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An agency of Industry Canada

CA 2700372 A1 2009/04/23

(21) 2 700 372

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2008/10/20
(87) Date publication PCT/PCT Publication Date: 2009/04/23
(85) Entrée phase nationale/National Entry: 2010/03/19
(86) N° demande PCT/PCT Application No.: US 2008/080503
(87) N° publication PCT/PCT Publication No.: 2009/052496
(30) Priorité/Priority: 2007/10/18 (US60/980,908)

(51) Cl.Int./Int.Cl. *A61M 1/00* (2006.01)

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(54) Titre : SYSTEME D'ASPIRATION PERMETTANT D'ELIMINER UN LIQUIDE EVACUE PAR LE CORPS HUMAIN, ET CAPTEUR DE LIQUIDE POUR CELUI-CI

(54) Title: ASPIRATION SYSTEM FOR REMOVING URINE DISCHARGED BY THE HUMAN BODY, AND LIQUID SENSOR THEREFOR

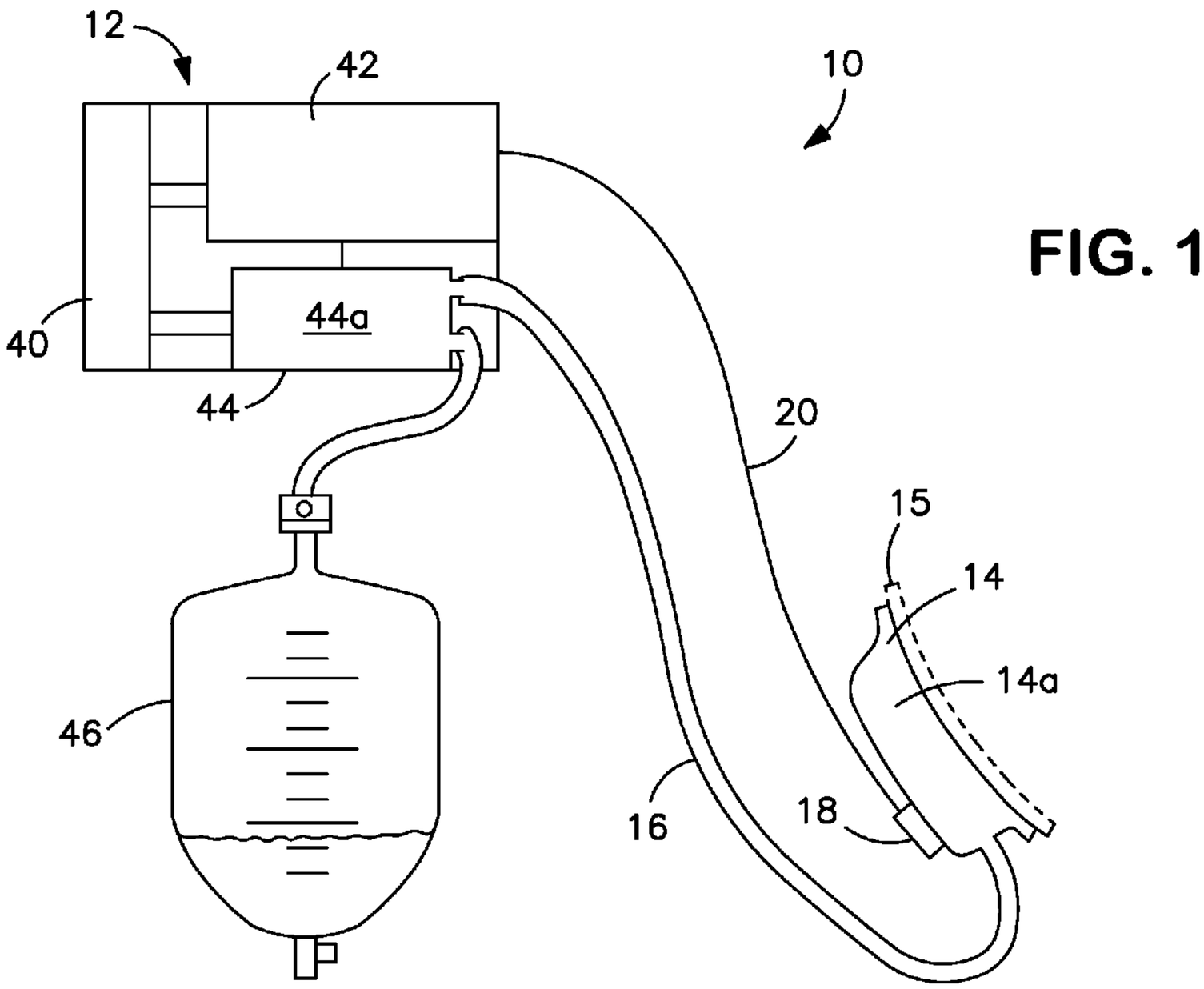

FIG. 1

(57) Abrégé/Abstract:
An aspiration system for removing urine from the human body comprises a disposable body interface device having a liquid collection chamber. A detachable or permanently attached non-contact liquid sensor disposed outside the liquid collection chamber detects the presence of urine within the chamber. The non-contact sensor is selected from: a capacitance sensor; an ultrasonic sensor; a piezo-resonant sensor; and a temperature sensor.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 April 2009 (23.04.2009)

PCT

(10) International Publication Number
WO 2009/052496 A1

(51) International Patent Classification:
A61M 1/00 (2006.01)

(21) International Application Number:
PCT/US2008/080503

(22) International Filing Date: 20 October 2008 (20.10.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/980,908 18 October 2007 (18.10.2007) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

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(54) **Title:** ASPIRATION SYSTEM FOR REMOVING LIQUID DISCHARGED BY THE HUMAN BODY, AND LIQUID SENSOR THEREFOR

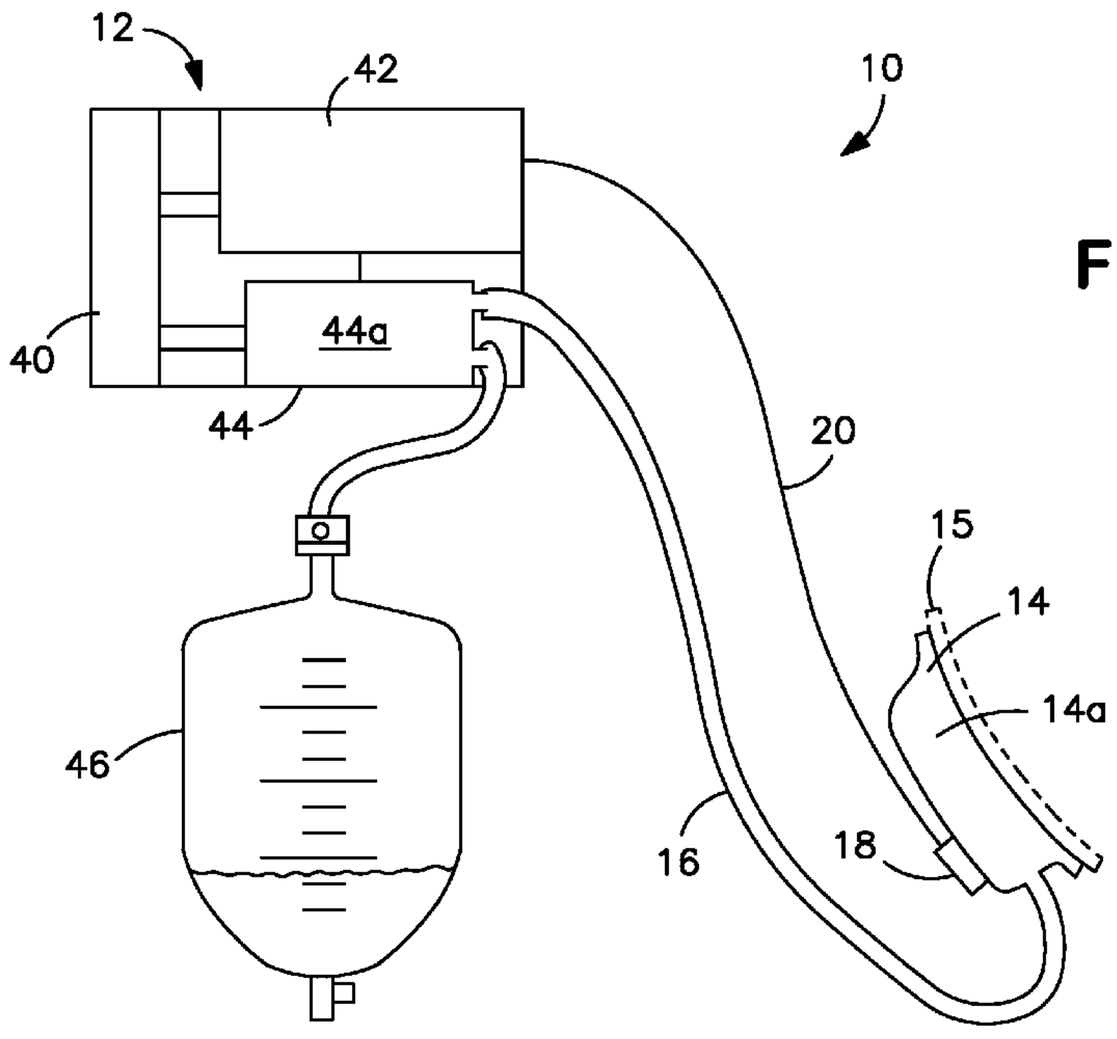

FIG. 1

(57) **Abstract:** An aspiration system for removing urine from the human body comprises a disposable body interface device having a liquid collection chamber. A detachable or permanently attached non-contact liquid sensor disposed outside the liquid collection chamber detects the presence of urine within the chamber. The non-contact sensor is selected from: a capacitance sensor; an ultrasonic sensor; a piezo-resonant sensor; and a temperature sensor.

WO 2009/052496 A1

WO 2009/052496 A1

Published:
— *with international search report*

ASPIRATION SYSTEM FOR REMOVING URINE DISCHARGED BY THE HUMAN BODY, AND LIQUID SENSOR THEREFOR

FIELD OF THE INVENTION

The present invention relates to an aspiration system for use in an aspiration system for removing liquids, discharged by the human body. Aspects of the invention are particularly directed to the problems of urine removal.

BACKGROUND TO THE INVENTION

Urinary management is of critical need in the acute and long term care settings. Urinary issues are generally grouped into two primary categories: failure to drain; and failure to contain. In the case of failure to drain, the patient cannot spontaneously drain urine from the bladder. The general solution to this problem is to catheterize the patient. In the case of failure to contain, the patient cannot contain the urine within their body until a convenient and expedient time. When patients are not conscious or cognizant, they are typically catheterized. Patients who are aware but non-ambulatory often utilize a manual collector for assistance, such as a bedpan, a male urinal, or an adult diaper. These can be cumbersome to use, and sometimes result in spills on or around the patient. Also, such manual collectors may require frequent changes, placing additional burden on caregivers. When it is desired to monitor the urine output, very often medical staff catheterize a patient even when catheterization is not otherwise required. Catheterization provides a means by which urine can be monitored more easily than with a manual collector.

There is a growing problem with nosocomial infections and a high incidence of catheter-related urinary tract infections (UTIs). Catheter associated UTI is the most common nosocomial infection in hospitals and nursing homes, accounting for up to 40% of all institutionally acquired infections, or more than 1 million infections in US hospitals each year. There is considerable pressure on the healthcare and nursing profession to reduce such infection.

U.S. Patent Nos. 5,002,541, 4,747,166 and 4,631,061 describe human urine aspiration systems. The urine aspiration systems include an electric pump for applying suction to a urinal. The urinal includes a liquid sensor for automatically activating the

pump when the presence of liquid urine is detected. The three patents all describe liquid-contact sensors in the form of electrodes forming a normally open circuit that is closed by electrical conduction through liquid, when the sensor is contacted by liquid. However, there are obvious concerns about the possibility of electrical current leaking from the electrodes, through the conductive urine, to the skin. Moreover, the sensor is necessarily used in close proximity to the sensitive genital area, increasing the concerns of leakage of current that is applied by the electrodes.

The last mentioned patent, U.S. Patent No. 4,631,061, also suggests the possibility of using at least one pair of optical elements, formed by opposed optical fibres integrated into the liquid passage of the urinal or collection tube to sense the liquid. This is said to avoid electrical currents applied to the urinal. However, the design is very expensive and impractical commercially. It requires at least one pair of optical elements that are optically aligned in a pad with a beam of light passing between the pair of optical elements to sense the presence of liquid. It also needs an optically transparent window to allow the beam of light to pass through. Any residues or moisture condensation could easily cloud the window and falsely trigger the pump to turn on. The optical fibres are expensive items, and integrating these into the urinal or tubing increases the cost of the urinal or tubing, which are preferably disposable for hygiene reasons. Moreover, the electro-optic part is remote from the urinal, and has to be connected by delicate and expensive optical fibres, making the system delicate and expensive as a whole.

It would be desirable to improve on prior art designs of aspirated liquid removal systems, especially in terms of urine detection, in order to satisfy commercial need and improve customer acceptance.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic block diagram of a first embodiment of aspiration system for collecting and removing liquid discharged by the human body.

Fig. 2 is a schematic plan view of a pair of briefs as an overgarment.

Fig. 3 is a schematic side view of a second embodiment showing an implementation of a capacitive, ultrasonic or piezo-electric non-contact liquid sensor.

Fig. 4 is a schematic side view of a third embodiment showing an implementation of an electro-optic non-contact liquid sensor.

Fig. 5 is a schematic side view of a fourth embodiment showing an implementation of a temperature, non-contact liquid sensor.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Preferred embodiments of the invention are now described with reference to the drawings. The same reference numerals are used to depict the same or equivalent features in each embodiment.

Referring to Fig. 1, an aspiration system 10 for removing body liquid discharged by the human body generally comprises an aspiration unit 12 and a body interface device 14 coupled to the aspiration unit 12 by means of a flexible conduit 16. The flexible conduit 16 may be regarded as part of the aspiration unit 12 and/or part of the body interface device 14. The body interface device 14 is configured for fitting to the body at, or around, the site of discharge of the body liquid desired to be collected. The body interface device 14 is preferably attachable to the body by means of an adhesive pad 15 that surrounds the site of discharge.

In the case of urine removal, the body interface device 14 is configured to fit at the genital region of a male or female wearer, or a surgical urostomy. For females, the body interface device 14 is in the form of a snug-fitting urinal (as illustrated herein). For males, the body interface device 14 is in the form of a male urinal or a condom (not illustrated). For urostomates, the body interface device 14 is in the form of a stoma fitment (not illustrated). The present embodiment is especially suitable for removing urine, since urine removal is most challenging in terms of the volume of the liquid to be removed and the speed of liquid discharge. This can distance the field of urine removal from other liquid collection systems. The speed of response of the aspiration system 10 to detect and remove the liquid is a significant factor in the ability of the aspiration system 10 to manage a urine discharge. Also, there are significant challenges in terms of cost versus hygiene of the aspiration system 10.

The aspiration system 10 includes a liquid sensor 18 for detecting the presence of liquid discharged by the body and collected at the body interface device 14. The liquid sensor 18 is preferably a non-contact sensor that is able to detect the presence or

proximity of liquid without contact with the liquid. The liquid sensor 18 generates an electrical output signal responsive to proximity of detected liquid. The electrical signal is communicated to the aspiration unit 12 by means of an electrical connector 20. The electrical connector 20 may be integrated with, or separate from, the flexible conduit 16. The electrical connector 20 also supplies power from the aspiration unit 12 to power the liquid sensor 18.

The feature of the liquid sensor 18 being a non-contact sensor provides significant advantages because: (i) the non-contact approach automatically avoids the concerns about passing an electrical current through the liquid in contact with the skin. Instead, there is no direct contact between the liquid sensor 18 and the liquid; (ii) the non-contact approach means that the liquid sensor 18 is not contaminated by touching the liquid. This allows the liquid sensor 18 easily to be reused with a different body interface device 14; and (iii) the non-contact approach means that the liquid sensor 18 does not itself have to be in a sterile condition before use, thus avoiding the difficulty of, or risk of damage when, sterilizing the aspiration system 10 that does interface intimately with the body. The feature of the liquid sensor 18 being coupled to the aspiration unit 12 by an electrical connector 20 avoids the expense and fragility associated with using an optical fiber connection.

A preferred feature of the invention is that the liquid sensor 18 is separate from, or at least separable from, the body interface device 14. The body interface device 14 is a disposable item that may be manufactured inexpensively, and disposed of after a single use, or a limited number of uses, according to the specific body interface device 14. The liquid sensor 18 is more expensive, but is intended to be used plural times, preferably, with a sequence of different body interface devices 14. This enables the aspiration system 10 to be produced and used very cost efficiently, since the disposable components are generally low cost. The higher cost components may be used multiple times, and may require infrequent replacement. In one form, the liquid sensor 18 is a universal device that may be used with any of a plurality of different types of body interface devices 14, such as a female urinal, a male condom, a urostomy body fitment, or a catheter. Optionally, the liquid sensor 18 can be permanently attached to the body interface device 14.

The liquid sensor 18 can take a variety of different forms.

In the embodiment illustrated in Fig. 3, the liquid sensor 18 is selected from: a capacitance sensor; an ultrasonic sensor; and a piezo-electric (or piezo-resonant) sensor. A capacitance sensor detects proximity of liquid according to changes in the dielectric effect of liquid proximity, compared to air proximity. The dielectric effect affects the electric field in the active zone around the sensor, and thus, the effective capacitance in the sensor. The capacitance is monitored by any suitable capacitance sensing circuit (not shown), such as an RC oscillator whose oscillation frequency and/or whether oscillation occurs, is dependent on the value of a resistor in combination with the effective capacitance of the sensor. The oscillation in turn triggers an output stage, coupled to an output amplifier, to generate an output signal indicative of liquid presence. The capacitance sensing circuit is preferably disposed near or at the liquid sensor 18 (e.g., as part of the liquid sensor 18 itself), or the capacitance sensing circuit can be disposed at the aspiration unit 12, or at a point along electrical connector 20. A suitable capacitance sensor and capacitance sensing circuit are described in U.S. Patent No. 5,576,619, the contents of which are hereby incorporated by reference.

The invention has been tested using a capacitance “smart” sensor from SIE Sensors. The sensor of dimension 35mm (length) x 22mm (width) x 10mm (height) was affixed to the external wall of a body interface device 14. The sensor detected the presence of two test liquids, water and saline solution, as soon as the liquid was introduced, and provided an activation signal to the aspiration unit 12 within milliseconds. The electric field from the sensor is able to penetrate a wide variety of plastic components (e.g., polyethylene (PE), polypropylene (PP) and acrylics), either transparent or opaque, with great sensitivity.

An ultrasonic sensor works using the principle of sonar at the ultrasonic frequency range. A transducer is resonated at a set frequency to convert electric energy into ultrasonic frequency range acoustic energy. The ultrasonic acoustic waves are emitted towards a liquid collection region. Energy is reflected either from the walls if the region is empty of liquid, or from liquid if present in the region. By measuring the time delay for reflected waves to arrive, and comparing this to one or more pre-calibrated time delays taken when the liquid collection region is empty, the presence of

liquid can be reliably and quickly detected. An example of ultrasonic liquid sensor is described in U.S. Patent No. 3,960,007, the content of which is incorporated herein by reference. A commercially available ultrasonic sensor is made available by ZEVEX Inc.

A piezo-electric or piezo-resonant sensor also uses high frequency, e.g., ultrasonic energy or acoustic signal, in a similar way to the ultrasonic sensor described above. The ultrasonic or acoustic signal could penetrate either transparent or opaque plastic walls. An example of piezo-electric sensor is described in U.S. Patent No. 3,948,098, the content of which is incorporated herein by reference.

The invention has been tested with a piezo-resonant sensor obtained from GEMS Sensors. The sensor of diameter 40mm was attached to the external wall of the body interface device 14, and detected the presence of liquid as soon as introduced.

With the arrangement illustrated in Fig. 3, the liquid sensor 18 is disposed outside the body interface device 14, or at least outside a liquid collection region 14a of the body interface device 14. The body interface device 14 is typically made of plastics, through which the sensing electric field can pass in the case of a capacitance sensor, or through which an ultrasonic vibration can pass in the case of an ultrasonic and/or piezo-electric sensor. The wall of the body interface device 14 is made suitably thin to provide the sensor with the desired sensitivity to liquid within the body interface device. Alternatively, the body interface device 14 may include a window portion made of material through which the electric field or ultrasonic vibration can pass easily if the entire body interface device 14 is not made of such a material. In the alternative embodiment illustrated in Fig. 5, the housing of the body interface device 14 can be shaped into a pocket 26, with or without membrane 24, for receiving and retaining a capacitive, ultrasonic or piezo-electric non-contact liquid sensor 18. Such a design also increases the interface area between the sensor 18 and the liquid collection region 14a of the body interface device 14.

In the alternative embodiment illustrated in Fig. 4, the body interface device 14 is configured for use with an electro-optical sensor. The body interface device 14 comprises a window region 22 made of material that is transparent to the optical radiation used by the electro-optical sensor. For example, the optical radiation may be in the infra-red range, and/or the visible range, and/or ultra-violet range. The term

"optical" as used herein means that the radiation lies in a frequency range that obeys substantially the laws of optics. The electro-optical sensor comprises an electro-optical emitter, an electro-optical receiver, and sensing circuitry for detecting the presence of liquid according to the electrical output of the electro-optical receiver. The sensing circuitry is preferably disposed at the liquid sensor 18 (e.g., as part of the liquid sensor 18), or the sensing circuitry is disposed at the aspiration unit 12, or at a point along electrical connector 20. An example electro-optical liquid sensor is described in U.S. Patent No. 4,354,180, the content of which is incorporated herein by reference.

In the further alternative embodiment illustrated in Fig. 5, the body interface device 14 is configured for use with a temperature sensor as the liquid sensor 18. The body interface device 14 comprises a liquid impermeable membrane 24 for allowing the temperature sensor 18 to be exposed to an increase in temperature should liquid discharged by the body (in the current case, urine) come into contact with the membrane 24. At the same time, the membrane 24 prevents the sensor 18 from coming into physical contact with the liquid. The membrane 24 may be made of a heat conductive material, or it may be made of other material that is thin enough (e.g., a film) so as not to provide substantial heat insulation. The use of a temperature sensor 18 can provide a reliable and quick indication of body liquid exiting the body, without requiring the sensor to be dispersed over a large area. Liquid, such as urine, exits the body at a temperature of about 37°C, which is notably higher than ambient room temperature (typically about 23°C), and also higher than the ambient temperature of a sensor positioned close to the human skin (typically about 32°C).

The presence of liquid may be detected by detecting (i) a rapid change in temperature, such as an increase of 1°C within two seconds and/or (ii) a temperature rise above a threshold, such as above 36°C.

In the present embodiment, the membrane 24 is shaped like a sock defining a pocket 26 for receiving and retaining the sensor 18. Such a design also increases the interface area between the sensor 18 and the liquid collection region 14a of the body interface device 14. However, the membrane 24 could be a simple window in the wall of the body interface device 14, similar to the window 22, if desired.

It will be appreciated that the different configurations illustrated in Figs. 3-5 may be intermixed, or used with different liquid sensors, as desired.

In all of the preceding embodiments, the liquid sensor 18 is separate from, or at least separable from, the body interface device 14. The liquid sensor 18 may be held in an operative position with respect to the body interface device 14 by a variety of possible arrangements:

(a) In one form, a detachable attachment device (not shown) may be used for releasably attaching the liquid sensor 18 to the body interface device 14. For example, the detachable attachment device could comprise a peelable adhesive, or a peelable mechanical fastener, such as Velcro, or a mechanical coupling based on interference fitting, or other mechanical means.

(b) In another form, the sensor could be held in position permanently using a an adhesive, or a mechanical coupling.

(c) In another form, the liquid sensor 18 may be held in the operative position by an overgarment (Fig. 2), such as a pair of briefs 30. In the illustrated form, the briefs 30 include a retainer 32 for retaining the liquid sensor 18 in position. The retainer 32 comprises, for example, a detachable attachment device for attaching the liquid sensor 18 to the briefs 30, or a pocket or sling for receiving the liquid sensor 18. In an alternative form, the briefs 30 might not include a dedicated retainer, but may instead embrace the body interface device 14 to hold the liquid sensor 18 in a recess 26 of the body interface device 14 (Fig. 5).

The aspiration unit 12 comprises a power supply 40, an electronic control unit 42, and a suction source 44. The power supply 40 is selected as one or more of: a replaceable battery, a rechargeable battery, radiation collection panels, and a mains power supply. Preferably, the power supply 40 includes a combination of a rechargeable battery and a mains power supply; such a combination allows portable operation when the aspiration system 10 is not connected to a mains power supply, as well as automatic recharging of the battery when the aspiration system 10 is coupled to a mains power supply. Additionally or alternatively, the power supply 40 includes radiation collection panels, such as photovoltaic panels or cells for generating electricity from ambient light, which can improve autonomy of operation or for charging the

rechargeable battery. The power supply 40 provides power for the electronic control unit 42, the liquid sensor 18 (if needed), and any power needed by the suction source 44. The electric control unit 42 and the liquid sensor 18 could have a separate power supply from the suction source 44. In the present embodiment, the suction source 44 is an electric pump 44a that operates under control of the electronic control unit 42, responsive to detection of liquid by the liquid sensor 18. The pump 44a could be a suction device based on diaphragm, peristaltic, volume displacement, spring, gravity, siphon, heat-recoverable metal drive, or an in-line pump. The flexible conduit 16 is coupled through the pump 44a to a liquid collection chamber 46. The liquid collection chamber 46 may either be separate from the aspiration unit 12 and coupled thereto with a suitable connector, or the liquid collection chamber 46 may be integral with and/or housed in the aspiration unit 12.

When the liquid sensor 18 indicates that no liquid is detected, the control unit 42 controls the pump 44a in a quiescent state. Either the pump 44a is deactivated to generate no suction, or the pump 44a is operated periodically or at a slow speed to produce low suction (which may encourage the body interface device 14 to hug against the skin, and produce a better seal against the skin).

When the liquid sensor 18 detects the presence of discharged liquid, the control unit 42 activates the pump 44a to generate suction through the flexible conduit 16 to draw the liquid from the body interface device 14 into the liquid collection chamber 46. The control unit 42 may operate the pump 44a for as long as liquid continues to be detected by the liquid sensor 18, or for a predetermined time interval after liquid detection has finished. Once collected by the liquid collection chamber 46, the volume of liquid output may be measured, or the liquid may be inspected visually, or sent for biochemical testing or analysis.

In an alternative form, instead of a pump 44a directly applying suction to the flexible conduit 16, the suction source 44 may comprise a vacuum chamber charged with a low pressure vacuum, and an electronically controlled valve for controlling application of suction from the vacuum chamber to the flexible conduit 16. A pump may be provided for charging the vacuum chamber with the vacuum.

When it is desired to replace the body interface device 14, either for the same patient or for fitting to a new patient, the liquid sensor 18 is separated from a current body interface device 14 and/or briefs 30. The current body interface device 14 and/or briefs 30 are disposed of, and the same liquid sensor 18 is available to be used with a replacement body interface device 14 and/or replacement briefs 30. In the case where the non-contact liquid sensor is permanently attached to the body interface device 14, a quick connector along electrical connector 20 and flexible conduit 16 is equipped to allow for the replacement of body interface device 14.

It will be appreciated that the aspiration system 10 as described herein provides significant advantages compared to the prior art, and can address or mitigate many of the drawbacks of the prior art, especially in terms of efficient detection of liquid without electrical contact with the body liquid. The disposability of the body interface device, and reusability of the liquid sensor 18 without contact with the discharged liquid, make the aspiration system 10 very hygienic and cost efficient. The aspiration system 10 is also extremely versatile, and a single aspiration system 10 or different embodiments can have a wide variety of applications. For example, the invention is usable in acute care, home care, and long term care situations or facilities. The invention is usable with wheelchairs, and with bed-bound patients, as well as being able to be implemented as a fully portable device. The invention enables the aspiration system 10 to be discrete, thereby preserving the patient's dignity and privacy. The invention may also be used with catheters, either for detecting liquid (urine) presence in a catheter, or for collecting urine from a short catheter that projects a short distance from the body into the body interface device 14. While the invention as described is especially suitable for removing urine, the invention may find use for removal of other body fluids and secretions.

Many modifications, improvements and equivalents to the present invention may be made without departing from the spirit and/or scope of the invention as claimed.

CLAIMS

We claim:

1. An aspiration system for removing urine discharged by the human body, the aspiration system comprising:
    a. a body interface device having a liquid collection region for collecting urine discharged by the human body; and
    b. a liquid sensor disposed or disposable adjacent to but outside the liquid collection region, for detecting the presence of discharged urine in the liquid collection region without contact with the urine, the sensor generating an electrical output indicative of detected urine.
2. The aspiration system according to claim 1, wherein the body interface device is a disposable device.
3. The aspiration system according to claim 1, wherein the liquid sensor is separate or separable from the body interface device.
4. The aspiration system according to claim 1, wherein the liquid sensor is permanently attached to the body interface device.
5. The aspiration system according to claim 1, wherein the liquid sensor is configured to be used a plurality of times with different body interface devices.
6. The aspiration system according to claim 1, further comprising an attachment part for detachably attaching the liquid sensor to the body interface device.
7. The aspiration system according to claim 1, further comprising a garment wearable over the body interface device, the garment being configured to hold the liquid sensor captive in an operative sensing position adjacent to the body interface device.
8. The aspiration system according to claim 7, wherein the body interface device comprises a male or female urinal, and the garment comprises a pair of briefs.
9. The aspiration system according to claim 7, further when at least one of the garment and the liquid sensor comprises a retainer for retaining the liquid sensor captive to the garment.

10. The aspiration system according to claim 1, wherein the liquid sensor is selected from: a capacitance sensor; an ultrasonic sensor; a piezo-electric sensor; an electro-optic sensor; and a temperature sensor.
11. The aspiration system according to claim 1, wherein the body interface device comprises a pocket or recess for receiving the liquid sensor adjacent to the liquid collection region.
12. The aspiration system according to claim 1, wherein the liquid sensor is a capacitance sensor, and wherein the body interface device comprises a wall or wall portion made of material through which the capacitance sensor can project an electric field.
13. The aspiration system according to claim 1, wherein the liquid sensor is an ultrasonic sensor, and wherein the body interface device comprises a wall or wall portion made of material through which an ultrasonic wave can be passed.
14. The aspiration system according to claim 1, wherein the liquid sensor is an electro-optic sensor, and wherein the body interface device comprises a wall or wall portion made of material through which optical radiation can be passed.
15. The aspiration system according to claim 1, wherein the liquid sensor is a temperature sensor, and wherein the body interface device comprises a membrane for permitting the temperature sensor to be exposed to the temperature of urine in the liquid collection region and contacting the membrane.
16. The aspiration system according to claim 1, further comprising a skin adhesive for releasably attaching the body interface device to the body.
17. The aspiration system according to claim 1, wherein the body interface device is selected from: a female urinal; a male urinal; a male condom; a urostomy body fitment; and a catheter.
18. An aspiration system for removing urine discharged by the human body, the aspiration system comprising:
    a. a body interface device having a liquid collection region for collecting urine discharged by the human body; and
    b. a liquid sensor disposed or disposable adjacent to but outside the liquid collection region, for detecting the presence of discharged urine in the

liquid collection region without contact with the urine, the sensor being separate or separable from the body interface device.

19. An aspiration system for removing urine discharged by the human body, the comprising:

a. a liquid sensor configured to detect urine discharged from the body in the proximity of the sensor without contact with the urine, the sensor generating an electrical output indicative of detected urine, and the sensor being selected from: a capacitance sensor; an ultrasonic sensor; a piezo-electric sensor; an optical sensor; a temperature sensor; and

b. a brief configured to be worn on the body and to hold the liquid sensor in an operative position at the genital area for sensing urine discharged by the body.

20. The aspiration system according to claim 18, further comprising a body interface device having a liquid collection region for receiving the urine, and wherein the liquid sensor is disposed outside the liquid collection region and configured to detect urine within the liquid collection region.

21. The aspiration system according to claim 19 wherein the brief is further configured to hold the body interface device in an operative position against the body.

22. The aspiration system according to claim 19, further comprising an aspiration unit responsive to the output from the liquid sensor, and configured to generate suction to aspirate liquid from the body interface device when liquid is detected by the liquid sensor.

23. The aspiration system of claim 1, wherein the liquid sensor is configured to detect liquid discharged from the body in the proximity of the sensor without contact with the liquid, the sensor being selected from: a capacitance sensor; an ultrasonic sensor; a piezo-electric sensor; and an optical sensor.

24. The aspiration system of claim 1, wherein the liquid sensor is configured, when disposed adjacent to but outside a liquid collection region of a body interface device for collecting liquid discharged from the body, to detect the presence of liquid in the liquid collection region.

25. The aspiration system of claim 1, further comprising an attachment part for detachably attaching the liquid sensor to a body interface device or to an over-garment.

26. A method of preparing an aspiration system for removing liquid discharged by the human body, the method comprising:

a. providing a body interface device having a liquid collection region for receiving liquid discharged by the human body;

b. providing a liquid sensor for detecting the presence of discharged liquid in the liquid collection region without contact with the liquid, the sensor generating an electrical output indicative of detected liquid; and;

c. providing an aspiration unit couplable to the body interface device and to the liquid sensor, the aspiration unit being operable to generate suction to aspirate liquid from the body interface device in response to detection of liquid by the liquid sensor.

27. The method of claim 25, wherein the liquid sensor is separate or separable from the body interface device.

28. The method of claim 25, wherein the liquid sensor is permanently attached to the body interface device.

29. The method of claim 25, wherein the body interface device is selected from: a female urinal; a male urinal; a male condom; a urostomy body fitment; and a catheter.

30. The method of claim 25, wherein the liquid sensor is selected from: a capacitance sensor; an ultrasonic sensor; a piezo-electric sensor; an electro-optic sensor; and a temperature sensor.

31. A method of preparing an aspiration system for removing liquid discharged by the human body, the method comprising:

a. providing a body interface device having a liquid collection region for receiving liquid discharged by the human body;

b. providing a liquid sensor for detecting the presence of discharged liquid in the liquid collection region without contact with the liquid, the sensor being separate or separable from he body interface device; and;

providing an aspiration unit couplable to the body interface device and to the liquid sensor, the aspiration unit being operable to generate suction to aspirate liquid from the body interface device in response to detection of liquid by the liquid sensor

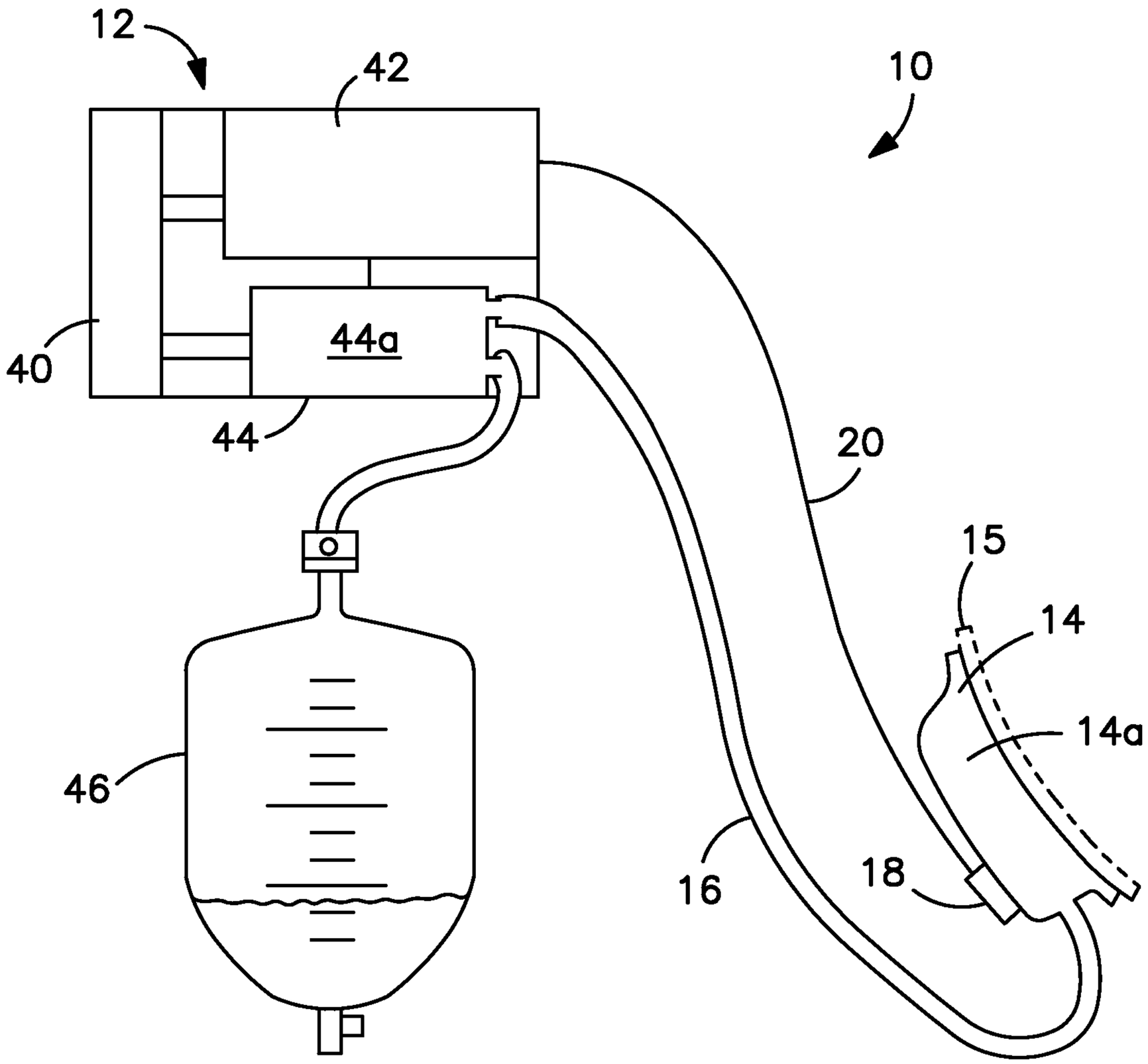

FIG. 1

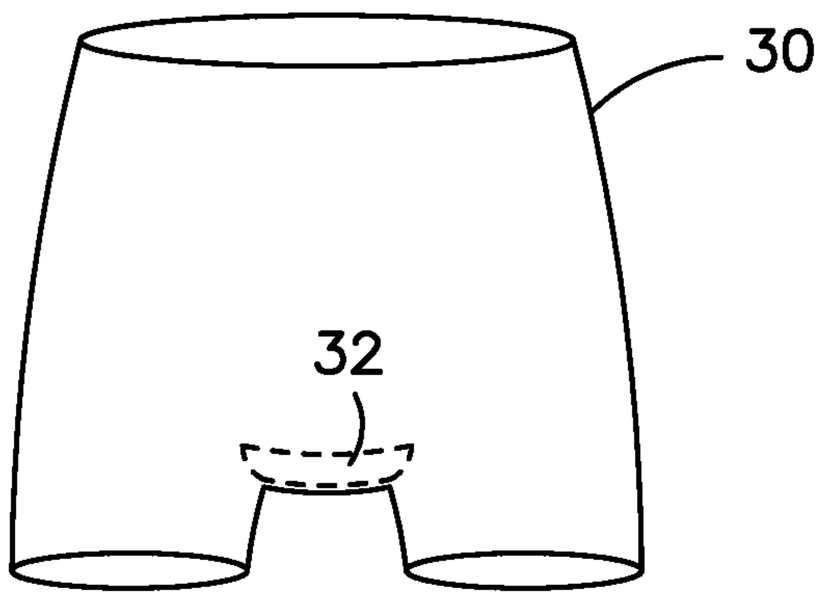

FIG. 2

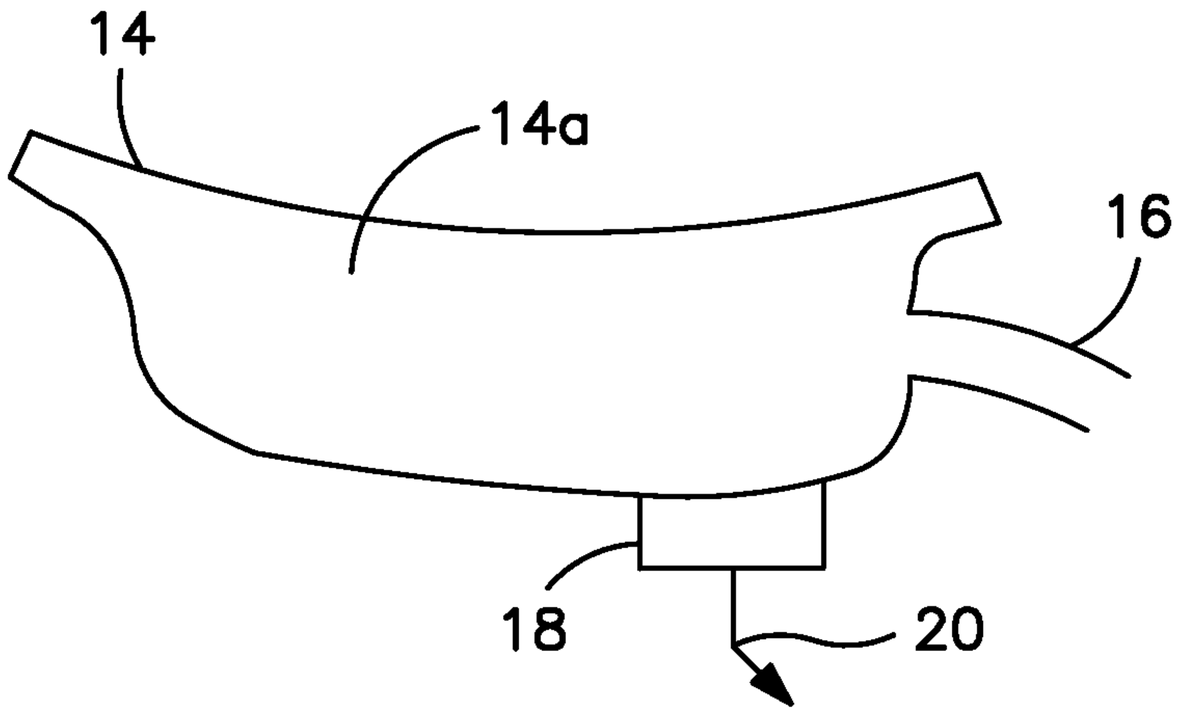

FIG. 3

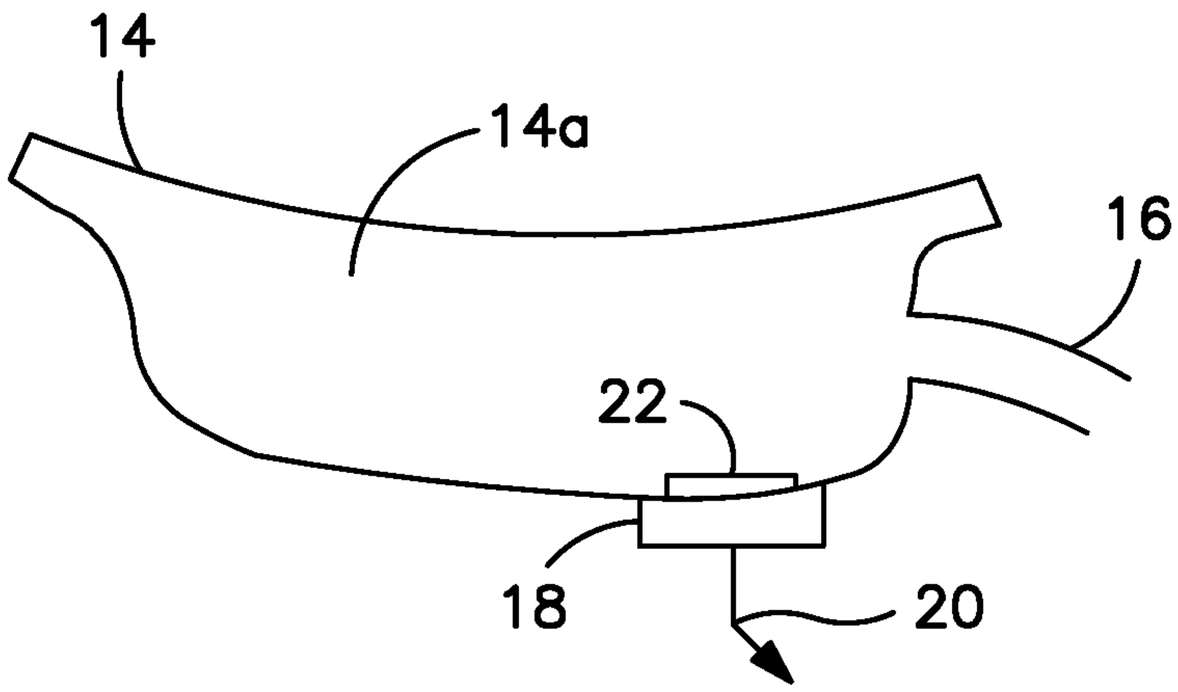

FIG. 4

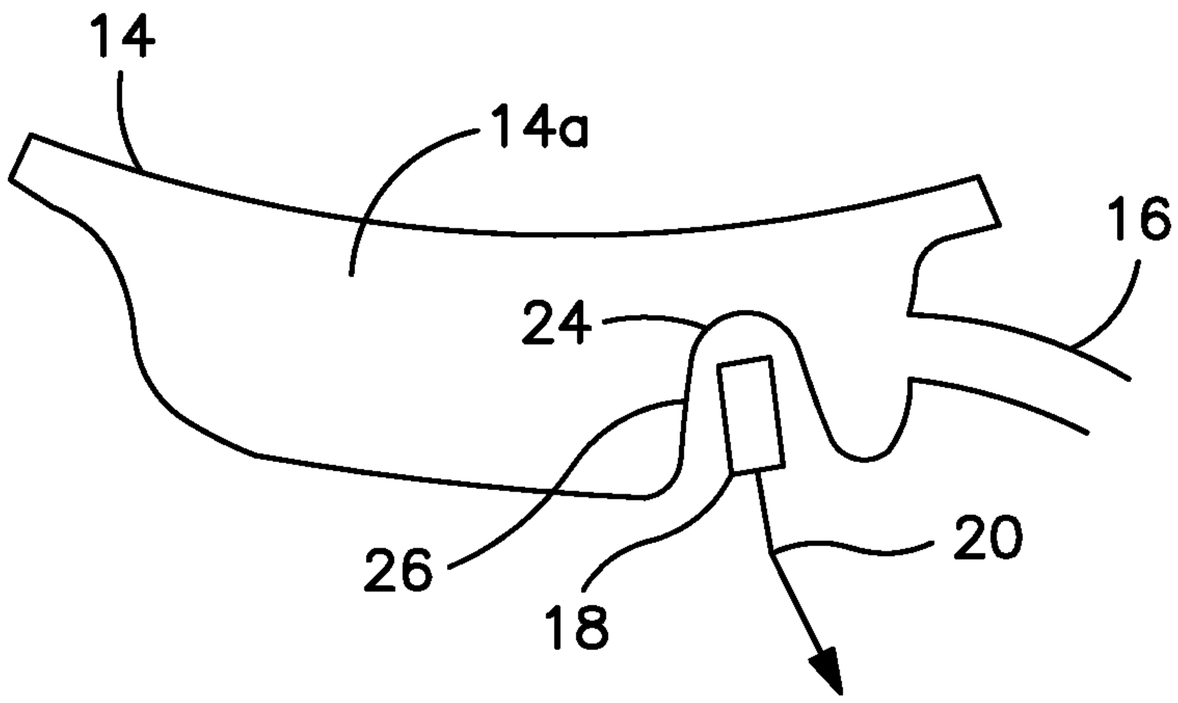

FIG. 5

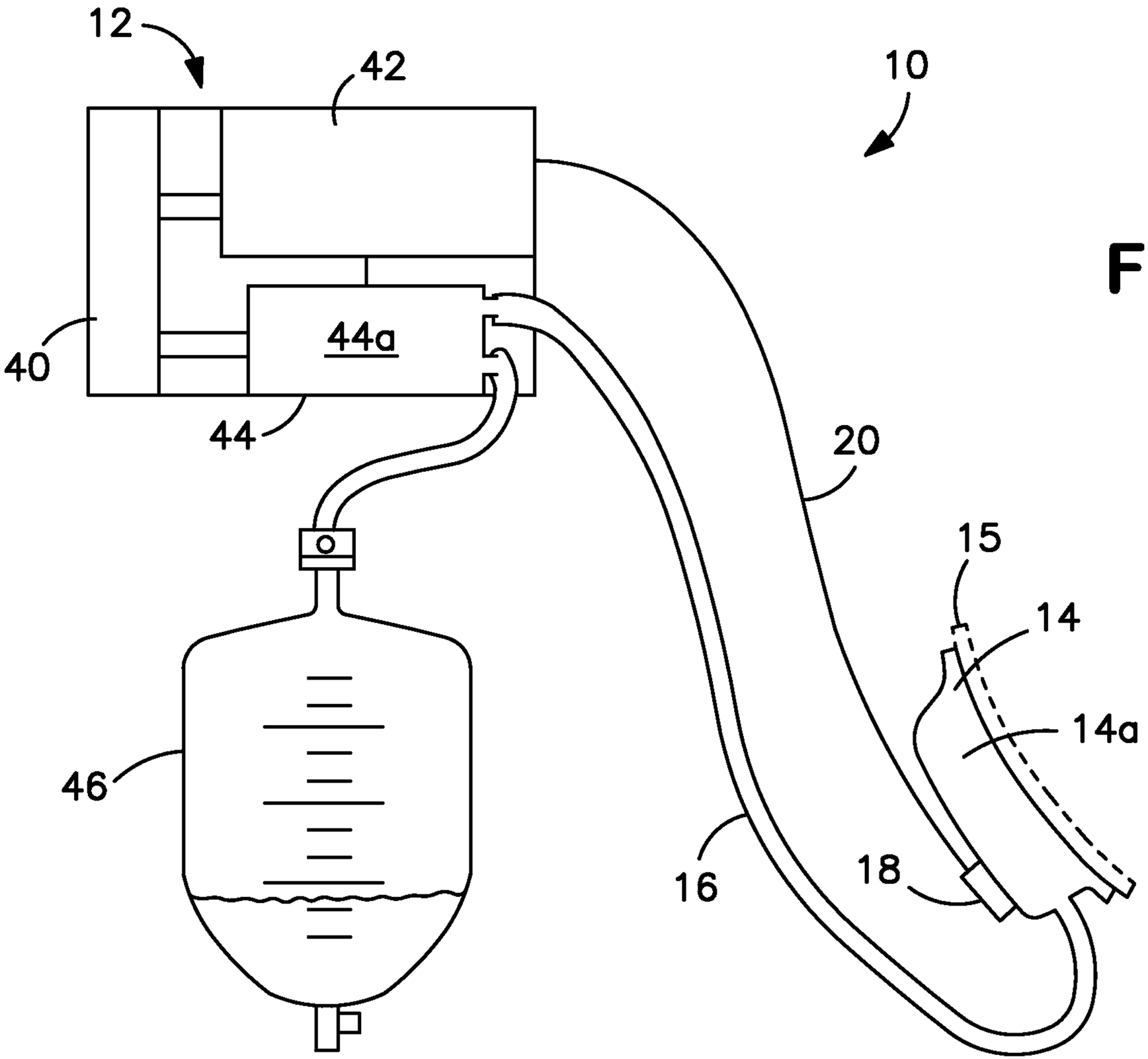

FIG. 1