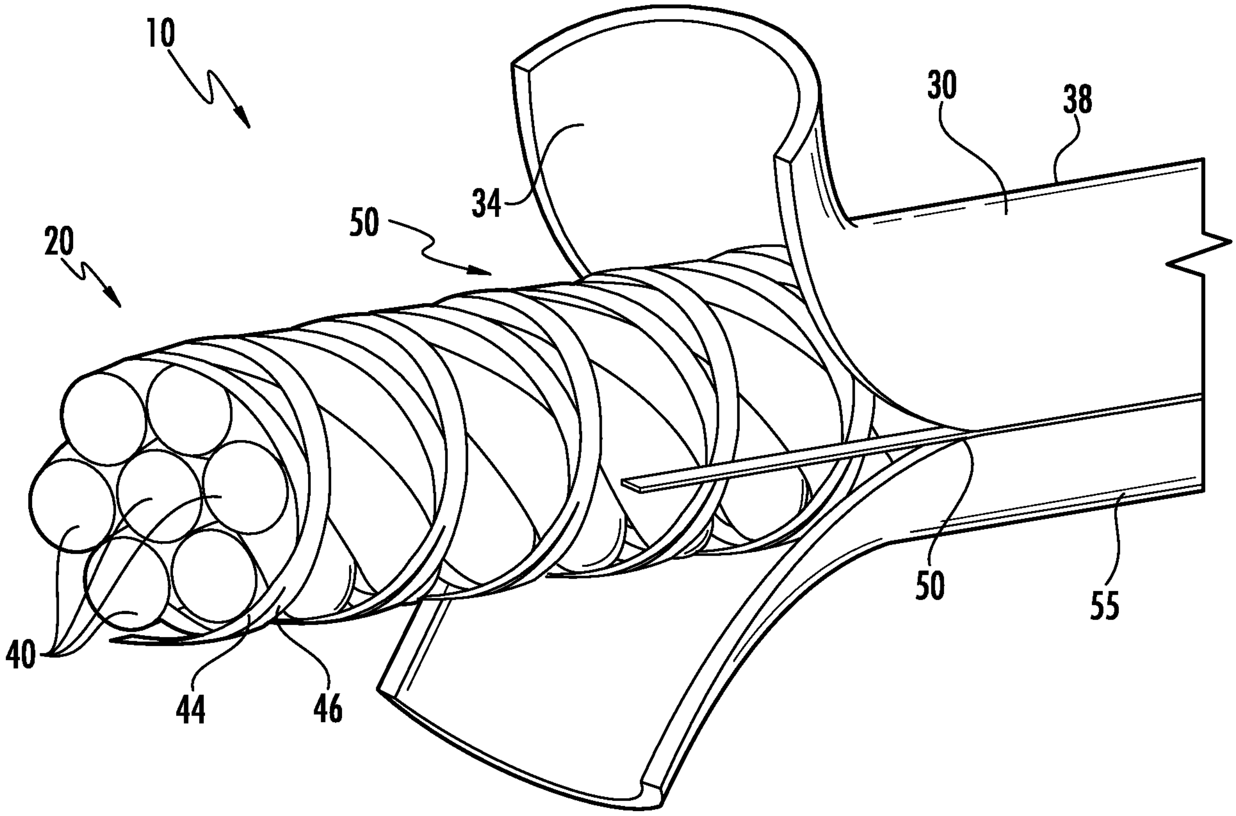

FIG. 1

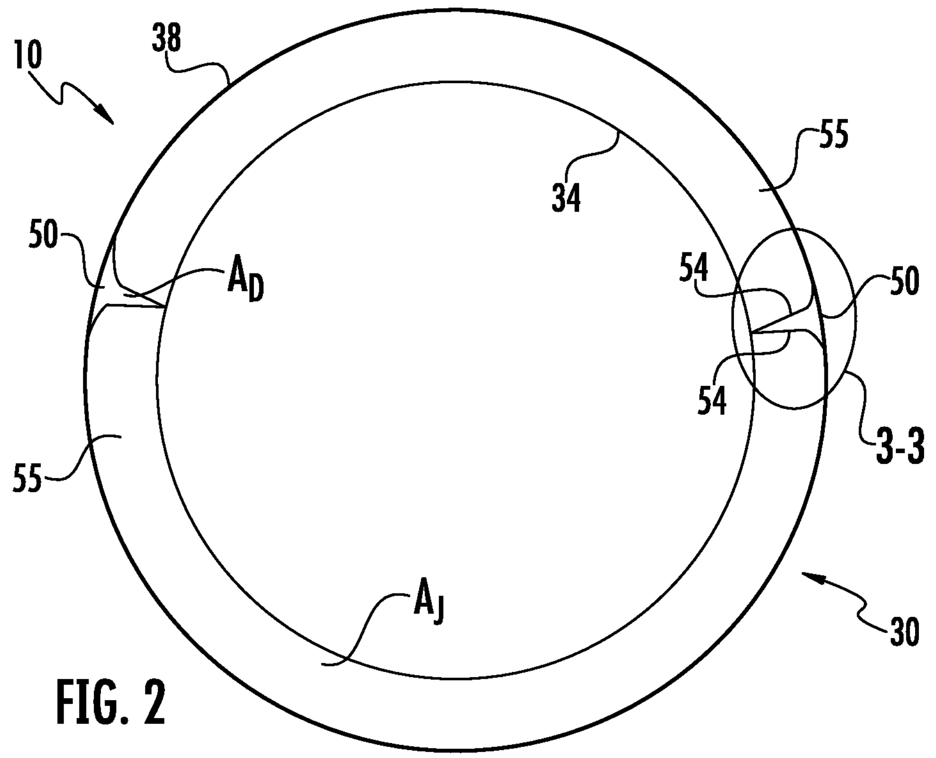

FIG. 2

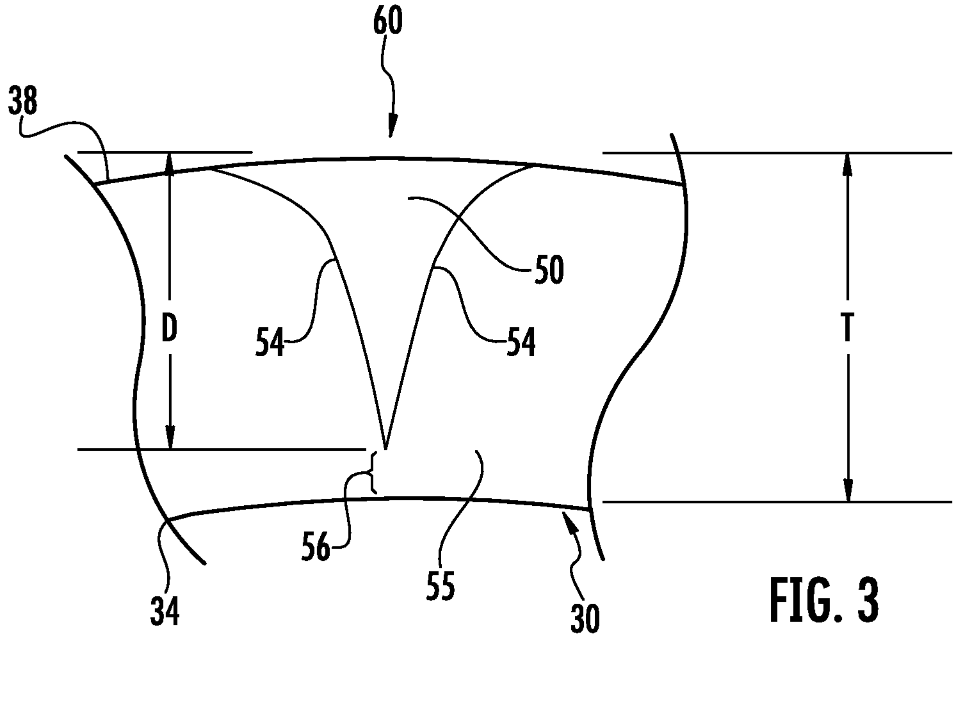

FIG. 3

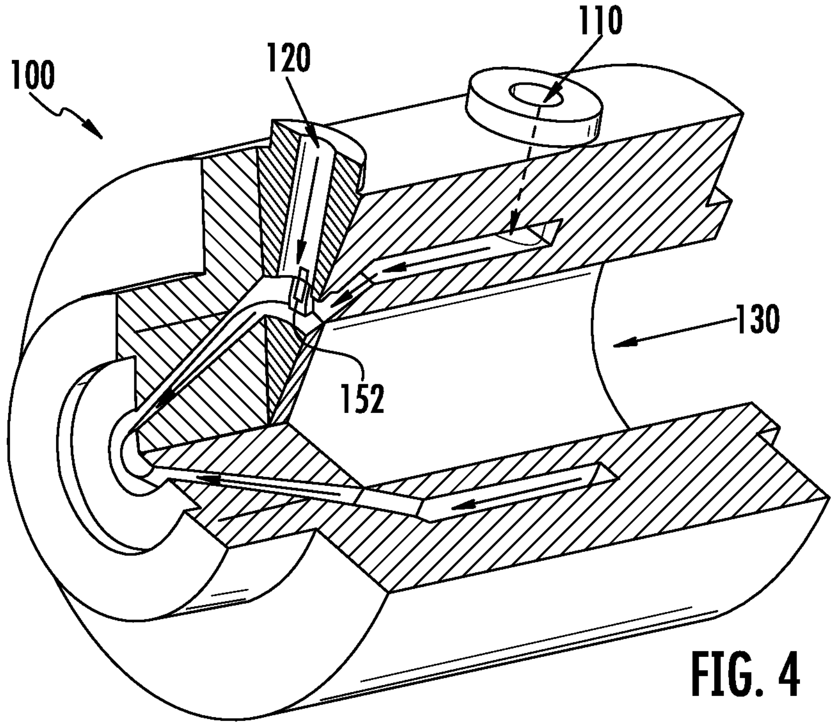

FIG. 4

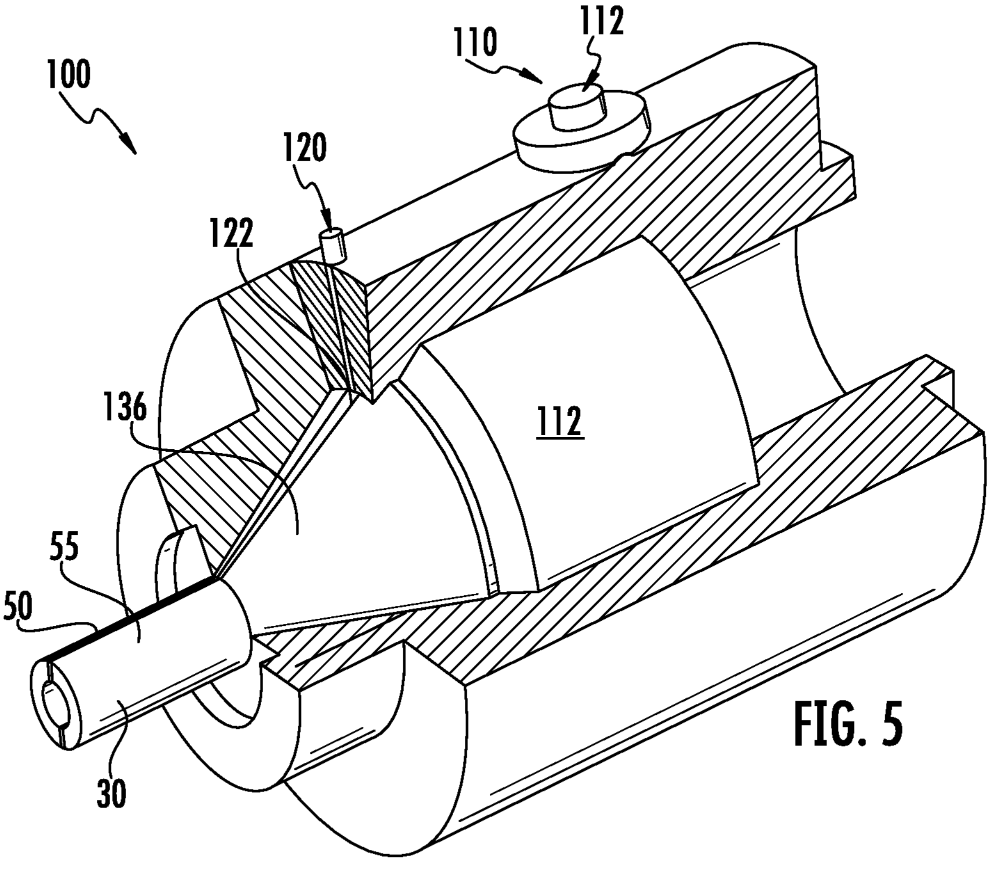

FIG. 5

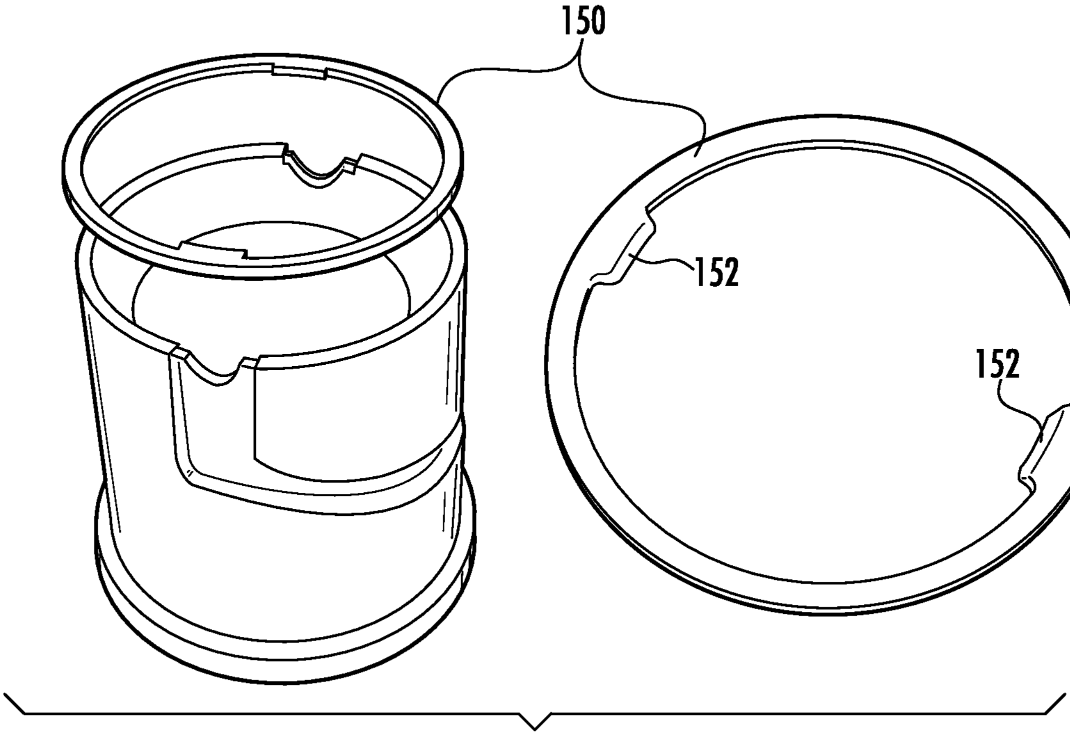

FIG. 6

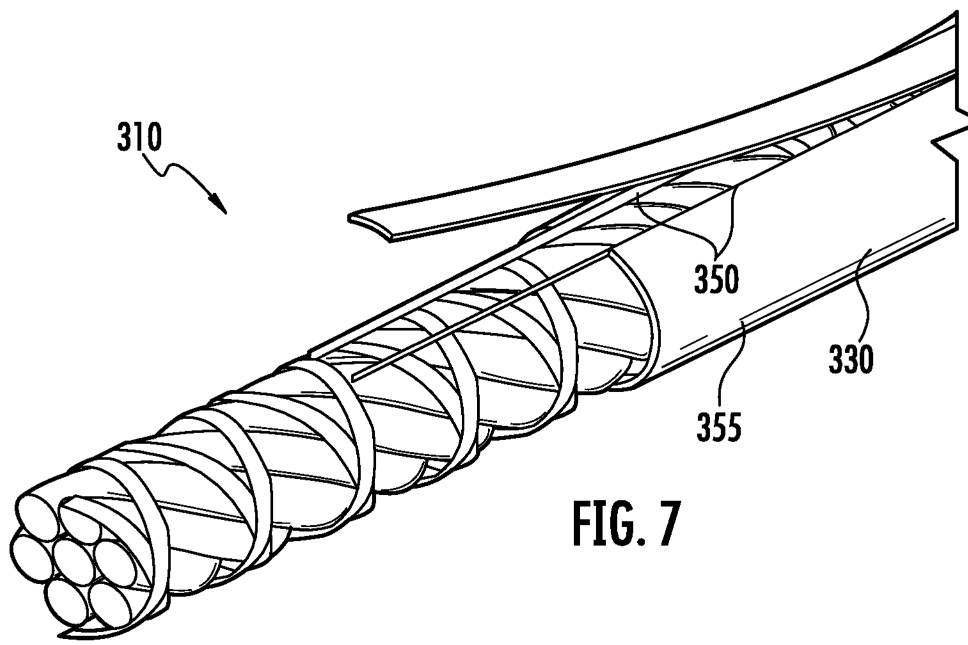

FIG. 7

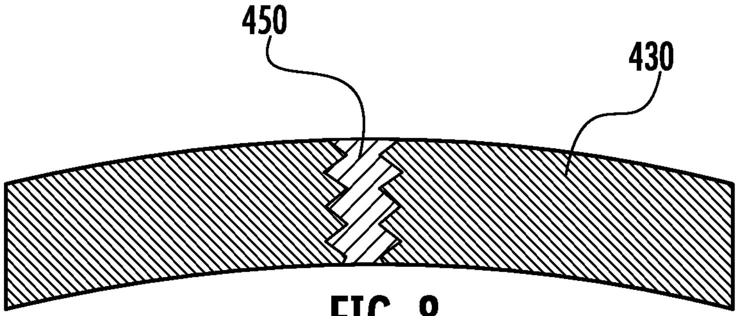

FIG. 8

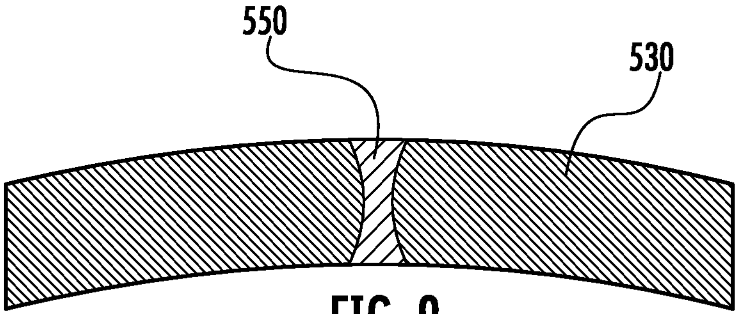

FIG. 9

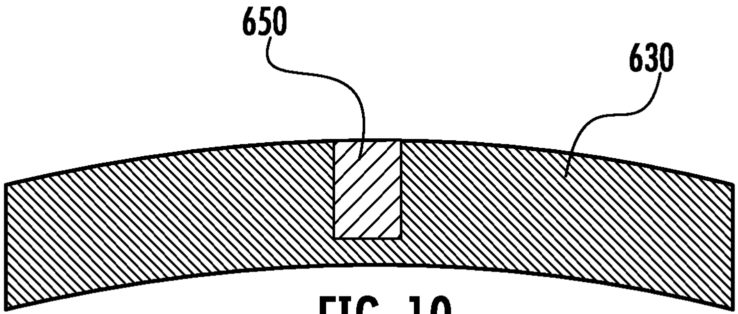

FIG. 10

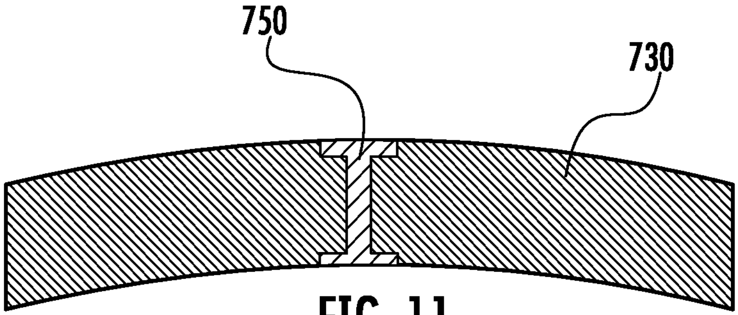

FIG. 11

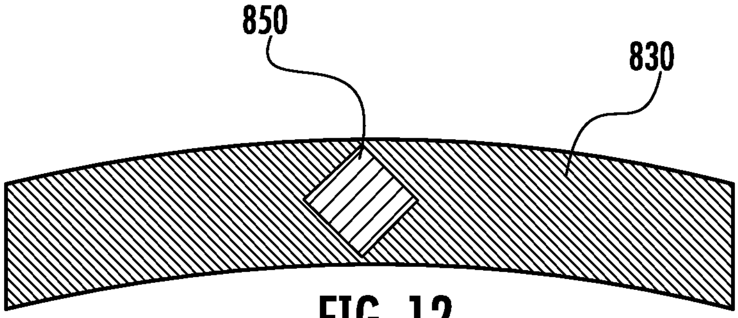

FIG. 12

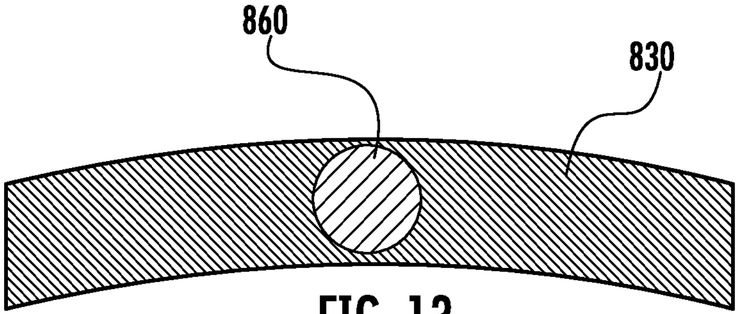

FIG. 13

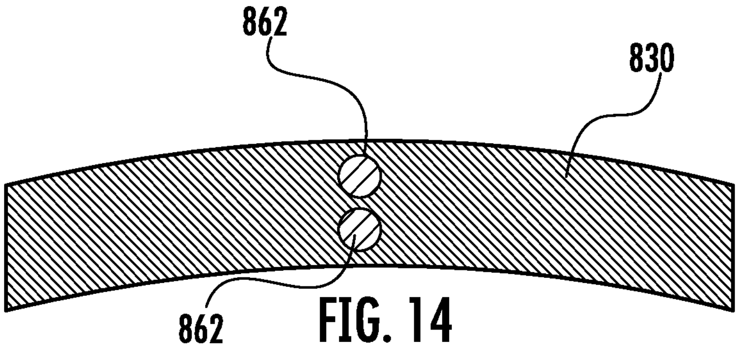

FIG. 14

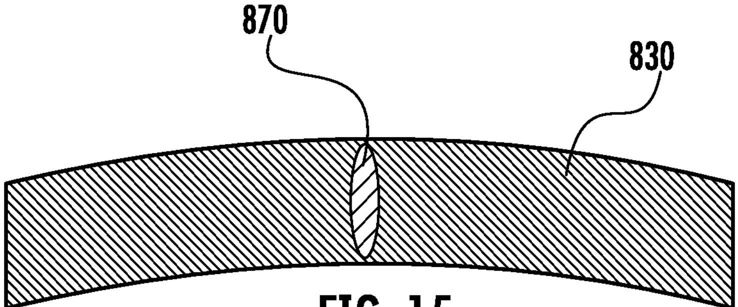

FIG. 15

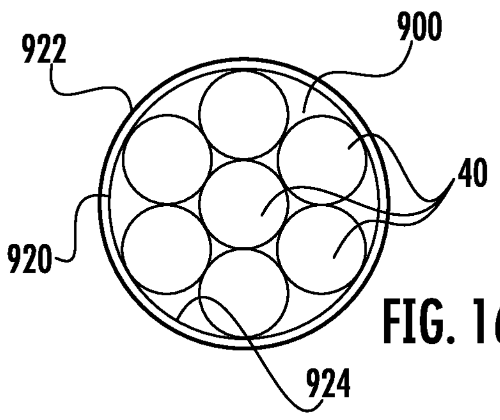

FIG. 16A

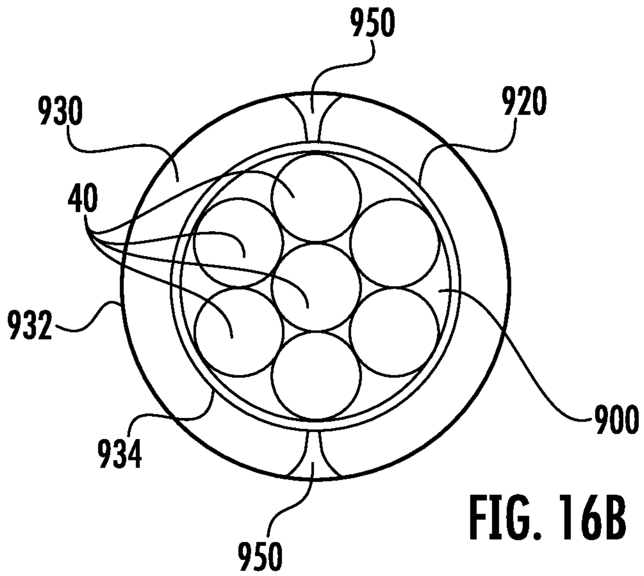

FIG. 16B

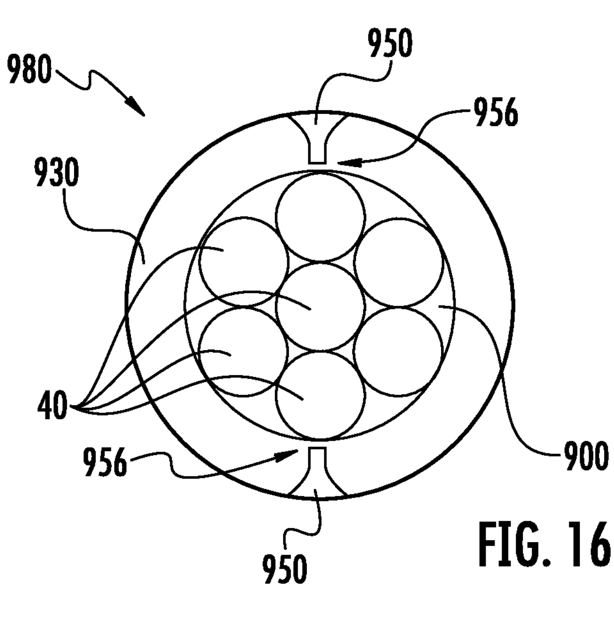

FIG. 16C