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(54) **METHOD AND APPARATUS FOR DETERMINING FLOW RATES OF EXCRETED OR SECRETED BODY FLUIDS**

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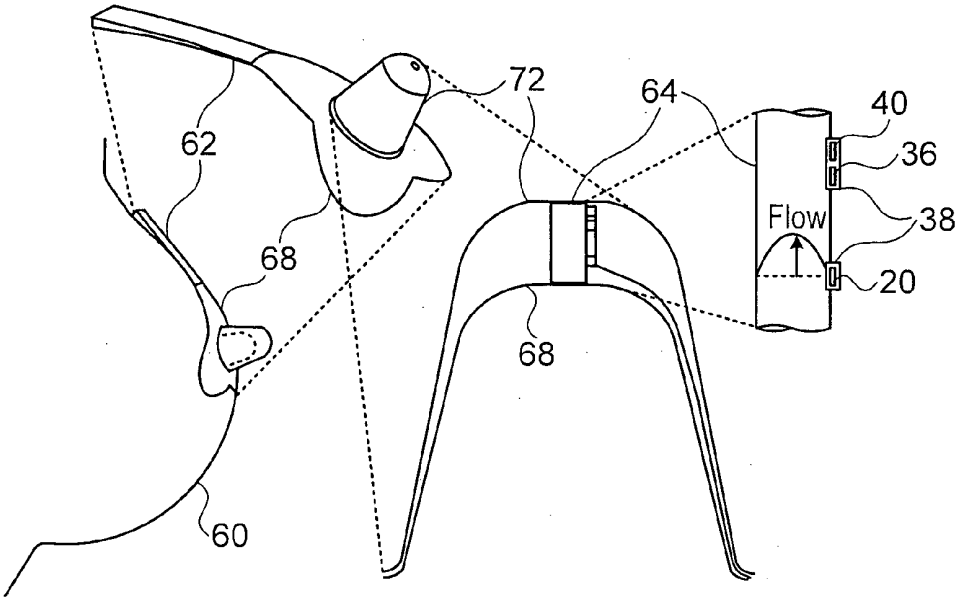
(57) **ABSTRACT**

The invention relates to an apparatus and method to determine and monitor the flow rates and volume of fluids excreted or secreted by the body. The invention achieves the above objects by providing an apparatus comprising; a measuring unit comprising a conduit made of a material having a low thermal conductivity and supporting at least two thermistors; an upstream thermistor serving as a compensation thermistor and a downstream thermistor located as far downstream as possible from said upstream thermistor and pre-heated to and kept at pre-defined temperature which is warmer than the fluid temperature to be metered; and means for applying small electric voltages to the thermistors to enable generation of an electric signal; and a control and display unit being operatively connected to the measuring unit.



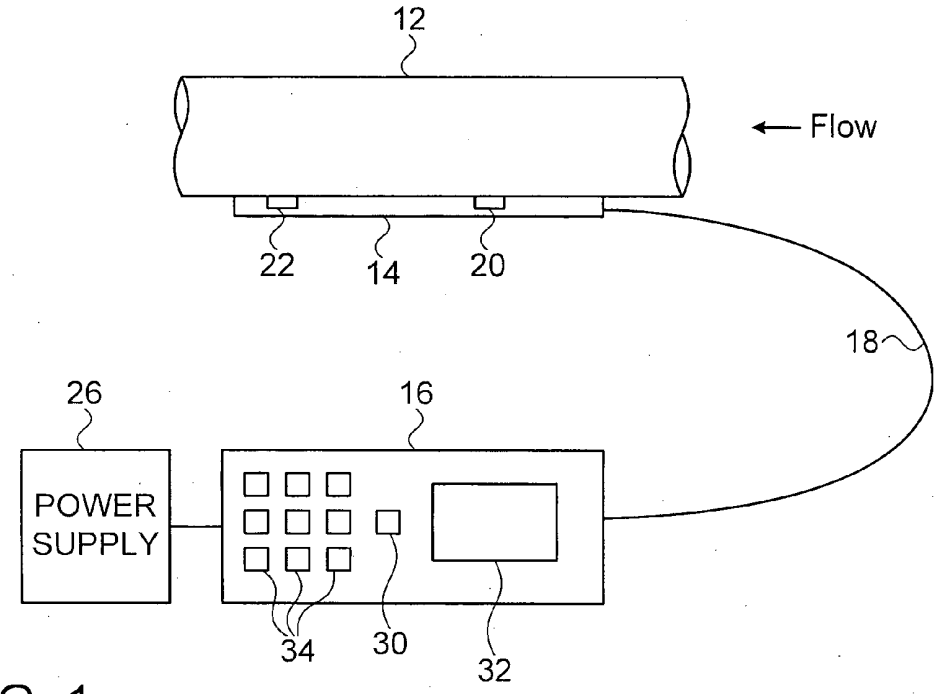


FIG. 1

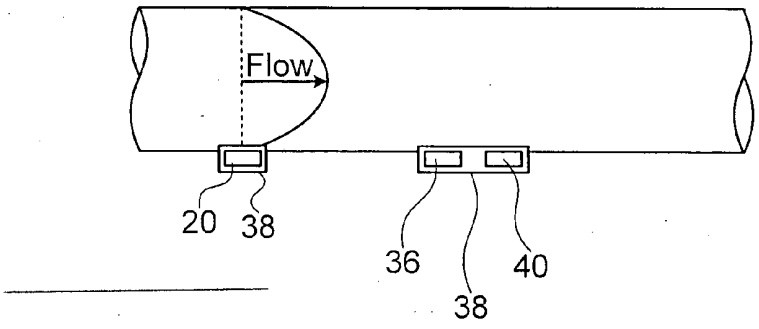


FIG. 2

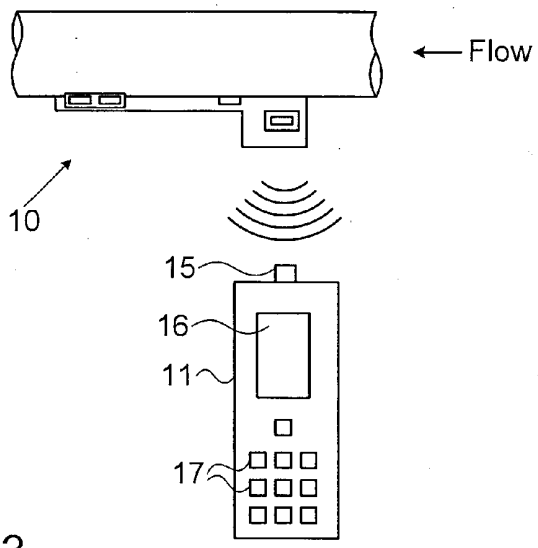


FIG. 3

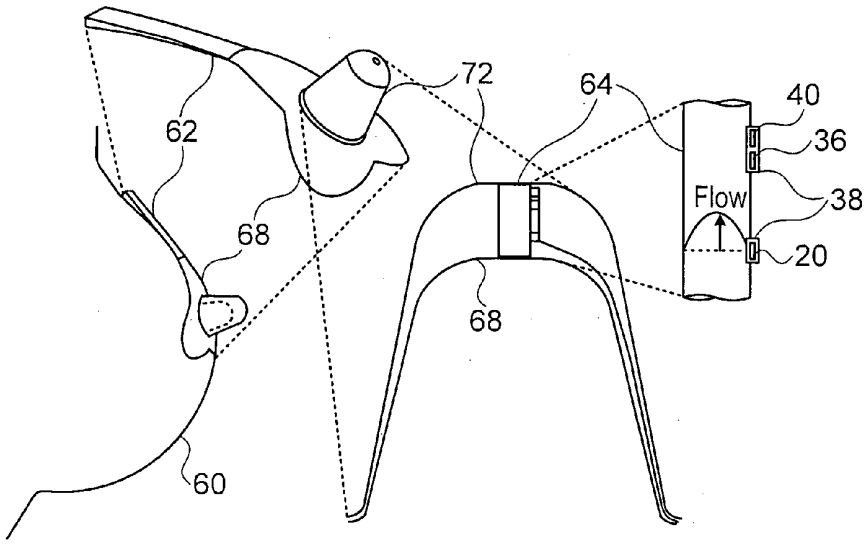
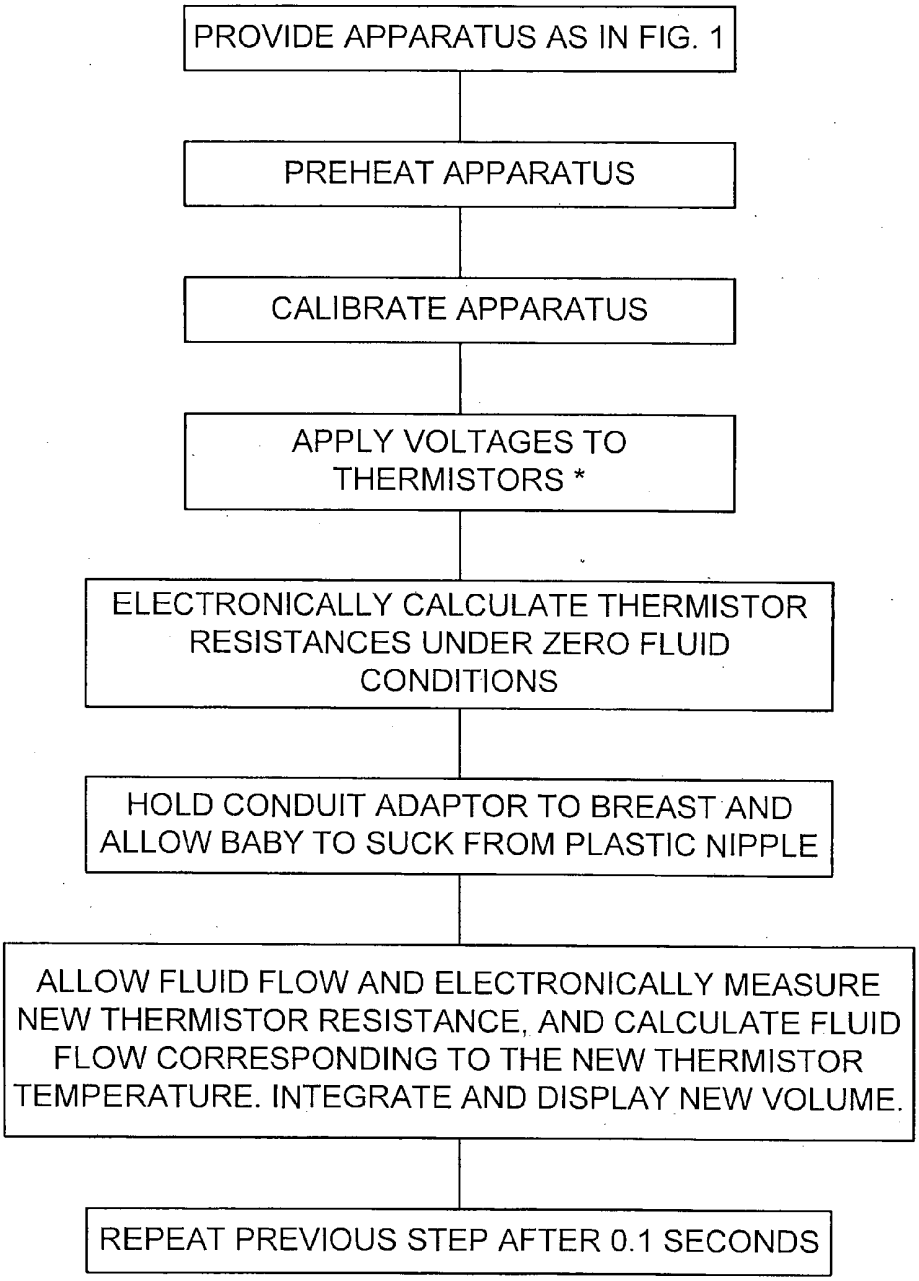
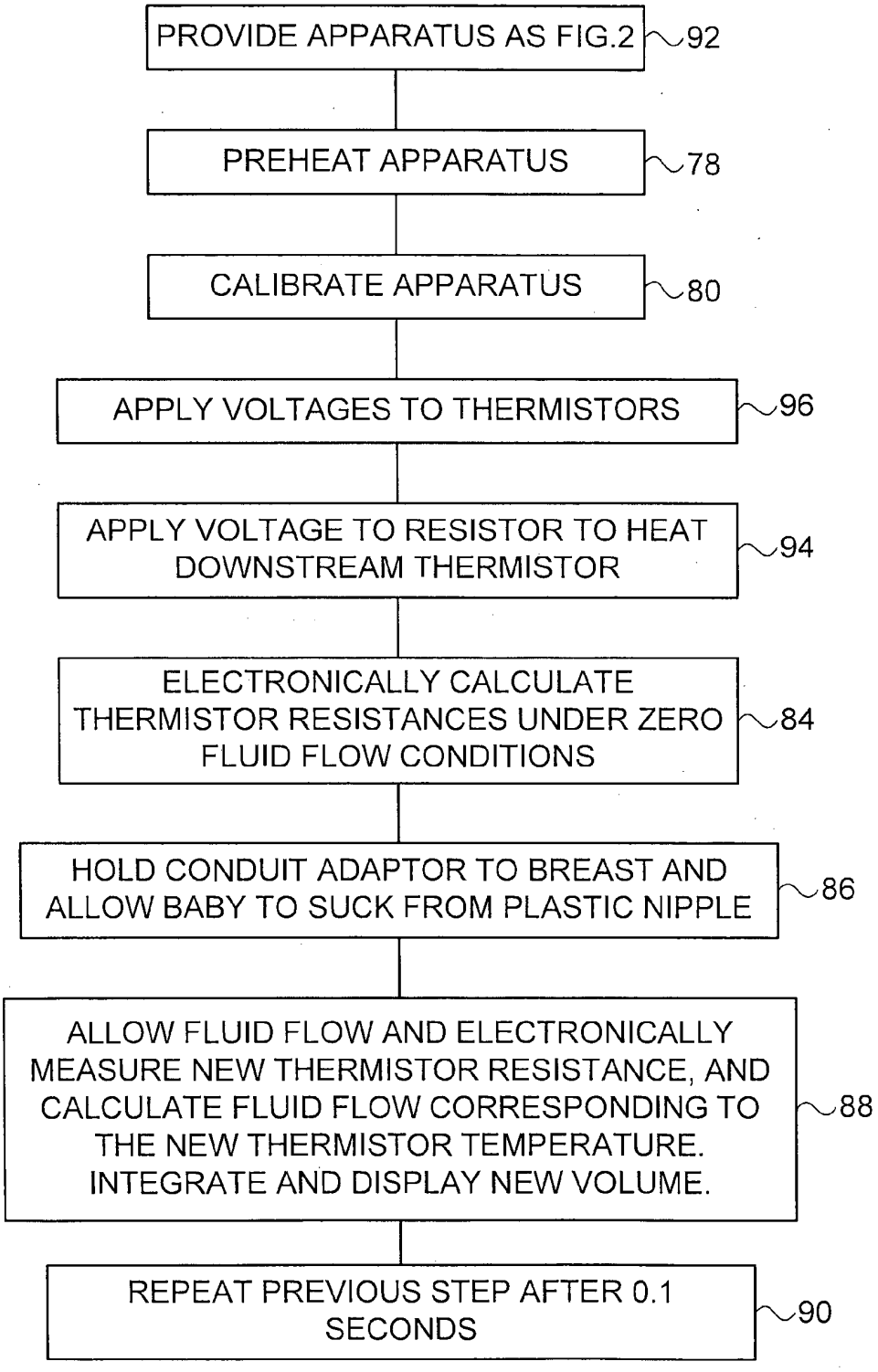


FIG. 4



*APPLY VOLTAGE OVER 15 VOLT TO HEAT DOWNSTREAM THERMISTOR

FIG. 5



* APPLY VOLTAGE OVER 15 VOLT TO HEAT DOWNSTREAM THERMISTOR

FIG. 6

METHOD AND APPARATUS FOR DETERMINING FLOW RATES OF EXCRETED OR SECRETED BODY FLUIDS

FIELD OF THE INVENTION

[0001] The present invention relates to health care products and methods and more particularly to an apparatus and method to determine and monitor the flow rates and volume of fluids excreted or secreted by the body.

DESCRIPTION OF THE RELATED ART

[0002] Body fluids are liquids that are inside the bodies of humans and animals. They include fluids that are excreted or secreted from the body as well as body water that is normally retained inside the body. Excretion is the process of eliminating waste products of metabolism and other superfluous substances. It is an essential process in all forms of life. In contrast is secretion, where the fluid may have specific tasks after leaving the cell or organ.

[0003] An example of excretion can be found in the urinary system, where the urinary bladder is the excreting organ and the urine is the excreted fluid. An example of secretion can be found in lactation, where the mammary glands are the secreting organ and the fluid is milk ideally suited to babies.

[0004] The functioning of organs that perform the secretion and excretion of fluids can be diagnosed and studied by measuring the flow rate of the fluid. Current devices and methods for measuring flow rates of e.g., urine and breast fluid are based on weighing the accumulated fluid in a defined unit of time (1 minute, 24 hours, etc.). Urine flow rate is measured by uroflowmeters and lactation is measured by test weighing of babies.

[0005] These current procedures require rather sensitive and thus expensive scales. They also require the presence of the subject in a clinic—test-weighing, for instance, is done by weighing the subject (a baby) before a breastfeeding session as well as during and immediately after the session, for a period of 24 hours.

[0006] There are many fluid flow-meters on the market, but none are known which can be used to meet the exceptional challenges posed by lactation. A first difficulty lies in the direct transfer of the fluid from the breast of the woman nursing directly to the mouth of a baby, leaving no room for instrumentation. A second difficulty is the intermittent nature of the flow. Thirdly the actual flow rate is of little interest—the data required is usually the volume of milk drunk by a baby under special care.

[0007] A search of US patents and patent applications produced patents 5,571,226 to Palmer and 6,358,226 to Ryan which disclose electrically operated means for lactation, the milk being received in a container. Measuring a baby's consumption could be effected by pouring the extracted milk from these devices into the widely used graduated baby bottle, which allows convenient monitoring of the baby's fluid intake. These devices require considerable power, the bulk of the apparatuses is cumbersome in mobile use, and the transfer of the milk from a first container to a second container is less hygienic than direct fluid passage from the woman to the baby.

OBJECT OF THE INVENTION

[0008] An object of the present invention is therefore to solve the above discussed problems and to provide an inexpensive device and method of measuring the rate and quantity of fluids secreted or excreted by the body, particularly milk being ingested from the breast by an infant.

[0009] It is a further object of the invention to provide a device which can be operated by non-medical persons in a private home without expert medical help.

SUMMARY OF THE INVENTION

[0010] The present invention achieves the above objects by providing an apparatus for determining the flow rate and amount of a selected secreted or excreted body fluid, comprising:

[0011] a) a measuring unit comprising a conduit made of a material having a low thermal conductivity and supporting at least two thermistors; an upstream thermistor serving as a compensation thermistor and a downstream thermistor located as far downstream as possible from said upstream thermistor and pre-heated to and kept at pre-defined temperature which is warmer than the fluid temperature to be metered;

[0012] b) means for applying small electric voltages to said thermistors to enable generation of an electric signal, said electric voltages flowing through said upstream thermistor being sufficiently low to prevent substantial heating of said thermistor; and

[0013] c) a control and display unit being operatively connected to said measuring unit, said control unit including means for calculating the difference between the electrical resistance of said upstream and said downstream thermistors and then calculating the flow rate based on the electrical resistance difference being a function of the body fluid flow rate and then calculating the accumulated amount of fluid based on the internal cross section of said conduit in which said fluid flows; and comprising a display for displaying the flow rate (optionally) and displaying the accumulating volume of body fluid being metered.

[0014] In a preferred embodiment of the present invention there is provided an apparatus further comprising a heating element, thermally coupled to said downstream thermistor and distant from said upstream compensation thermistor, said heating element heating said downstream thermistor and maintaining said downstream thermistor in a pre-defined temperature range.

[0015] An alternative embodiment of the apparatus further comprises a heating element, thermally coupled to said downstream thermistor and distant from said upstream compensation thermistor, said thermistors and heating element being supplied with a fixed constant regulated level of electric power.

[0016] In a further preferred embodiment of the present invention there is provided an apparatus wherein said heating element has a low electrical resistance and is powered by a low voltage power supply, the combination of which is sufficient to maintain said downstream thermistor at said constant pre-defined temperature.

[0017] In another preferred embodiment of the present invention there is provided an apparatus wherein said heating element is thermally coupled to said downstream thermistor by means of a heat conducting material.

[0018] In a further preferred embodiment of the present invention there is provided an apparatus wherein said connector means for interconnecting said control and display unit to said measuring unit comprises a connection selected from

the group comprising electronic circuitry, a data and power communication cable, and an electromagnetic transmitter/receiver.

[0019] In a further preferred embodiment of the present invention there is provided an apparatus for determining the flow rate and amount of milk passing from the breast of a woman to a baby, comprising

[0020] a) a measuring unit having a short conduit containing at least two thermistors ;

[0021] b) an adaptor arranged to fit and retain contact with the nipple area of the breast, said adaptor being attached to an upstream extremity of said short conduit;

[0022] c) a baby nipple attached at a downstream extremity of said conduit; and

[0023] d) a control and display unit as seen in FIG. **1** operatively connected to said measuring unit.

[0024] In another preferred embodiment of the present invention there is provided a method for determining the flow rate and amount of secreted or excreted body fluid, comprising the following steps:

step a) providing an apparatus a detail of which is seen in FIG. **2**;

step b) applying a voltage of about 15-50 volt across said downstream thermistor to serve as an integral heat source, the temperature of said downstream thermistor being held constant at about 39-45 degrees C.;

step c) applying a low voltage of about 2-6 volts across said upstream thermistor to generate a electric measurement varying with the fluid flow with which said downstream thermistor is in direct thermal contact;

step d) preheating said apparatus;

step e) introducing the body fluid to be monitored into the upstream extremity of said conduit; and

step g) several times per second measuring the electric current flowing through both of said thermistors, and calculating the difference between said currents, and calculating the fluid flow rate as a function of thermistor resistance while using a memory component to effect corrections as required for any particular unit, and integrating the series of values over time to arrive at the increasing volume of fluid having passed through said conduit and displaying the value of said volume.

[0025] In a most preferred embodiment of the present invention there is provided a method for determining the flow rate and amount of secreted or excreted body fluid except that in step c) said voltage applied across said downstream thermistor is less than **15** volts and heating of said downstream thermistor is effected by a resistance element in close thermal contact with said downstream thermistor and with said body fluid.

[0026] The use of thermistors ensures high sensitivity through large resistance change (negative change—for NTC thermistor, or positive change—for PTC thermistors) and corresponding large voltage signal for small changes in their temperature, induced by the fluid, at no-flow situation or during constant or varying flow rates. As such, the use of thermistors is preferable, but other electrical resistance elements, presenting resistance change over temperature, can also be used.

[0027] It will thus be realized that the novel device of the present invention serves to provide an apparatus and a method are provided for determining the flow rate and amount of secreted or excreted body fluids. The apparatus includes a measuring unit and a control and display unit. Depending on the required configuration of the apparatus, a connector cable, an electronic circuitry, a data communication cable, or electromagnetic transmitter/receiver, may be used for connecting the measuring unit to the control and display unit.

[0028] The measuring unit may comprise a set of two or three electrical components—two thermistors (NTC or PTC) or a resistor and two thermistors (NTC or PTC), mounted, in direct contact with the fluid, within the wall of a conduit that defines an outlet through which the fluid passes.

[0029] The display means may comprise a liquid crystal or similar display, and/or may be adapted to print a graphical representation of the data received from measuring unit.

[0030] The display means may also include a number of keys for entering data (e.g. the name of the subject, his age, etc.) or for selectively display of the flow rate or amount of fluid per measuring session, the accumulating amount of fluid in several measuring sessions, and previously measured fluid flow rates or accumulated amounts.

[0031] Thus, the apparatus according to the invention provides the subject, in real time, with an indication of the volume of fluid that is excreted or secreted from the body. It would accordingly no longer be necessary to follow the cumbersome weighing process mentioned hereinbefore.

[0032] The invention will now be described further with reference to the accompanying drawings, which represent by example preferred embodiments of the invention. Structural details are shown only as far as necessary for a fundamental understanding thereof. The described examples, together with the drawings, will make apparent to those skilled in the art how further forms of the invention may be realized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] In the drawings:

[0034] FIG. **1** is a diagrammatic view of a preferred embodiment of the apparatus according to the invention;

[0035] FIG. **2** is an enlarged sectional view of a part of the apparatus having an auxiliary heating element;

[0036] FIG. **3** is a schematic view of an embodiment wherein the measuring unit is connected to the control and display unit by a radio or infrared link;

[0037] FIG. **4** is a sectional view of an apparatus arranged for monitoring lactation;

[0038] FIG. **5** is a diagram of a method which operates without any auxiliary heater; and

[0039] FIG. **6** is a diagram of a method which operates with an auxiliary heater at low voltage.

DETAILED DESCRIPTION OF THE INVENTION

[0040] There is seen in FIG. **1** an apparatus **10** for determining the flow rate and amount of a selected secreted or excreted body fluid passing through a conduit **12**. The apparatus **10** comprises a measuring unit **14** , a control and display unit **16**, a data and power link **18** interconnecting these units, and a power supply **26**, which can be integral to the control and display unit **16**.

[0041] The measuring unit **14** comprising a conduit **12** made of a material having a low thermal conductivity and supporting two thermistors **20**, **22**. The conduit **12** is made of a grade suitable for the transmission of the measured fluid, e.g., food grade material for lactation measurement. The low thermal conductivity of the conduit material allows for reducing the heat loss from the heated thermistor **22** to the environment and thus allows effective heat transfer from the electrical components **20**, **22**, directly to the measured fluid.

[0042] The upstream thermistor **20** serves as a compensation thermistor. The electrically heated downstream thermistor **22** is wired in parallel to the upstream thermistor. The thermistors **20**, **22** are located as far away as possible from each other. The downstream thermistor **22** is cooled by the body fluid flowing through the conduit **12**, and is held at pre-defined temperature which is about 2-8 degrees warmer than the temperature of the body fluid being metered. Preferably, both thermistors **20**, **22** are surface mounted devices mounted on a flexible printed circuit board **24** seen in FIG. **2**. Both thermistors **20**, **22** are mounted in direct contact with the fluid within the conduit **12** through which the body fluid passes.

[0043] With regard to applying electric voltages to the thermistors **20**, **22** to enable the generation of an electric signal, in the present embodiment the needed power can be supplied by a multi-voltage transformer/rectifier **26** or a similar power supply which is arranged to provide over 15 volt to the downstream thermistor. The precise voltage is arranged to be sufficient to heat the thermistor between 2 and 8 degrees C. above the temperature of the body fluid being metered. Thus there is no requirement for an auxiliary heater.

[0044] The control and display unit **16** is operatively connected to the measuring unit **14** in the present embodiment by means of a flexible cable **18**.

[0045] The control and display unit **16** includes means for calculating the difference between the electrical signals from the upstream and the downstream thermistors **20**, **22** and then calculating the fluid flow rate based on these values. The difference between the two values is a function of the body fluid flow rate. The control unit **16** then calculates the accumulated amount of fluid which has passed through the conduit by an integration function based on the internal cross section of the conduit **12** in which the fluid flows.

[0046] The electrical signal of the upstream compensation thermistor **20** will relate to the temperature of the fluid. This value is deducted from the electrical signal value registered by the downstream measuring thermistor **22**. The compensated electrical signal value registered by the downstream measuring thermistor is an independent signal that is free of the influence of temperature changes of the fluid. Keys **34** are provided to enable users to enter data such as the name of the baby, date and time etc.

[0047] These calculations are easily performed by a microprocessor **30** located in the control and display unit **16**. Readings are taken and processed many times per second. The microprocessor **30** uses these readings and the calibration data in the memory component of the measuring unit to convert the signal to flow data. The flow data is then integrated over time to give the accumulating amount of fluid which has passed through the conduit, based on the cross section area thereof. This value is then shown on the LCD display **32**. Optionally the display **32** also shows the flow rate. In the present higher voltage apparatus, the temperature rise is induced by applying a voltage directly to the thermistor **22**. The thermistor **32** is encapsulated using a highly thermally conductive compound **38**, seen in FIG. **2**, for electrically isolating the thermistor from the fluid, while being in direct contact with it.

[0048] With reference to the rest of the figures, similar reference numerals have been used to identify similar parts.

[0049] Referring now to FIG. **2**, there is seen an apparatus **38** further comprising a heating element **36**, which is thermally coupled to the downstream thermistor **22** and distant from the upstream compensation thermistor **20** seen in FIG. **1**. Using a separate resistor **36** for heating purposes, allows use of a high resistance thermistor **40** for flow measurement. The use of a separate heating resistor also eliminates the self heating effects of the thermistor **40**, and allows a low current electrical circuit to be used to generate the electric signal from the thermistor **40**.

[0050] The heating element **36** raises the temperature of the downstream thermistor **40**, and maintains the downstream thermistor in a pre-defined temperature range. The precise voltage is arranged to be sufficient to heat the thermistor between 2 and 8 degrees C. above the temperature of the body fluid being metered.

[0051] Alternatively the downstream thermistor **40** is provided with a controlled quantity of power, and fluid flow is calculated from the temperature loss of the thermistor **40**. As will be seen in FIG. **4**, with regard to applying small electric voltages to the thermistors **20**, seen in FIG. **1**, and the thermistor **40** to enable the generation of an electric signal, in the present embodiment the needed power can be supplied by batteries **42** which are small enough to be housed in the control and display unit **44**. It should be noted that the electrical signal generated by the thermistor **20** is required to be sufficiently low to prevent substantial heating thereof, while maintaining the downstream thermistor at the constant predefined temperature.

[0052] Preferably the heating element **36** is thermally coupled to the downstream thermistor **40** by means of a heat conducting material, for example copper. When there is a flow of a body fluid the electric signal value received from the upstream compensation thermistor **20** will register the value that corresponds to the temperature of the body fluid, while the electric signal obtained from the downstream measuring thermistor **40** will change as a function of the flow rate—the higher the flow rate the larger the change. The heating element **36** provides heat to this thermistor **40**, to return same to its original value after flow ceases.

[0053] The electrical signal values of the thermistors **20**, **40** when in use, which in turn represent thermistor temperature, and the reduction of temperature on the downstream thermistor **40** indicates the flow rate of the body fluid which acts as a coolant.

[0054] FIG. **3** illustrates an apparatus **46** wherein the means for interconnecting the control and display unit **48** to the measuring unit **50** comprises an electromagnetic transmitter/receiver **52**, **54**.

[0055] Electric power is preferably supplied by batteries **42** in the measuring unit **50**, while either batteries or a transformer/rectifier supply power **26** is contained in the control and display unit **48**.

[0056] Seen in FIG. **4** is an apparatus **58** adapted for the specific purpose of determining the flow rate and amount of milk passing from the breast **60** of a woman to a baby (not shown).

[0057] A measuring unit **62** has a short conduit **64** containing two thermistors **20**, **22** as described with reference to FIG. **1**. This unit **62** is held in position by a vest, a bra or a special belt **66** which is arranged to support the measuring unit **62**.

[0058] A flexible adaptor **68** is arranged to fit and retain contact with the nipple area of the breast **60**, the adaptor **68** being attached to the upstream extremity **70** of the short conduit **64**.

[0059] An elastomer baby nipple **72** is attached at a downstream extremity **74** of the conduit **64**.

[0060] The adaptor **68** and nipple **72** can be molded as an integrated unit.

[0061] A control and display unit **16** as described with reference to FIG. **1** is operatively connected to the measuring unit **62** by a cable **18**.

[0062] Referring now to FIG. **5**, there is depicted diagrammatically a method for determining the flow rate and amount of secreted or excreted body fluid, comprising the following steps:

[0063] STEP a) providing an apparatus as seen in FIG. **1**. **76**

[0064] As minor variations occur during the production process of the measuring unit, and since each electronic component in the measuring unit is inherently different, a calibration of this unit is required. A memory component (e.g., EPROM) may be used to store calibration data. The calibration data should represent the true resistance-temperature data of the components in the measuring unit.

[0065] STEP b) applying a voltage **82** of about 15—50 volt across the downstream thermistor to serve as an integral heat source, **82** the temperature of the downstream thermistor being held constant at about 39-45 degrees C., or the thermistor being supplied with a precisely constant regulated power level;

[0066] Using the available calibration data, stored in the memory component of the measuring unit the electrical signal generated on the thermistors can then be corrected and used for calculating the flow rate. This is done by the microprocessor (or microcontroller) inside the control and display unit in which a pre-defined table (or equation) is stored, representing the specific electrical signal that corresponds to the specific flow rate.

[0067] STEP c) applying a voltage **82** of about 2-6 volts across the upstream thermistor to generate an electric signal varying with the fluid flow with which the downstream thermistor is in direct thermal contact;

[0068] STEP d) preheating **78** of the apparatus;

[0069] The pre-heating is essential for eliminating transient phenomena of resistance change of the thermistor when the flow starts and it allows for measurement to start immediately at the start of the flow. The apparatus can thus continuously measure the fluid flow (usually non stable, or oscillating flow), from start, based on small changes from a baseline resistance of the thermistor, corresponding to the pre-defined temperature. These small changes correspond to the fluid flow, and allow fast response of the measuring unit.

[0070] The correct pre-heating of the resistor, or the thermistor, should be determined based on the fluid to be measured (for e.g. retaining the original characteristics of the fluid, maintaining the overall original temperature of the fluid, etc.) and based on the thermal behavior of the thermistor e.g., the resistance-temperature behavior at the relevant temperature ranges, the maximum allowed power over the component, etc.

[0071] For example, the initial temperature of the thermistor in a lactation measurement apparatus may be predefined to be between 39-45° C., based on the fact that the breast milk exits the body at 35-37° C. at the skin surface, and based on need to maintain the overall temperature of the fluid in human-relevant temperatures.

[0072] STEP e) introducing the body fluid **86** to be monitored into the upstream **88** extremity of the conduit; and

[0073] STEP g) 10-200 times per second measuring **90** the voltage over both of the thermistors, and calculating the difference between the voltages, and calculating **84** the fluid flow rate as a function of the downstream's thermistor's compensated voltage while using a memory component to effect corrections as required for any particular unit, and integrating the series of values over time to arrive at the increasing volume of fluid having passed through the conduit and displaying the value of the volume.

[0074] FIG. **6** represents a second method for determining the flow rate and amount of secreted or excreted body fluid. The second method **78-96** is similar to that described with reference to FIG. **5** except that the downstream thermistor is heated **94** by an electric resistance element. The advantage of this arrangement is in obviating the need to apply a higher voltage to the downstream thermistor.

[0075] Accordingly in STEP c) the voltage applied **96** across the downstream thermistor is less than 15 volts and heating of the downstream thermistor is effected by said resistance element in close thermal contact with the downstream thermistor and with the body fluid.

[0076] The temperature of the thermistor should preferably be raised, by pre-heating of the heating element (resistor or thermistor itself) to several degrees higher than the expected temperature of the fluid, prior to the measurement starting point. Either the downstream thermistor is kept at this predefined constant temperature, by starting and stopping the power supply to the heating element based on the resistance value of the thermistor that corresponds to its temperature, or this thermistor is supplied with a precisely constant power level.

[0077] Using the available calibration data, stored in the memory component of the measuring unit the electrical signal generated on the thermistors is then corrected and used for calculating the flow rate. This is done by the microprocessor (or microcontroller) inside the control and display unit in which a pre-defined table (or equation) is stored, representing the specific voltage signal that corresponds to the specific flow rate.

[0078] The scope of the described invention is intended to include all embodiments coming within the meaning of the following claims. The foregoing examples illustrate useful forms of the invention, but are not to be considered as limiting its scope, as those skilled in the art will be aware that additional variants and modifications of the invention can readily be formulated without departing from the meaning of the following claims.

1. An apparatus for determining the flow rate and amount of a selected secreted or excreted body fluid, comprising:

a) a measuring unit comprising a conduit made of a material having a low thermal conductivity and supporting at least two thermistors; an upstream thermistor serving as a compensation thermistor and a downstream thermistor located as far downstream as possible from said upstream thermistor and pre-heated to a temperature which is warmer than the fluid temperature;

b) means for applying constant small electric voltages to said thermistors to enable generation of electric signals, said signals flowing through said upstream thermistor being sufficiently low to prevent substantial heating of said thermistor; and

c) a control and display unit being operatively connected to said measuring unit, said control unit including means for calculating the difference between the electrical resistance of said upstream and said downstream thermistors and then calculating the flow rate based on the electrical signal difference, the flow rate being a func-

tion of the body fluid flow rate and then calculating the accumulated amount of fluid based on the internal cross section of said conduit in which said fluid flows; and comprising a display for displaying the flow rate and displaying the accumulating volume of body fluid.

2. The apparatus as claimed in claim **1**, further comprising a heating element, thermally coupled to said downstream thermistor and distant from said upstream compensation thermistor, said heating element heating said downstream thermistor and maintaining said downstream thermistor in a predefined temperature range.

3. The apparatus as claimed in claim **1**, further comprising a heating element, thermally coupled to said downstream thermistor and distant from said upstream compensation thermistor, said thermistors and heating element being supplied with a fixed constant regulated level of electric power.

4. The apparatus as claimed in claim **2** wherein said heating element has a low electrical resistance and is powered by a low voltage power supply, the combination of which is sufficient to maintain said downstream thermistor at said constant pre-defined temperature.

5. The apparatus as claimed in claim **2**, wherein said heating element is thermally coupled to said downstream thermistor by means of a heat conducting material.

6. The apparatus as claimed in claim **1** wherein said connector means for interconnecting said control and display unit to said measuring unit comprises a connection selected from the group comprising electronic circuitry, a data and power communication cable, and an electromagnetic transmitter/receiver.

7. An apparatus for determining the flow rate and amount of milk passing from the breast of a woman to a baby, comprising

a) a measuring unit having a short conduit containing at least two thermistors as claimed in claim **1**;

b) an adaptor arranged to fit and retain contact with the nipple area of the breast, said adaptor being attached to an upstream extremity of said short conduit;

c) a baby nipple attached at a downstream extremity of said conduit; and

d) a control and display unit as claimed in claim **1**, operatively connected to said measuring unit.

8. (canceled)

9. A method for determining the flow rate and amount of secreted or excreted body fluid, comprising the following steps:

step a) providing an apparatus according to claim **1**;

step b) applying a voltage across said downstream thermistor to serve as an integral heat source, the temperature of said downstream thermistor being held constant at about 39-45 degrees C.;

step c) applying a voltage of about 2-6 volts across said upstream thermistor to generate an electric signal varying with the fluid flow with which said downstream thermistor is in direct thermal contact;

step d) preheating of said apparatus;

step e) introducing the body fluid to be monitored into the upstream extremity of said conduit; and

step g) 10-200 times per second measuring the voltage over both of said thermistors, and calculating the difference between these electric signals, and calculating the fluid flow rate as a function of the compensated electric signal while using a memory component to effect corrections as required for any particular unit, and optionally integrating the series of values over time to arrive at the increasing volume of fluid having passed through said conduit and displaying the value of said volume.

10. The method for determining the flow rate and amount of secreted or excreted body fluid as claimed in claim **9**, wherein said voltage applied across said downstream thermistor is less than 15 volts and heating of said downstream thermistor is effected by a resistance element in close thermal contact with said downstream thermistor and with said body fluid.

11. The method according to claim **9** wherein said voltage applied across said downstream thermistor is approximately 15-50 volts.

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专利名称(译)	用于确定排泄或分泌的体液的流速的方法和设备		
公开(公告)号	US20130096461A1	公开(公告)日	2013-04-18
申请号	US13/636718	申请日	2011-03-10
[标]申请(专利权)人(译)	SELLA约阿夫		
申请(专利权)人(译)	蝶鞍，约阿夫		
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摘要(译)

本发明涉及一种确定和监测由身体排泄或分泌的流体的流速和体积的装置和方法。本发明通过提供一种装置实现上述目的：测量单元，包括由导热率低的材料制成的导管，并支撑至少两个热敏电阻;上游热敏电阻，用作补偿热敏电阻，下游热敏电阻位于尽可能远离所述上游热敏电阻的下游，并预热至并保持在预定温度，该温度比待计量的流体温度更热;以及用于向热敏电阻施加小电压以产生电信号的装置;控制和显示单元可操作地连接到测量单元。