OPIC
OFFICE DE LA PROPRIÉTÉ INTELLECTUELLE DU CANADA

CIPO
CANADIAN INTELLECTUAL PROPERTY OFFICE

(12) (19) (CA) **Demande-Application**

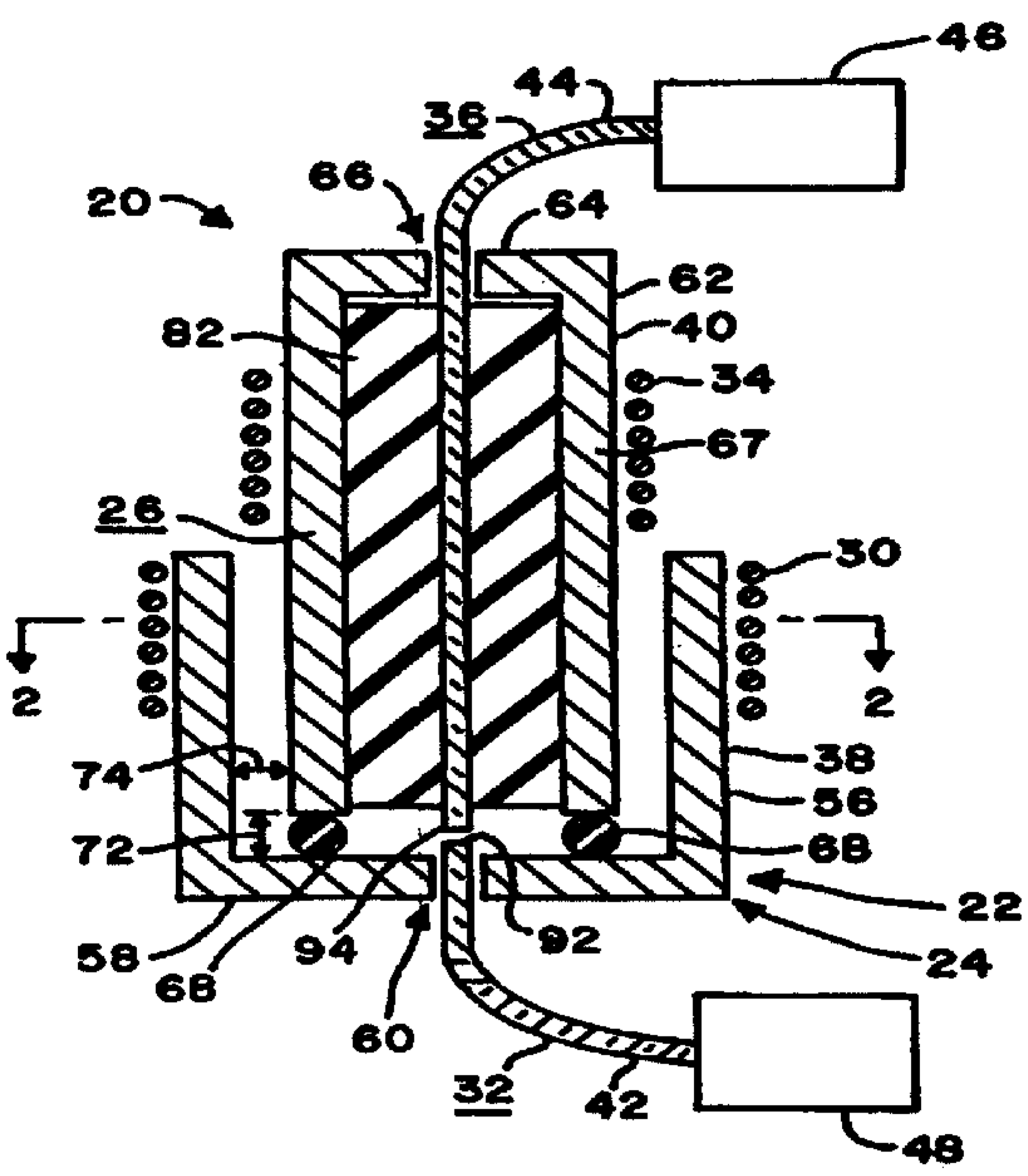
(21) (A1) **2,290,438**
(86) 1998/05/15
(87) 1998/11/19

(72) SMITH, WILLIAM V., US
(72) ALPERIN, ALFRED M., US
(71) LECTROLARM CUSTOM SYSTEMS, INC., US

(51) Int.Cl.^{7} H04N 5/225, H04N 1/40, H01R 11/30, H01R 39/00
(30) 1997/05/16 (08/857,311) US

(54) **COUPLEUR PERMETTANT DE TRANSMETTRE DES SIGNAUX VIA UNE INTERFACE ROTATIVE**

(54) **COUPLER FOR TRANSMITTING SIGNALS ACROSS A ROTATING INTERFACE**



(57) Coupleur (20) destiné à transmettre des signaux via une interface rotative (22), qui comporte une première partie (24) et une seconde partie (26) montée de manière à tourner autour d'un axe par rapport à la première partie (24). La première partie (24) comprend un premier enroulement magnétique (30) et un premier dispositif (32) de transmission optique de signaux. La seconde partie comprend un second enroulement magnétique (34) couplé de manière inductive au premier enroulement magnétique (30) et un second dispositif (36) de transmission optique de signaux. Les premier et second enroulements magnétiques (30, 34) sont inductivement couplés afin de transmettre une puissance électrique via l'interface rotative (22). Les premier et second dispositifs (32, 36) de transmission optique de signaux sont optiquement couplés en vue de la transmission d'un signal optique entre eux. Le premier ou le second dispositif (32, 36) de transmission optique de signaux

(57) A coupler (20) for transmitting signals across a rotating interface (22). The coupler (20) comprises a first part (24) and a second part (26) mounted for rotation about an axis with respect to the first part (24). The first part (24) comprises a first magnetic coil (30) and a first optical signal transmission device (32). The second part comprises a second magnetic coil (34) inductively coupled to the first magnetic coil (30) and a second optical signal transmission device (36). The first and second magnetic coils (30 and 34) are inductively coupled for transmitting electrical power across the rotating interface (22). The first and second optical signal transmission devices (32 and 36) are optically coupled for transmission of an optical signal therebetween. One of the first and second optical signal transmission devices (32 and 36) includes an electrical to optical signal conversion device (46), and the other of the first and second optical signal transmission devices

OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(21) (A1) **2,290,438**
(86) 1998/05/15
(87) 1998/11/19

comporte un dispositif de conversion de signal électrique-optique (46) et l'autre dispositif comporte un dispositif de conversion de signal optique-électrique (48). Les premier et second dispositifs (32, 36) de transmission optique de signaux comportent également de préférence des fibres optiques. Ledit coupleur peut être utilisé pour monter une caméra vidéo sur un mécanisme panoramique et d'inclinaison si bien que les signaux de puissance, vidéo et de commande peuvent être transmis via l'interface rotative (22).

includes an optical to electrical signal conversion device (48). The first and second optical signal transmission devices (32 and 36) preferably also include optical fibers. The coupler can be used to mount a video camera on a pan and tilt mechanism so that power, video, and control signals can be transmitted across the rotating interface (22).

CA 02290438 1999-11-15

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 **:**
H04N 5/225, 1/40, H01R 39/00, 11/30 **A1**

(11) International Publication Number: **WO 98/52350**

(43) International Publication Date: 19 November 1998 (19.11.98)

(21) International Application Number: PCT/US98/10050

(22) International Filing Date: 15 May 1998 (15.05.98)

(30) Priority Data:
08/857,311 16 May 1997 (16.05.97) US

(71) Applicant: LECTROLARM CUSTOM SYSTEMS, INC. [US/US]; 3120 Summer Avenue, Memphis, TN 38112 (US).

(72) Inventors: SMITH, William, V.; 1617 Duke Road, Memphis, TN 38108-2619 (US). ALPERIN, Alfred, M.; 1504 Vinton Avenue, Memphis, TN 38104-4922 (US).

(74) Agents: LONDA, Bruce et al.; Londa and Traub LLP, 37th floor, 20 Exchange Place, New York, NY 10005 (US).

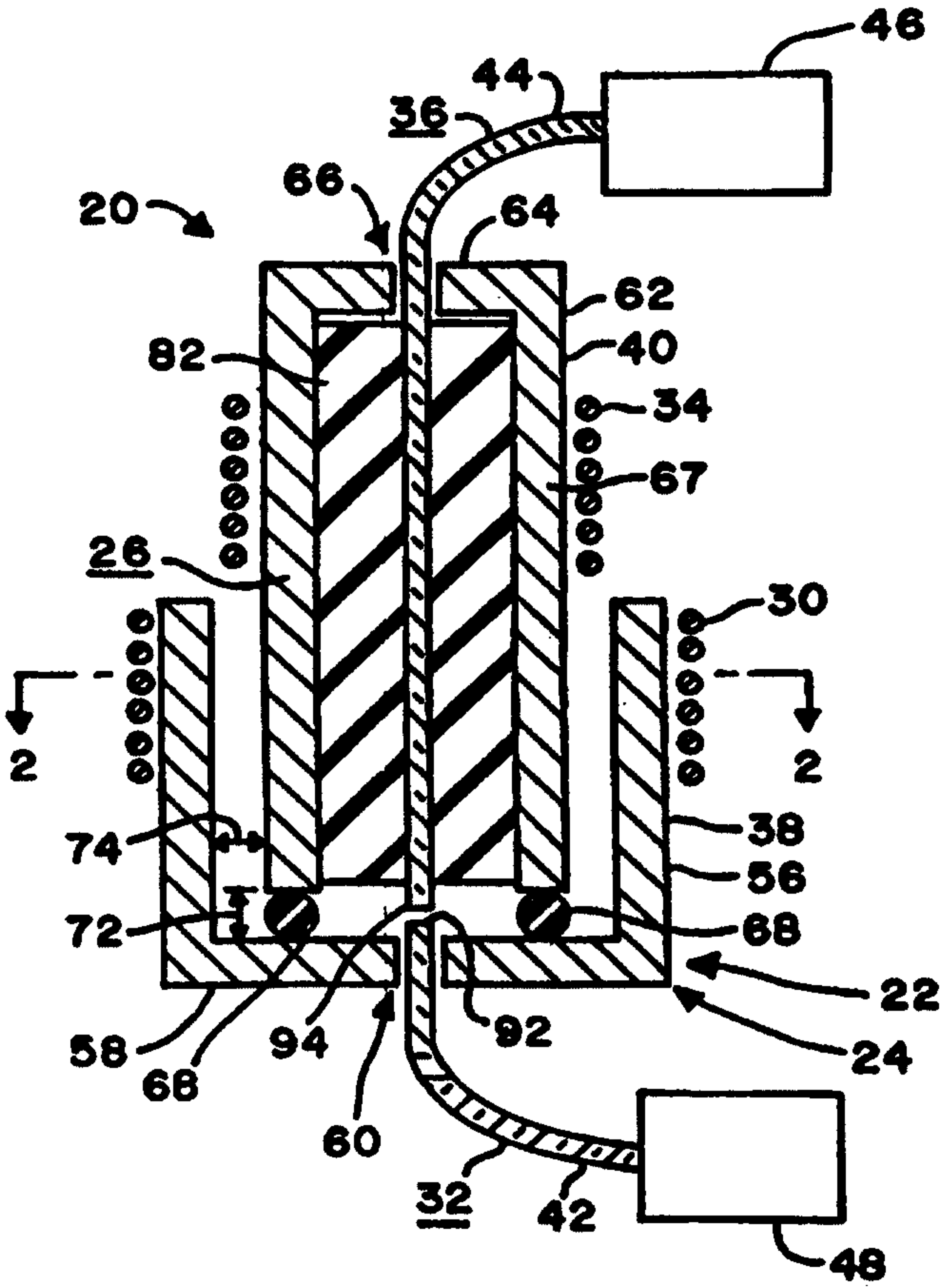
(81) Designated States: AL, AM, AT, AU, AZ, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: COUPLER FOR TRANSMITTING SIGNALS ACROSS A ROTATING INTERFACE

(57) Abstract

A coupler (20) for transmitting signals across a rotating interface (22). The coupler (20) comprises a first part (24) and a second part (26) mounted for rotation about an axis with respect to the first part (24). The first part (24) comprises a first magnetic coil (30) and a first optical signal transmission device (32). The second part comprises a second magnetic coil (34) inductively coupled to the first magnetic coil (30) and a second optical signal transmission device (36). The first and second magnetic coils (30 and 34) are inductively coupled for transmitting electrical power across the rotating interface (22). The first and second optical signal transmission devices (32 and 36) are optically coupled for transmission of an optical signal therebetween. One of the first and second optical signal transmission devices (32 and 36) includes an electrical to optical signal conversion device (46), and the other of the first and second optical signal transmission devices includes an optical to electrical signal conversion device (48). The first and second optical signal transmission devices (32 and 36) preferably also include optical fibers. The coupler can be used to mount a video camera on a pan and tilt mechanism so that power, video, and control signals can be transmitted across the rotating interface (22).



Coupler for Transmitting Signals across a Rotating Interface

BACKGROUND OF THE INVENTION

The present invention relates, in general, to a signal transmission device, and in particular, to a coupler for transmitting signals across a rotating interface.

It is often desirable to transmit signals across a rotating interface. Well-known prior art solutions have provided slip rings and brushes to form electrical contacts across a rotatable interface, thereby enabling continuous, multiple 360 degree revolutions in each direction of rotation. Slip rings and brushes, however, need frequent replacement and often introduce noise into the signals being transmitted across the interface.

Nothing in the prior art is directed toward a coupler which, instead of using slip rings and brushes, uses inductively-coupled magnetic coils to transmit a power signal across a rotating interface and also uses optically-coupled optical signal transmission means to transmit one or more data and/or control signal(s) across the rotating interface, thereby enabling continuous, multiple 360 degree revolutions, in each direction of rotation, of one part of the rotating interface with respect to the other part of the rotating interface.

The following references may be relevant to the present invention: Divan *et al.*, U.S. Patent No. 5,341,280, issued August 23, 1994; Hulsey, U.S. Patent No. 5,264,776, issued November 23, 1993; Chan *et al.*, U.S. Patent No. 5,245,248, issued September 14, 1993; Ishii *et al.*, U.S. Patent No. 5,070,293, issued December 3, 1991; Grabbe, U.S. Patent No. 5,047,830, issued September 10, 1991; Dodier, U.S. Patent No. 4,838,797, issued June 13, 1989; Szabo, U.S. Patent No. 4,675,638, issued June 23, 1987; Steffen, U.S. Patent No. 4,419,783, issued December 13, 1983; Weston, U.S. Patent No. 3,995,209, issued November 30, 1976; and Crafts *et al.*, U.S. Patent No. 3,387,606, issued June 11, 1968.

Additionally, the inventors are aware of Wheeler *et al.*, U.S. Patent No. 4,673,268, issued June 16, 1987, which may be relevant to the present invention.

None of these references, either singly or in combination, disclose or suggest the present invention.

BRIEF SUMMARY OF THE INVENTION

The present invention is a coupler for transmitting signals across a rotating interface. The coupler comprises a first part and a second part mounted for rotation about an axis with respect to the first part. The first part comprises a first magnetic coil and first optical signal transmission means. The second part comprises a second magnetic coil being inductively coupled to the first magnetic coil and second optical signal transmission means. First and second optical signal transmission means are optically coupled for transmission of an optical signal therebetween.

It is an object of the present invention to provide a coupler which comprises means for transmitting a power signal across a rotating interface and which also comprises optically-coupled optical signal transmission means for transmitting data and/or control signal(s) across a rotating interface.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

Fig. 1 is a side sectional view of a first preferred embodiment of the present invention, taken substantially along a plane containing the axis of rotation of the first preferred embodiment.

Fig. 2 is a downward-looking sectional view a first preferred embodiment of the present invention, taken along the line 2-2 of Fig. 1.

Fig. 3 is a schematic block diagram of the present invention, shown electrically connected to a video camera.

Fig. 4 is a perspective view of a second preferred embodiment of the present invention.

Fig. 5 is a side sectional view of a second preferred embodiment of the present invention, taken substantially along a plane containing the axis of rotation of the second preferred embodiment.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figs. 1 and 2, a first preferred embodiment of the present invention is seen to comprise a coupler **20** for transmitting signals across a rotating interface **22**. Fig. 1 is a side sectional view of the coupler **20** taken substantially along a plane containing the axis of rotation of the coupler **20**, and Fig. 2 is a downward-looking sectional view of the coupler **20** taken substantially along the line 2-2 of Fig. 1. The coupler **20** is seen to comprise a first, or bottom, part **24** and a second, or top, part **26** mounted for rotation about an axis with respect to the first part **24**. The first part **24** comprises first optical signal transmission means **32** and a first magnetic coil **30**, which preferably includes a first magnetic core **38** preferably formed into an upwardly-open first cylinder **56** having a circular base **58** for mounting to a stationary support, not shown. The circular base **58** has a first hole **60** therethrough for mounting first optical signal transmission means **32** along the axis of rotation. The first magnetic coil **30** is preferably wound, in a manner well-known to those skilled in the art, around the first cylinder **56**. The material of first cylinder **56** that forms first magnetic core **38** is preferably a ferrous material capable of being induced with a magnetic field, such as, for example, iron.

The second part **26** comprises a second magnetic coil **34** being inductively coupled to the first magnetic coil **30**, and the second part **26** also comprises second optical signal transmission means **36**. The second magnetic coil **34** preferably includes a second magnetic core **40** inductively coupled to the first magnetic core **38**, with second magnetic core **40** being preferably formed into a downwardly-open second cylinder **62** having an outer diameter that is slightly smaller than the inner diameter of the first cylinder **56** so that a portion of the second cylinder **62** can be mounted within the first cylinder **56**, and so that a slight circumferential gap **74** is maintained between the first cylinder **56** and the second cylinder **62**. The second part **26** also includes a circular top **64** for mounting an electronic device, such as a video camera and its associated electronics, as hereinafter described. The circular top **64** has a second hole **66** therethrough for mounting second optical signal transmission means **36** along the axis of rotation. The second cylinder **62** preferably extends above first cylinder **56** a sufficient height to expose a portion **67** of cylinder **62** around which is circumferentially wound the second magnetic coil **34**. The material of second cylinder **62** that forms second magnetic core **40** is preferably a ferrous material capable of being induced with a magnetic field, such as, for example, iron.

To minimize magnetic core losses, the first **38** and second **40** magnetic cores are preferably constructed of well-known thin ferrous disks that are concentrically stacked on top of one another along the axis of rotation so as to form the respective cores **38** and **40**. To maximize the inductive coupling between the first **38** and second **40** magnetic cores, the first **38** and second **40** magnetic cores are constructed so that, when the first **24** and second **26** parts are rotated, the circumferential air gap **74** is maintained at a minimum, preferably less than 0.005 inches. It is desirable to avoid fluctuations in the inductive coupling between the first **30** and second **34** magnetic coils as the second part **26** is rotated with respect to the first part **24**. Constructing and mounting the first **38** and second **40** magnetic cores so that the change in the circumferential air gap **74** remains minimal as the first **24** and second **26** parts are rotated with respect to one another helps to avoid these undesirable fluctuations in the inductive coupling. Bearings **68** are preferably used to concentrically and rotatably mount the first part **24** to the second part **26** so as to form the rotating interface **22**. The bearings **68** also act to maintain a vertical air gap **72** between the first **24** and second **26** parts. The bearings **68** are constructed from a non-magnetic, non-ferrous material, thereby ensuring that the first **38** and second **40** magnetic cores are not magnetically shunted together. Many other well-known friction-reducing devices may be used to mount the first part **24** to the second part **26**, as will now be apparent to those skilled in the art. For illustrative purposes and for clarity, Figs. 1 and 2 show the vertical air gap **72** and the circumferential air gap **74** with exaggerated dimensions.

First **32** and second **36** optical signal transmission means are optically coupled for transmission of an optical signal therebetween. One of first **32** and second **36** optical signal transmission means preferably includes electrical to optical signal conversion means **46**, and the other of first **32** and second **36** optical signal transmission means preferably includes optical to electrical signal conversion means **48**. Electrical to optical signal conversion means **46** and optical to electrical signal conversion means **46** are optically coupled for transmission of an optical signal therebetween. In Fig. 1, first optical signal transmission means **32** includes electrical to optical signal conversion means **46** and second optical signal transmission means **36** includes optical to electrical signal conversion means **48**; however, the inclusion of the signal conversion means **46**, **48** within the respective signal transmission means **36**, **32** could be reversed for transmission of an optical signal therebetween in the other direction, as will now be understood. First optical signal transmission means **32** also preferably includes a first optical fiber **42** and second optical signal transmission means **36** also preferably includes a second optical fiber **44**. Electrical to optical signal conversion means **46** is a well-known means for converting an electrical signal, such as a first electrical video signal responsive to a scene viewed by a video camera, into an optical signal, and optical to electrical signal conversion means **48** is a well-known complementary means for converting this optical signal back into an electrical signal, such as, for example, a second electrical video signal similar to the first electrical video signal. The optical signal preferably travels from electrical to optical signal conversion means **46** to optical to electrical signal conversion means **48** via the first **42** and second **44** optical fibers. An example of such well-known conversion means for converting a first electrical signal into an optical signal and then for converting an optical signal back into a second electrical signal are the CX-series light emitting diodes having connectors for attachment to a fiber optic bundle, and the complementary CR-series photodiodes for a similar attachment to a fiber optic bundle. These CX-series light emitting diodes and CR-series photodiodes are manufactured by Math Associates Inc., 5500 New Horizons Blvd., Amityville, NY 11701. Fiber optic connectors for optically coupling two fiber optic cables together are those similar to the SPB-series, FCPC-series, SMA5-series, SMA6-series, and STC-series, also manufactured by Math Associates Inc. Such connectors could be used at the rotating interface to optically couple the two fiber optic cables **42** and **44** together, although the chosen connectors preferably would be of the type that allow free rotation at the connector interface.

The first optical fiber **42** extends through the first hole **60** and one end **92** of the first optical fiber **42** is mounted along the axis of rotation. The second optical fiber **44** extends through the second hole **66** and is preferably mounted within the second part **26** using a solid lightweight non-magnetic material **82**, such as cork, for example. One end **94** of the second optical fiber **44** is mounted in close proximity and axially aligned with end **92** of the first optical fiber so that the first **42** and the second **44** optical fibers are optically coupled for transmission of an optical signal therebetween.

With respect to the first part **24**, the second part **26** can be continuously rotated through multiple 360 degree rotations in either direction of rotation using rotation means well-known to those skilled in the art. The inductively-coupled magnetic coils **30**, **34** enable electrical power to be transmitted between the first **24** and second **26** parts, and the optically-coupled optical signal transmission means **32, 36** enable an optical signal to be transmitted between the first **24** and second **26** parts. It should be readily apparent that the coupler **20** can be used to transmit signals between numerous devices which can be inductively and optically coupled between opposite parts of the rotating interface **22**.

Fig. 4 shows a perspective view and Fig. 5 shows a side sectional view taken substantially along a plane containing the axis of rotation of a second preferred embodiment of the present invention. Identifying reference designators are marked similarly to those of the first preferred embodiment, except with the prefix "2". It shall be understood that many aspects of the two embodiments are substantially the same, and only the differences will be treated in detail, it being understood that similar structural features of both embodiments perform similar functions.

Referring to Figs. 4 and 5, a second preferred embodiment of the present invention is seen to comprise a coupler **2.20** for transmitting signals across a rotating interface **2.22**. The coupler **2.20** is seen to comprise a first, or bottom, part **2.24** and a second, or top, part **2.26**. The first part **2.24** comprises a first circular disk **84** having a first channel **86** that is concentric with the central axis of the first circular disk **84** and which partially extends into the depth of the first circular disk **84**, as best seen in the view shown in Fig. 5. A first magnetic coil **2.30**, preferably having a first magnetic core **2.38**, is affixed within the first channel **86**. The first circular disk **84** also has a first hole **2.60** therethrough for mounting first optical signal transmission means **2.32** along the central axis of the first circular disk **84**. The second part **2.26** comprises a second circular disk **88** having a second channel **90** that is concentric with the central axis of the second circular disk **88** and which partially extends into the depth of the second circular disk **88**, as best seen in Fig. 5. The first **86** and second **90** channels are preferably constructed so that each channel **86**, **90** has the same depth and width and so that the two channels **86** and **90** are in concentric alignment with each other. A second magnetic coil **2.34**, preferably having a second magnetic core **2.40**, is affixed within the second channel **90**. The second circular disk **88** has a second hole **2.66** therethrough for mounting second optical signal transmission means **2.36** along the central axis of the second circular disk **90**. The first **2.24** and second **2.26** parts are concentrically mounted for rotation with respect to each other about the common central axis of discs **84** and **88** so that the first **2.30** and second **2.34** magnetic coils are inductively coupled, the first **2.38** and second **2.40** magnetic cores are inductively coupled, and first **2.32** and second **2.36** optical signal transmission means are optically coupled. For the sake of clarity and in order to clearly show other features, Figs. 4 and 5 omit the rotatable mounting of first part **2.24** to second part **2.26**, but means for such rotatable mounting of one object to another, e.g., bearings and the like, are well-known to those skilled in the art.

Fig. 3 illustrates preferred applications of the present invention. A first preferred application of the coupler **20** is in combination with a video camera **28**. Fig. 3, depicts a block diagram showing the coupler **20** electrically and optically coupled to the video camera **28**, with coupler **20** being enclosed within dashed lines, it being understood that either the first embodiment **20** or the second embodiment **2.20** of the coupler could be equivalently used in the block diagram shown in Fig. 3. The coupler **20** transmits electrical power from an external power source 78 across the rotating interface to the video camera 28, and is configured to transmit a video signal from the video camera 28 across the rotating interface 22 to the video recorder or display 76. For illustrative purposes, the video camera 28 is shown spaced apart from the coupler 20, although preferably the video camera 28 is, directly or indirectly, physically mounted on the second part 26. Preferably, coupler 20 will be included and mounted within a well-known "pan and tilt" mechanism 70 at a rotating interface therewithin.

The first part 24 is mounted on a base, not shown, to support the coupler 20 and the video camera 28. First optical signal transmission means 32 includes optical to electrical signal conversion means 48 and the first optical fiber 42; second optical signal transmission means 36 includes electrical to optical signal conversion means 46 and the second optical fiber 44. The first magnetic coil 30 is electrically coupled to a power source 78, which supplies an alternating current voltage so as to induce a magnetic field from the second magnetic coil 34, with the induced magnetic field providing power for the video camera 28. The video camera 28 includes video camera power input means, such as wires 50, operably connected to the second magnetic coil 34 for receiving electrical power therefrom and for distributing the induced electrical power to the video camera 28. Depending upon the power requirements of the video camera 28, the second magnetic coil 34 could be directly operably connected to video camera power input means 50, thereby providing alternating current power to camera 28, or could be operably connected through a well-known alternating current to direct current ("A.C. to D.C.") converter 80, as shown in Fig. 3.

Video camera **28** also includes a signal output means, such as wires **54**, operably connected to well-known electrical to optical signal conversion means **46** to provide an electrical video signal to electrical to optical signal conversion means **46**. Electrical to optical signal conversion means **46** converts the electrical video output signal into an optical signal, the optical signal then travels from the second optical fiber **44** to the optically-coupled first optical fiber **42**, and well-known optical to electrical signal conversion means **48** then converts the optical signal back into an electrical video signal similar to the video signal produced by camera **28**. The video camera **28** can thus be continuously rotated through multiple 360 degree rotations in either direction of rotation, and the electrical video signal that is transmitted across the rotating interface by coupler **20** can then be processed by one or more of numerous electrical equipment well-known in the art, such as video recorder/display **76**, for example.

It should also be understood that second optical signal transmission means **36**, in addition to being a well-known uni-directional electrical to optical signal conversion means **46**, could instead also be bi-directional and also include well-known optical to electrical signal conversion means. Similarly, first optical signal transmission means **32**, in addition to being a well-known optical to electrical signal conversion means **48**, could instead also be bi-directional and include well-known electrical to optical signal conversion means. By such a structure, optical signals and/or control signals could flow bi-directionally across the rotating interface **22**.

A second preferred application of the coupler **20** is for use in combination with a pan and tilt mechanism **70** having a variable elevation and a variable azimuth. Using a video camera **28** with the combination of the coupler **20** and the pan and tilt mechanism **70** enables continuous multiple 360 degree rotations of the video camera **28** in each direction of rotation, and enables the video camera **28** to be upwardly and downwardly tilted. As with the first preferred application, electrical power, control and video signals are transmitted across the rotating interface **22** of the coupler **20**. The construction of pan and tilt mechanisms are well-known in the art, and one example of a pan and tilt mechanism for mounting a video camera thereupon is shown in Wheeler *et al.*, U.S. Patent No. 4,673,268, issued Jun. 16, 1987, which is herein incorporated fully by reference.

Referring to Fig. 3, the second preferred application of the coupler **20** can also be seen. First **32** and second **36** optical signal transmission means are constructed to be bi-directional, as previously discussed, so that each includes electrical to optical signal conversion means and optical to electrical signal conversion means. The pan and tilt mechanism **70** includes a pan and tilt mechanism control input/output means, such as wires **52**, operably connected to the optical to electrical signal conversion means **46** included as a part of second optical signal transmission means **36**, for receiving a first electrical control signal. Well-known pan and tilt control means **71**, responsive to the first electrical control signal, are provided for selectively altering the azimuth and elevation of the pan and tilt mechanism in response to the first electrical control signal, in a manner well-known to those skilled in the art. A second electrical signal flows from the operators panel **96** to electrical to optical signal conversion means **48** included with first optical signal transmission means **32**. Electrical to optical signal conversion means **48** converts the electrical signal to an optical signal, the optical signal then travels from the first optical fiber **42** to the optically-coupled second optical fiber **44**, and optical to electrical signal conversion means **46** included with second optical signal transmission means **36** converts the optical signal back to an electrical signal. This electrical signal is then received by the pan and tilt mechanism control input/output means **52** and is passed to pan and tilt control means **71** to cause selective alteration of the azimuth and elevation of the pan and tilt mechanism **70** in response to manipulation of the operator's panel **96**.

Pan and tilt mechanism **70** includes pan and tilt mechanism power input means, such as wires **100**, operably connected to the second magnetic coil **34** for receiving electrical power therefrom and distributing the electrical power to the pan and tilt mechanism **70** and to pan and tilt control means **71**. Electrical power is supplied to the pan and tilt mechanism power input means **100** from the second magnetic coil **34** in a manner similar to that already discussed regarding video camera power input means **50**.

Referring to Fig. 3, the third preferred application of the coupler **20** in combination with a video camera **28** can also be seen. First **32** and second **36** optical signal transmission means are constructed to be bi-directional, as previously discussed, so that each includes electrical to optical signal conversion means and optical to electrical signal conversion means. The video camera **28** is, directly or indirectly, physically mounted on the second part **26**. The video camera **28** includes variable focus means **102** for varying the focus of camera **28**, and includes a video camera control input/output means, such as wires **98**, operably connected to optical to electrical signal conversion means **46** included with second optical signal transmission means **36**. An electrical control signal flows from the operators panel **96** to electrical to optical signal conversion means **48** included with first optical signal transmission means **32**. Electrical to optical signal conversion means **48** converts the electrical control signal from the operator's panel to an optical signal, the optical signal travels from the first optical fiber **42** to the optically-coupled second optical fiber **44**, and optical to electrical signal conversion means **46** included with second optical signal transmission means **36** converts the optical signal back to an electrical control signal similar to that emitted from the operator's panel **96**. This electrical control signal is received by the video camera control input/output means **98** and is supplied to variable focus means **102**, which is responsive to this electrical control signal, and which responds by varying the focusing of the video camera **28**, in a manner well-known to those skilled in the art. The video camera **28** includes video camera power input means **50** for receiving electrical power from coil **34** and for distributing the electrical power to the video camera **28**, in a manner similar to that already heretofore described.

It is now apparent that all of the aforementioned applications could be combined so that electrical power, video signals, signals to control the focusing of the video camera **28**, and signals to control the pan and tilt mechanism **70** are transmitted across the rotating interface **22** of the coupler **20**.

Although the present invention has been described and illustrated with respect to a preferred embodiment and a preferred use therefor, it is not to be so limited since modifications and changes can be made therein which are within the full intended scope of the invention.

CLAIMS

We claim:

1: A coupler for transmitting signals across a rotating interface, said coupler comprising a first part and a second part mounted for rotation about an axis with respect to said first part, said first part comprising:

(a) a first magnetic coil; and

(b) first optical signal transmission means;

said second part comprising:

(c) a second magnetic coil being inductively coupled to said first magnetic coil; and

(d) second optical signal transmission means; said first optical signal transmission means being optically coupled to said second optical signal transmission means, for transmission of an optical signal therebetween.

2: The coupler as recited in claim 1, in which said first magnetic coil includes a first magnetic core and said second magnetic coil includes a second magnetic core, said first magnetic core being inductively coupled to said second magnetic core.

3: The coupler as recited in claim 2, in which one of said first and second optical signal transmission means includes electrical to optical signal conversion means for converting a first electrical signal into said optical signal transmitted between said first and said second optical signal transmission means, and the other of said first and second optical signal transmission means includes optical to electrical signal conversion means for converting said optical signal into a second electrical signal.

4: The coupler as recited in claim 3, in which said first optical signal transmission means includes a first optical fiber and said second optical signal transmission means includes a second optical fiber.

5: The coupler as recited in claim 2 in combination with a video camera, said video camera supplying a first electrical video signal responsive to a scene viewed by said video camera, in which:

said second optical signal transmission means includes electrical to optical signal conversion means for converting said first electrical video signal into said optical signal transmitted between said first and second optical signal transmission means;

said first optical signal transmission means includes optical to electrical signal conversion means for converting said optical signal into a second electrical video signal; and

said video camera includes video camera power input means operably connected to said second magnetic coil for receiving electrical power therefrom and for distributing said electrical power to said video camera.

6: The coupler as recited in claim 2 in combination with a pan and tilt mechanism having a variable azimuth and a variable elevation, in which:

said second optical signal transmission means includes optical to electrical signal conversion means for converting said optical signal transmitted between said first and said second optical signal transmission means into a first electrical control signal;

said first optical signal transmission means includes optical to electrical signal conversion means for converting said optical signal into a second electrical control signal; and

said pan and tilt mechanism includes:

(a) pan and tilt mechanism power input means operably connected to said second magnetic coil for receiving electrical power therefrom and for distributing said electrical power to said pan and tilt mechanism; and

(b) pan and tilt control means, responsive to said first electrical control signal, for selectively altering said azimuth and said elevation of said pan and tilt mechanism in response to said first electrical control signal.

7: The coupler as recited in claim 2 in combination with a video camera, in which:

said second optical signal transmission means includes optical to electrical signal conversion means for converting said optical signal transmitted between said first and second optical signal transmission means into a first electrical control signal;

said first optical signal transmission means includes electrical to optical signal conversion means for converting a second electrical control signal into said optical signal; and

said video camera includes:

(a) video camera power input means operably connected to said second magnetic coil for receiving electrical power therefrom and for distributing said electrical power to said video camera; and

(b) variable focus means, responsive to said first electrical control signal, for varying the focus of said camera in response to said first electrical control signal.

8: A coupler for transmitting signals across a rotating interface, said coupler comprising a first part and a second part mounted for rotation about an axis with respect to said first part, said first part comprising:

(a) a first magnetic coil, said first magnetic coil including a first magnetic core; and

(b) first optical signal transmission means including optical to electrical conversion means for converting an optical signal into a first electrical signal;

said second part comprising:

(c) a second magnetic coil; said second magnetic coil including a second magnetic core; said second magnetic coil being inductively coupled to said first magnetic coil; said first magnetic core being inductively coupled to said second magnetic core; and

(d) second optical signal transmission means including electrical to optical signal conversion means for converting a second electrical signal into said optical signal; said electrical to optical signal conversion means being optically coupled to said optical to electrical signal conversion means for transmission of said optical signal therebetween.

FIG. 1

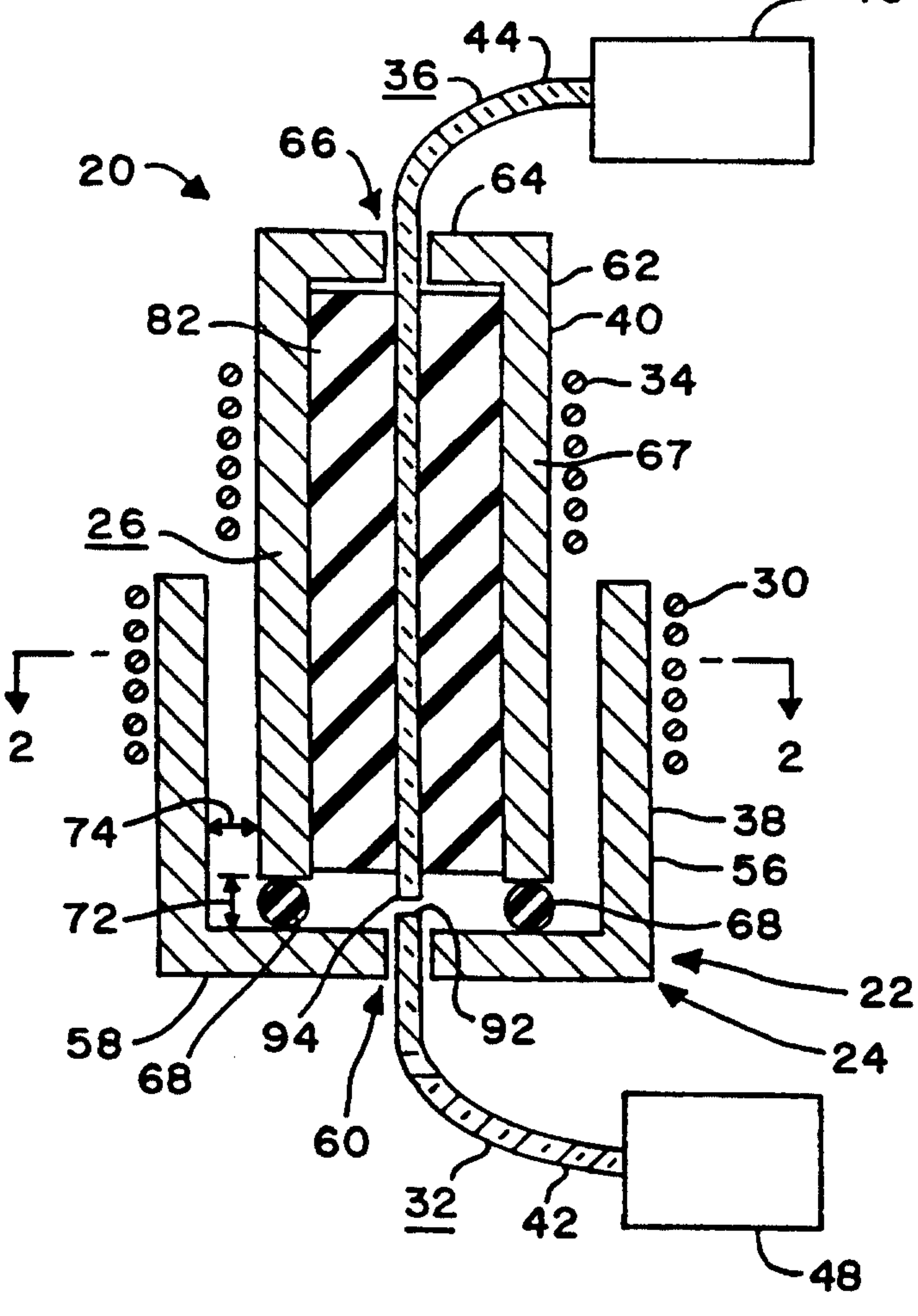
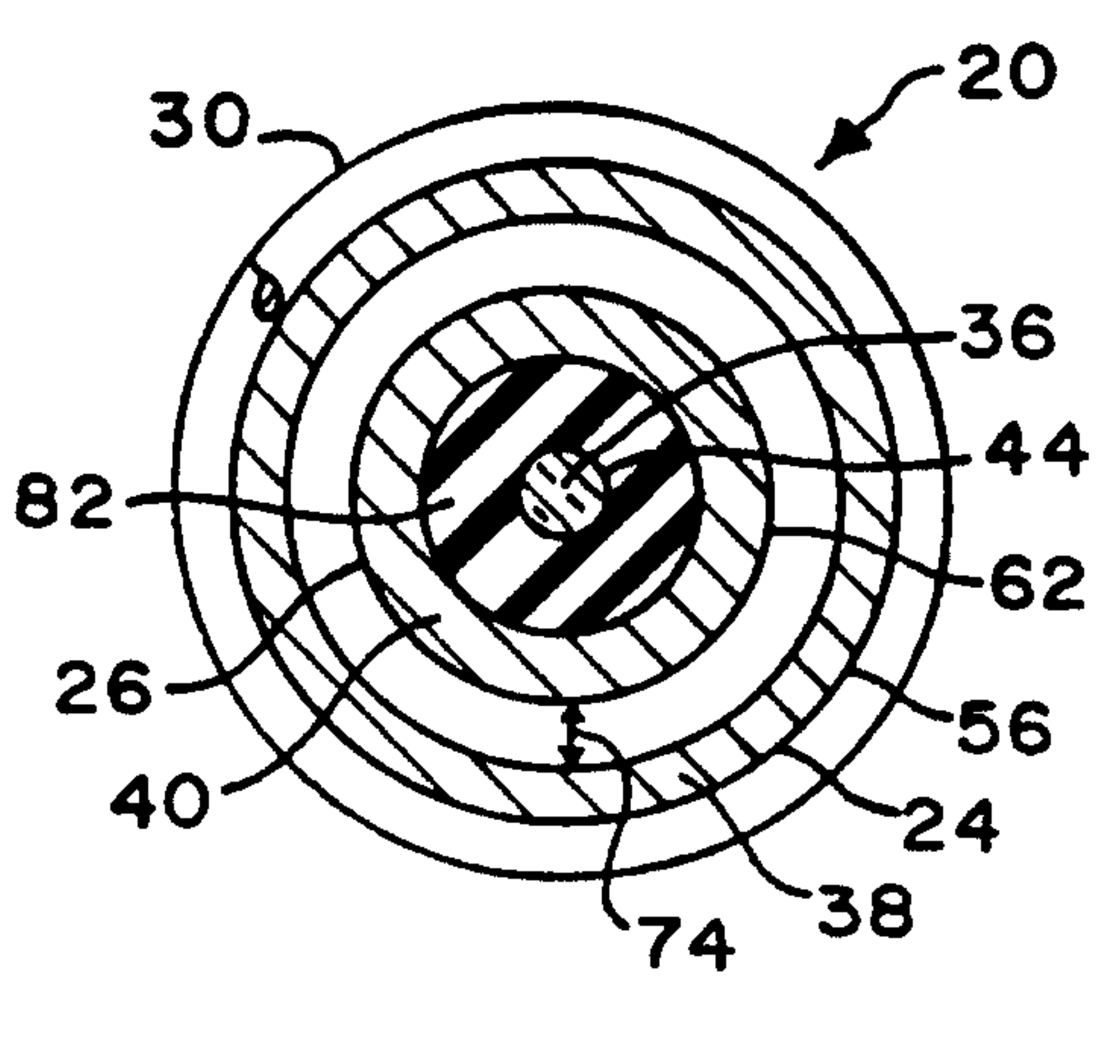

46
44
36
20
66
64
62
82
40
34
67
26
30
2
2
38
74
56
72
68
22
58
68
94
92
24
60
32
42
48

FIG. 2


20
30
36
44
82
62
26
56
40
24
74
38

2/2

FIG. 3

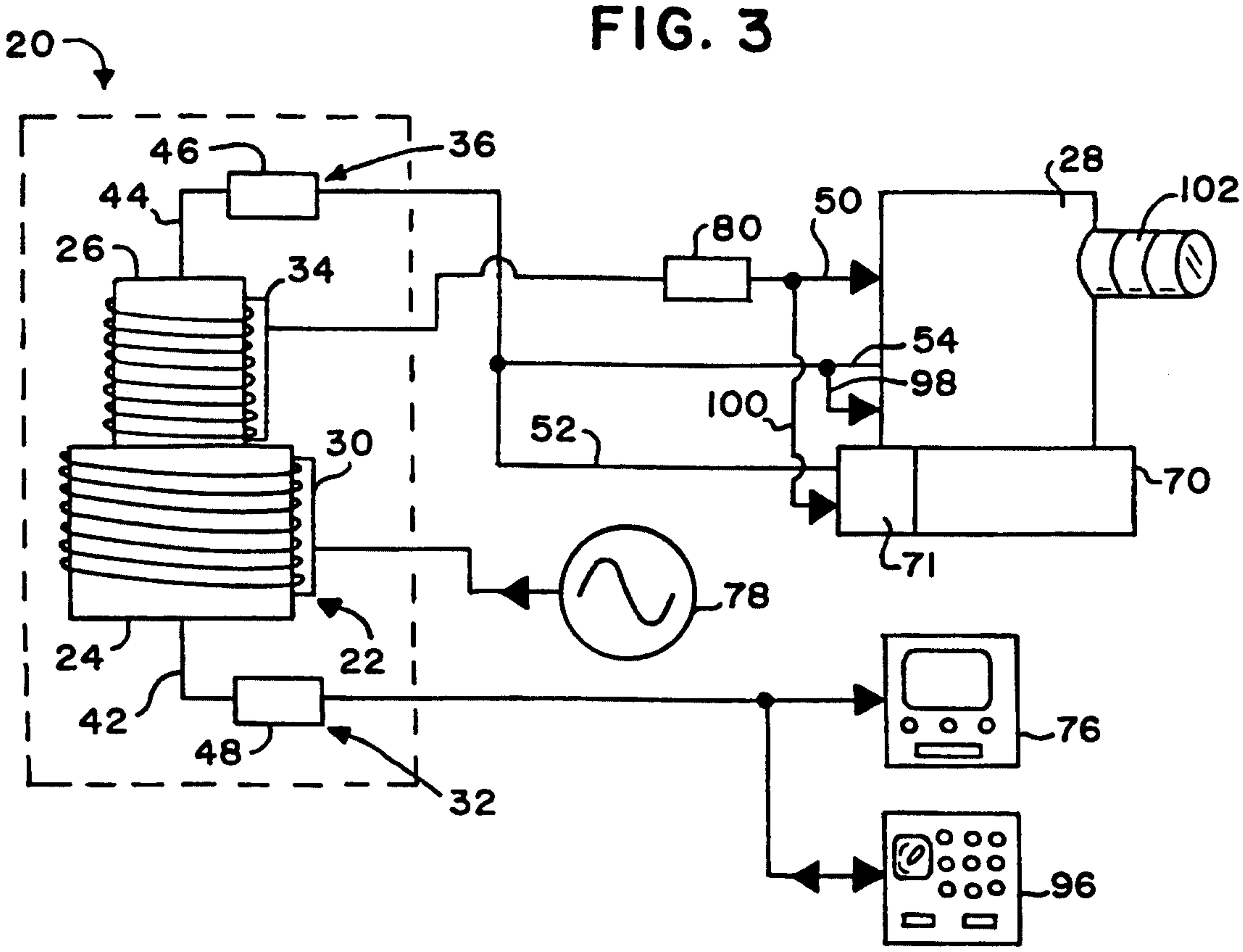


FIG. 4

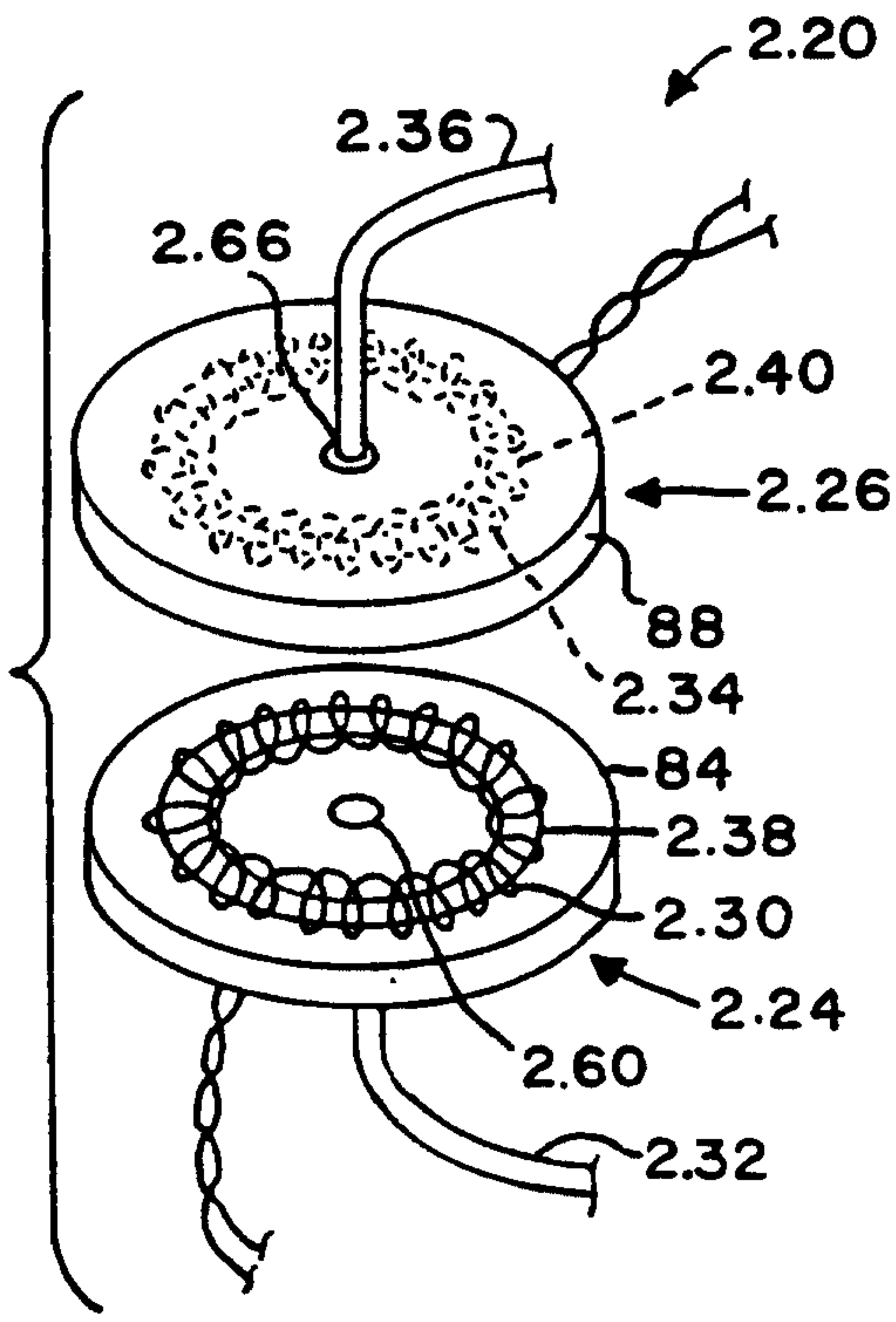


FIG. 5