Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2499683 C 2012/06/19

(11)(21) **2 499 683**

(12) **BREVET CANADIEN**
CANADIAN PATENT

(13) **C**

(86) **Date de dépôt PCT/PCT Filing Date:** 2003/09/24
(87) **Date publication PCT/PCT Publication Date:** 2004/04/08
(45) **Date de délivrance/Issue Date:** 2012/06/19
(85) **Entrée phase nationale/National Entry:** 2005/03/21
(86) **N° demande PCT/PCT Application No.:** US 2003/030061
(87) **N° publication PCT/PCT Publication No.:** 2004/028290
(30) **Priorités/Priorities:** 2002/09/26 (US60/413,884); 2002/10/10 (US60/417,584)

(51) **Cl.Int./Int.Cl.** *A45F 3/04* (2006.01), *A45F 3/16* (2006.01), *A45F 3/20* (2006.01), *C02F 1/32* (2006.01)

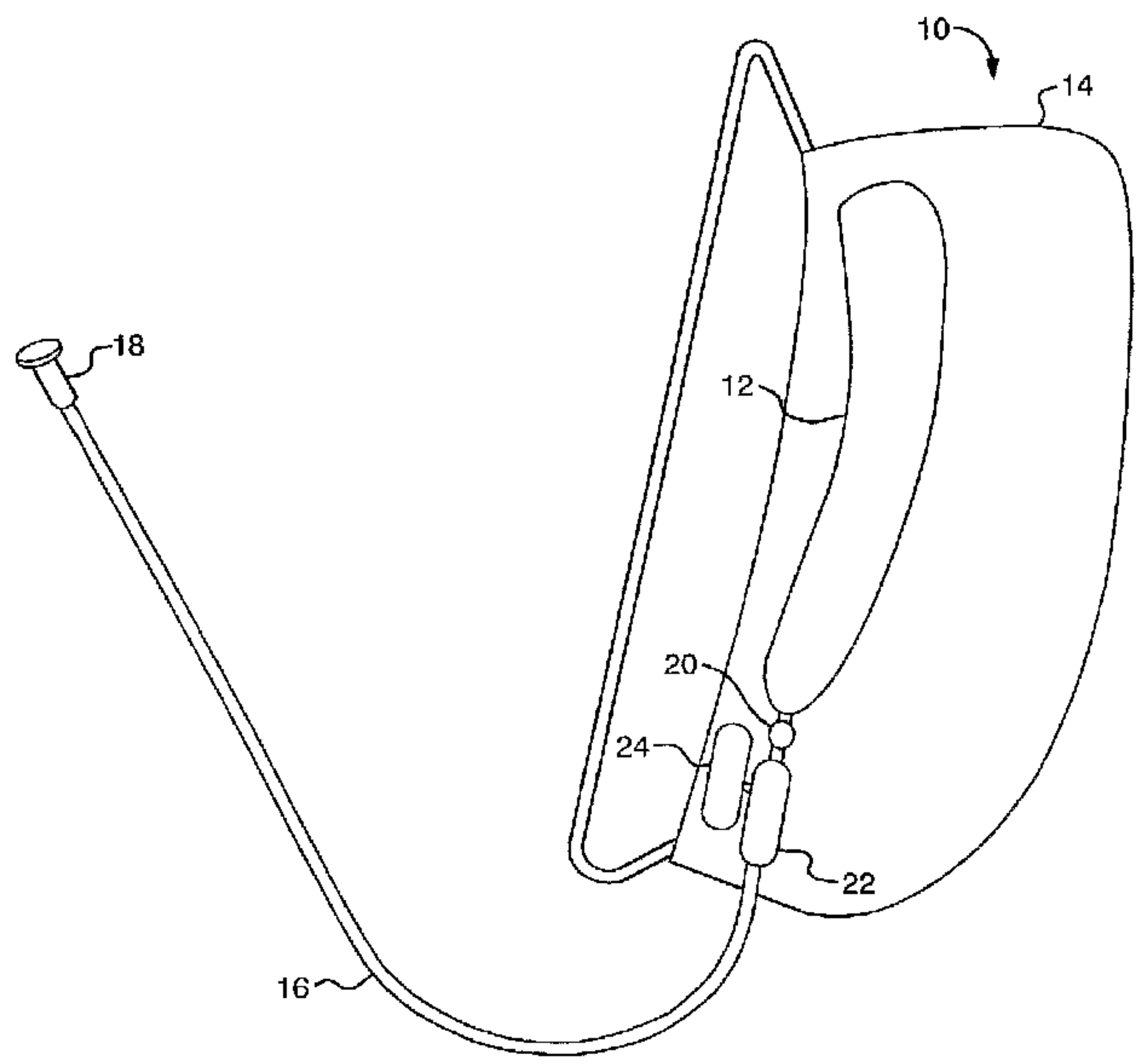
(72) **Inventeur/Inventor:**
MAIDEN, MILES, US

(73) **Propriétaire/Owner:**
HYDRO-PHOTON, INC., US

(74) **Agent:** SMART & BIGGAR

(54) Titre : MODULE DE PURIFICATION D'EAU BASE SUR UNE DIODE ELECTROLUMINESCENTE (DEL) A UV POUR SYSTEMES D'HYDRATATION A RECIRCULATION D'EAU INTERMITTENTE

(54) Title: UV LED BASED WATER PURIFICATION MODULE FOR INTERMITTANTLY OPERABLE FLOW-THROUGH HYDRATION SYSTEMS



(57) **Abrégé/Abstract:**
A wearable or portable intermittently operable hydration system (10) includes a purification module (22) that contains one or more solid state UV devices that are positioned in the path of hydrating fluid, or water, flow through the hydration system to a mouthpiece (18) or other orifice. The purification module (22) provides a path for the fluid past one or more solid state UV devices, such as UV LEDs, that produce UV radiation in a germicidal range. When the fluid is flowing past the UV LEDs, the LEDs are turned on to provide sufficient UV radiation to purify the water. The UV LEDs are instant on devices with essentially no ramp-up required, and a sensor (20) or other signaling means in the flow path controls the turning on of the UV LEDs whenever the user initiates the fluid flow. The fluid flow path may run from a bladder (12) in a backpack (19) worn by the user, a sports bottle worn by or carried by the user or may be through a water filtration system that a user operates via a pump. The power for the purification module may come from batteries, solar cells, fuel cells, power converted from pumping or winding action or any combination thereof. Further, UV LEDs may be included in the walls of the container as additional or alternative sources of UV radiation. The UV LEDs in the walls of the container may then be turned on when sufficient energy is available, as a precaution against, for example, a change in environmental conditions.

CA 02499683 2005-03-21

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 April 2004 (08.04.2004)

PCT

(10) International Publication Number
WO 2004/028290 A1

(51) International Patent Classification[7]: **A45F 3/04**, 3/16, C02F 1/32

(21) International Application Number: PCT/US2003/030061

(22) International Filing Date: 24 September 2003 (24.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/413,884 26 September 2002 (26.09.2002) US
60/417,584 10 October 2002 (10.10.2002) US

(71) Applicant *(for all designated States except US)*: **HYDRO-PHOTON, INC.** [US/US]; P.O. Box 789, Blue Hill, ME 04614 (US).

(71) Applicant and
(72) Inventor: MAIDEN, Miles [US/US]; Parker Point Road, Blue Hill, ME 04614 (US).

(74) Agents: SHEEHAN, Patricia, A. et al.; Cesari and McKenna, LLP, 88 Black Falcon Avenue, Boston, MA 02210 (US).

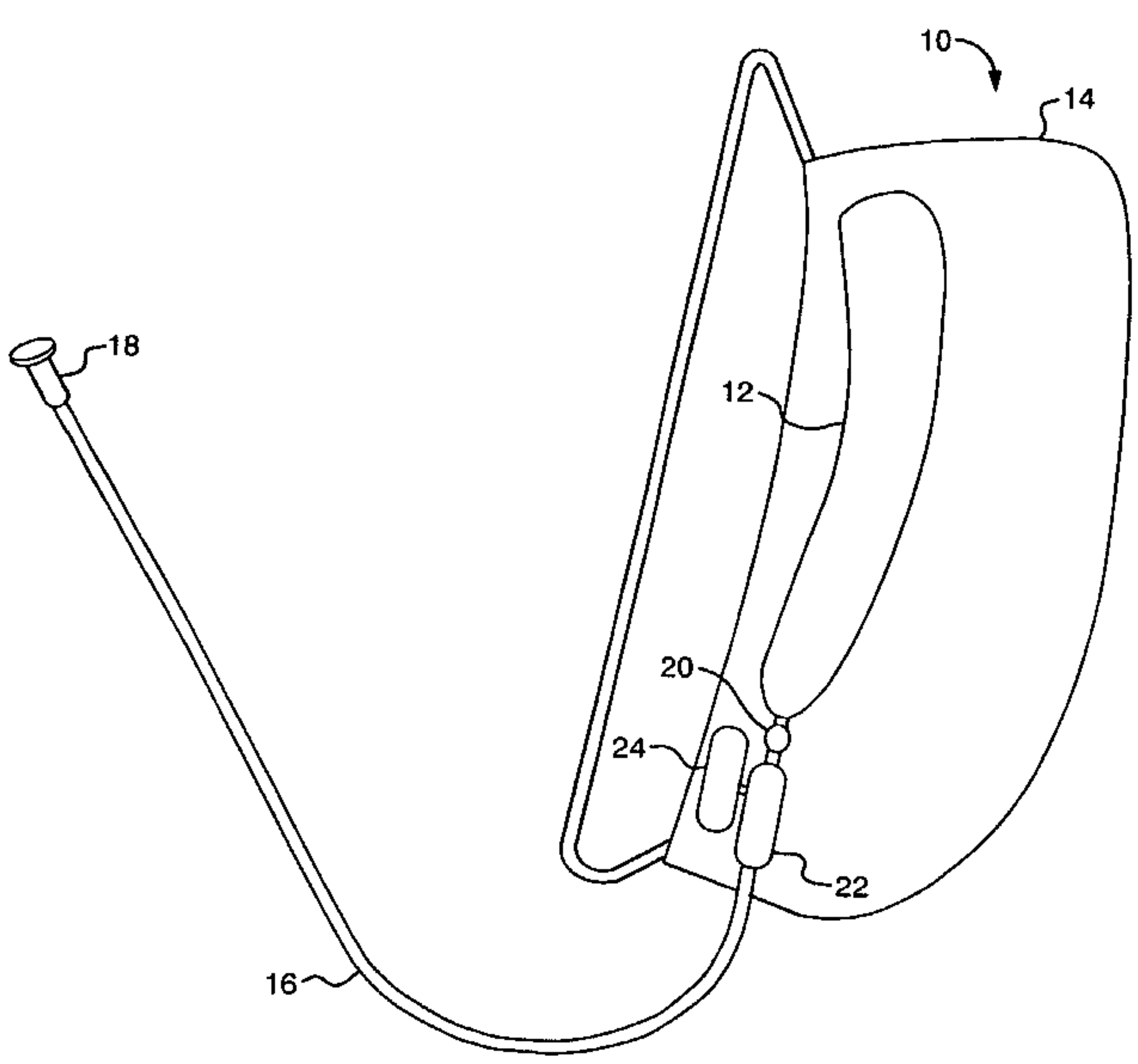
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

[Continued on next page]

(54) Title: UV LED BASED WATER PURIFICATION MODULE FOR INTERMITTANTLY OPERABLE FLOW-THROUGH HYDRATION SYSTEMS



(57) Abstract: A wearable or portable intermittently operable hydration system (10) includes a purification module (22) that contains one or more solid state UV devices that are positioned in the path of hydrating fluid, or water, flow through the hydration system to a mouthpiece (18) or other orifice. The purification module (22) provides a path for the fluid past one or more solid state UV devices, such as UV LEDs, that produce UV radiation in a germicidal range. When the fluid is flowing past the UV LEDs, the LEDs are turned on to provide sufficient UV radiation to purify the water. The UV LEDs are instant on devices with essentially no ramp-up required, and a sensor (20) or other signaling means in the flow path controls the turning on of the UV LEDs whenever the user initiates the fluid flow. The fluid flow path may run from a bladder (12) in a backpack (19) worn by the user, a sports bottle worn by or carried by the user or may be through a water filtration system that a user operates via a pump. The power for the purification module may come from batteries, solar cells, fuel cells, power converted from pumping or winding action or any combination thereof. Further, UV LEDs may be included in the walls of the container as additional or alternative sources of UV radiation. The UV LEDs in the walls of the container may then be turned on when sufficient energy is available, as a precaution against, for example, a change in environmental conditions.

WO 2004/028290 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

UV LED BASED WATER PURIFICATION MODULE FOR INTERMITTANTLY OPERABLE FLOW-THROUGH HYDRATION SYSTEMS

FIELD OF THE INVENTION

The inventive system described herein uses ultraviolet ("UV") light emitting diode (LED) technology to disinfect drinking water in intermittently operated flow-through hydration systems, such as wearable bladder bags. In such systems, water generally flows intermittently and on-demand from a bladder bag, or other "reservoir," through a tube and out into the user's mouth or, alternately, a drinking vessel.

BACKGROUND OF THE INVENTION

Currently, most UV water treatment systems use low pressure cold cathode fluorescent (CCFL) mercury vapor lamps with a primary radiative emission of 254 nanometers (2,537 angstroms). This wavelength, which falls within the short wave UV-C band, is highly germicidal.

The CCFL UV lamps can be very effective in batch UV water purification systems, such as the system described in United States Patents 5,900,212 and 6,110,424. However, the CCLF lamps are not well suited for wearable hydration systems. The lamps and their thermally insulating sleeves must be made from high quality, optical grade quartz, and thus, the CCFL UV lamp assemblies tend to be both costly and fragile. In addition, the CCFL UV lamps require high voltage AC power, and the circuitry needed to deliver this power is complex and relatively expensive, particularly if the input is from a DC source such as a battery.

The lamps also require a significant "warm-up" period during which lamp output "ramps up" from zero to full power. During this "ramp-up" period, any water flowing past a CCFL UV lamp will not have predictable or uniform UV exposure. As a result, the efficacy of the treatment of water in such a flow-through system, from a micro-biological standpoint, becomes unpredictable and unreliable. For this reason, safety dictates that CCFL UV lamps be allowed to "ramp-up" to a steady- state output before water flow past the lamp is permitted. Achieving this steady-state output may take up to several minutes.

In a wearable flow-through hydration system or other intermittently operated on-demand flow-through systems, water consumption is not only intermittent but sudden and unpredictable. Accordingly, the CCFL UV lamps must, for safe operation, have been "ramped-up" to a steady state output before the water is allowed to flow past. The user must thus either keep the CCFL UV lamp on all the time or turn on the lamp for up to several minutes prior to each use, in order to allow for the "ramp-up" to steady state output. Neither of these scenarios is particularly desirable. In the first, the lamp must be kept on all the time and consumption of limited battery power quickly becomes a problem. In the second, the lamp must be turned on minutes before taking each drink and there is an obvious inconvenience.

SUMMARY OF THE INVENTION

In one aspect of the invention, there is provided a wearable hydration system including: a bladder for holding a hydrating fluid; tubing for providing a path for the hydrating fluid from the bladder; a sensor for signaling when the hydrating fluid is flowing from the bladder; a purification module including one or more solid state UV devices that are positioned in the tubing to provide UV radiation in a germicidal range to purify the flowing fluid, the UV devices turning on when the sensor indicates that fluid is flowing from the bladder and turning off when the sensor indicates that fluid is not flowing from the bladder; and a wearable pack for holding at least the bladder.

In another aspect of the invention, there is provided a purification module for use with a wearable or portable hydrating fluid container, the water purification system comprising: tubing for providing a path for the hydrating fluid from the container; means for signaling when water flow is initiated through the tubing from the container; one or more solid state UV devices that are positioned in the path, either in the tubing, or in the region of the container that is shaped to join the tubing, or both, the UV devices providing UV radiation in a germicidal range to purify the flowing water, the UV devices turning on when the means for signaling indicates that water flow is initiated from the container and through the tubing and turning off when the means for signaling indicates that water is not flowing through the tubing; and a power supply that provides power to the purification module.

In another aspect of the invention, there is provided a purification module including tubing for providing a path for hydrating fluid, the tubing including a first end through which water enters the tubing and a second end through which water exits the tubing; a sensor positioned in the tubing for signaling when water is flowing into and through the tubing; one or more solid state UV devices that are positioned in the tubing and provide UV radiation in a germicidal range to purify the water flowing along the path from the first end to the second end, the UV devices turning on when the sensor indicates that water is flowing along the path and turning off when the sensor no longer indicates that water is flowing along the path; and a power supply for supplying power to the UV devices.

In another aspect of the invention, there is provided a water filtration system including: one or more filters positioned for removing sediment from the water; tubing for providing a path for flowing water; a pump for introducing water to the tubing; a purification module including one or more solid state UV devices that are positioned in the tubing and provide UV radiation in a germicidal range to purify the water flowing along the path, the UV devices operating intermittently to turn on when the module senses that the pump introduces water to the path and turn off when the module senses that water flow ceases along the path; and a power supply for providing DC power to the UV devices.

The invention is a wearable or portable intermittently operable hydration system in which a water purification module containing one or more solid state UV devices, such as UV LEDs, is positioned in the path of the flow of the hydrating fluid, such as water, from a container or reservoir through a tube or straw to a mouthpiece or other orifice. The purification module provides a path for the water past the one or more UV LEDs, which are turned on to subject the water to sufficient UV radiation to purify the water. The UV LEDs are “instant on” devices with essentially no ramp-up, and a sensor or switch situated in the flow path signals the UV LEDs to turn on whenever the user initiates water flow through the path.

The UV LEDs are DC devices, and thus, require simpler, lower cost drive and control circuitry, than is required to operate CCFL lamps. Further, the UV LEDs are solid state devices and are thus less fragile than the CCFL lamps. Accordingly, the UV LEDs are well suited for intermittently operated wearable or portable flow-through hydration devices, such as wearable bladders, user-carried or worn sports water bottles, and so forth.

The DC power for the UV LEDs may be supplied by batteries, fuel cells and/or by solar cells, that is, photovoltaic panels, and the batteries and fuel cells and/or capacitors may be charged by solar cells. Further, a backpack that holds the system may be made from flexible photovoltaic material or material that supports or incorporates photovoltaic panels, and thus, provide power directly to the unit. Alternatively, the UV LEDs may be powered by windup or crank-type dynamos in addition to or in place of the batteries, cells and, in a black-out condition, grid power.

The purification module and associated water flow sensor may instead be positioned in a drinking straw, and thus, be used to purify water flowing through the straw from any type of water bottle, canteen and so forth, carried by the user. The purification module may additionally include a filter that removes sediment from the water. Alternatively, the purification module may be included in the tubing of a portable water filtering system, such as a pump system used by campers. The filter in such a system may then be relatively coarse, since the filter needs only to trap sediment and not microbes, which are destroyed by the purification module. Further, such a filtering system would not require use of chemicals. In addition, the pump action may be harnessed to power the UV LEDs, and batteries and the like may thus be eliminated.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention description below refers to the accompanying drawings, of which:

Fig. 1 is schematic representation of a wearable hydration system constructed in accordance with the current invention;

Figs. 2-4 depict in more detail a purification module included in the system of Fig. 1;

Fig. 5 is a schematic drawing of an alternative system that includes the purification module in a drinking straw;

Fig. 6 is a schematic drawing of a system in which the purification module is included in a bottle top;

Fig. 7 is a functional block diagram of a portable water filtration system constructed in accordance with the invention;

Fig. 8 is a functional block diagram that depicts in more detail a power supply that may be included in the system of Fig. 1; and

Fig. 9 is a schematic drawing of an alternative to the system depicted in Fig. 1.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

As shown in Fig. 1, a wearable flow-through hydration system 10 includes a bladder 12 that is contained in a backpack 14. The bladder supplies hydrating fluids, such as water, to a user through a tube 16 and mouthpiece 18. The tube includes a purification module 22 that ensures that the water is sufficiently irradiated by ultraviolet ("UV") light in the germicidal range. As the water flows through the module 22, the UV radiation destroys the DNA of the microbes present in the water, thereby preventing microbial reproduction, and therefore, infection. The purification module 22 is discussed in more detail below with reference to Figs. 2-4

When a user requires water from the bladder 12, the water is drawn out of the bladder and flows past a water flow sensor 20. When the water flow sensor senses the flow, the sensor switches on the purification module 22. A power supply 24 supplies between 6 and 9 volts DC power to the purification module, and as discussed in more detail below, one or more solid state UV device, such as, UV light emitting diodes ("LEDs"), turn on to irradiate the water as the water flows through the purification module.

Referring now to Figs. 2-4, the purification module 22 includes an LED unit 30 that preferably contains a plurality of UV LEDs (not shown individually). The module 22 is positioned in the tube 16 such that water flows on paths 23a and 23b largely surrounding the unit 30. The dimensions of the purification module 22 and the associated section of the tube 16 are such that water flowing past and at a maximum distance away from the UV LEDs receives energy of at least $25mJ/cm^2$.

As shown in the drawings, the module 22 is widened where the LED unit 30 resides, such that water flow is not impeded by having to flow around, that is, on the paths 23a and 23b on either side of, the LED unit. This prevents a backing up or other interruption of the water flow through the tube 16 to the user.

Unlike CCFL UV lamps, UV LEDs are "instant on" devices meaning that UV output reaches steady state in micro or nanoseconds. Also, unlike fragile CCFL UV lamps, UV LEDs are robust solid state devices which do not require low pressure gas mixtures that can leak and fail. In addition, UV LEDs are DC devices which require simple, low cost drive and control circuitry, as compared with the much more expensive and involved high voltage ballast circuitry of CCFL lamps.

In a wearable flow-through hydration system, where water is drawn periodically and unpredictably, UV LED based purification has a further advantage over CCFL UV systems. With "instant on" and no need for a "ramp-up" period, and thus, the LEDs can be activated only as needed, i.e., while water is being drawn. When water is not being drawn, the LEDs are off and no power is consumed.

A "drinking straw" embodiment of the invention is shown in Fig. 5. A flow-through purification module 32 is connected in line between the mouthpiece 33 and the tailpiece 34 of a drinking straw generally indicated at 35. The module is of the same construction as the module 22 of Figs. 1-4, with an attached power supply 36. A flow sensor 37 is disposed below the module 32. In the illustration the drinking straw has been inserted through the cover 38 of a container 40 containing a liquid such as water. The user imbibes the liquid as she would through a conventional drinking straw, with the "instant on" feature of the purifier module purifying the water on-demand as the water flows through the module.

In Fig. 6 a purification module 50 has been combined with a bottle top 52 that contains a power supply (not shown) in a cavity 52a. The upper end of the module 52 terminates in a "push-pull" valve 53 of the type often used by cyclists, hikers, etc. The lower end of the module, which extends into the bottle 54 to which the top 52 is attached, may carry an optional filter 56 for removal of particles entrained in the water entering the module 50. The sensor 58 may be eliminated, and the push-pull operation of the valve 53 may instead be used to control the turning on of the UV LEDs, with the pulling or opening of the valve turning on the purification module.

Fig. 7 depicts a purification module 60 in use in a portable water filtration system 62, such as those used by campers. The purification unit destroys microbes in the water that is pumped through the system via pump 64, while one or more filters 66 remove sediments from the water. The pump action may also provide power to the UV LEDs through the power supply 68, which operates in a known manner to convert pumping action to DC power. In such a filtration system, a water flow sensor is not required, since the power supply utilizes pumping action and thus does not provide power to the UV LEDs unless the pump is operated to draw water through the system.

The one or more filters need not be as fine as those used in conventional water filtration systems, since the filters need not trap the microbes, which are instead destroyed by the UV radiation. Further, the water filtration system does not require the chemicals used in conventional filtration systems.

The power supplies discussed above may include conventional batteries or solar cells, that is, photovotaic panels. Alternatively, the power supply may include batteries, fuel cells or capacitors that are charged by solar cells, and/or windup or crank-type dynamos. Further, the backpack 14 (Fig. 1) that holds the system may be made from flexible photovoltaic material or made of material that supports or incorporates the photovoltaic panels, and thus, provide power directly to the unit. Similarly, a carrier (not shown) for the bottle 54 (Fig. 6) may be made from, support or incorporate photovoltaic material. In addition or instead, the bottle top 52 may be made relatively inflexible photovoltaic material or support one or more photovoltaic panels. Alternatively, the UV LEDs may be powered by windup or crank-type dynamos (not shown) in addition to or in place of the batteries, cells and, in a black-out condition, grid power.

Referring now to Fig. 8, when solar cells are used, the power supply 80 preferably includes a current shunt 82 that is coupled to a microcontroller 84, for measuring the current supplied to the UV LEDs and calculating the UV dose, which is proportional to the current. When there are fluctuations in solar energy, such as when a cloud covers the sun, the microcontroller may impede the flow of the water, to provide longer periods of exposure to the UV radiation by controlling the amount by which a valve 86 opens to allow water flow past the UV LEDs in unit 88. The microcontroller may instead prevent the water from flowing through the purification module until sufficient current can be supplied. As appropriate, the unit may be switched from, for example, solar power to backup battery power at appropriate times by the microcontroller and/or the user.

As depicted in Fig. 9, the LED unit 22 may instead be positioned in the narrowing channel 13 that connects the bladder 12 to the tubing 16, with the UV LEDs turning on when water flows through the channel. Alternatively or in addition, UV LEDs 90 may be positioned facing inwardly in the walls 92 of the bladder or in the area proximate to the channel 13 to supply UV radiation to the water held in the bladder.

The UV LEDs in the walls may, for example, be turned on when associated solar cells have stored sufficient energy, as a precaution against changing environmental conditions that might otherwise disrupt the power to the UV LEDs. As appropriate, the treated water may then flow through the purification module as discussed above and be subject to further UV radiation, assuming the solar cells are sufficiently charged. Alternatively, the water may be diverted around the unit or flow through the unit without further treatment. A similar arrangement and operation of the wall-mounted UV LEDs may be used in the water bottle 54 depicted in Fig.6.

In the embodiments described above, the water flow sensors may be replaced with user-activated switches that a user turns on to activate the UV LEDs in the LED unit 30 when, for example, the user desires to take a drink. Further, automatic or user-activated switches may be included to actuate the UV LEDs 90 in the walls of the containers at desired times, such as when sufficient solar power is available or it is convenient for the user to operate a dynamo, and so forth.

In summary, the UV LED purification system described above has numerous advantages. The UV LED purification system is less costly, more robust, less complicated, more convenient, and less power-consuming. It also has the potential to be smaller and lighter than CCFL technology. Further, the UV LED purification system is particularly well suited for intermittent on-demand use. Accordingly, the system is well suited for use in wearable or portable hydration devices.

What is claimed is:

CLAIMS

1. A wearable hydration system including:

a bladder for holding a hydrating fluid;

tubing for providing a path for the hydrating fluid from the bladder;

a sensor for signaling when the hydrating fluid is flowing from the bladder;

a purification module including one or more solid state UV devices that are positioned in the tubing to provide UV radiation in a germicidal range to purify the flowing fluid, the UV devices turning on when the sensor indicates that fluid is flowing from the bladder and turning off when the sensor indicates that fluid is not flowing from the bladder; and

a wearable pack for holding at least the bladder.

2. The wearable hydration system of claim 1 further including a power supply that provides power to the purification module.

3. The wearable hydration system of claim 2 wherein the power supply includes solar cells.

4. The wearable hydration system of claim 2 wherein the power supply includes one or more of batteries, fuel cells, capacitors, solar cells, and windup or crank-type dynamos.

5. The wearable hydration system of claim 4 wherein the power supply includes solar cells that charge one or more of the batteries, fuel cells and capacitors.

6. The wearable hydration system of claim 1 wherein the wearable pack is made of photovoltaic material and the pack supplies power to the UV devices.

7. The wearable hydration system of claim 4 wherein the wearable pack is made of photovoltaic material and supplies power to charge one or more of the batteries, fuel cells, solar cells and capacitors.

8. The wearable hydration system of claim 1 wherein the path through the purification module includes a wider section to allow water to flow unimpeded past the UV devices.

9. The wearable hydration system of claim 8 wherein the path provided through the purification module is sized to provide UV radiation of at least 25 mJ/cm^2 to all of the water flowing past the UV devices.

10. The wearable hydration system of claim 1 wherein the bladder is integral with the wearable pack.

11. The wearable hydration system of claim 1 further including one or more filters to remove sediments from the fluid.

12. The wearable hydration system of claim 1 further including a plurality of solid state UV devices mounted in walls of the bladder.

13. The wearable hydration system of claim 12 further including a user-activated switch to turn on the wall-mounted UV devices.

14. The wearable hydration system of claim 12 further including a switch that turns on the wall-mounted UV devices when the power supply has sufficient power.

15. A purification module for use with a wearable or portable hydrating fluid container, the water purification system comprising:

tubing for providing a path for the hydrating fluid from the container;

means for signaling when water flow is initiated through the tubing from the container;

one or more solid state UV devices that are positioned in the path, either in the tubing, or in the region of the container that is shaped to join the tubing, or both, the UV devices providing UV radiation in a germicidal range to purify the flowing water, the UV devices turning on when the means for signaling indicates that water flow is initiated from the container and through the tubing and turning off when the means for signaling indicates that water is not flowing through the tubing; and

a power supply that provides power to the purification module.

16. The purification module of claim 15 wherein the means for signaling is a water flow sensor.

17. The purification module of claim 15 wherein the means for signaling is a user-operated valve that a user opens to provide water flow.

18. The purification module of claim 17 wherein the valve is a push-pull valve positioned on a top of the container and water flow is initiated by opening the valve and upending the container.

19. The purification module of claim 15 wherein the means for signaling is a user-activated switch.

20. The purification module of claim 15 wherein the power supply includes one or more of batteries, fuel cells, capacitors, solar cells and windup or crank-type dynamos.

21. The purification module of claim 20 wherein the power supply includes solar cells that charge one or more of the batteries, fuel cells and capacitors.

22. The purification module of claim 15 further including a wearable pack for carrying the container and the wearable pack is made of photovoltaic material that supplies power to the UV devices.

23. The purification module of claim 22 wherein the wearable pack supplies power to charge one or more batteries, fuel cells, solar cells and capacitors that are included in the power supply.

24. The purification module of claim 15 wherein the path through the purification module includes a wider section to allow water to flow unimpeded past the UV devices.

25. The purification module of claim 24 wherein the path provided through the purification module is sized to provide UV radiation of at least 25 mJ/cm^3 to all of the water flowing past the UV devices.

26. The purification module of claim 15 further including one or more filters to remove sediments from the fluid.

27. The purification module of claim 15 further including a plurality of UV solid state devices mounted in the walls of the container.

28. The purification module of claim 27 further including a user-activated switch to turn on the wall-mounted UV devices.

29. The purification module of claim 27 further including a switch that turns on the wall-mounted UV devices when the power supply has sufficient power.

30. The purification module of claim 22 wherein the container is integral with the wearable pack.

31. The purification module of claim 22 wherein the container is a water bottle.

32. A purification module including

tubing for providing a path for hydrating fluid, the tubing including a first end through which water enters the tubing and a second end through which water exits the tubing;

a sensor positioned in the tubing for signaling when water is flowing into and through the tubing;

one or more solid state UV devices that are positioned in the tubing and provide UV radiation in a germicidal range to purify the water flowing along the path from the first end to the second end, the UV devices turning on when the sensor indicates that water is flowing along the path and turning off when the sensor no longer indicates that water is flowing along the path; and

a power supply for supplying power to the UV devices.

33. The purification module of claim 32 wherein the power supply includes one or more of batteries, fuel cells, capacitors and solar cells.

34. The purification module of claim 33 wherein the power supply includes solar cells that charge one or more of the batteries, fuel cells and capacitors.

35. The purification module of claim 32 wherein the path through the purification module includes a wider section to allow water to flow unimpeded past the UV devices.

36. The purification module of claim 35 wherein the path provided through the purification module is sized to provide UV radiation of at least 25 mJ/cm^2 to all of the water flowing past the UV devices.

37. The purification module of claim 32 further including one or more filters to remove sediments from the fluid.

38. A water filtration system including:

one or more filters positioned for removing sediment from the water;

tubing for providing a path for flowing water;

a pump for introducing water to the tubing;

a purification module including one or more solid state UV devices that are positioned in the tubing and provide UV radiation in a germicidal range to purify the water flowing along the path, the UV devices operating intermittently to turn on when the module senses that the pump introduces water to the path and turn off when the module senses that water flow ceases along the path; and

a power supply for providing DC power to the UV devices.

39. The water filtration system of claim 38 wherein the power supply converts energy associated with the pumping action of the pump to DC power for use by the UV devices.

40. The water filtration system of claim 38 wherein the power supply includes one or more of batteries, fuel cells, capacitors, solar cells and windup or crank-type dynamos.

41. The water filtration system of claim 40 wherein the power supply includes solar cells that charge one or more of the batteries, fuel cells and capacitors.

42. The water filtration system of claim 38 wherein the path through the purification module includes a wider section to allow water to flow unimpeded past the UV devices.

43. The water filtration system of claim 42 wherein the path provided through the purification module is sized to provide UV radiation of at least 25 mJ/cm^2 to all of the water flowing past the UV devices.

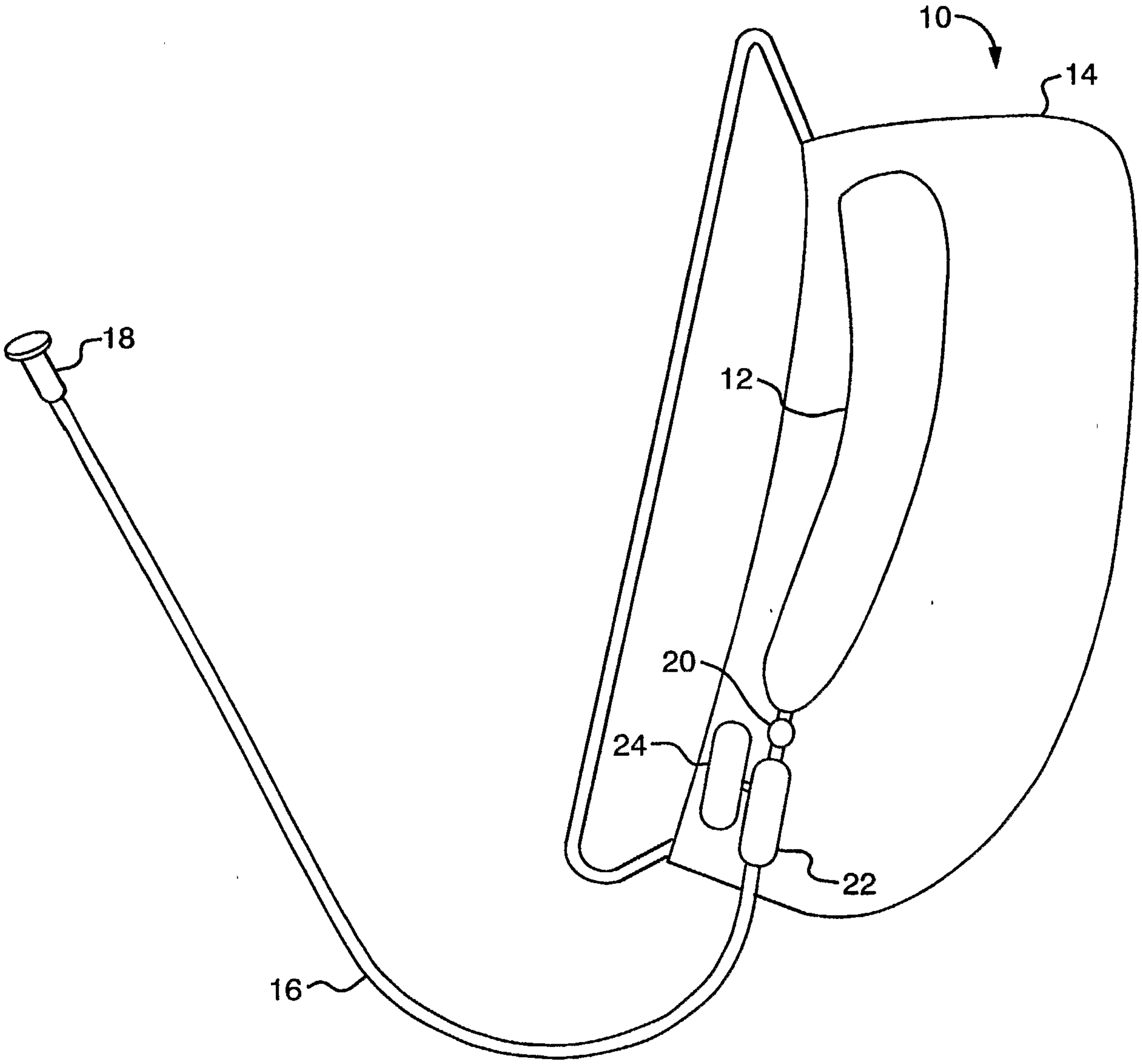


FIG. 1

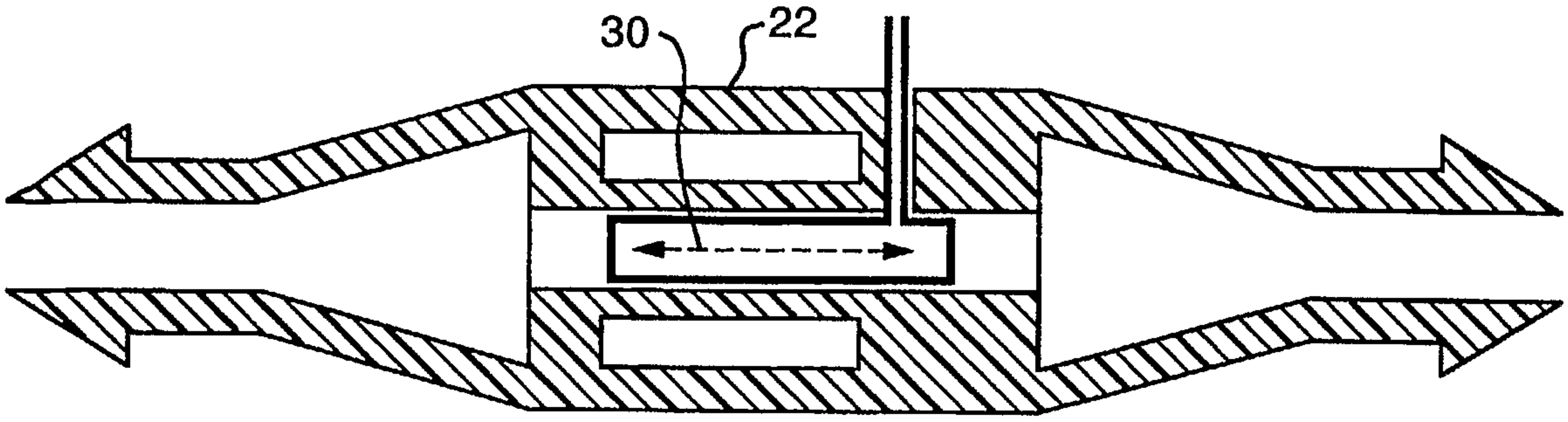


FIG. 2

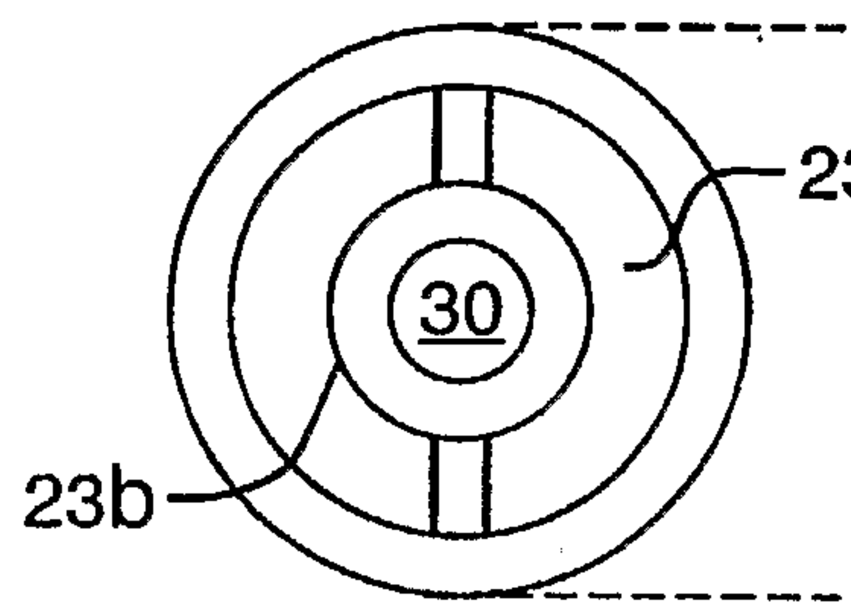


FIG. 3

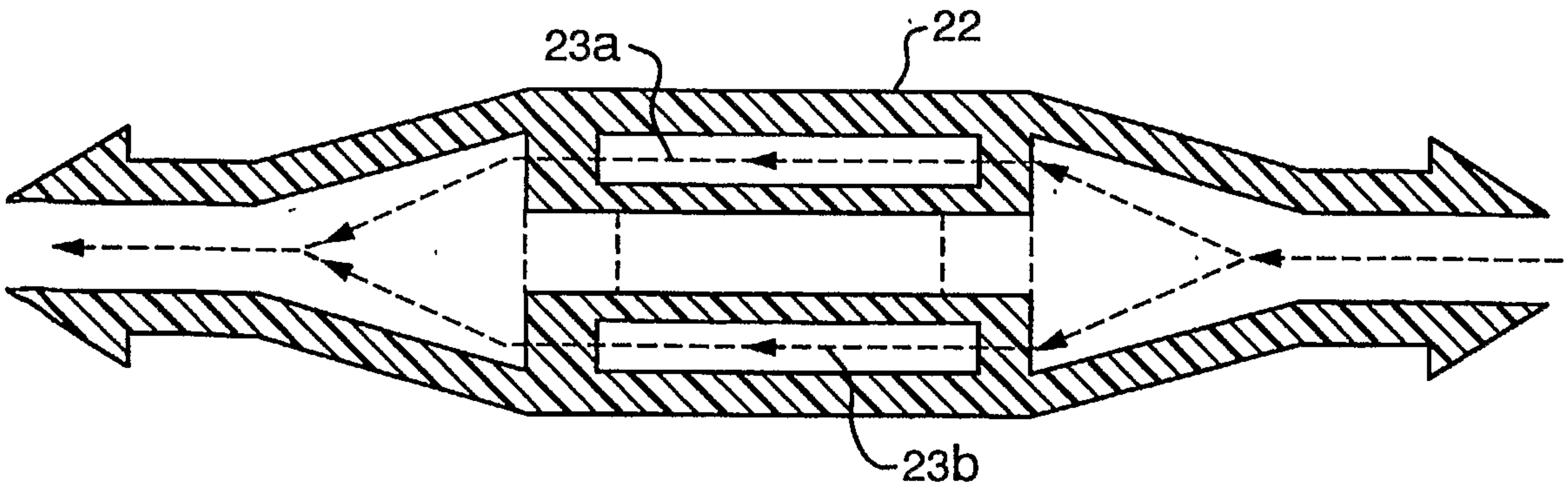


FIG. 4

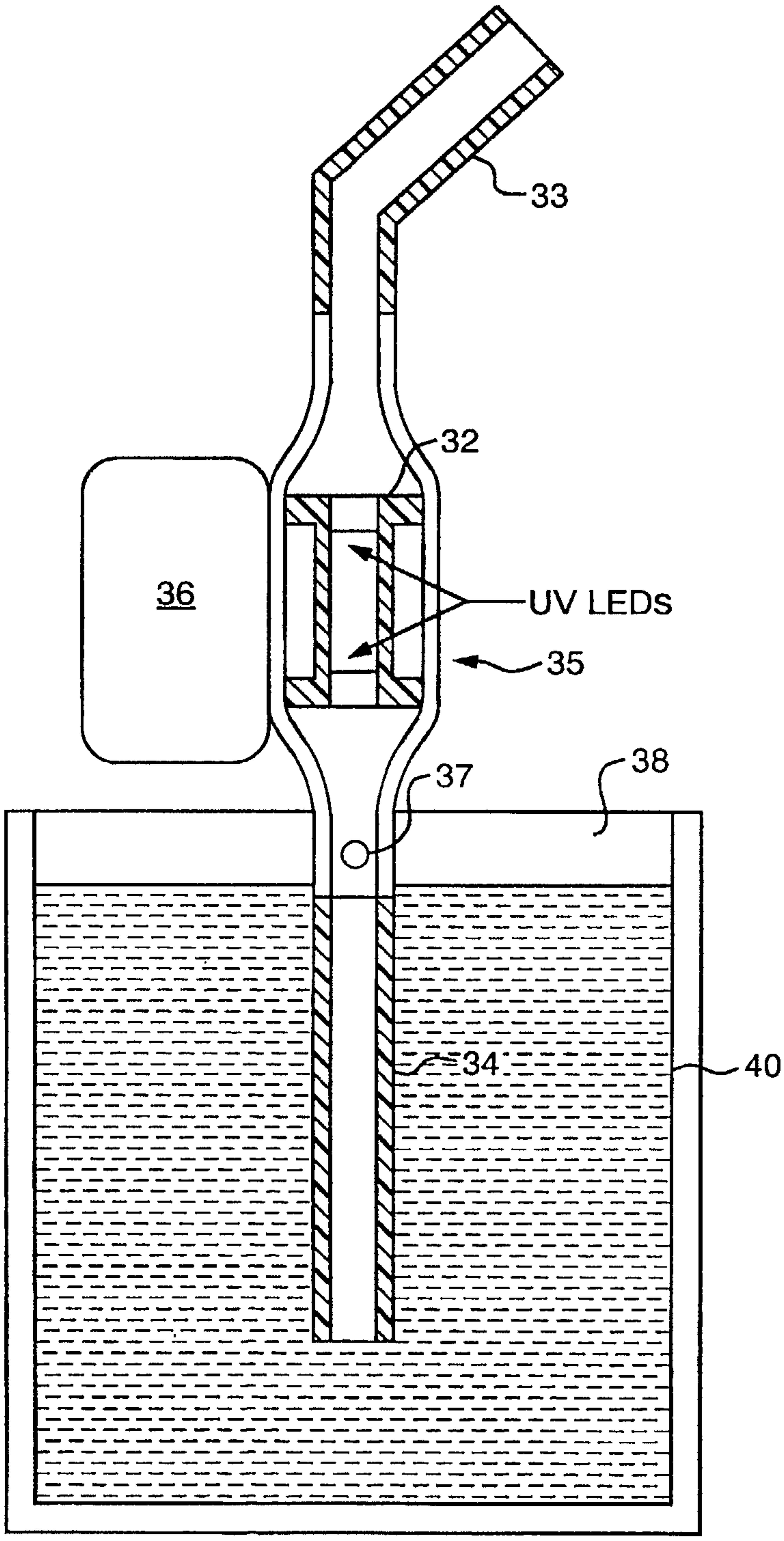


FIG. 5

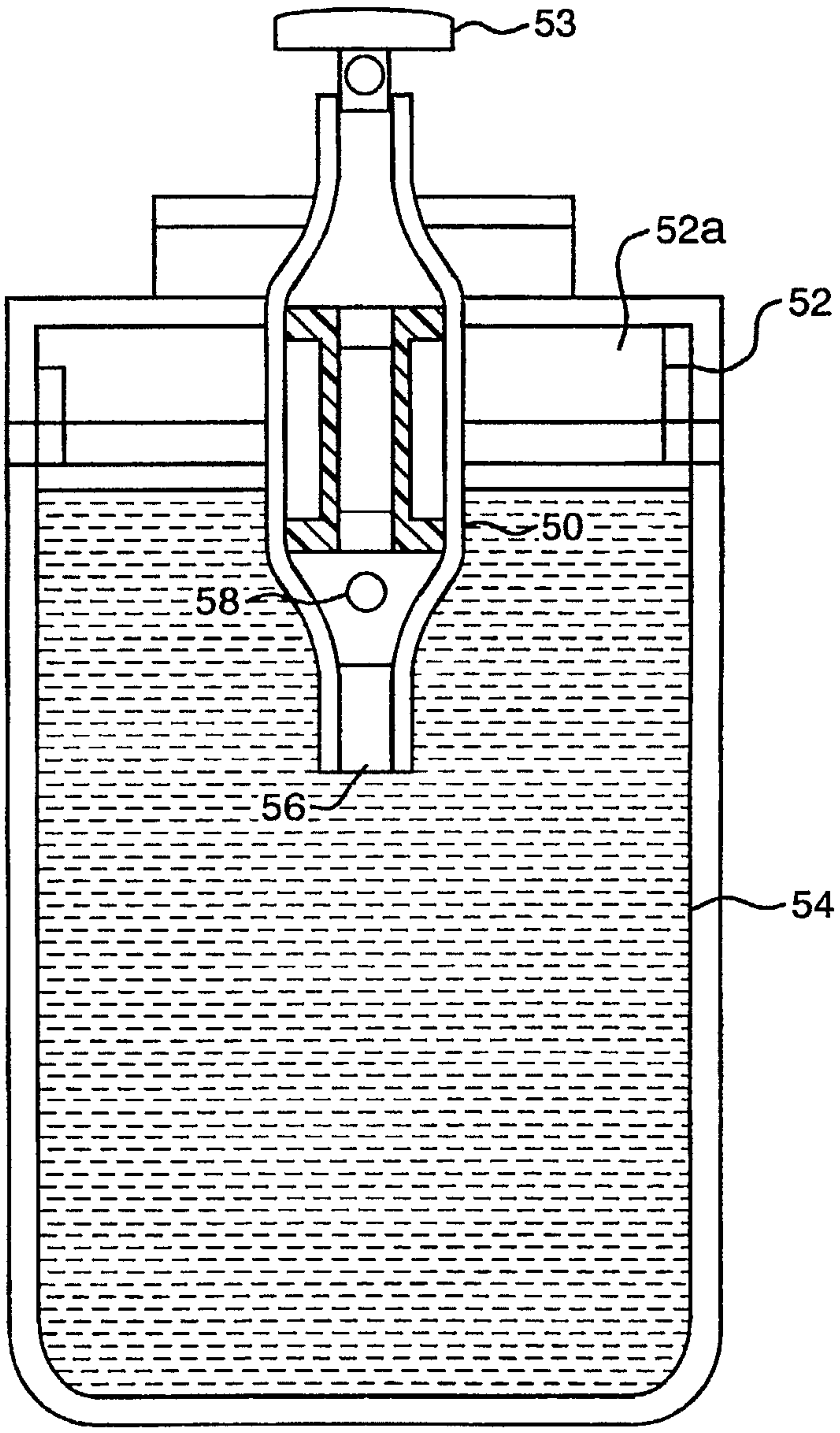


FIG. 6

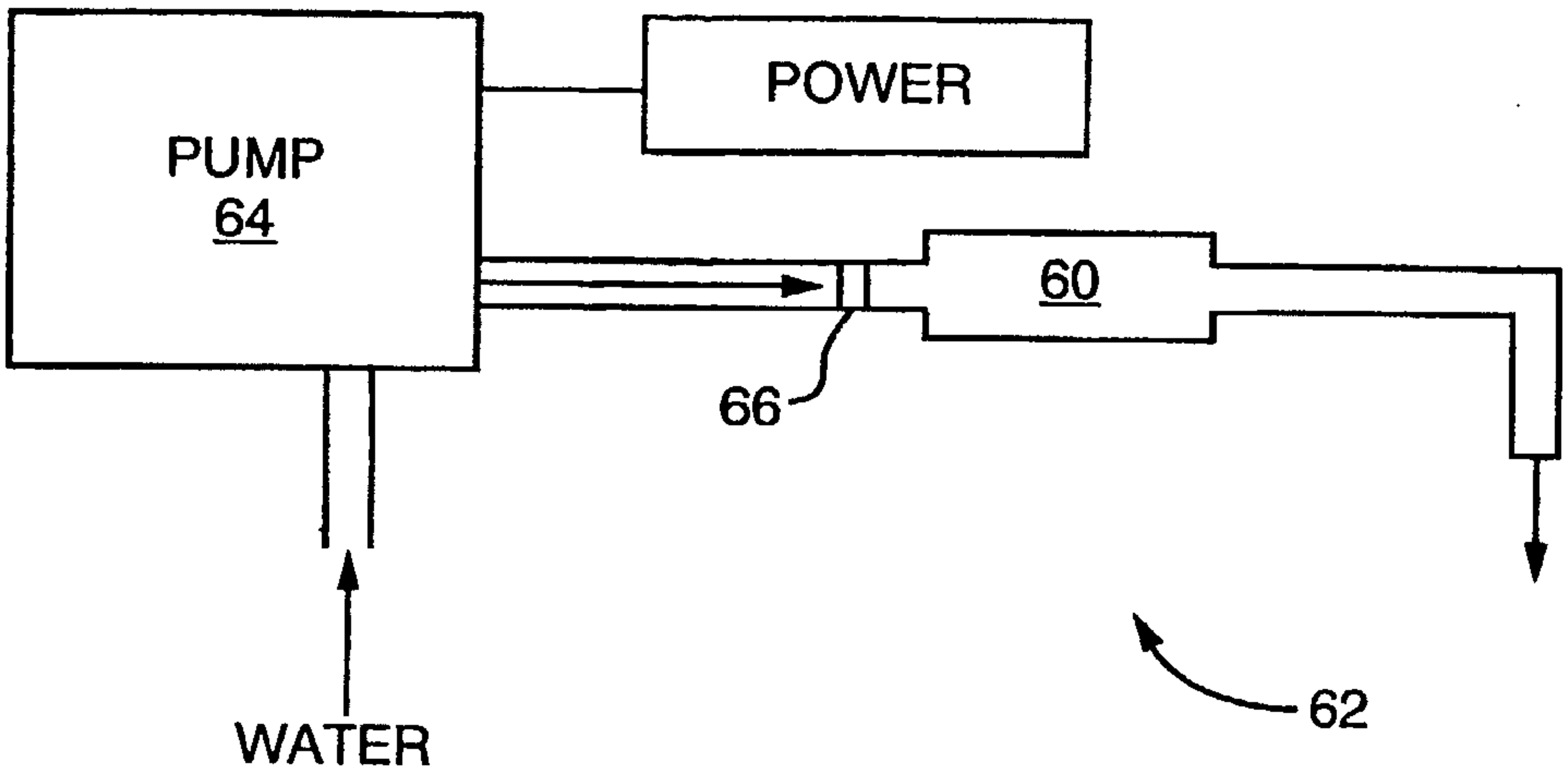

POWER
PUMP
64
60
66
WATER
62

FIG. 7

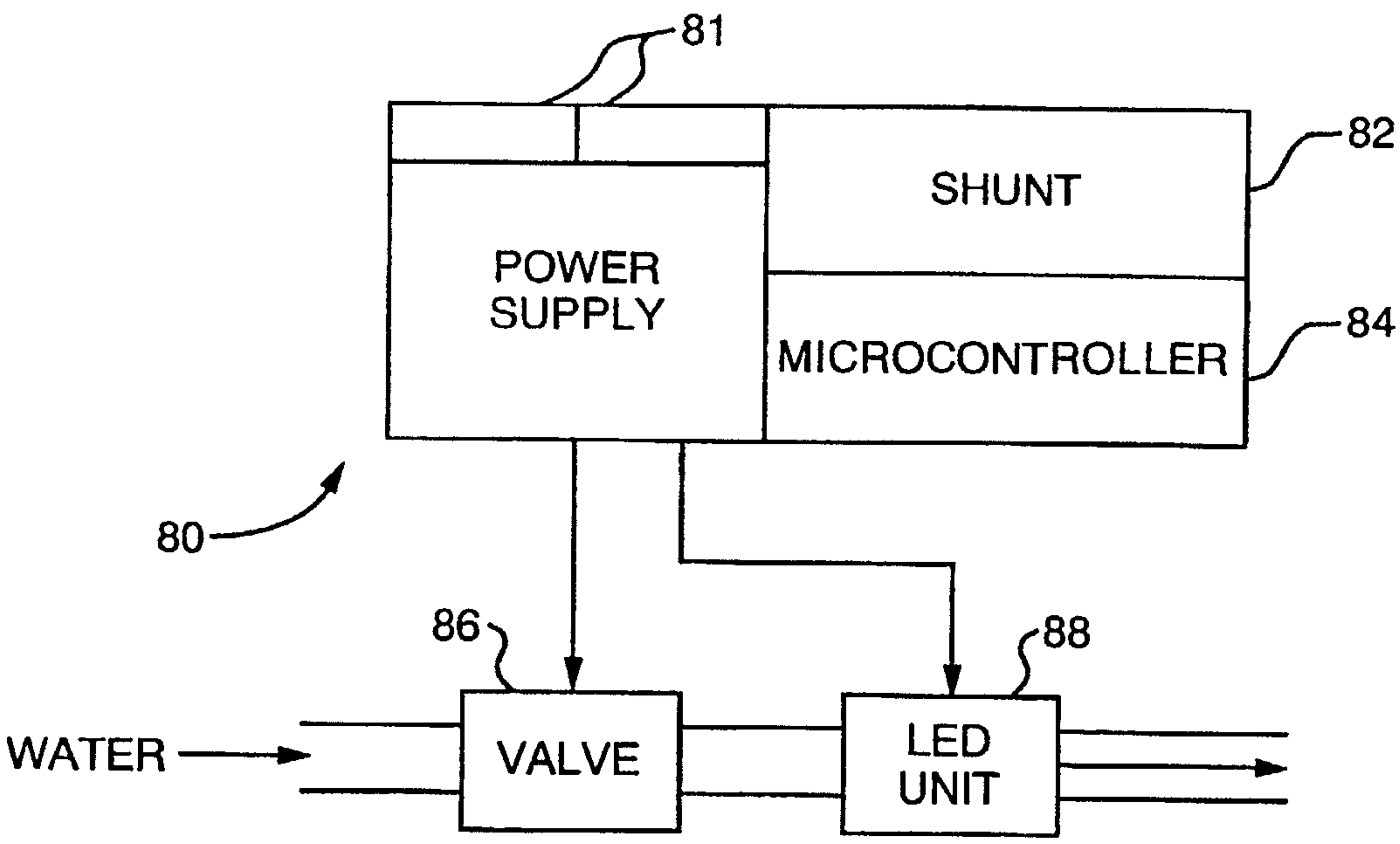

81
82
SHUNT
POWER
SUPPLY
84
MICROCONTROLLER
80
86
88
WATER
VALVE
LED
UNIT

FIG. 8

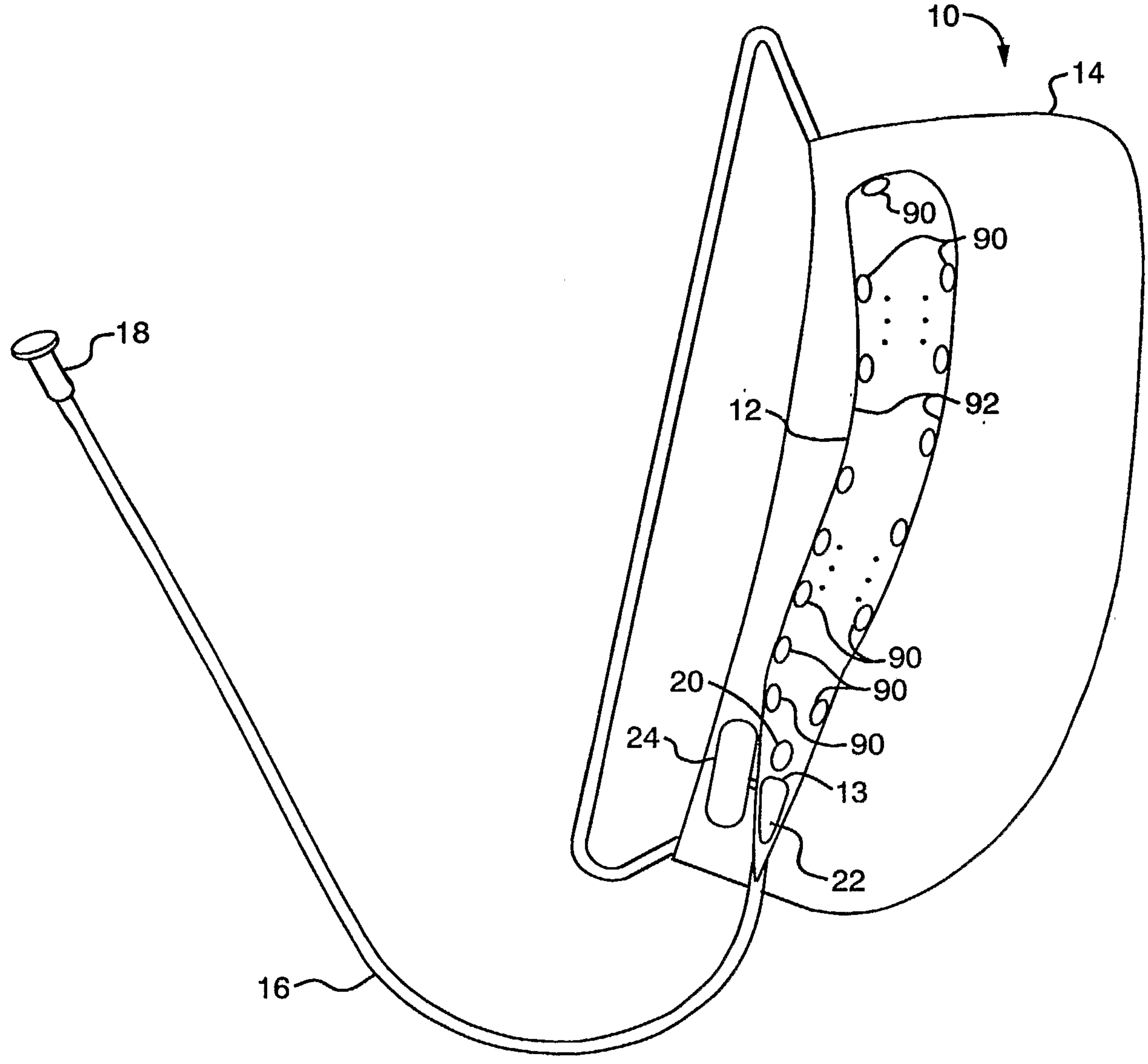
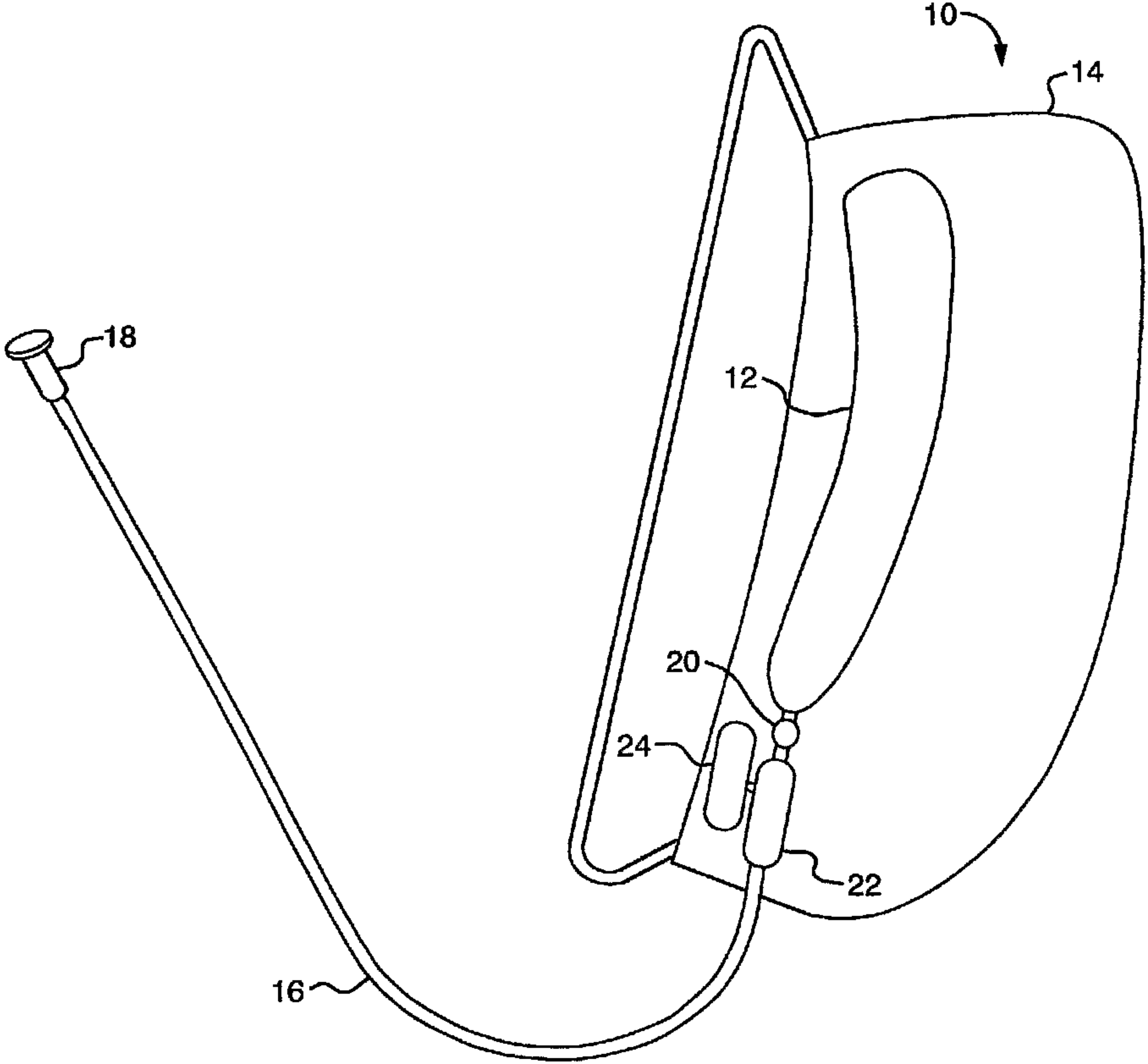


FIG. 9


10
14
18
12
20
24
22
16