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(72) Inventors:
• **Meyer, Peter F.**
Shrewsbury
Massachusetts, MA 01545 (US)
• **Zaiken, Eliot**
Sparta
New Jersey 07871 (US)

(30) Priority: **28.09.2006 US 528914**

(74) Representative: **Pratt, David Martin et al**
Withers & Rogers LLP
Goldings House
2 Hays Lane
London SE1 2HW (GB)

(71) Applicant: **Tyco Healthcare Group LP**
Mansfield, MA 02048 (US)

(54) **Cable monitoring apparatus**

(57) A cable monitoring apparatus includes a housing having an input interface adapted to electrically connect to one end of a medical cable and an output interface adapted to electrically connect to an electrical system. Signal processing circuitry is incorporated within the housing for receiving a medical signal from the medical cable via the input interface and for selectively passing the medical signal to the electrical system via the output interface when in a first mode of operation, and has application software for selectively testing functionality of the medical cable when in a second mode of operation.

The medical signal may include at least one monitoring signal selected from a group consisting of fetal and maternal medical signals. Preferably, the at least one monitoring signal is generated from a medical device selected from a group consisting of at least one medical electrode, a medical electrode array, an abdominal strain gauge, a tocodynamometer, an intrauterine pressure catheter, an ultrasonic transducer, a vacuum pressure sensor, a pulse oximeter, a pH sensor, a cervical dilation sensor, a cervical effacement sensor, a cervical length sensor, a fetal station sensor, and an ultrasound transducer.

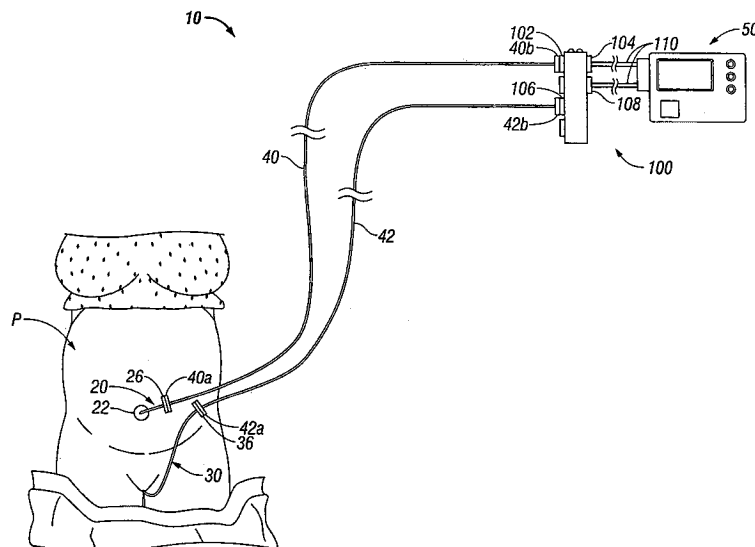


FIG. 1

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Description**BACKGROUND****Technical Field**

[0001] The present disclosure relates to medical equipment. In particular, the present disclosure relates to a cable monitoring apparatus which checks the functionality of an electrical cable adapted to connect to a medical apparatus, such as a fetal monitor.

Description of Related Art

[0002] Fetal monitors have been widely used and are capable of measuring a wide variety of uterine, fetal and maternal parameters, such as for example, uterine temperature, intra-uterine pressure, fetal electrocardiogram, etc. This information may be gathered via a variety of sensors (e.g., electrode arrays, pressure transducers, catheters, etc.) applied to the maternal patient. Monitoring signals, from the fetus and maternal patient, are received by the sensors, transmitted via electrical cables to a fetal monitor and displayed on the fetal monitor.

[0003] Typically, during labor and delivery, a multitude of sensors are required to receive monitoring signals containing maternal and fetal information. Application of maternal and fetal sensors is time consuming and at times unpleasant to the woman, particularly the application of invasive devices such as an intrauterine pressure transducer or a fetal scalp electrode. The proper operation of sensors is essential and clinicians continually monitor the various sensors and the associated systems to check functionality and to insure the sensors are providing accurate information.

[0004] When a sensor is not functioning properly or not providing accurate information, it becomes necessary to troubleshoot the entire fetal monitoring system to determine the origin of the malfunction. One troubleshooting step includes determining if the origin of the malfunction is hardware related, in particular a faulty sensor and/or electrical cable. Typically, electrical cables are easier to diagnose and replace since electrical cable replacement usually does not require the removal and re-application of the sensor. Reusable cables may cost much more than disposable sensors, making the potentially unnecessary replacement of cables wasteful. Therefore, there is a need for a cable monitoring apparatus for determining whether the fetal monitoring cables are functioning properly.

SUMMARY

[0005] The present disclosure relates to medical equipment. In particular, the present disclosure relates to a cable monitoring apparatus which checks the functionality of an electrical cable adapted to connect to a medical apparatus, such as a fetal monitor, as well as

allows for zeroing and/or re-zeroing of monitoring functions of the medical apparatus, wherein monitoring signals are supplied from fetal and maternal monitoring sensors.

5 [0006] In accordance with one preferred embodiment, a cable monitoring apparatus includes a housing having an input interface, adapted to electrically connect to one end of a medical cable, and an output interface adapted to electrically connect to an electrical system. Signal processing circuitry is incorporated within the housing for receiving a medical signal from the medical cable via the input interface and for selectively passing the medical signal to the electrical system via the output interface when in a first mode of operation, and has application software for selectively testing the functionality of the medical cable when in a second mode of operation. The medical signal may include at least one monitoring signal selected from a group consisting of fetal and maternal medical signals. Preferably, the at least one monitoring signal is generated from a medical device selected from a group consisting of at least one medical electrode, a medical electrode sensor array, an abdominal strain gauge, a tocodynamometer, an intrauterine pressure catheter, an ultrasound transducer, a vacuum pressure sensor, a pulse oximeter, a pH sensor, a cervical dilation sensor, a cervical effacement sensor, a cervical length sensor, a fetal station sensor, and an ultrasound transducer.

15 [0007] The housing may include a cable diagnostic interface adapted to electrically connect with the remaining end of the medical cable whereby the software of the signal processing circuitry tests the functionality of the medical cable when in the second mode of operation. The housing includes at least one indicator for indicating an operating parameter corresponding to functionality of the medical cable. The housing may include first and second input interfaces for electrical connection to respective first and second medical cables.

20 [0008] The signal processing circuitry may be adapted to process the at least one monitoring signal when in the first mode of operation and provide an output signal indicative of an operating parameter of the at least one monitoring signal. The output signal may correspond to one of uterine activity or ECG activity. The housing may also include an output signal indicator associated with the output signal for displaying a condition of the output signal. The output signal indicator may be one of a visual or an audible alarm.

25 [0009] The signal processing circuitry may be further configured to perform a zero / re-zero function wherein the at least one monitoring signal is short-circuited to create a zero voltage signal. The signal processing circuitry is adapted to short circuit the at least one monitoring signal for a predetermined period of time. An indicator may be provided for indicating that the at least one monitoring signal is short-circuited.

30 [0010] Alternatively, a signature signal transmitter may be adapted to transmit a signature signal through the

medical cable to a patient. The signature signal may be identifiable by the signal processing circuitry to determine the functionality of the medical cable.

[0011] In accordance with another embodiment, a cable monitoring system includes a cable monitor operable between a first and a second mode of operation wherein the first mode of operation selectively passes at least one monitoring signal from a medical device to a monitoring apparatus, and wherein the second mode of operation determines the functionality of an electrical cable. The at least one monitoring signal may be selected from a group consisting of fetal and maternal medical signals. A first input receives the at least one monitoring signal and a first output selectively passes the at least one monitoring signal to the monitoring apparatus. A diagnostic input may be provided whereby, in the second mode of operation, one end of the medical cable is connected to the first input and a second end of the medical cable is connected to the diagnostic input to thereby determine the functionality of the electrical cable. Signal processing circuitry is adapted to selectively pass the at least one monitoring signal from the medical device to the monitoring apparatus and to determine the functionality of the electrical cable.

[0012] In accordance with another embodiment, a method for fetal monitoring is disclosed. A medical cable monitor is electrically connecting with a fetal monitoring apparatus. One end of a medical cable is electrically connecting to an input interface of the medical cable monitor. In one mode of operation, the other end of the medical cable is electrically connected to a cable diagnostic interface of the cable monitor. In this mode of operation, signal processing circuitry of the medical cable monitor tests the functionality of the medical cable connected between the input interface and the cable diagnostic interface. In another mode of operation one end of medical cable is electrically connected to a sensor. The sensor senses maternal or fetal parameters and sends a maternal or fetal monitoring signal associated with the maternal or fetal parameters to the input of the medical cable monitor. Signal processing circuitry of the medical cable monitor passes the fetal monitoring signal to the fetal monitor.

[0013] In the step of connecting one end of the medical cable to a sensor, a sensor is selected from a group consisting of a medical electrode, a medical electrode sensor array, an abdominal strain gauge, a tocodynamometer, an intrauterine pressure catheter, a vacuum pressure sensor, a pulse oximeter, a pH sensor, a cervical dilation sensor, a cervical effacement sensor, a cervical length sensor, a fetal station sensor, and an ultrasound transducer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Various embodiments of the present disclosure are described herein with reference to the drawings wherein:

[0015] **FIG. 1** is a view of a fetal monitoring system

incorporating a cable monitoring apparatus in accordance with the present disclosure;

[0016] **FIG. 2** is a view of the cable monitoring apparatus of **FIG. 1**;

[0017] **FIG. 3** is an electrical schematic illustrating the components of the cable monitoring apparatus; and

[0018] **FIG. 4** is a programming flowchart illustrating functionality of the cable monitoring apparatus.

DETAILED DESCRIPTION

[0019] Particular embodiments of the present disclosure are described hereinbelow with reference to the accompanying drawings. In the following description, well-known functions or constructions are not described in detail to avoid obscuring the present disclosure in unnecessary detail.

[0020] **FIG. 1** shows a fetal monitoring system **10** incorporating a cable monitoring apparatus according to the present disclosure. The fetal monitoring system **10** includes one or more sensor, devices or probes, such as fetal electrocardiogram (FECG) sensor **20** and an intrauterine pressure (IUP) catheter **30**. The FECG sensor **20** may include at least one electrode adapted to adhere to skin on the abdomen of the patient **P**. The IUP catheter **30** may be a pressure catheter placed within the uterus of the patient **P**. The FECG sensor **20** and the IUP catheter **30** are operably and electrically coupled with the FECG sensor cable connector **26** and IUP catheter cable connector **36**, respectively.

[0021] In the discussion which follows, the term cable may incorporate a single conductor or may comprise an assembly of conductors arranged in any mode of operation known in the art. Connector refers to a single plug, receptacle, or other device capable of electro-mechanically connecting to a cable, device or apparatus. A connector assembly refers to the connection between two connectors wherein the connectors facilitate connectivity between two cables, devices or apparatus, or any combination thereof. Connection between the two components may be solely electrical without any mechanical means of connection. Such electrical connection may be infrared or incorporate electromagnetic wave principles. Thus, the term "connection" or "electrical connection" is to be construed as any electrical, mechanical connection or combination thereof known in the art.

[0022] The FECG electrical cable **40** and the IUP electrical cable **42** first connectors **40A**, **42A** are connected to the respective device connectors **26**, **36**. In the prior art, second connectors **40B**, **42B** of the cables **40**, **42** connect directly to the monitoring device **50**. Signal loss at the monitoring device **50** typically resulted in the replacement of an electrical cable **40**, **42** since cable replacement is easier than the removal and subsequent reapplication of a sensor **20,30**.

[0023] The first embodiment of a cable monitoring apparatus **100** in accordance with the present disclosure will now be discussed. Cable monitoring apparatus **100**

is coupled between one or more electrical cables **40, 42** and the monitoring device **50**. The FECG electrical cable second connector **40B** of the FECG sensor cable **40** electro-mechanically connects to the first input connector **102** and the sensed information from the FECG sensor **20** is selectively passed through the first output connector **104** to the monitoring device **50**. The IUP sensor cable second connector **42B** of the IUP sensor cable **42** electro-mechanically connects to the second input connector **106** and the sensed information from the IUP sensor **30** is selectively passed through the second output connector **108** to a monitoring device **50**. Cable monitoring apparatus **100** electro-mechanically connects to the monitoring device **50** with two interface cables **110**. It is envisioned that the cable monitoring apparatus **100** electro-mechanically connects to the monitoring device in any number of ways known in the art.

[0024] FIG. 1 illustrates a fetal monitoring system **10** with a cable monitoring apparatus **100** interfacing with two sensor cables **40, 42** and one monitoring device **50**. Monitoring device **50** may be a fetal monitoring device or any other device capable of receiving and displaying a monitoring signal. The present disclosure may interface with any number of cables or monitoring devices.

[0025] In a first mode of operation of cable monitoring apparatus **100**, sensed information is passed from the sensors **20, 30** through the cables **40, 42** and the cable monitoring apparatus **100** and to the monitoring device **50**. In a first mode of operation, cable monitoring apparatus **100** does not substantially alter or degrade the signal provided to the fetal monitoring system **10**.

[0026] With reference to FIG. 2, cable monitoring apparatus **100** consists of a housing **120** which houses a plurality of connectors and user interface devices described hereinbelow. In this particular embodiment, cable monitoring apparatus **100** is configured to connect to two medical sensors although it is envisioned cable monitoring apparatus **100** described herein may connect to any number of medical sensors or devices. Housing **120** may be sufficiently small and manufactured from lightweight materials, such as plastic, such that the cable monitoring apparatus **100** is a light-weight inline device.

[0027] FIG. 2 illustrates the cable monitoring apparatus **100** in a second mode of operation wherein cable monitoring apparatus **100** is utilized in a diagnostic capacity. Clinicians start the process of troubleshooting after it is determined that the fetal monitoring system **10** is not operating correctly. The cable monitoring apparatus **100** may be used as a diagnostic tool to determine the functionality of electrical cables **140, 142**. The cable monitoring apparatus **100** may perform a number of diagnostic tests known in the art.

[0028] Second connector **140B** of an electrical cable **140** is electro-mechanically connected to the first input connector **102**. The first connector **140A** of the same electrical cable **140** is disconnected from a medical sensor and electro-mechanically connected to the first diagnostic connector **103**. A second electrical cable **142** may

connect in a similar fashion with the second connector **142B** connected to a second input connector **106** and the first connector **142A** connected to a second diagnostic connector **107**. The various electrical cables **140, 142** attached to the cable monitoring apparatus **100** may operate independent of each other wherein an electrical cable may be arranged in the first mode of operation while a second electrical cable may be arranged in the second mode of operation.

[0029] With reference to FIGS. 1 and 2, switching from the first mode of operation, as shown in FIG. 1 wherein sensed information is selectively passed through the cable monitoring apparatus, to the second mode of operation, as shown in FIG. 2 wherein the cable monitoring apparatus is used to diagnose an electrical cable, requires disconnecting the first connectors **140A, 142A** of the first and second electrical cables **40, 42** from the FECG sensor cable connector **26** and the IUP catheter cable connector **36** and reconnecting the first connectors **140A, 142A** to the first and second diagnostic connectors **103, 107**.

[0030] Alternatively, the clinician may diagnose the electrical cable with cable monitoring apparatus **100** prior to connecting the first connectors **140A, 142A** to the sensors connectors **26, 36**.

[0031] Returning to FIG. 2, first cable indicator **150** indicates the functionality of a cable connected between the first input connector **102** and the first diagnostic connector **103**. Second cable indicator **152** indicates the functionality of a cable connected between the second input connector **106** and the second diagnostic connector **107**. First and second cable indicators **150, 152** may be audio indicators, visual indicators, or any indicator known in the art, or combination thereof.

[0032] FIG. 3 is a schematic of the cable monitoring apparatus **100** including signal processing circuitry **150** operably coupled to the various input connectors, output connectors, test connectors and indicator devices described hereinbelow. Signal processing circuitry **150** may include a Digital Signal Processor (DSP) **150A** having a memory storing a set of programmable instructions capable of being executed by the DSP **150A** for performing the functions described herein. Signal processing circuitry **150** may be an application-specific integrated circuit (ASIC) customized for this particular use or may be a general purpose device adapted for this use.

[0033] In the first mode of operation, signal processing circuitry **150** selectively passes monitoring information from the first and second input connectors **102, 106** to the respective first and second output connectors **104, 108**. First and second output connectors **104, 108** pass monitoring information to display monitor **50**. In this mode of operation, the monitoring information received at the display monitor **50** is essentially identical to the monitoring information received by the sensors **20, 30**.

[0034] In the second mode of operation, signal processing circuitry **150** performs a diagnostic check on an electrical cable attached between the first or second

input connectors **102, 106** and the respective first or second diagnostic connectors **103, 107**. Signal processing circuitry **150** is connected to various indicators **152, 153** to indicate the results of the diagnostic check for each electrical cable. Diagnostic check may include testing the continuity and impedance of the various conductors, testing continuity and impedance between the various conductors, testing the capacitive properties of the cable, testing the insulation in the cable, measuring losses within the cable and conductors, measuring the frequency response and signal losses at various frequencies and any other test known in the art. Various indicators **152, 153** are indicative of at least one operating feature of the electrical cable which include test performed, or measurements made, on the cable. Indicators **152, 153** may be audible indicators, visual indicators, or other indicators known in the art.

[0035] The first or second input connectors **102, 106** may interface with various medical sensors (not shown) including a medical electrode, a medical electrode sensor array, an abdominal strain gage, a tocodynamometer, an **intrauterine** pressure catheter, and an ultrasound transducer.

[0036] One such sensor, the pressure catheter, is a common apparatus for measuring the uterine contractions of a maternal abdomen. Various pressure catheter components and systems are described in U.S. Patent No. 5,566,680 to Urion et al. titled "Transducer-Tipped Intrauterine Pressure Catheter System", the contents of which are incorporated herein by reference. Referring to **FIG. 1**, the IUP catheter **30** is a type of pressure catheter that measures force applied to the pressure catheter by the patient **P**.

[0037] In monitoring fetal contractions with a pressure catheter it often becomes necessary or desirable to "zero" or "re-zero" the pressure catheter in situ. U.S. Application 10/952,942 to Zaiken et al. titled "Intrauterine Pressure Catheter Interface Cable System", the contents of which are incorporated herein by reference, describes a pressure catheter and a zero / re-zero apparatus and method.

[0038] Referring again to **FIG. 3**, an alternative embodiment of the present disclosure includes zero / re-zero hardware **154**. The signal processing circuitry **150** of the cable monitoring apparatus is operably connected to zero / re-zero selector **156** and zero / re-zero indicator **158**. Clinicians initiate a zero / re-zero of the monitoring device **50** and the pressure catheter by depressing the zero / re-zero selector **156**. The signal processing circuitry **150** short-circuits the output connector, corresponding to the pressure catheter, to ground thus creating a zero voltage signal to the monitoring device **50**. The zero voltage signal is held for a predetermined period of time and clinicians are alerted that the output connector is short-circuited by a zero / re-zero indicator **158**. The length of time the zero voltage signal is held must be sufficient for clinician to perform a zero / re-zero operation on the monitoring device **50**, typically between 5 and 30 seconds.

[0039] In yet another embodiment, the cable monitoring apparatus includes an indicator circuit **160**. At least one indicator **162**, corresponding to a medical signal received by an input connector **102, 106**, provides information about an operating feature of the medical signal. Indicators may identify the presence of uterine or fetal ECG activity

[0040] Referring again to **FIG. 3**, indicators **162** may correspond to the number of electrodes on the electrode array **167** applied to the maternal abdomen **170**. Indicator circuit **160** is operably connected to the signal processing circuitry **150** and the signal processing circuitry **150** may drive the indicators **162** with a signal indicative of at least one operating feature of the electrical cable **140**. An operating feature of the electrical cable **140** may be associated with the functionality of the cable, the quality of the signal transmitted by the electrical cable, or a feature of the electrical cable or medical signal.

[0041] In yet another embodiment of the present disclosure, indicators **162** include lights driven by signals from the signal processing circuitry **150** wherein the signals are indicative of the functionality of an electrical cable. Indicator circuit **160** includes an array of indicator lights **162** with at least one indicator light corresponding to a medical sensor. Each individual indicator light may be driven with a signal proportional to the medical signal from the sensor or device. Clinicians can troubleshoot problems with an electrical cable **140**, sensor or device containing sensors, such as an electrode array **167**, by observing the array of indicator lights **162** on the cable monitoring apparatus **100**.

[0042] Referring again to **FIG. 3**, in yet another embodiment, the cable monitoring apparatus includes a signal transmitter assembly **164** having a signal generator **166** and a signal applicator **168**. Signal generator **166** generates and supplies a signature signal to the signal processing circuitry **150** and the signal applicator **168**. The signature signal is a low energy signal with distinct and identifiable voltage and frequency characteristics. The signal applicator **168** is applied to patient skin **170** in close proximity to a medical device, such as an electrode **172** in an electrode array **167**. Electrode **172** receives the signature signal and supplies the sensed information, including the signature signal, to the cable monitoring apparatus **100** through the electrical cable **140**. The signal processing circuitry **150** receives the sensed information, including the signature signal, and processes the sensed information and signature signal. The DSP **150A** of the signal processing circuit **150** may compare the received signature signal to the generated signature signal to determine the functionality of the circuit between the signal applicator **168** and the cable monitoring apparatus **100**. Various factors which may affect the circuit include the conductivity of patient skin **170** adjacent the electrode, the connection between patient skin **170** and the electrode **172**, the electrical cable **140** and the electrical cable connections **140A, 140B**.

[0043] In yet another embodiment, the signal applica-

tor **168** is integrated into the electrode array **167**. In use, signature signal is transmitted on one conductor of electrical cable **140**, applied to patient skin **170** by the signal applicator integrated into the electrode array and received by the plurality of electrodes **172** on the electrode array **167**. The DSP **150A** of the signal processing circuit **150** may compare the received signal to the generated signal to determine the functionality of the electrode array **167** and electrical cable **140**. In the case where all electrodes are receiving a signature signal of poor quality DSP **150A** may compare the plurality of received signals to determine if the poor signal is due to the signal applicator.

[0044] Referring now to **FIG. 4**, programming flowchart **200** illustrates processes executed by the DSP **150A** for performing the functions described herein in accordance with the present disclosure. Cable monitoring apparatus may be configured in a first or second mode of operation prior to executing the steps and the mode of operation and connections may be modified at any time. While the programming flowchart of **FIG. 4** includes multiple embodiments of the present disclosure, the steps executed by the DSP **150A** may be limited to one or more of the various embodiment described herein.

[0045] Step **202** determines if a monitoring signal or sensor is present on an input connector. Various methods of detecting the presence of an input connector may be used such as measuring the impedance of the input or by analyzing the input signal. Sensors may also exhibit a distinct impedance characteristic or may contain a specific identification feature, such as a fixed resistor. Step **204** is executed if the signal or device is not detected on the input.

[0046] Step **204** checks for a cable connected between a input connector and a corresponding diagnostic connector. The presence of a cable between a input connector and a diagnostic connector may be determined by checking continuity, by a sensor detecting the physical presence of a cable or by user input. Step **208**, which resets the diagnostic indicator, is executed if a cable is not detected between the input connectors. Step **216**, which is executed if a cable is detected, performs cable diagnostic and the results of the diagnostics are indicated in Step **212**.

[0047] Returning to Step **202**, if a signal is detected on the input, the diagnostics indicator is reset in Step **218**. The next step in sequence, Step **220**, determines if the user has initiated a zero / re-zero function.

[0048] Zero / re-zero function is executed by Steps **224**, **228**, **232** and **236**. Step **224** resets and starts the zero / re-zero timer. A zero voltage signal is held on the output in Step **228**. If the zero / re-zero timer, in Step **232**, has not exceeded the pre-determined time, the zero / re-zero indicator is turned on in Step **236**, and the zero voltage signal is maintained on the output in Step **228**. When the zero / re-zero timer exceeds the pre-determined time, the zero / re-zero indicator is turned off in Step **240**, and the zero voltage signal is removed from the output in Step

244.

[0049] Returning to Step **220**, if a zero / re-zero function is not performed, the monitoring signal at the input is analyzed in Step **248**. The next step in the sequence, Step **252**, checks for the presence of a signature signal in the monitoring signal. The clinician applies the signature signal transmitter to the patient (not shown in flow chart), in close proximity to the sensor, or to the sensor itself, in order to either check the functionality of the electrical cables and/or the electrical circuits. If the signature signal is present, Step **256** determines various cable and circuit parameters by comparing the received signature signal to the generated signature signal. Step **260** indicates at least one parameters indicative of the functionality of the electrical cable or circuit. Step **264** selectively filters the medical signal and removes at least a portion of the signature signal from the medical signal.

[0050] Next, in Step **268**, the medical signal is analyzed to determine one or more operating features of the medical signal. At least one operating feature is indicated in Step **272** and the medical signal is passed to the output in Step **276**.

[0051] In yet another embodiment, the features, functions and methods of the present disclosure, are incorporated into another electronic device, such as a personal computer, oscilloscope or monitoring device.

[0052] While several embodiments of the disclosure have been shown in the drawings and/or discussed herein, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. Therefore, the above description should not be construed as limiting, but merely as exemplifications of particular embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

Claims

1. A cable monitoring apparatus, which comprises:

a housing including an input interface adapted to electrically connect to one end of a medical cable and an output interface adapted to electrically connect to an electrical system; and signal processing circuitry within said housing for receiving a medical signal from the medical cable via said input interface and for selectively passing the medical signal to the electrical system via said output interface when in a first mode of operation, and having application software for selectively testing functionality of the medical cable when in a second mode of operation.

2. The cable monitoring apparatus according to Claim 1, wherein the medical signal includes at least one monitoring signal selected from a group consisting

- of fetal medical signals and maternal medical signals.
3. The cable monitoring apparatus according to Claim 2, wherein the at least one monitoring signal is generated from a medical device selected from a group consisting of at least one medical electrode, a medical electrode sensor array, an abdominal strain gauge, a tocodynamometer, an intrauterine pressure catheter, and an ultrasound transducer.
 4. The cable monitoring apparatus according to Claim 2, wherein the at least one monitoring signal is generated from a vacuum pressure sensor.
 5. The cable monitoring apparatus according to Claim 2, wherein the at least one monitoring signal is generated from a pulse oximeter.
 6. The cable monitoring apparatus according to Claim 2, wherein the at least one monitoring signal is generated from a pH sensing device.
 7. The cable monitoring apparatus according to Claim 2, wherein the at least one monitoring signal is generated from a sensor selected from a group consisting of a cervical dilation sensor, a cervical effacement sensor and a cervical length sensor.
 8. The cable monitoring apparatus according to Claim 2, wherein the at least one monitoring signal is generated from a fetal station sensor.
 9. The cable monitoring apparatus according to Claim 1, wherein said housing includes a cable diagnostic interface adapted to electrically connect with the remaining end of the medical cable whereby said signal processing circuitry tests the functionality of the medical cable when in said second mode of operation.
 10. The cable monitoring apparatus according to Claim 9, wherein said housing includes at least one indicator for indicating an operating parameter corresponding to functionality of the medical cable.
 11. The cable monitoring apparatus according to Claim 1, wherein said signal processing circuitry is adapted to process the at least one monitoring signal when in said first mode of operation and provides an output signal indicative of an operating parameter of the at least one monitoring signal.
 12. The cable monitoring apparatus according to Claim 11, wherein said output signal is of one of uterine activity or ECG activity.
 13. The cable monitoring apparatus according to Claim 12, wherein said housing includes an output signal indicator associated with said output signal for displaying a condition of said output signal.
 14. The cable monitoring apparatus according to Claim 13, wherein said output signal indicator is one of a visual or an audible alarm.
 15. The cable monitoring apparatus according to Claim 1, wherein said signal processing circuitry is configured to perform a zero / re-zero function wherein the at least one monitoring signal is short-circuited to create a zero voltage signal.
 16. The cable monitoring apparatus according to Claim 15, wherein said signal processing circuitry is adapted to short circuit the at least one monitoring signal for a predetermined period of time.
 17. The cable monitoring apparatus according to Claim 16, further comprising an indicator for indicating that the at least one monitoring signal is short-circuited.
 18. The cable monitoring apparatus according to Claim 1, further comprising a signature signal transmitter adapted to transmit a signature signal to a patient, said signature signal being identifiable by said signal processing circuitry for determining the functionality of the medical cable.
 19. The cable monitoring apparatus according to Claim 18, wherein said signature signal transmitter is selected from a group consisting of a wand, an electrode and a medical cable.
 20. The cable monitoring apparatus according to Claim 2 wherein the housing includes first and second input interfaces for electrical connection to respective first and second medical cables.
 21. A cable monitoring system comprising:
 - a cable monitor operable between a first and a second mode of operation wherein said first mode of operation selectively passes at least one monitoring signal from a medical device to a monitoring apparatus, and wherein said second mode of operation determines the functionality of an electrical cable.
 22. The cable monitoring system according to claim 21, wherein the at least one monitoring signal is selected from a group consisting of fetal medical signals and maternal medical signals.
 23. The cable monitoring system according to claim 22, comprising a first input for receiving the at least one monitoring signal and a first output for selectively

passing the at least one monitoring signal to the monitoring apparatus.

24. The cable monitoring system according to claim 23, comprising a diagnostic input whereby, in the second mode of operation, one end of the medical cable is connected to the first input and a second end of the medical cable is connected to the diagnostic input to thereby determine the functionality of the electrical cable.

25. The cable monitoring system according to claim 24, comprising signal processing circuitry adapted to selectively pass the at least one monitoring signal from the medical device to the monitoring apparatus and to determine the functionality of the electrical cable.

26. A method for fetal monitoring, comprising the steps of:

electrically connecting a medical cable monitor with a fetal monitoring apparatus;

electrically connecting one end of a medical cable to an input interface of the medical cable monitor and the other end of the medical cable to a cable diagnostic interface of the medical cable monitor;

activating the medical cable monitor in one mode of operation whereby signal processing circuitry of the medical cable monitor tests the functionality of the medical cable connected between the input interface and the cable diagnostic interface;

electrically connecting the other end of the medical cable to a sensor;

sensing a fetal parameter with the sensor and sending a fetal monitoring signal associated with the fetal parameter to the input interface of the cable monitor; and

activating the medical cable monitor in another mode of operation whereby the signal processing circuitry passes the fetal monitoring signal to the fetal monitor.

27. The cable monitoring system according to claim 26, where the step of electrically connecting the other end of the medical cable to a sensor includes connecting said medical cable to a sensor selected from the group consisting of at least one medical electrode, a medical electrode sensor array, an abdominal strain gauge, a tocodynamometer, an intrauterine pressure catheter, and an ultrasound transducer.

28. The cable monitoring apparatus according to Claim 26, wherein the step of electrically connecting the other end of the medical cable to a sensor includes connecting said medical cable to a vacuum pressure sensor.

29. The cable monitoring apparatus according to Claim 26, wherein the step of electrically connecting the other end of the medical cable to a sensor includes connecting said medical cable to a pulse oximeter.

30. The cable monitoring apparatus according to Claim 26, wherein the step of electrically connecting the other end of the medical cable to a sensor includes connecting said medical cable to a pH sensing device.

31. The cable monitoring apparatus according to Claim 26, wherein the step of electrically connecting the other end of the medical cable to a sensor includes connecting said medical cable to a sensor selected from a group consisting of a cervical dilation sensor, a cervical effacement sensor and a cervical length sensor.

32. The cable monitoring apparatus according to Claim 26, wherein the step of electrically connecting the other end of the medical cable to a sensor includes connecting said medical cable to a fetal station sensor.

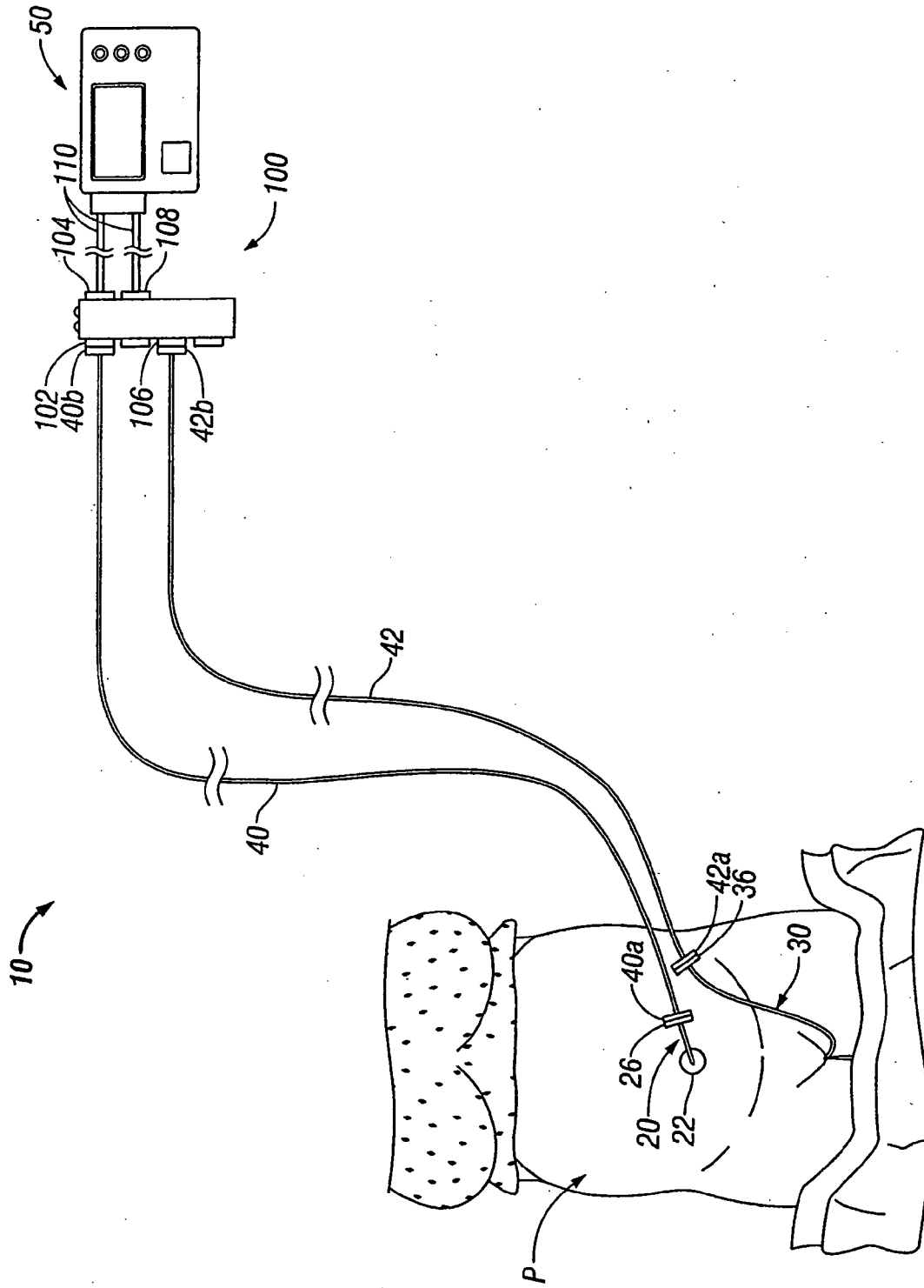


FIG. 1

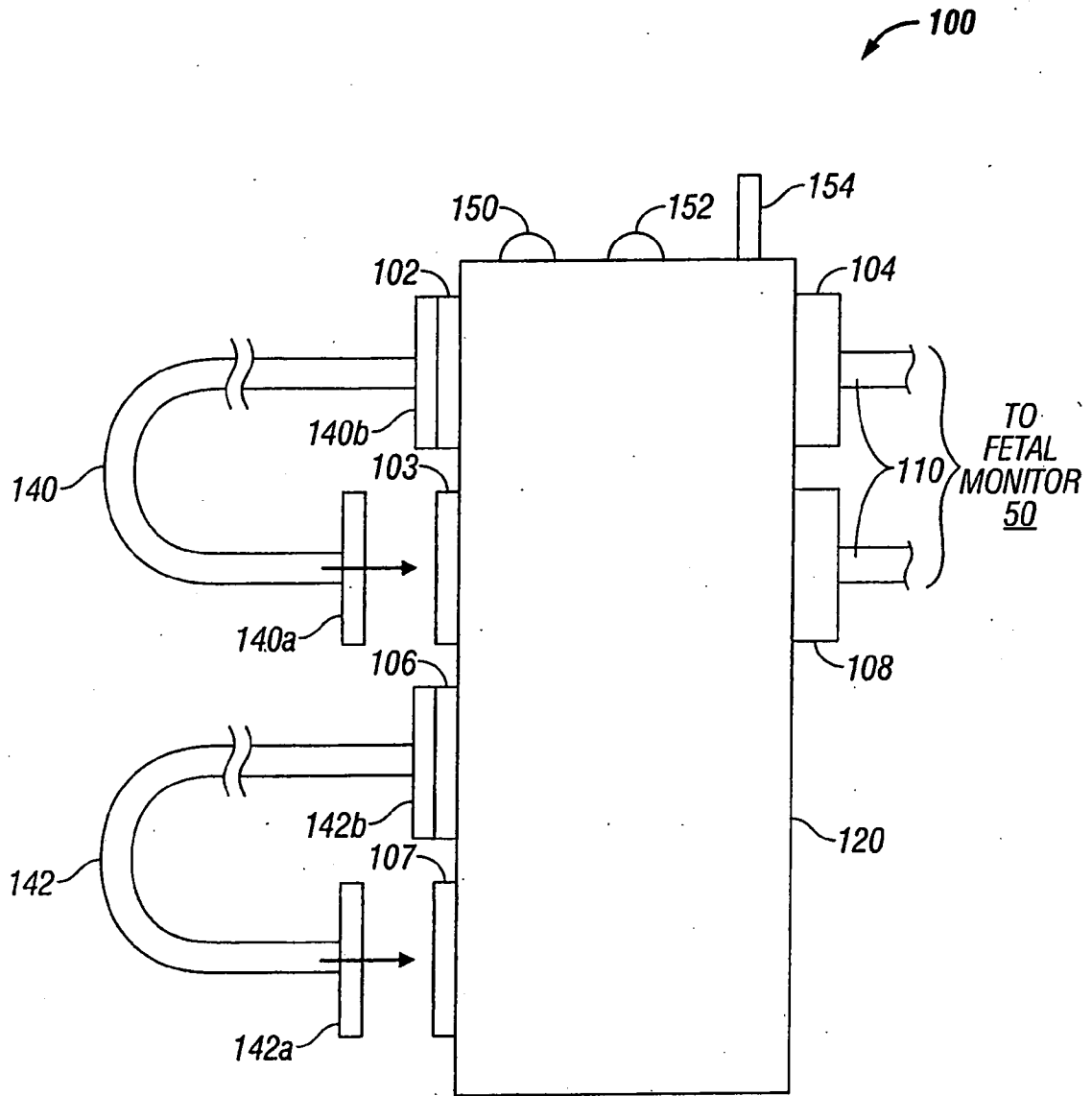


FIG. 2

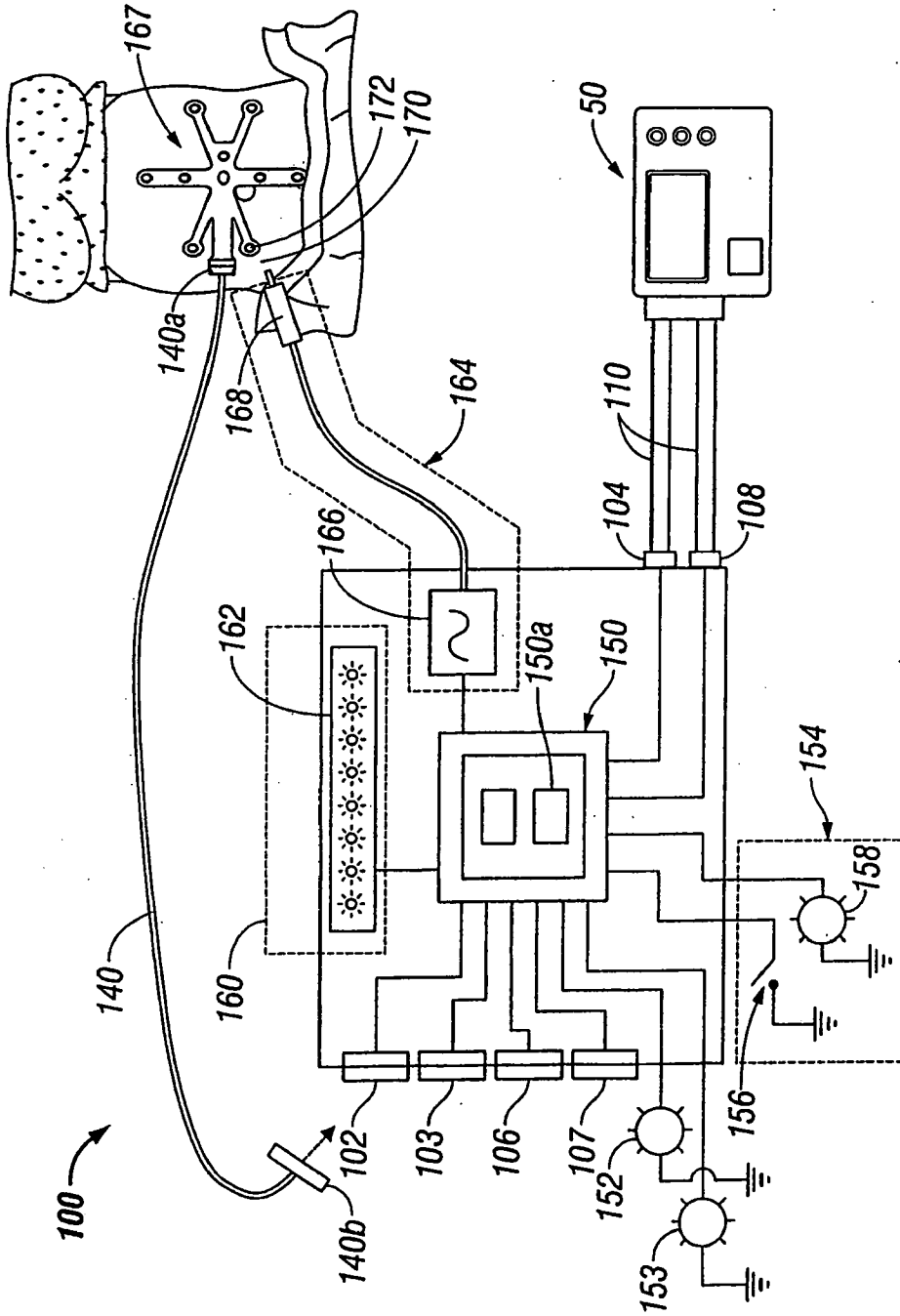


FIG. 3

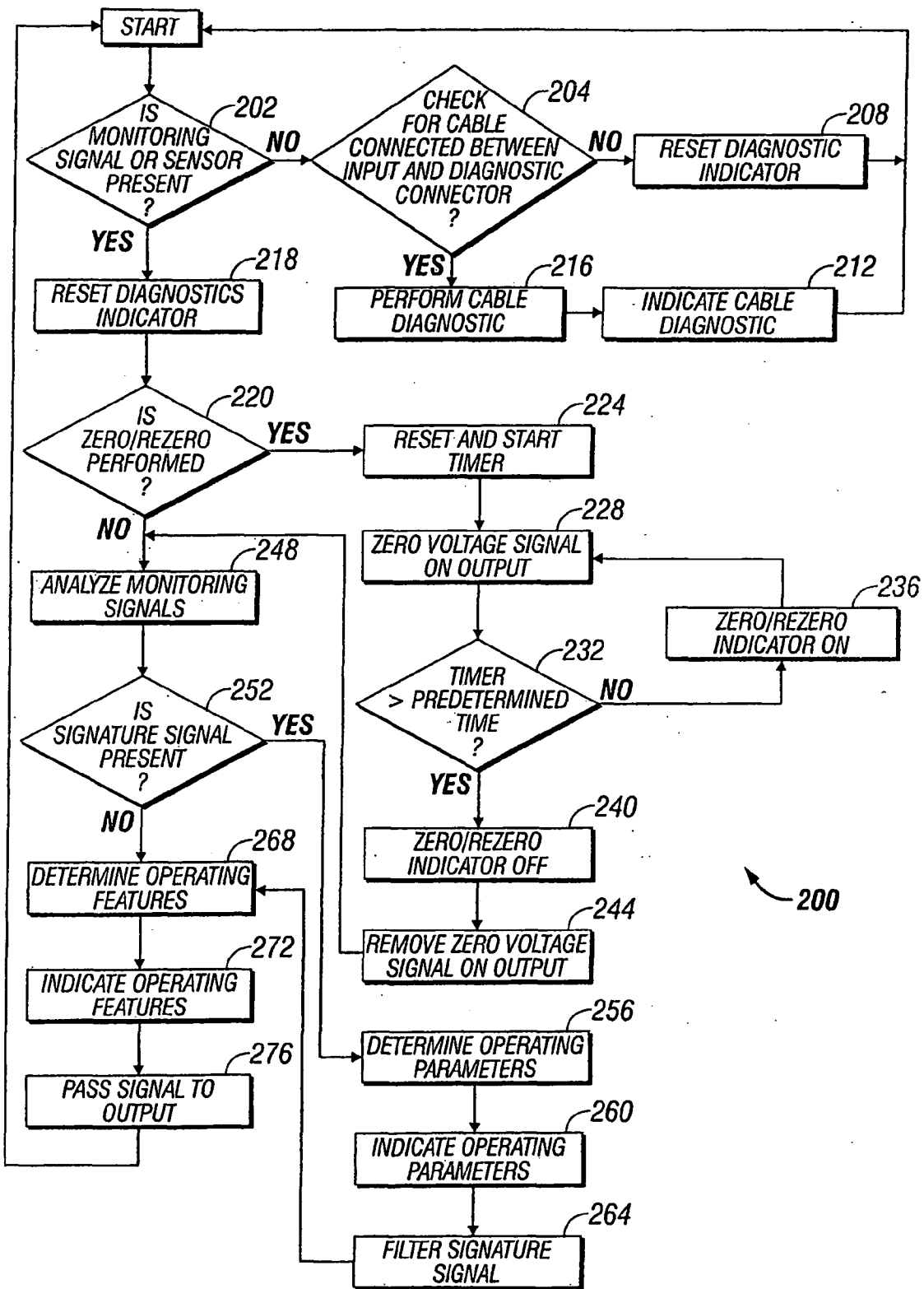


FIG. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 766 946 A (GRAPHIC CONTROLS CORP [US] GRAPHIC CONTROLS CORP) 9 April 1997 (1997-04-09)	1-9,15, 16,20-32	INV. A61B5/00 G01R19/25
Y	* abstract; figure 1 * * column 6, lines 42-57 * * column 14, lines 45-48 * * column 22, line 29 - column 23, line 3; figure 27 * * column 24, lines 9-16 * * column 26 *	10-14,17	H01R13/66
Y	----- US 2006/073728 A1 (ZAIKEN ELIOT J [US] ET AL) 6 April 2006 (2006-04-06)	10-14,17	
A	* abstract; figure 1 * * paragraphs [0023], [0039], [0042] *	1-9,15, 16,18-32	
A	----- US 2002/137997 A1 (MASTROTOTARO JOHN J [US] ET AL) 26 September 2002 (2002-09-26) * the whole document *	1-32	
A	----- US 5 405 269 A (STUPECKY JOSEF J [US]) 11 April 1995 (1995-04-11) * the whole document *	1-32	TECHNICAL FIELDS SEARCHED (IPC) A61B G01R H01R
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 December 2007	Examiner Daniel, Christian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 07 25 3850

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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21-12-2007

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专利名称(译)	电缆监测装置		
公开(公告)号	EP1905353A1	公开(公告)日	2008-04-02
申请号	EP2007253850	申请日	2007-09-27
[标]申请(专利权)人(译)	柯惠有限合伙公司		
申请(专利权)人(译)	泰科医疗集团LP		
当前申请(专利权)人(译)	泰科医疗集团LP		
[标]发明人	MEYER PETER F ZAIKEN ELIOT		
发明人	MEYER, PETER F. ZAIKEN, ELIOT		
IPC分类号	A61B5/00 G01R19/25 H01R13/66		
CPC分类号	A61B5/0011 A61B5/4343 A61B5/4362 A61B2560/0276 A61B2562/222 A61B2562/227 G01R31/50 G01R31/58 H01R13/66 H01R2201/12 H01R2201/20		
优先权	11/528914 2006-09-28 US		
外部链接	Espacenet		

摘要(译)

一种电缆监测装置，包括：壳体，具有适于电连接到医疗电缆一端的输入接口；以及输出接口，适于电连接到电气系统。信号处理电路结合在壳体内，用于接收来自医疗信号的医疗信号。电缆通过输入接口并且当处于第一操作模式时通过输出接口选择性地将医疗信号传递到电气系统，并且具有用于在处于第二操作模式时选择性地测试医疗电缆的功能的应用软件。医学信号可以包括从由胎儿和母体医学信号组成的组中选择的至少一个监测信号。优选地，所述至少一个监测信号由选自包括至少一个医用电极，医用电极阵列，腹部应变仪，分娩力计，子宫内压力导管，超声换能器，真空的医疗装置产生。压力传感器，脉搏血氧仪，pH传感器，宫颈扩张传感器，宫颈消失传感器，宫颈长度传感器，胎儿站传感器和超声换能器。

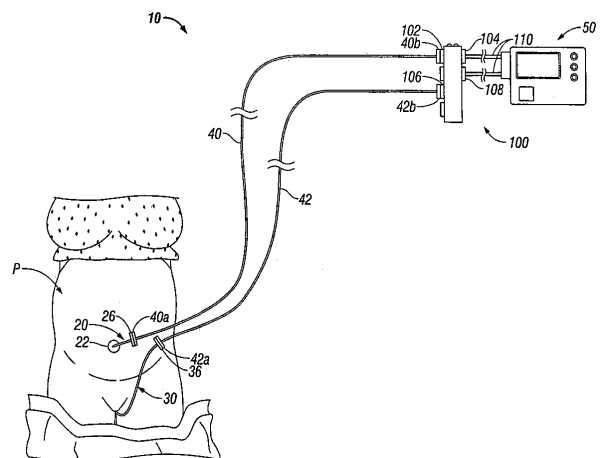


FIG. 1