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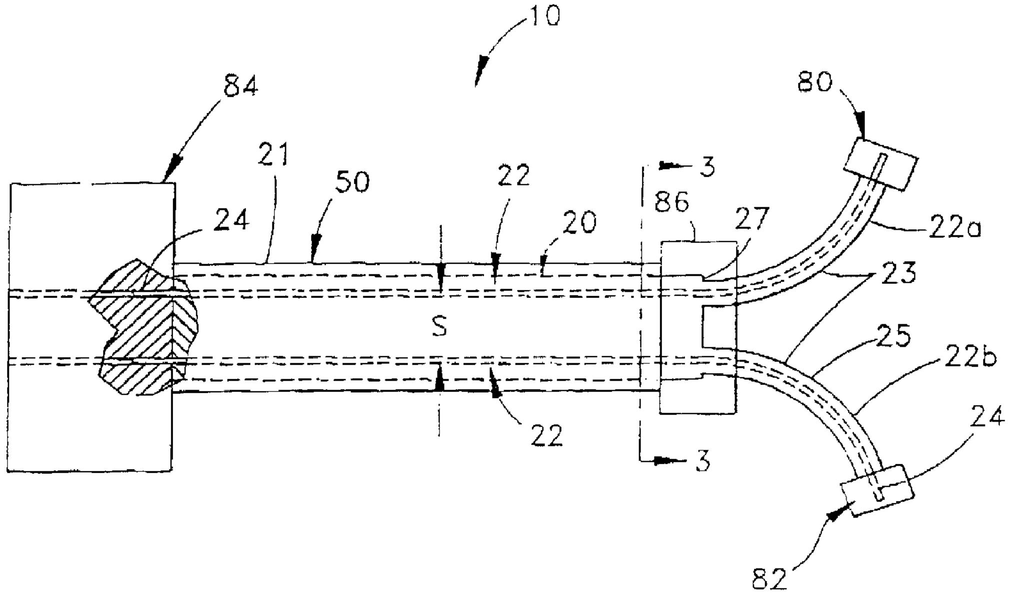
(54) **CABLE RUBAN D'INTERCONNEXION DE FIBRES OPTIQUES**

(54) **FIBER OPTIC RIBBON INTERCONNECT CABLE**



(57) Câble optique (50) pour utilisation dans un assemblage de câble à fibres optiques (10). L'assemblage de câble à fibres optiques (10) comprend des connecteurs classiques à fibre unique (80, 82), un connecteur à deux fibres (84) et un logement de connecteur de sortie (86). Le connecteur à deux fibres (84) est du type utilisé pour interface avec, notamment, un transducteur opto-électrique et électro-optique. Le câble à fibres optiques (50) comprend un ruban (20). Le ruban (20) comprend des fibres optiques (24), une section à espacement variable (23) et une section de transition (27) à l'intérieur du logement de connecteur

(57) An optical cable (50) for use in a fiber optic cable assembly (10). Fiber optic cable assembly (10) comprises conventional single fiber connectors (80, 82), a dual fiber connector (84), and a connector fan-out housing (86). Dual fiber connector (84) is of the type used to interface with, for example, an opto-electrical and electro-optical transducer. Fiber optic cable (50) comprises a ribbon (20). Ribbon (20) includes optical fibers (24), a variable spacing section (23), and a transition section (27) inside connector housing (86). Optical fibers (24) are spaced at a nominal fiber-to-fiber distance, defined as spacing S, in cable section (21).

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(86). Les fibres optiques (24) sont espacées à une distance nominale de fibre à fibre, définie comme l'espacement S, dans la section du câble (21). La section à espacement variable (23) comprend des sections porteuses intermédiaires (22a, 22b) constituées de tubes en plastique, p. ex. des tubes d'embranchement, dont l'espacement est variable. L'espacement S correspond à l'espacement nécessaire dans un système électrique pour éviter la diaphonie.

Variable spacing section (23) comprises sub-carrier sections (22a, 22b) comprising plastic tubes, e.g. furcation tubing, the spacing of which is variable. Spacing S matches the spacing needed in an electrical system to avoid crosstalk.

Abstract of the Disclosure

An optical cable (50) for use in a fiber optic cable assembly (10). Fiber optic cable assembly (10) comprises conventional single fiber connectors (80,82), a dual fiber connector (84), and a connector fan-out housing (86). Dual fiber connector (84) is of the type used to interface with, for example, an opto-electrical and electro-optical transducer. Fiber optic cable (50) comprises a ribbon (20). Ribbon (20) includes optical fibers (24), a variable spacing section (23), and a transition section (27) inside connector housing (86). Optical fibers (24) are spaced at a nominal fiber-to-fiber distance, defined as spacing S, in cable section (21). Variable spacing section (23) comprises sub-carrier sections (22a,22b) comprising plastic tubes, e.g. furcation tubing, the spacing of which is variable. Spacing S matches the spacing needed in an electrical system to avoid crosstalk.

Fiber Optic Ribbon Interconnect Cable

The present invention relates to a fiber optic cable for use in a cable assembly comprising fiber optic connectors connectorized to a ribbon in the cable.

Background of the Invention

Electrical and fiber optic components are used to transmit data signals in telecommunication, computer, and closed circuit television systems. Conventional components, for example, opto-electrical and electro-optical transducers, are used in such systems to interface between electrical and fiber optic modes of signal transmission. Electrical systems, however, may experience crosstalk between the signal wires thereof. This type of electrical crosstalk occurs due to electromagnetic fields surrounding the transmitting wires. The electromagnetic fields due to one given circuit induce currents and electromotive forces in other circuits spaced close enough to the disturbing electrical circuit to be affected. For example, electrical crosstalk affecting a telephone line may result in the undesired mixing of caller conversations over the affected line. Spacing the electrical wires of different circuits apart tends to reduce electrical crosstalk. On the other hand, because optical-based systems use confined light as the information carrying medium rather than electricity, optical-based systems are not as susceptible to crosstalk and therefore do not require a significant crosstalk type spacing between the optical fibers.

Opto-electrical and electro-optical transducers generally require electrical wires to be spaced apart sufficiently enough to avoid crosstalk. For convenience, respective ends of optical fibers in single fiber cables are connected to such transducers by placing them in housings comprising spaced fiber receiving apertures. Another method is to use a two-fiber optical ribbon with a 250μm spacing between the fibers whereby the fibers are separated, stripped, and individually connectorized. Both of the foregoing conventional methods are relatively expensive in respect of installation and material costs because two fibers must be individually connectorized.

Objects of the Invention

In view of the foregoing, it is an object of the present invention to provide a fiber optic ribbon having optical fibers therein, the fibers being spaced apart at a fiber-to-fiber spacing which matches the spacing needed in an electrical system to avoid crosstalk.

It is another object of the present invention to provide a fiber optic cable including a fiber optic ribbon having a fiber-to-fiber spacing which matches the spacing needed in an electrical system to avoid crosstalk.

Brief Description of the Drawings

Figure 1 shows a fiber optic cable assembly including a fiber optic cable according to the present invention.

Figure 2 shows a cross section of a fiber optic ribbon of the fiber optic cable of Figure 1.

Figure 3 shows a cross section of the fiber optic cable of Figure 1 taken across line 3-3.

Figure 4 shows a cross section of a fiber optic cable according to a second embodiment of the present invention.

Figure 5 shows a cross section of a fiber optic cable according to a third embodiment of the present invention.

Figure 6 shows a cross section of a fiber optic ribbon according to a fourth embodiment of the present invention.

Figure 7 shows a cross section of a fiber optic ribbon according to a fifth embodiment of the present invention.

Detailed Description of the Invention

Referring to Figures 1-3, an optical cable 50 according to the present invention, for use in a fiber optic cable assembly 10, will be described. Fiber optic cable assembly 10 comprises conventional single fiber connectors 80 and 82, a conventional dual fiber connector 84, and a fan-out housing 86. Single fiber connectors 80 and 82 may be of the FC Ultra PC type made by the SIECOR™ Corporation of Hickory, North Carolina. Dual fiber connector 84 is of the type used to interface with, for example, an opto-electrical or electro-optical transducer (not shown). Dual fiber connector 84 is a conventional connector, for example, as disclosed in US-A-5214730, which is hereby incorporated by reference herein in its entirety. Fiber optic cable 50 comprises a fiber optic ribbon 20. Ribbon 20 includes optical fibers 24, a variable spacing section 23, and a transition section 27 inside connector housing 86. Optical fibers 24 are spaced at a nominal fiber-to-fiber distance, herein defined as spacing S. Variable spacing section 23 comprises sub-carrier sections 22a and 22b comprising plastic tubes, e.g. furcation tubing, the spacing of which is variable.

Each carrier section 22 includes an optical fiber 24 with a core and a cladding layer 26 therearound. Cladding layer 26 is surrounded by a protective coating 25. Protective coating 25 is surrounded by an identification ink layer 27. A separation layer 28 is strategically disposed between ink layer 25 and a peelable ribbon matrix layer 29. Separation layer 28 comprises a suitable material, for example, a TBII™ or silicone based material. Matrix layer 29 comprises, for example, a UV curable acrylate material or any suitable thermoplastic material, e.g. a PVC material.

Matrix layer 29 constrains fibers 24 to spacing S. The nominal fiber-to-fiber distance defined by spacing S advantageously comprises an integer multiple of the nominal outside diameter (OD) of the fiber, for example, spacing S would nominally be 500μm, 750μm, 1000μm, or etc. The 750μm spacing would permit ribbon 20 to be connectorized to a conventional four fiber connector (not shown).

Separation layer 28 allows a craftsman to remove matrix layer 29 from separation layer 28, whereby sub-carrier sections 22a and 22b are no longer constrained by ribbon matrix layer 29 (Figure 1). After the peeling operation, ribbon 20 will yet comprise a generally nominal fiber-to-fiber spacing S, which spacing matches the spacing needed in an electrical system to avoid crosstalk. The present invention advantageously permits two fibers 24 to be connectorized in one step. The use of ribbon 20 with a dual fiber connector 84, therefore, reduces installation time and material costs. Sub-carrier sections 22a and 22b, no longer constrained by matrix layer 29, may be variably spaced and individually connectorized to respective connectors 80 and 82.

Ribbon 20 is preferably part of an inside or outside plant optical cable 50 (Figure 3). Optical cable 50 comprises strength member 52 located about ribbon 20. A jacket 54 surrounds strength members 52. In application, jacket 54 and strength members 52 would be stripped away from variable spacing section 23 so that sub-carrier sections 22a and 22b would extend out of fan-out housing 86 for termination with respective connectors 80,82.

In a second embodiment of the present invention, a ribbon 30 comprises carrier sections 32 with a separation layer 38 disposed between a ribbon matrix layer 39 and an ink layer 35 (Figure 4). Spacer fibers 36 are strategically placed between carrier sections 32 thereby defining the desired spacing S between carrier sections 32, as in the first embodiment of the present invention. Ribbon 30 may comprise part of an inside or outside plant optical cable 60. Optical cable 60 comprises strength members 62 located about ribbon 30. A jacket 64 surrounds strength members 62.

Figure 5 shows a third embodiment of the present invention, wherein a fiber optic cable 70 includes carrier sections 42 each having a separation layer 48 between a ribbon matrix layer 49 and an ink layer 45. A protective layer 46 surrounds a glass core and cladding 44. A UV acrylate material 47 is over-coated to a desired diameter thereby spacing fibers 44 at the desired spacing S, as in the first embodiment of the present invention. Ribbon 40 may comprise part of an inside or outside plant optical cable 70. Optical cable 70 comprises strength members 72 which surround ribbon 40. A jacket 74 surrounds strength members 72.

Figure 6 shows a fourth embodiment of the present invention wherein a ribbon 90 comprises carrier sections 92 each having a separation layer 98 disposed between a ribbon matrix layer 99 and an ink layer 97. Cladding 96 surrounds a core 94, and cladding 96 is surrounded by a protective layer 95. Ribbon 90 includes a radius of curvature R, which advantageously lessens the cross sectional area of ribbon matrix 99 between carrier sections 92. The amount of matrix layer material per unit length of cable is also reduced, consequently, the unit cost to produce ribbon 90 may be less as compared to the unit cost of ribbon 20. As in the foregoing embodiments, ribbon 90 may comprise part of an inside or outside plant optical cable.

Figure 7 shows a ribbon 200 with carrier sections 222. Each carrier section 222 includes an optical fiber core 224 having a fiber cladding layer 226 therearound. Cladding layer 226 is surrounded by a protective coating 225. Protective coating 225 is surrounded by an identification ink layer 227. A separation layer 228 is strategically disposed between ink layer 225 and a peelable ribbon matrix layer 229. Separation layer 228 comprises a suitable material, for example, a TBII™ or a silicone based material. Matrix layer 229 comprises, for example, a suitable thermoplastic material, e.g. a PVC material. Matrix layer 229 constrains fibers 224 to a spacing S, as in the first embodiment of the present invention. The nominal fiber-to-fiber distance of spacing S is an integer multiple of the nominal outside diameter (OD) of the fiber. A 750μm spacing advantageously permits ribbon 200 to be connectorized to a conventional four fiber connector (not shown). As in the foregoing embodiments, ribbon 200 may be surrounded by a jacket and strength members. To reduce material costs, a thickness t, medially located between carrier sections 222, is about 15% to 75% of a thickness T of carrier sections 222.

The present invention has thus been described with reference to the foregoing embodiments, which embodiments are intended to be illustrative rather than limiting. Persons of skill in the art will appreciate that variations and modifications of the embodiments may be made without departing from the scope of the appended claims. For example, the fiber optic cables of the present invention are adaptable for use with boots attached to connectors or fan-out housings.

Accordingly, what is claimed:

1. A fiber optic cable comprising:

a ribbon having optical fibers therein, said ribbon comprises a removable matrix layer; and

said optical fibers are generally constrained by said matrix layer, the fibers being spaced apart by said matrix layer at a fiber-to-fiber spacing which matches the spacing needed in an electrical system to avoid crosstalk.

2. The fiber optic cable of claim 1, wherein said fiber-to-fiber spacing comprises an integer multiple of an OD of one of said optical fibers.

3. The fiber optic cable of claim 2, wherein said ribbon comprises spacer fibers for defining said fiber-to-fiber spacing.

4. The fiber optic cable of claim 2, wherein said ribbon comprises an over-coated material for defining said fiber-to-fiber spacing.

5. The fiber optic cable of claim 1, wherein said matrix layer constraint being removed from said ribbon allows a variable fiber-to-fiber spacing of said optical fibers.

6. The fiber optic cable of claim 1, wherein said ribbon includes a radius of curvature which lessens the cross sectional area of said matrix layer between said optical fibers.

7. The fiber optic cable of claim 1, wherein said ribbon comprises carrier sections having respective carrier section thicknesses, and a medial portion of said ribbon located between said carrier sections has a thickness of about 15% to 75% of said carrier section thicknesses.

8. A fiber optic cable comprising:

(a) a fiber optic ribbon;

(b) a variable spacing section;

(c) said nominal and variable spacing sections each include optical fibers therethrough;

(d) said ribbon comprises a matrix layer, a separation layer, and an identification layer, said separation layer is disposed between said matrix and identification layers for permitting removal of said matrix layer;

(e) said ribbon comprises optical fibers, said fibers are generally constrained by said matrix layer to a nominal fiber-to-fiber spacing which matches the spacing needed in an electrical system to avoid crosstalk in the electrical system with which said fiber optic cable interfaces; and

(f) whereby, said matrix layer constraint being removed from said variable spacing section at said separation layer, allows fiber-to-fiber spacing between said variable spacing section fibers to be variable.

9. The fiber optic cable of claim 8, wherein said matrix layer comprises a peelable ribbon matrix layer.

10. The fiber optic cable of claim 8, wherein said optical fibers are generally spaced at a fiber-to-fiber spacing comprising an integer multiple of an OD of an optical fiber.

11. The fiber optic cable of claim 10, wherein said ribbon comprises spacer fibers for defining said fiber-to-fiber spacing.

12. The fiber optic cable of claim 10, wherein said ribbon comprises an over-coated material for defining said fiber-to-fiber spacing.

13. The fiber optic cable of claim 8, wherein said spacing is about 750μm.

14. The fiber optic cable of claim 8, wherein ribbon comprises a transition section.

15. The fiber optic cable of claim 8, wherein said ribbon includes a radius of curvature which lessens the cross section area of said matrix layer between said optical fibers.

16. The fiber optic cable of claim 8, wherein said ribbon comprises carrier sections with respective said optical fibers therethrough, said carrier sections having respective carrier section thicknesses, a medial portion of said ribbon, located between said carrier sections, has a thickness of about 15% to 75% of said carrier section thicknesses.

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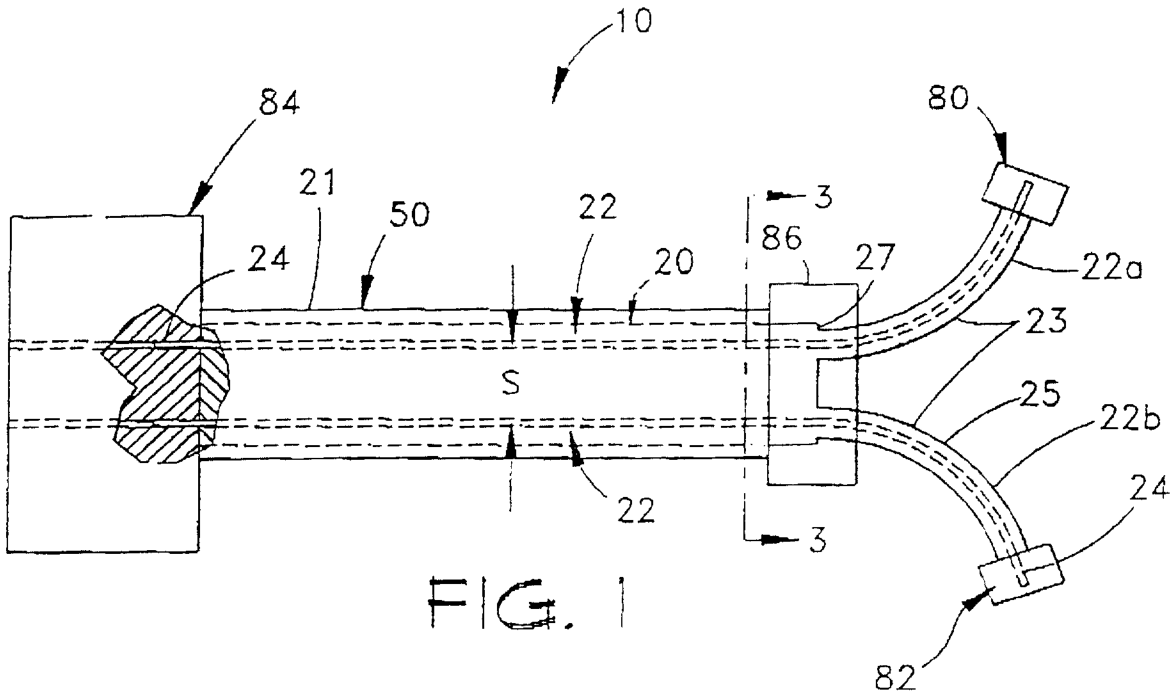

FIG. 1

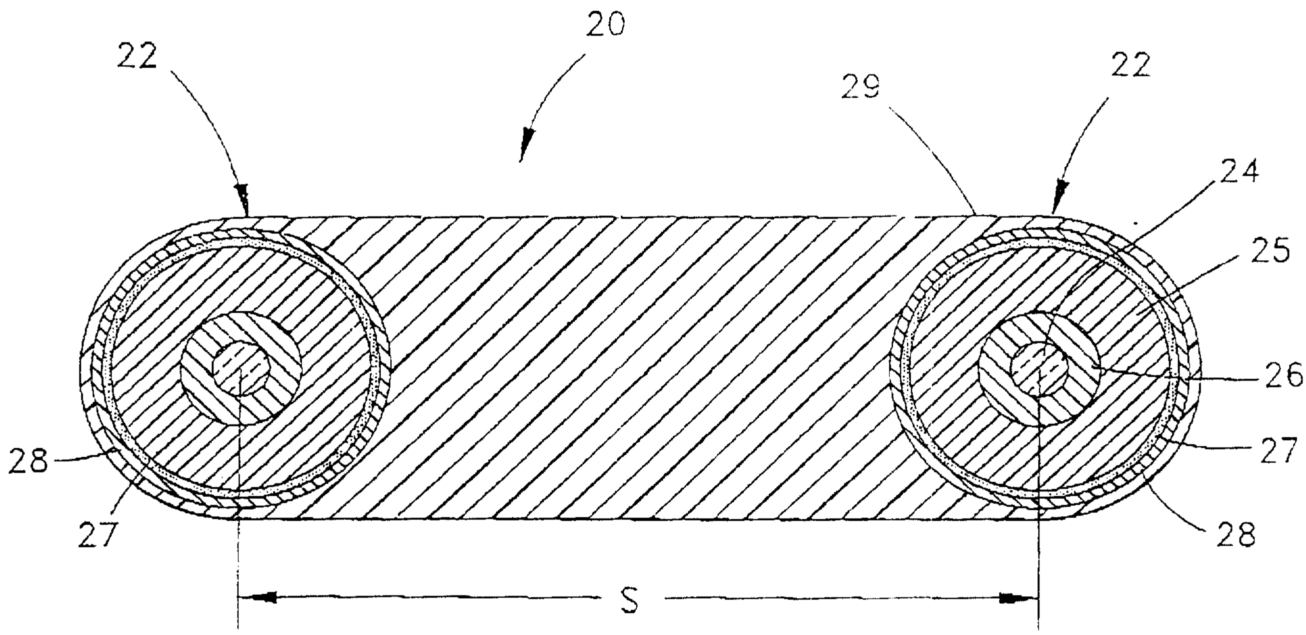

FIG. 2

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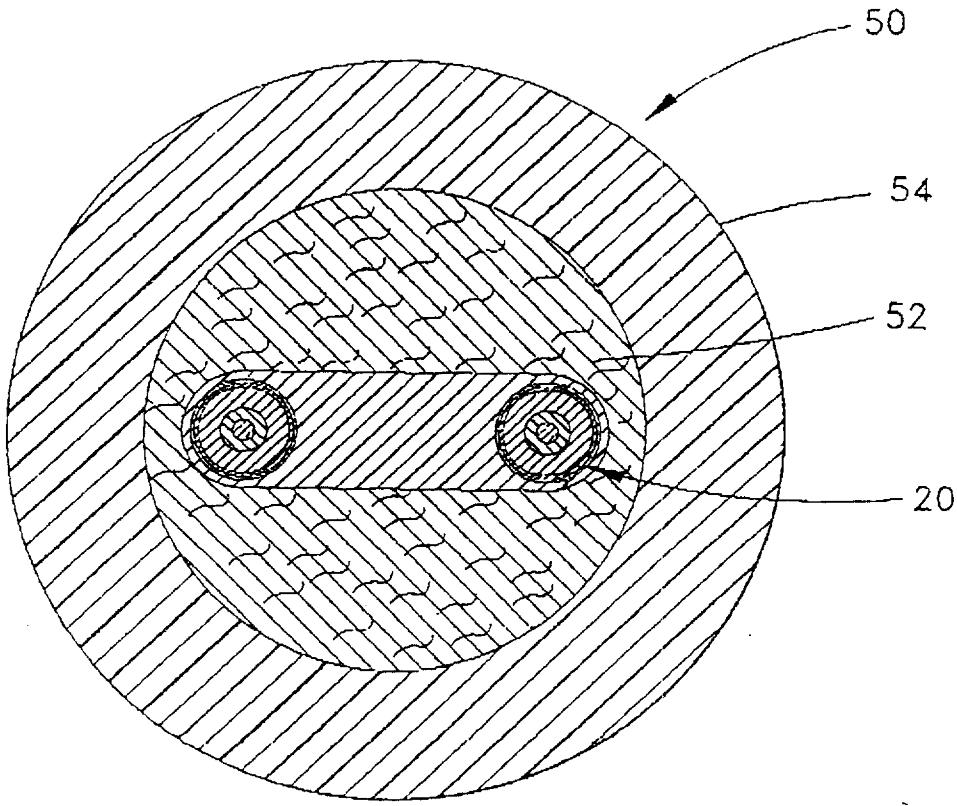

FIG. 3

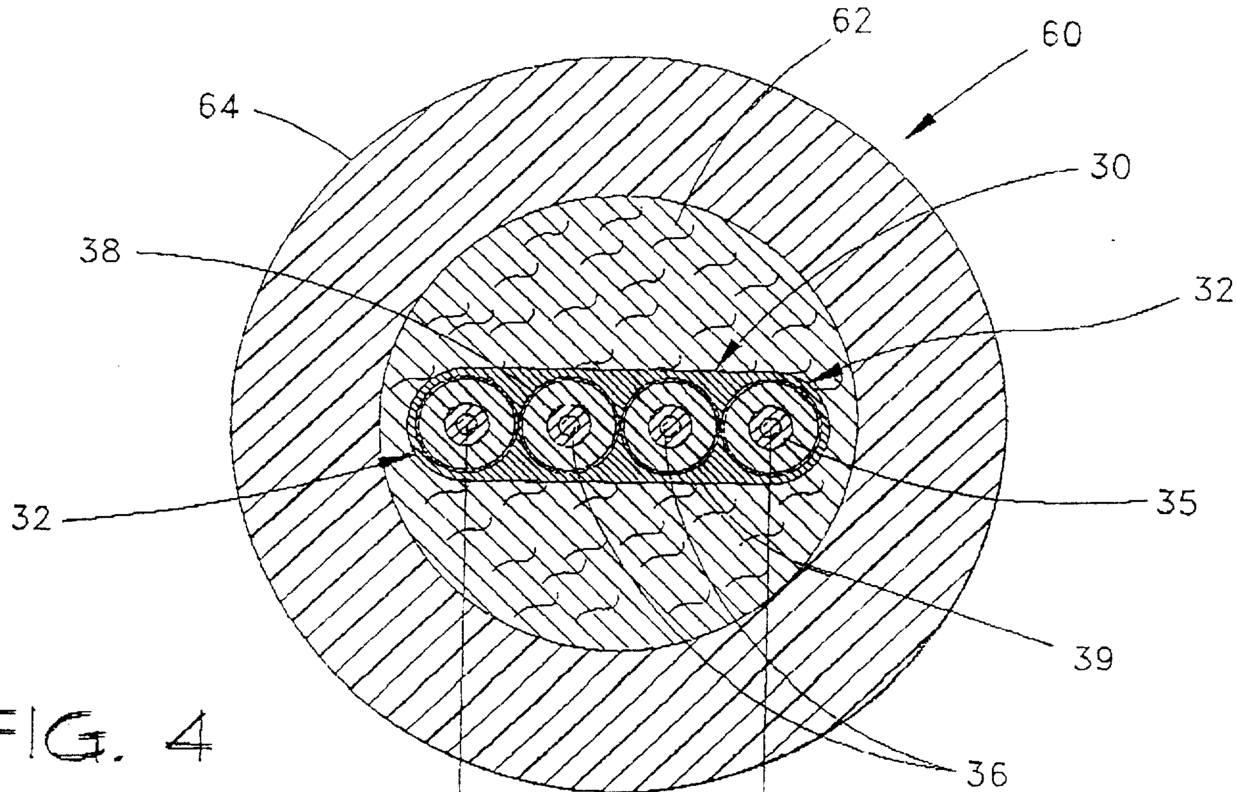

FIG. 4

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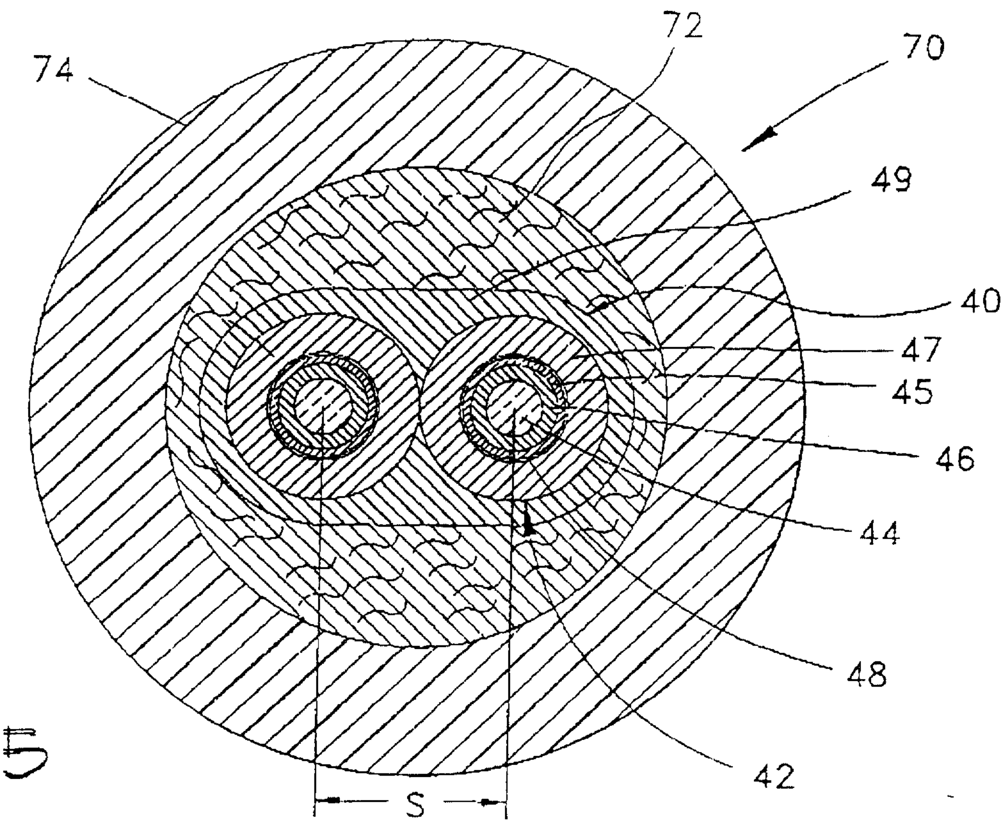

FIG. 5

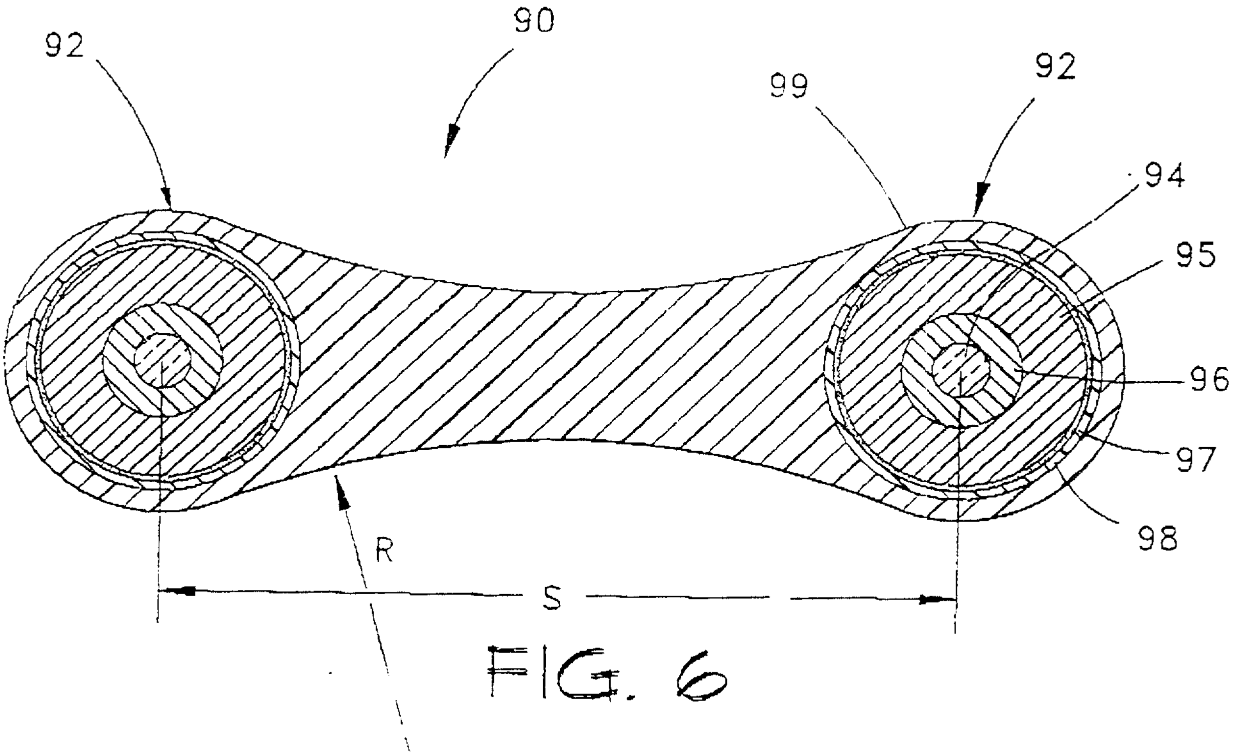

FIG. 6

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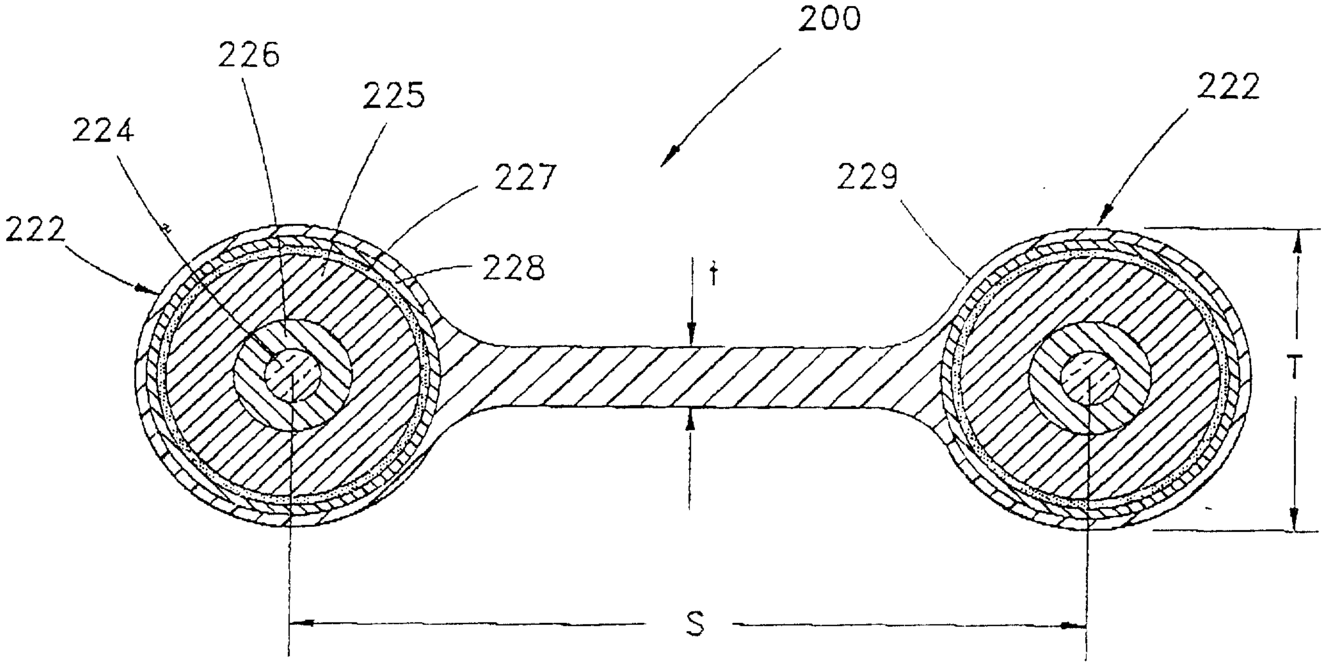

Fig. 7

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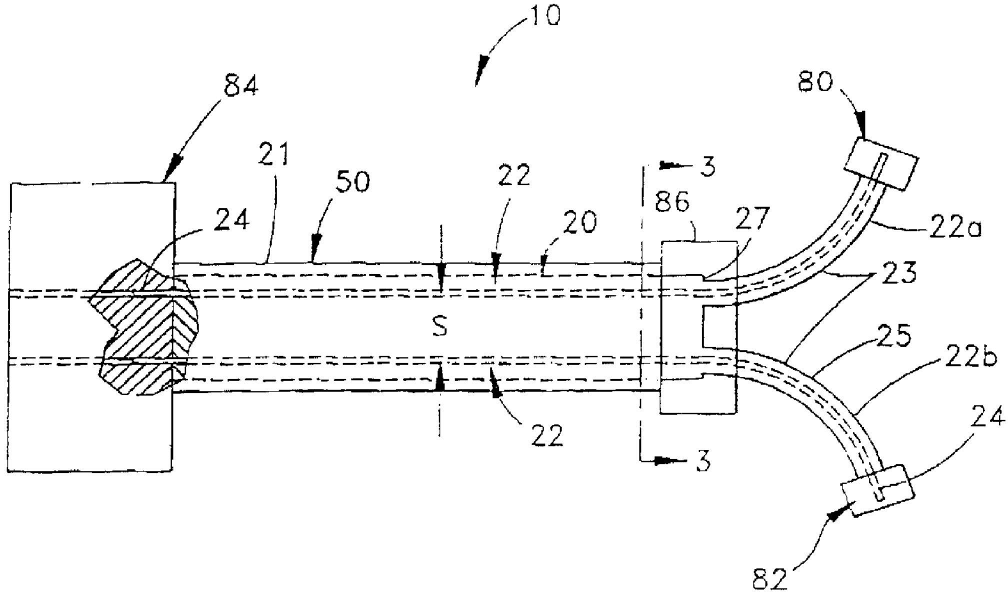
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