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Huang

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(54) **PORTABLE LIQUID STORAGE DEVICE**

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B05C 17/005 (2006.01)

(52) **U.S. Cl.**
CPC .. ***B05C 17/00543*** (2013.01); ***B05C 17/00546*** (2013.01)

(58) **Field of Classification Search**
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USPC 222/146.5, 146.2; 219/386
See application file for complete search history.

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Primary Examiner — Paul R Durand
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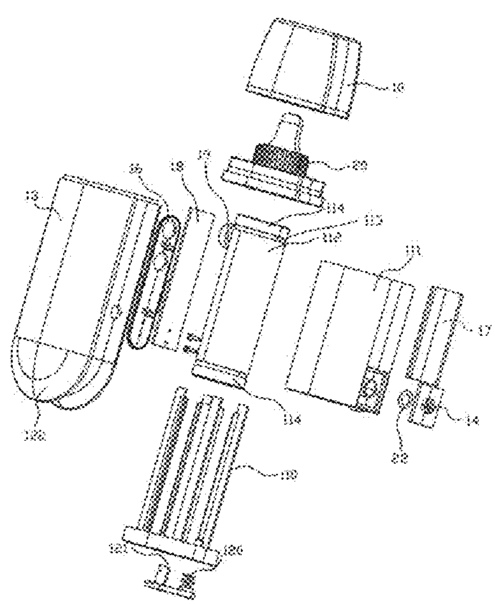
(57) **ABSTRACT**

A portable liquid storage device includes a housing; a heating cylinder assembly mounted in the housing and including a heat-conducting cylinder being configured for accommodating a liquid therein and an electric-heating piece attached to an outer wall of the heat-conducting cylinder; and a battery and a circuit board mounted in the housing, the battery being electrically connected to the electric-heating piece through the circuit board, so as to supply electric power to make the electric-heating piece generate heat to warm up the liquid inside the heat-conducting cylinder.

20 Claims, 16 Drawing Sheets



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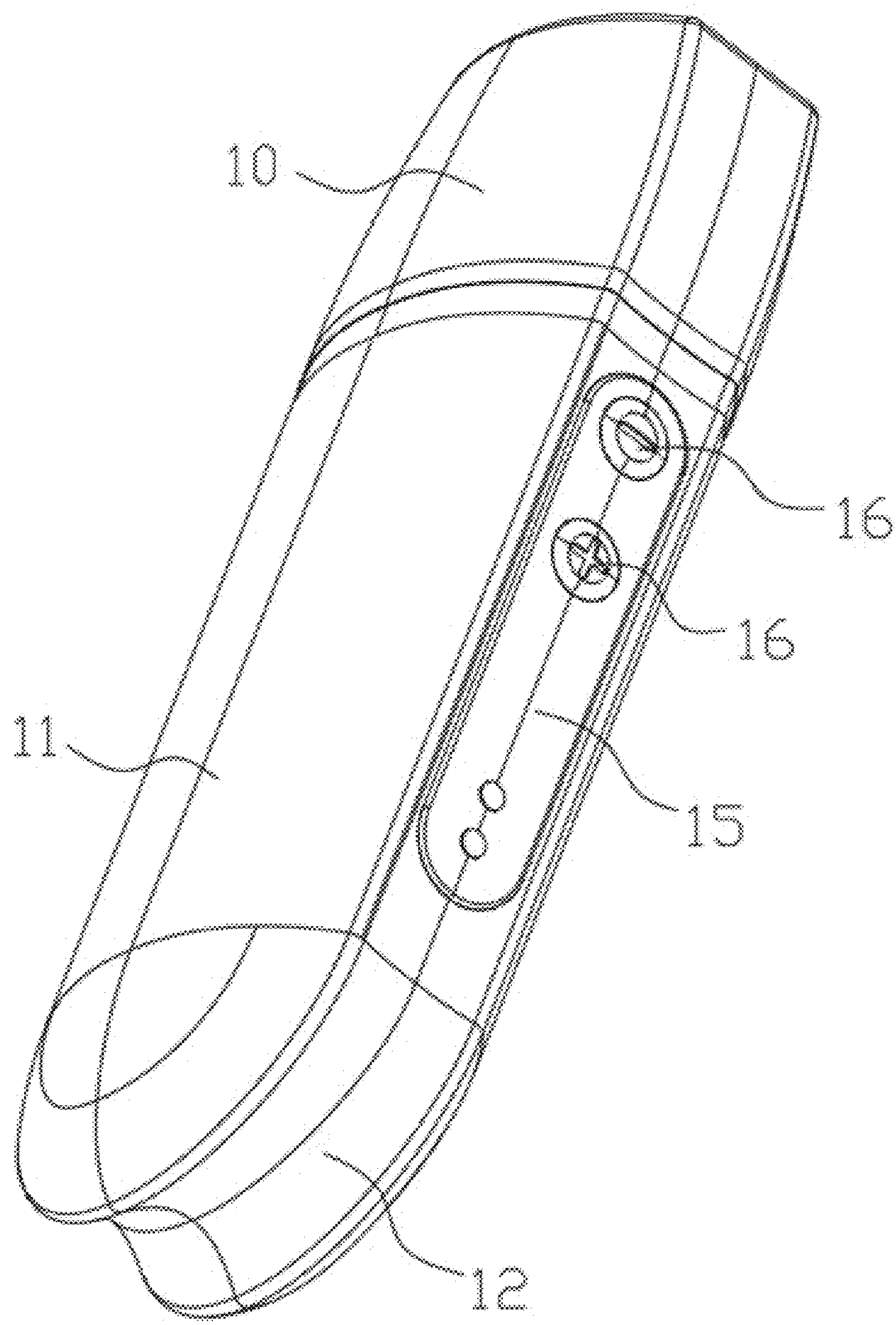

FIG. 1

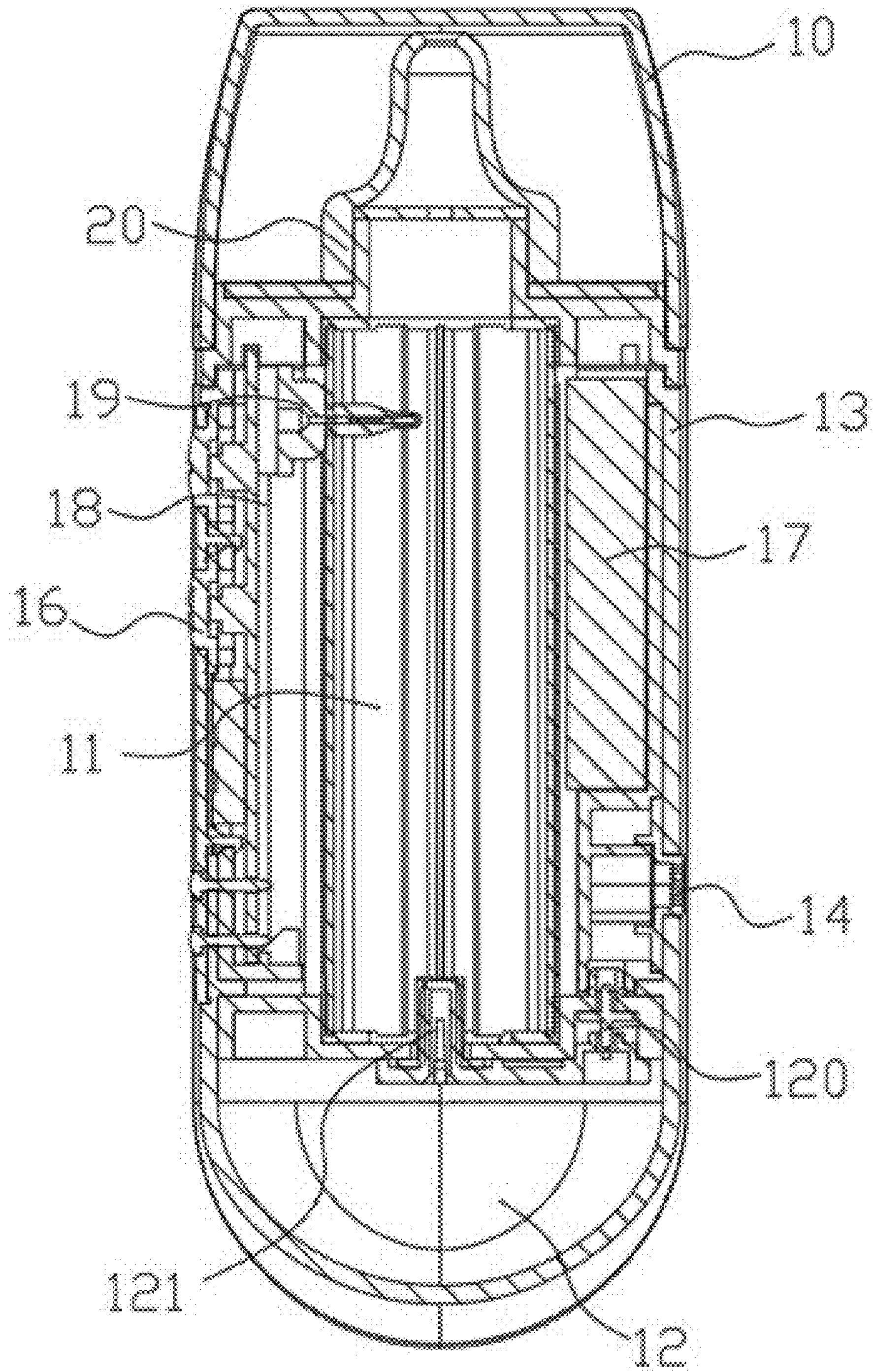

FIG. 2

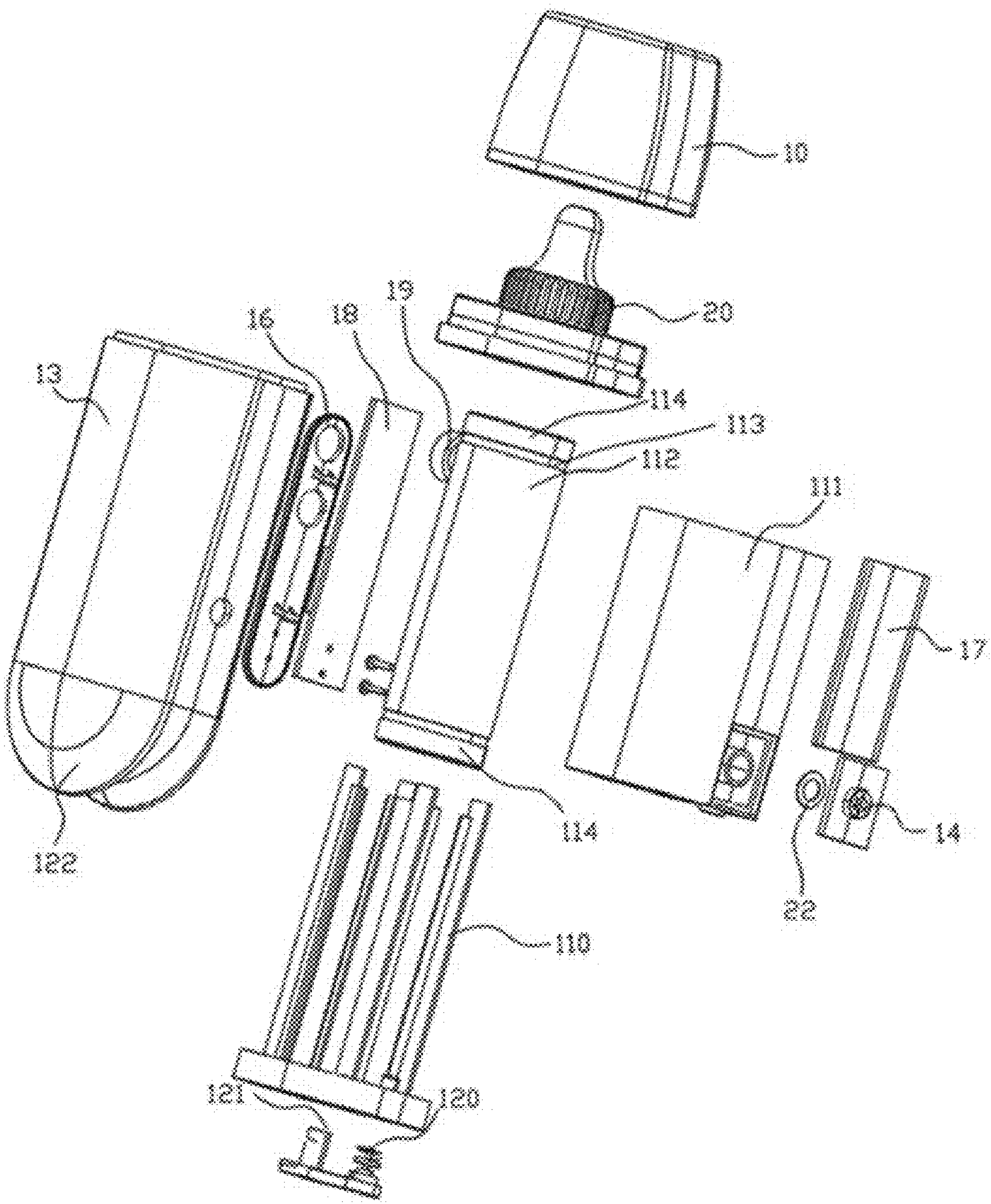

FIG. 3

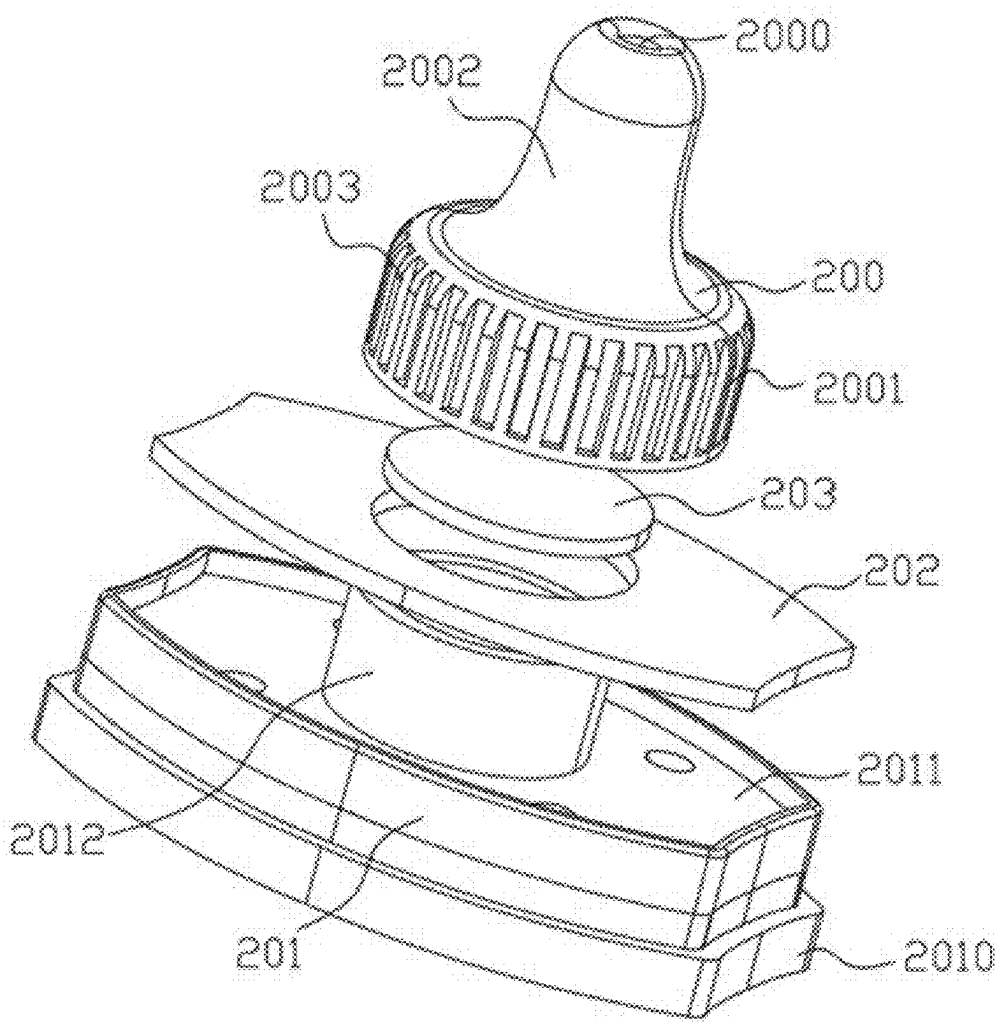

FIG. 4

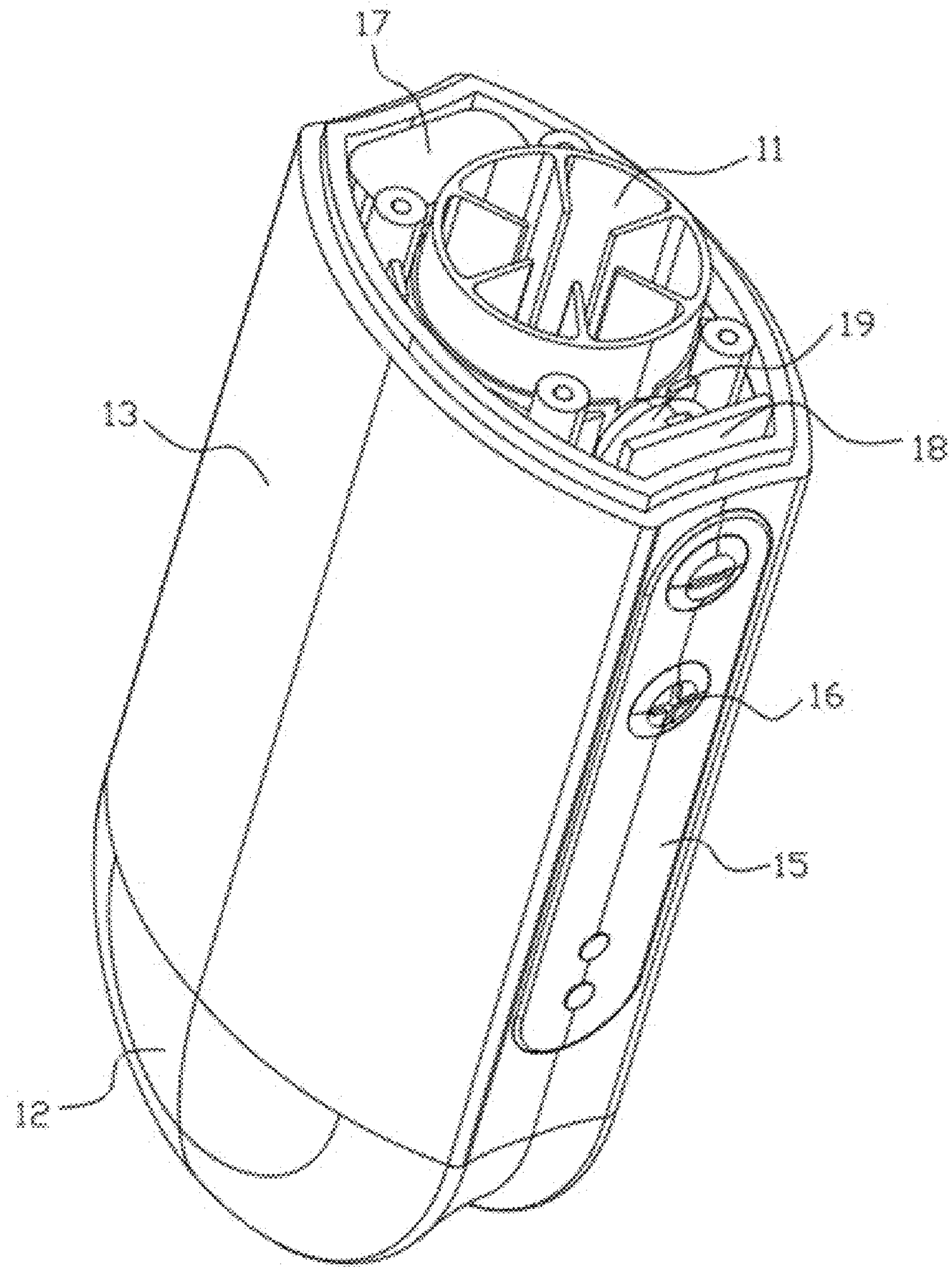

FIG. 5

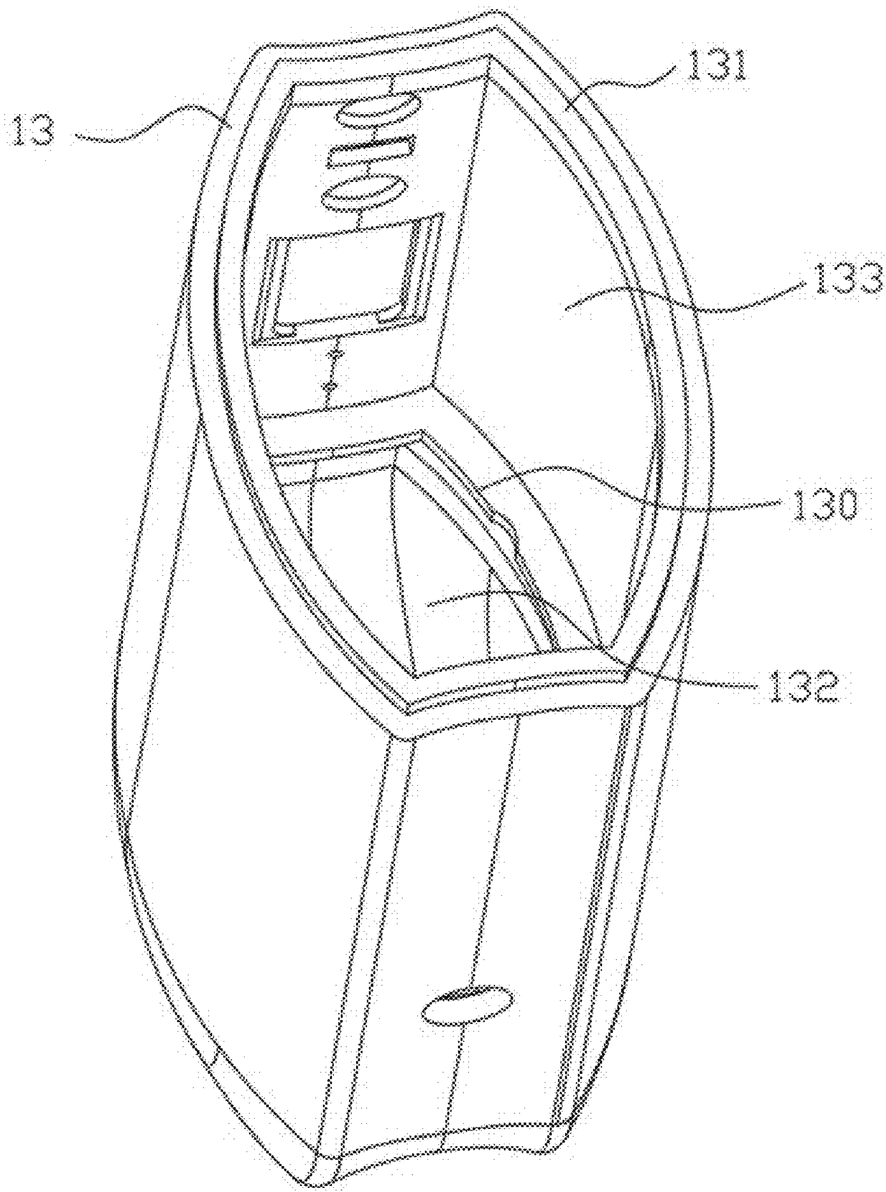

FIG. 6

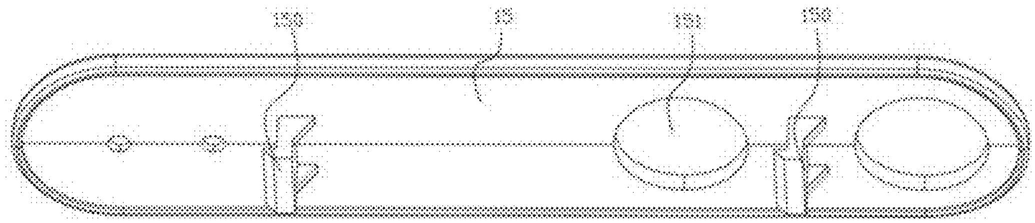

FIG. 7

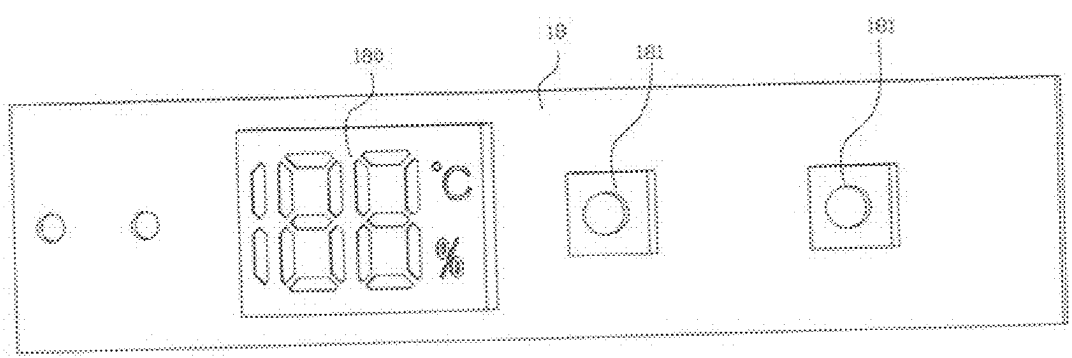

FIG. 8

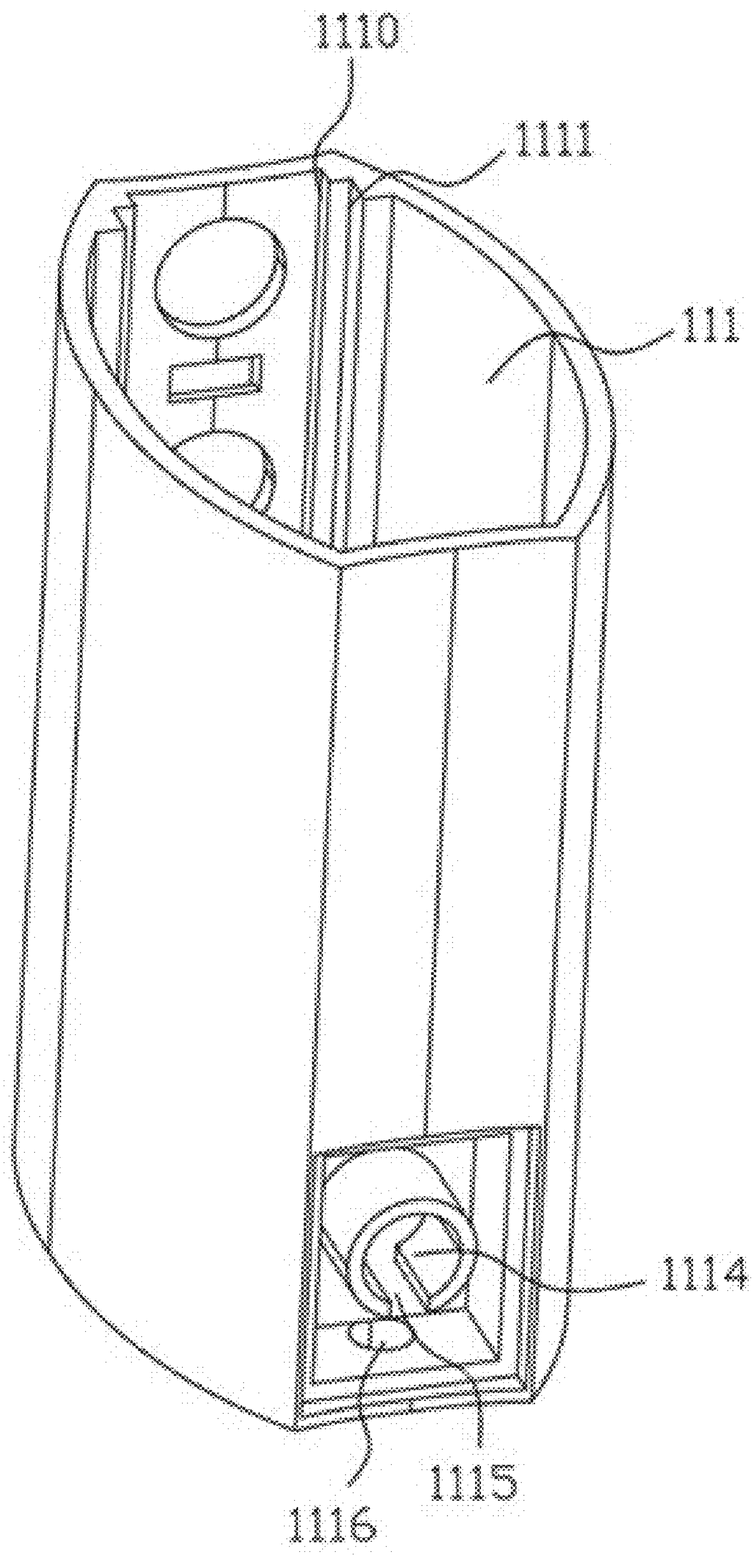

FIG. 9

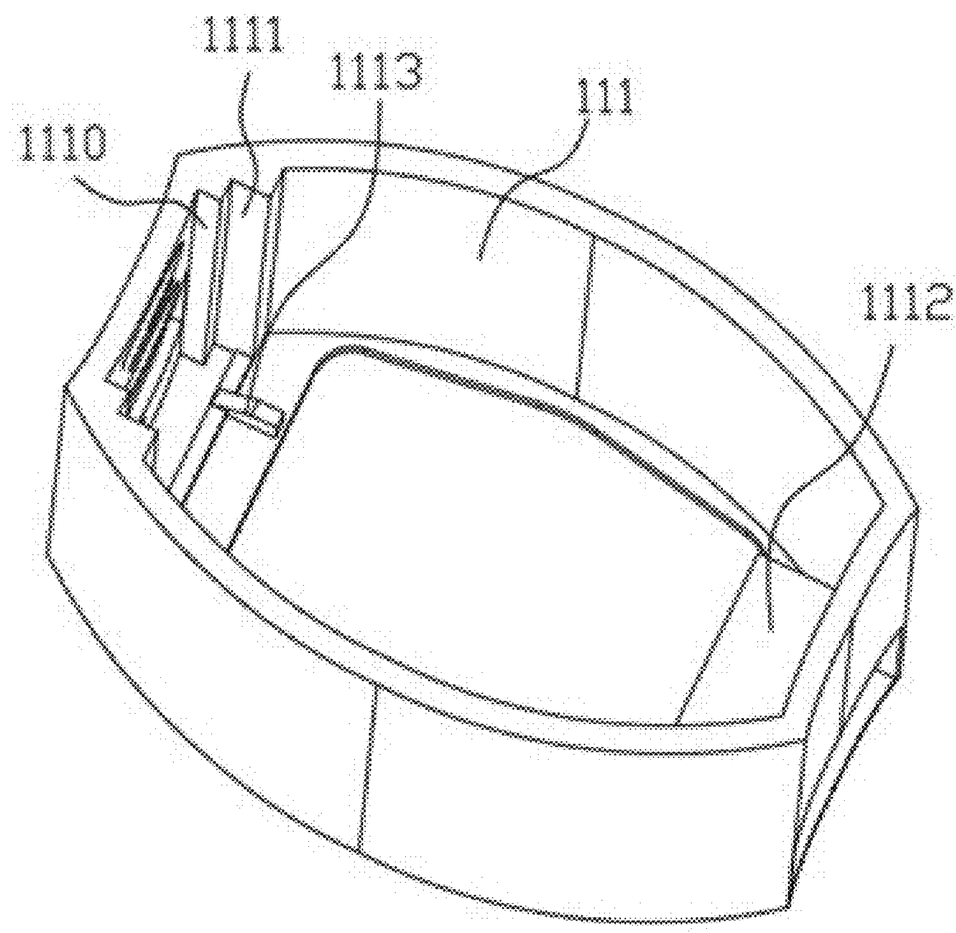

FIG. 10

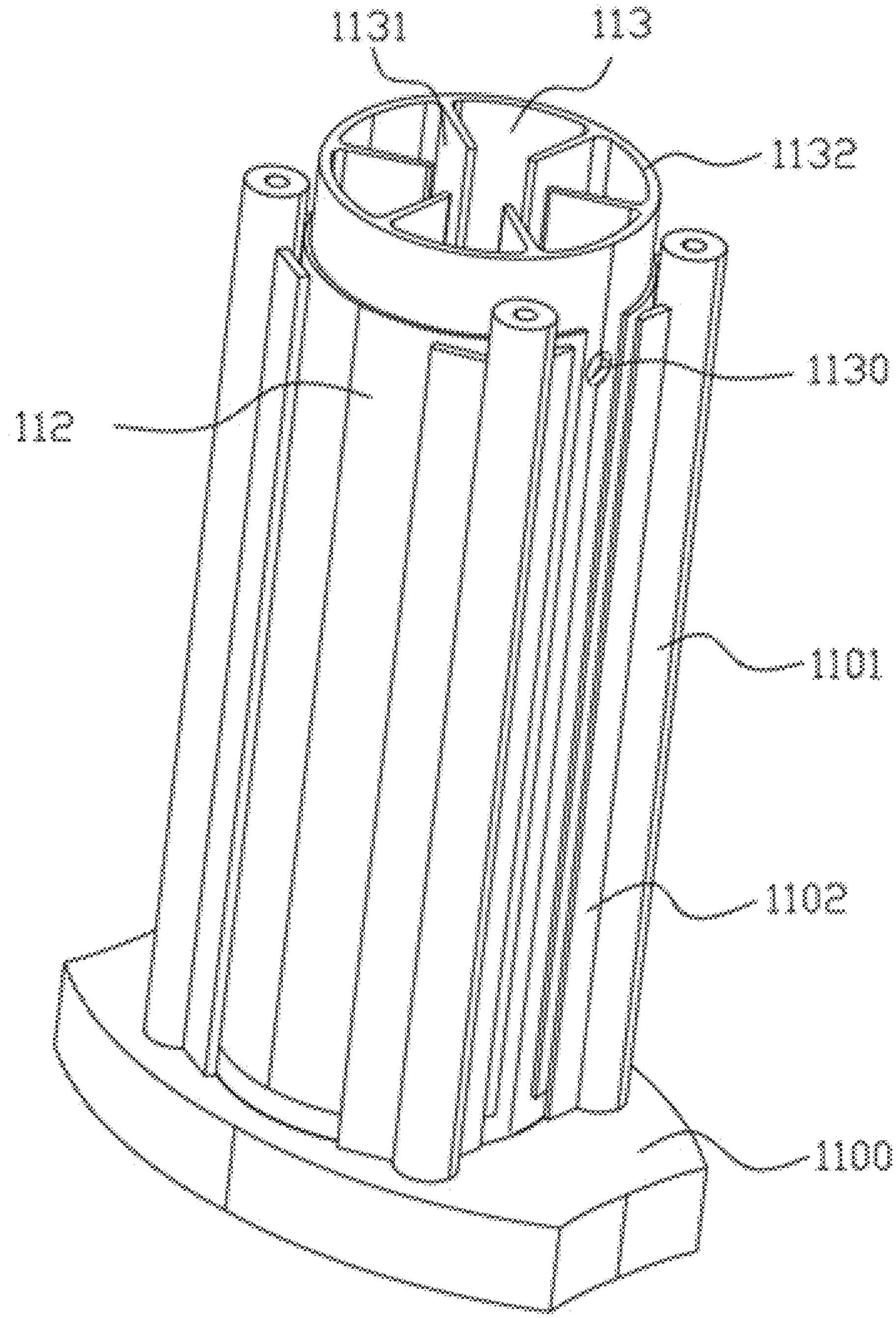

FIG. 11

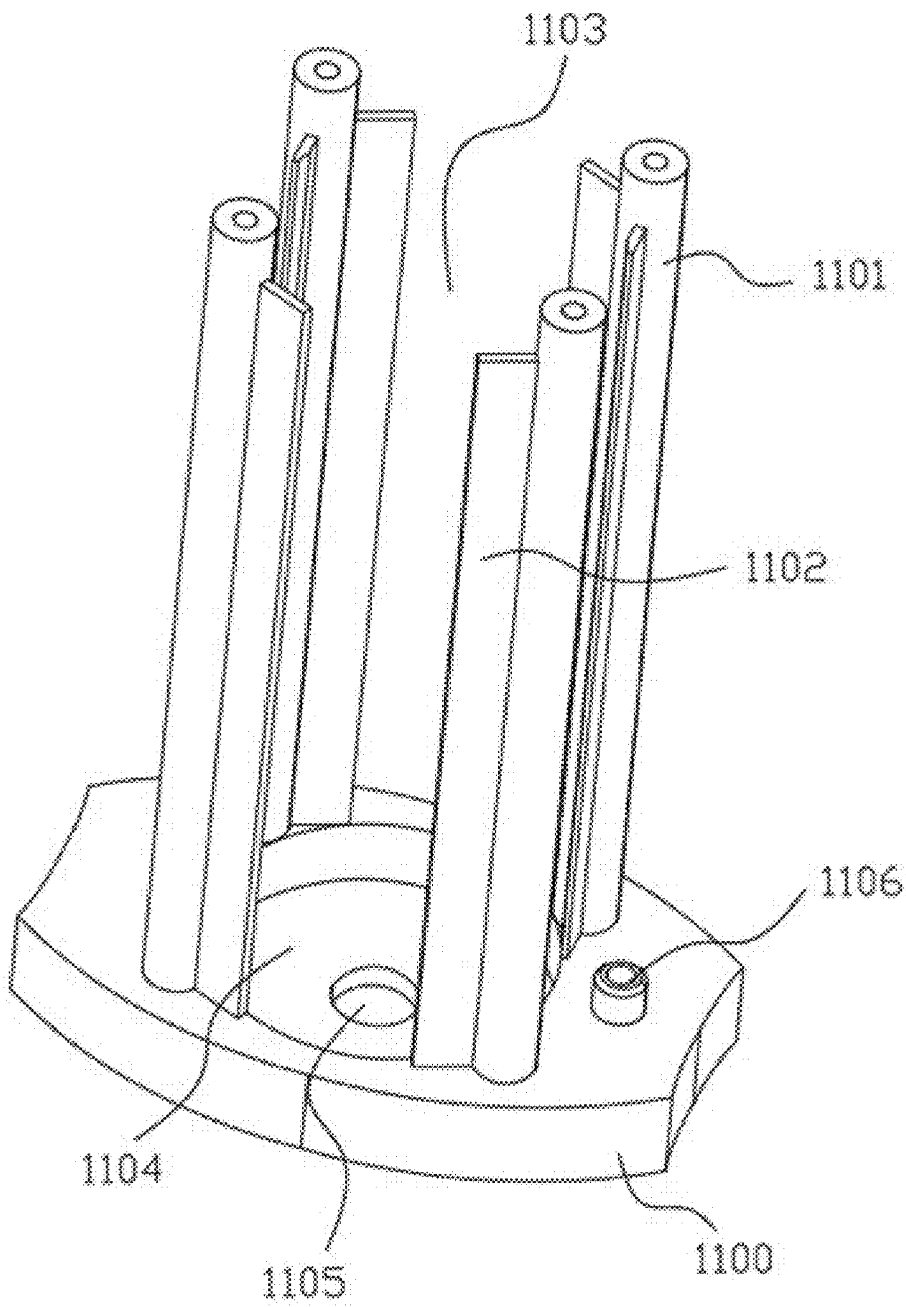

FIG. 12

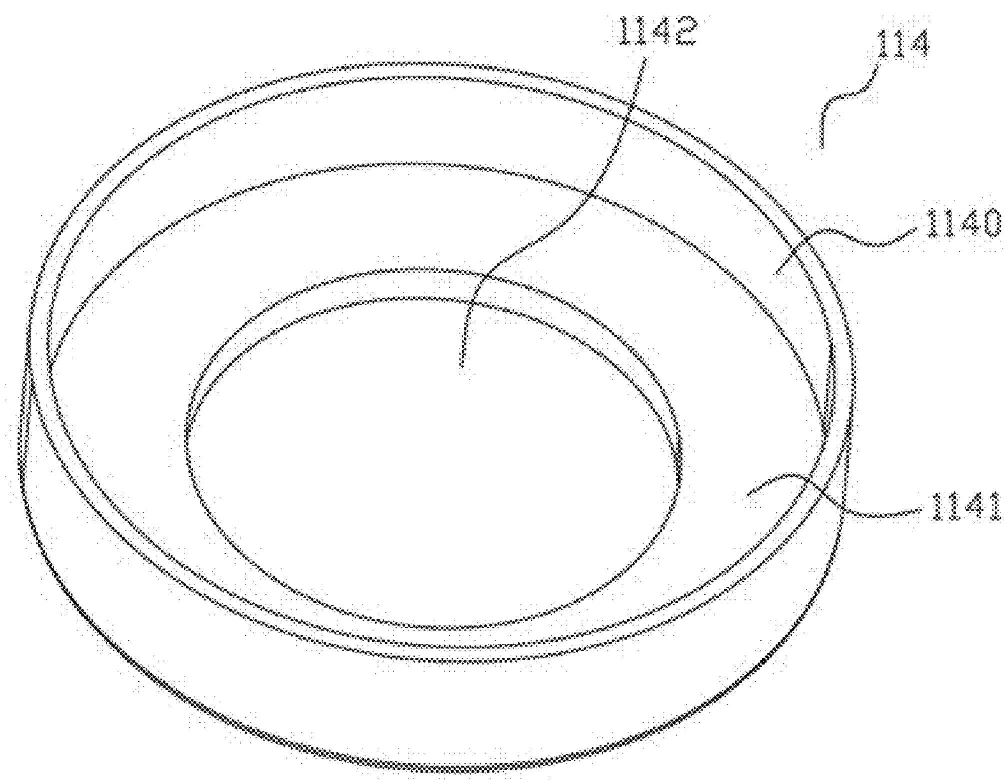

FIG. 13

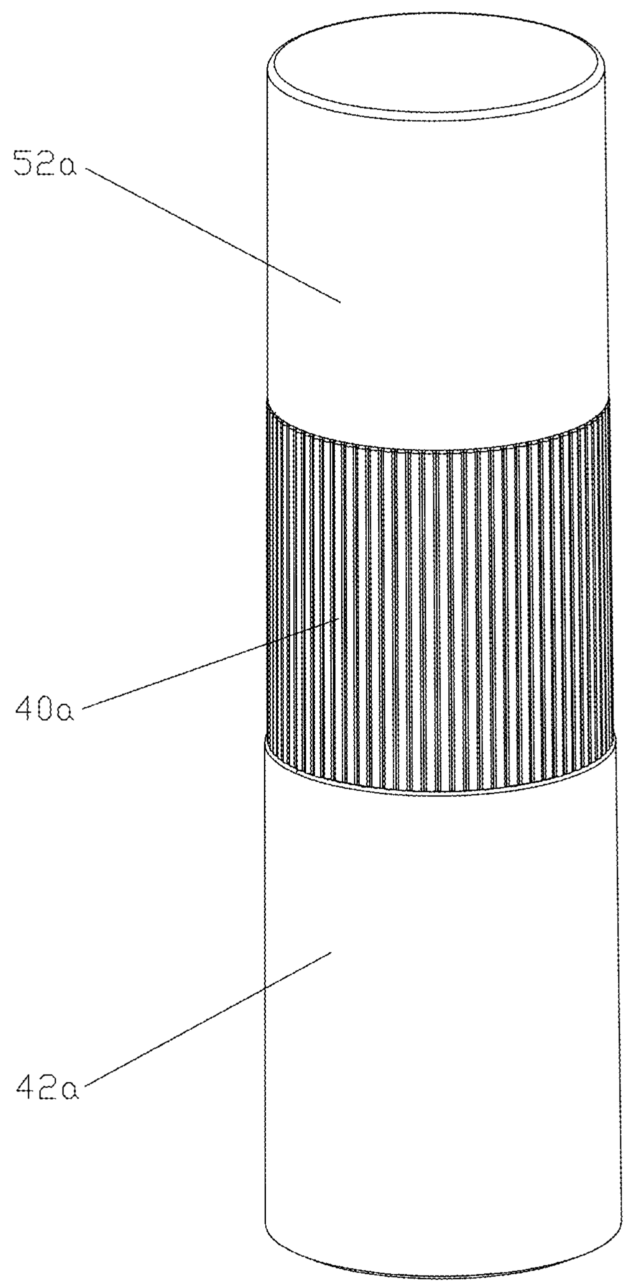

FIG. 14

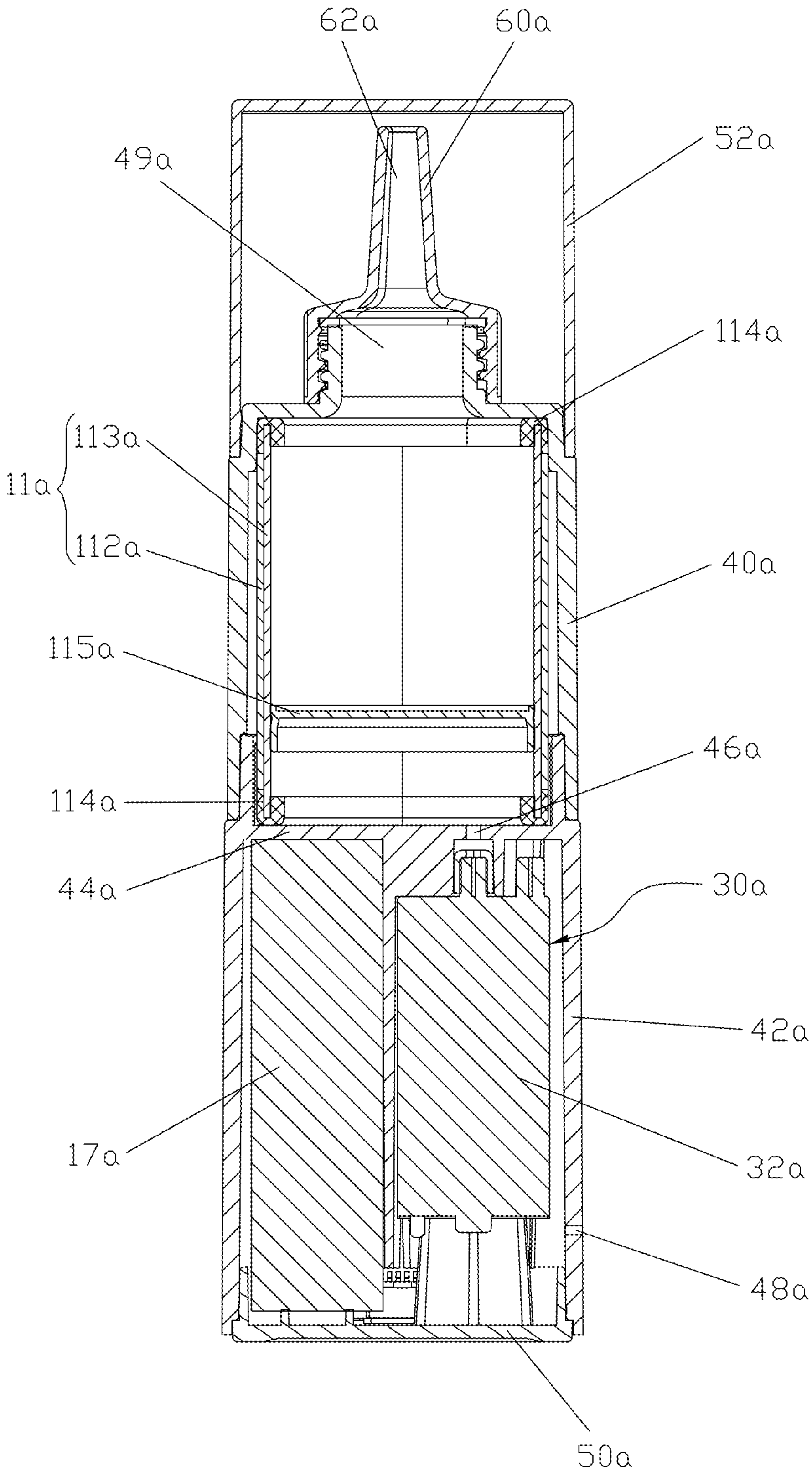
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FIG. 15

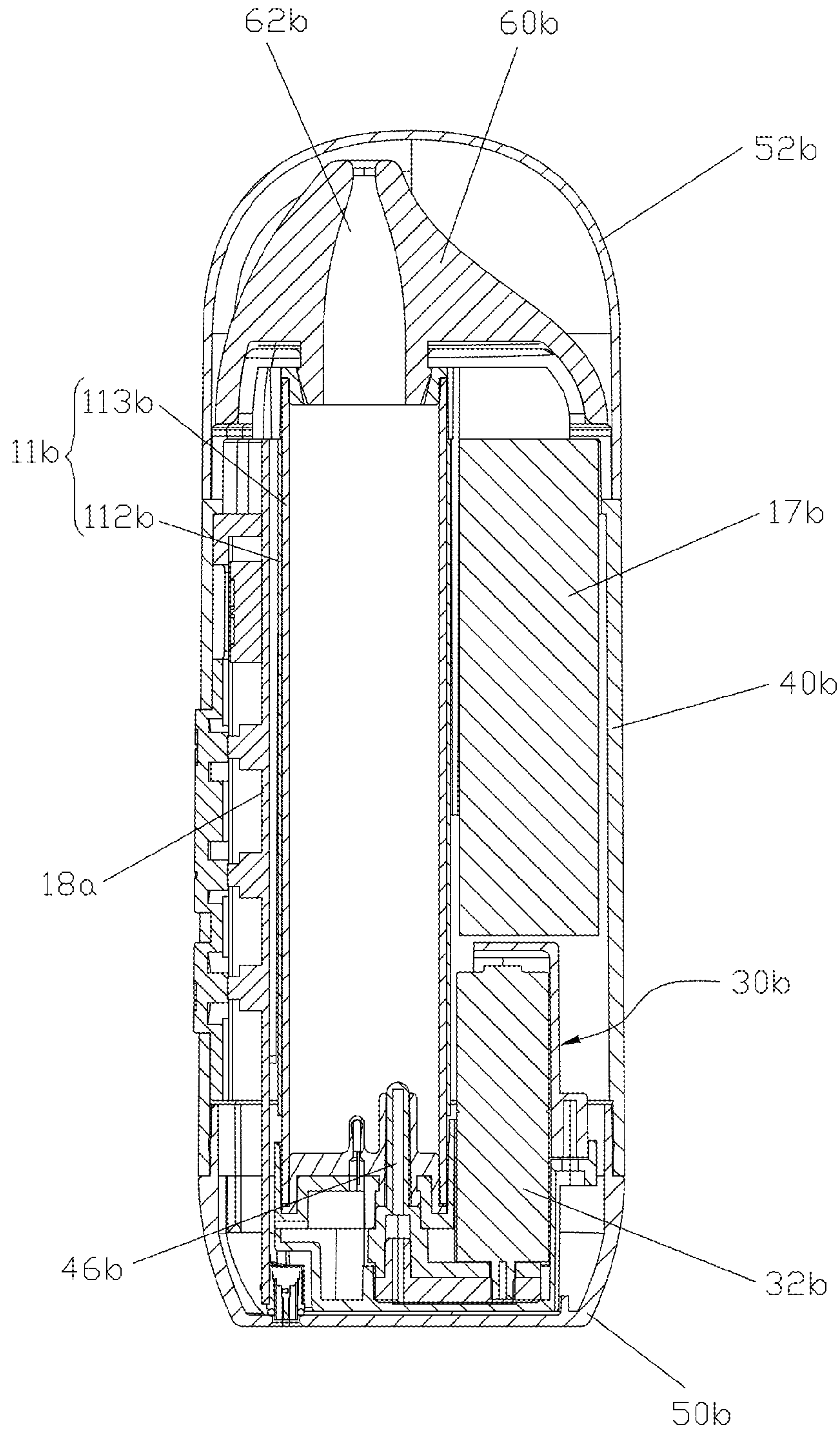

FIG. 16

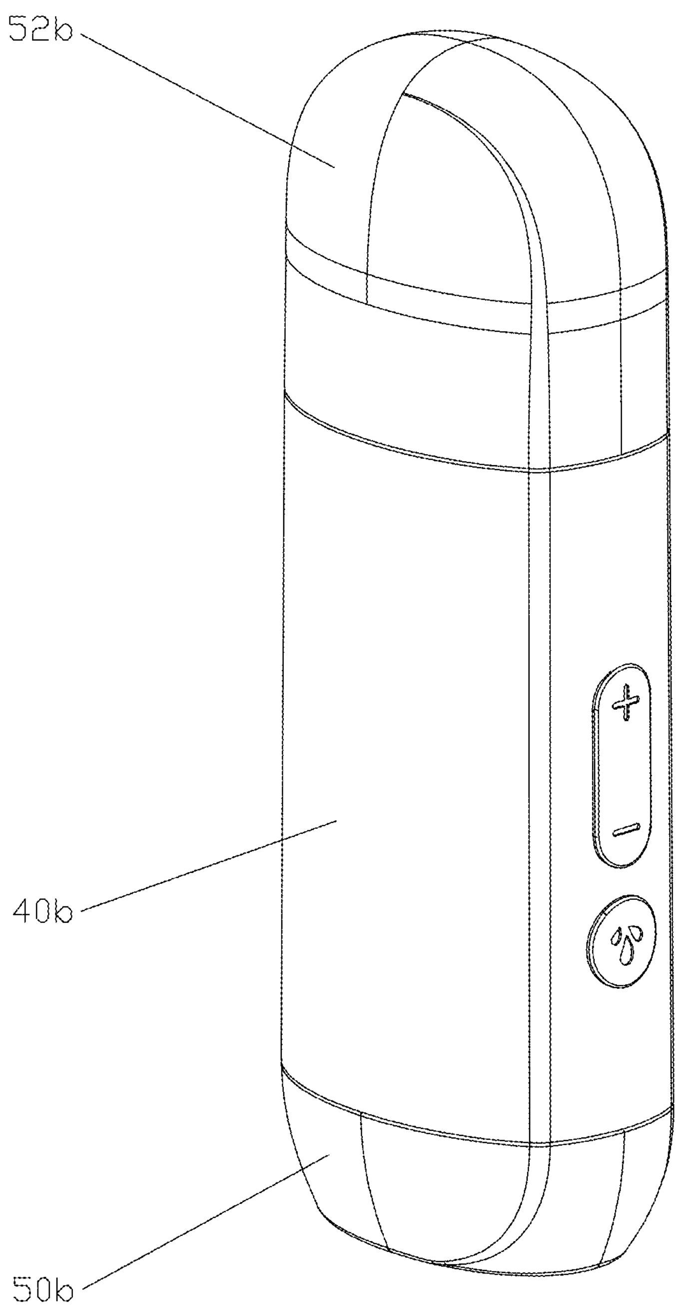

FIG. 17

PORTABLE LIQUID STORAGE DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to Chinese Patent Application No. 202422726448.3, filed on Nov. 8, 2024. The content of the aforementioned application, including any intervening amendments thereto, are incorporated herein by reference.

TECHNICAL FIELD

This application relates to the technical field of liquid storage devices, and in particular to a portable liquid storage device.

BACKGROUND

Containers are mainly used to store substances, such as liquids, gases, and etc. In daily life, common containers include gas cylinders, oil drums, water bottles, seasoning cans, and etc.

In the beauty, fitness, medical and other industries, oils, such as essential oils, lubricating oils and the like are often used. These products are usually stored in bottle like containers and are squeezed out during use. However, most existing containers do not have a heating function, so that the temperature of the oils when squeezed out of the containers is lower than body temperature. Before applying the oils to the human body, it is necessary to rub the oils hot by hands, otherwise it will make users feel uncomfortable and to some extent affect the effectiveness of use. Therefore, there are some inconveniences in the use of these products.

SUMMARY

An object of this application is to provide a portable liquid storage device that can heat the liquid contained therein to a preset temperature, making it more convenient to use and providing a better user experience.

In order to achieve the above object, an embodiment of this application provides a portable liquid storage device, including:

a housing;

a heating cylinder assembly mounted in the housing, including a heat-conducting cylinder being configured for accommodating a liquid therein and an electric-heating piece attached to an outer wall of the heat-conducting cylinder; and

a battery and a circuit board mounted in the housing, the battery being electrically connected to the electric-heating piece through the circuit board, so as to supply electric power to make the electric-heating piece generate heat to warm up the liquid inside the heat-conducting cylinder.

Compared with the prior art, the above portable liquid storage device has the following advantages: by means of setting a flexible electric-heating piece onto an outer wall of the heat-conducting cylinder, the heat generated by the electric-heating piece can be transferred to the heat-conducting cylinder rapidly and efficiently to warm up the liquid inside the heat-conducting cylinder; further, heat-conducting fins may be provided inside the heat-conducting cylinder to transfer the heat to the liquid at the center of the heat-conducting cylinder, resulting in uniform heating of the liquid and better constant temperature effect; moreover, the battery is arranged inside the housing for supplying electric power and thus the device is portable. During use, the liquid with a preset temperature can be squeezed out from the device to the human body, which is convenient in use and comfortable for users.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to illustrate the technical solution in embodiments of the present application more clearly, the following briefly introduces accompanying drawings used in the description of the embodiments. Obviously, the accompanying drawings in the following description are only some embodiments of the present application. Those of ordinary skill in the art can obtain other accompanying drawings from these accompanying drawings without any creative efforts.

FIG. **1** is a schematic, assembled view of a portable liquid storage device according to an embodiment of the present application.

FIG. **2** is a cross sectional view of the portable liquid storage device of FIG. **1**.

FIG. **3** is a schematic, exploded view of the portable liquid storage device of FIG. **1**.

FIG. **4** is a further exploded view of a mouth assembly of the portable liquid storage device of FIG. **3**.

FIG. **5** is a schematic view of the portable liquid storage device of FIG. **1**, wherein a bottle cap and a mouth assembly are removed.

FIG. **6** is a schematic view of a soft shell of the portable liquid storage device of FIG. **1**.

FIG. **7** is a schematic view of a key panel of the portable liquid storage device of FIG. **1**.

FIG. **8** is a schematic view of a circuit board of the portable liquid storage device of FIG. **1**.

FIG. **9** is a schematic view of a cylinder fixing sleeve of the portable liquid storage device of FIG. **1**.

FIG. **10** shows the cylinder fixing sleeve from another aspect.

FIG. **11** is an assembled view of a first sealing cover and a heat-conducting cylinder of the portable liquid storage device of FIG. **1**.

FIG. **12** is a schematic view of the first sealing cover of the portable liquid storage device of FIG. **1**.

FIG. **13** is a schematic view of a sealing member of the portable liquid storage device of FIG. **1**.

FIG. **14** is a schematic, assembled view of a portable liquid storage device according to a second embodiment of the present application.

FIG. **15** is a cross sectional view of the portable liquid storage device of FIG. **14**.

FIG. **16** is a schematic, assembled view of a portable liquid storage device according to a third embodiment of the present application.

FIG. **17** is a cross sectional view of the portable liquid storage device of FIG. **16**.

DESCRIPTION OF THE EMBODIMENTS

In order to make those skilled in the art better understand the technical solution of the present application, the technical solution in the embodiments of the present application will be clearly and completely described below with reference to accompanying drawings in the embodiments of the present application. Obviously, the embodiments described below are a part of the embodiments of the present application, rather than the entire embodiments. Based on the embodiments of the present application, all other embodiments obtained by those skilled in the art without any creative efforts fall within the protection scope of the present application.

Referring to FIGS. **1-3**, a portable liquid storage device according to an embodiment of the present application is shown. The portable liquid storage device includes a heating cylinder assembly **11** and an airbag assembly **12** arranged below the heating cylinder assembly **11**. The airbag assembly **12** is connected to and communicated with the heating cylinder assembly **11**, so that the liquid inside the heating cylinder assembly **11** can be squeezed out by squeezing the airbag assembly **12**. In an embodiment, the liquid accommodated inside the heating cylinder assembly **11** may be lubricating oils, essential oils and the like, and the present portable liquid storage device may be used to provide oils at a preset temperature for adult products, such as masturbation cups, love eggs, dildos, and etc.

A mouth assembly **20** is arranged on and detachably connected to the heating cylinder assembly **11**. When the mouth assembly **20** is disconnected to the heating cylinder assembly **11**, the liquid can be injected into the heating cylinder assembly **11**; and, when the mouth assembly **20** is connected to the heating cylinder assembly **11**, the liquid inside the heating cylinder assembly **11** can be squeezed out. Thus, it is convenient for injecting liquid into and discharging liquid from the heating cylinder assembly **11**. A soft shell **13**, which may be made of silicone rubber, is mounted around the heating cylinder assembly **11**. A cap **10** is covered on the mouth assembly **20** and coupled to the soft shell **13** to seal the mouth assembly **20**. When the cap **10** is open, the liquid inside the heating cylinder assembly **11** can be squeezed out via the mouth assembly **20**.

As shown in FIG. **3** and FIG. **5**, the heating cylinder assembly **11** includes a heat-conducting cylinder **113** with top and bottom open ends. A sealing member **114**, which may be made of soft rubber, is provided on each open end of the heat-conducting cylinder **113**. Through holes are defined in the sealing members **114**, wherein the through hole in the sealing member **114** at the bottom open end is communicated with the airbag assembly **12**, allowing the liquid inside the heating cylinder assembly **11** to be squeezed through the airbag assembly **12**. The through hole in the sealing member **114** at the top open end is communicated with the mouth assembly **20**, so as to achieve the discharging of the liquid from the heating cylinder assembly **11**.

The heating cylinder assembly **11** further includes a first sealing cover **110** coupled to the bottom open end of the heat-conducting cylinder **113**. A flexible electric-heating piece **112** is mounted around and attached to an outer wall of the heat-conducting cylinder **113**. A cylinder fixing sleeve **111** is mounted around and spaced from the heating cylinder assembly **11**. A battery **17** and a circuit board **18** connected to the battery **17** are arranged inside the cylinder fixing sleeve **111**, wherein the circuit board **18** is connected to the flexible electric-heating piece **112** electrically and controls the heat generation of the flexible electric-heating piece **112**. The heat generated by the electric-heating piece **112** is transferred to the heat-conducting cylinder **113**, so that the heated heat-conducting cylinder **113** can heat the liquid contained therein.

The soft shell **13** is covered on the cylinder fixing sleeve **111**, and cooperatively the soft shell **13** and the cylinder fixing sleeve **111** form a housing of this portable liquid storage device. A lower portion of the soft shell **13** extending beyond the cylinder fixing sleeve **111** is configured as an airbag of the airbag assembly **12**. Since the soft shell **13** is made of silicone rubber, the airbag is easy to deform when a force is applied thereon. Thus, when the user pinch the airbag with their hand, the air inside the airbag is squeezed out and flows into the heat-conducting cylinder **113**, causing the liquid inside the heat-conducting cylinder **113** to be discharged through the mouth assembly **20**.

Due to the battery **17** is arranged inside the present portable liquid storage device to supply electric power to the electric-heating piece **112**, this device is portable and it is easy to achieve constant temperature of the liquid in the heat-conducting cylinder **113**. A temperature measuring member **19**, such as a temperature measuring probe, is provided at the top of the heat-conducting cylinder **113** and near a liquid discharge hole of the heat-conducting cylinder **113**, so as to penetrate into the heat-conducting cylinder **113** to contact the liquid and thus detect the temperature of the liquid, wherein signals according to detected temperature are transmitted to the circuit board **18**. The soft shell **13** is equipped with temperature control keys **16**, wherein the temperature control keys **16** are arranged corresponding to the circuit board **18**. By means of operating the temperature control keys **16**, the circuit board **18** is controlled to adjust the heat generation of the flexible electric-heating piece **112**, thereby adjusting the heating temperature of the liquid inside the heat-conducting cylinder **113**.

The heat-conducting cylinder **113** may be configured as a hollow cylinder and made of heat-conducting materials, such as aluminum, iron, copper and the like, which can not only store liquids therein, but also transfer the heat of the flexible electric-heating piece **112** out of the heat-conducting cylinder **113** to the liquid inside the heat-conducting cylinder **113**, thereby heating the liquid to a preset temperature, wherein the preset temperature is preferably close to the body temperature.

As shown in FIG. **5** to FIG. **8**, a partition plate **130** is provided in a middle portion of the soft shell **13** to divide an interior space of the soft shell **13** into an airbag chamber **132** and a cylinder chamber **133**. The airbag assembly **12** is at the airbag chamber **132**, and the heating cylinder assembly **11** is arranged in the cylinder chamber **133**. Sealing rings may be provided at two opposite sides of the partition plate **130** to prevent liquid from entering the airbag assembly **12**. The cylinder fixing sleeve **111** is arranged around the heating cylinder assembly **11**, wherein top and bottom ends of the cylinder fixing sleeve **111** are open. A support seat **1112** is provided at the bottom end of the cylinder fixing sleeve **111**, and the battery **17** is supported by the support seat **1112**. A position of the battery **17** is raised by the support seat **1112**, so as to prevent liquid flowing into the cylinder fixing sleeve **111** from coming into contact with the battery **17** and thus causing malfunctions. Further, a support seat may be arranged corresponding to the circuit board **18**.

In this embodiment, an inner wall of the cylinder fixing sleeve **111** is provided with a first step **1110**, and the circuit board **18** is placed at the first step **1110**. A notch is defined in the cylinder fixing sleeve **111** for exposing the circuit board **18**. A portion of the soft shell **13** corresponding to the notch is provided with a key panel **15**, and a clip **150** is provided on the key panel **15**. By means of engagement of the clip **150** with the cylinder fixing sleeve **111** at a periphery of the notch, the key panel **15** is detachably connected to the cylinder fixing sleeve **111**, improving the appearance of the present portable liquid storage device. Circular holes **151**, corresponding to the temperature control keys **16**, are defined in the key panel **15**. Keys **181**, corresponding to the circular holes **151**, are provided on the circuit board **18**, wherein the keys **181** correspond to the temperature control keys **16**. Digital display tubes **180** are set in a middle portion of the circuit board **18**, and the key panel **15** is transparent. The battery level and detected liquid temperature may be displayed through the digital display tubes **180**, so that the liquid temperature and remaining battery level can be seen intuitively.

As shown in FIG. **9** to FIG. **13**, the first sealing cover **110** includes a support base **1100** with a recessed cavity **1104** defined in a middle portion thereof. The bottom end of the heat-conducting cylinder **113** is fixed in the recessed cavity **1104**, and a plurality of locking columns **1101** extend upwardly from an upper side of the support base **1100**. Each locking column **1101** is provided with two reinforcing plates **1102** on two opposite sides thereof, respectively. Do to the fact that the locking columns **1101** need to be longer, the setting of the reinforcing plates **1102** can increase the strength of the locking columns **1101**. The locking columns **1101** cooperatively form a mounting space **1103** for receiving the heat-conducting cylinder **113**. A gap is formed between the reinforcing plates **1102** of adjacent locking columns **1101**, so as to facilitate the installation of the heat-conducting cylinder **113** into the mounting space **1103**. The reinforcing plates **1102** fix the heat-conducting cylinder **113** into the mounting space **1103**. A through hole **1105** in defined in a middle portion of the recessed cavity **1104** of the support base **1100**, intercommunicating the heat-conducting cylinder **113** with the airbag. The airbag assembly **12** supplies air to the heat-conducting cylinder **113** via the through hole **1105**, thereby discharging the liquid inside the heat-conducting cylinder **113**.

The heat-conducting cylinder **113** may be open at its top and bottom ends, and sealing members **114** are mounted to the open ends of the heat-conducting cylinder **113**. Referring to FIG. **13**, each sealing member **114** includes a side wall **1140** and a bottom wall **1141** integrated formed with the side wall **1140** as one piece. The bottom wall **1141** defines a circular hole **1142** therein, and the side wall **1140** is attached to an outer wall of a corresponding open end of the heat-conducting cylinder **113**. The bottom walls of the sealing members **114** seal the top and bottom open ends of the heat-conducting cylinder **113**, and air intake and liquid discharge are allowed for the heat-conducting cylinder **113** through the circular holes **1142** in the bottom walls **1141**. A silicone fixing member at the bottom end of the heat-conducting cylinder **113** may be arranged in the recessed cavity **1104** to provide a certain support for the heat-conducting cylinder **113**, while the recessed cavity **1104** increases the sealing performance of the connection between the sealing member **114** and the heat-conducting cylinder **113**. In order to prevent the first sealing cover **110** from shaking, limiting ribs **1113** may be provided inside the cylinder fixing sleeve **111**. The limiting ribs **113** and the support seat **1112** cooperatively fix the first sealing cover **110** to prevent it from shaking.

As shown in FIG. **11**, in order to achieve uniform heating of the liquid inside the heat-conducting cylinder **113**, a plurality of heat-conducting fins **1131** are provided inside the heat-conducting cylinder **113**. The heat-conducting fins **1131** extend radially from an inner wall of the heat-conducting cylinder **113** towards the center, and the heat of the heat-conducting cylinder **113** can be transferred to the fins **1131** to warm up the liquid at the center of the heat-conducting cylinder **113** quickly and efficiently, resulting in more uniform heating of the liquid at each position inside the heat-conducting cylinder **113**. The heat-conducting fins **1131** may extend straightly or curvedly. When the heat-conducting fins **1131** are configured in arc shape, it can further increase a heat-exchanging area thereof and thus provide better heating effect to the liquid at the center of the heat-conducting cylinder **113**. Due to the presence of the flexible electric-heating piece **112**, the liquid inside the heat-conducting cylinder **113** may always be in a preset temperature.

As shown in FIG. **9** to FIG. **10**, a second step **1111** is provided on the inner wall of the cylinder fixing sleeve **111**, which is located between the first step **1110** and the first sealing cover **110**. A temperature measuring hole **1130** is provided on a top end side of the heat-conducting cylinder **113**, and the temperature measuring member **19** is inserted into the heat-conducting cylinder **113** through the temperature measuring hole **1130** to measure the temperature of the liquid inside the heat-conducting cylinder **113**. A part of the temperature measuring member **19** beyond the heat-conducting cylinder **113** is placed on the second step **111**, and a force towards the heat-conducting cylinder **113** is applied on this part of the temperature measuring member **19** by the circuit board **18** to prevent it from loosening.

As shown in FIG. **2** and FIG. **3**, an air inlet **120** and an air outlet **121** are defined in the airbag assembly **12**, wherein the air outlet **131** is set corresponding to the through hole **1105** of the support base **1100**, and the air inlet **120** is set corresponding to an air guide column **1106** (as shown in FIG. **12**) provided on the first sealing cover **110**. The air outlet **121** is connected to the bottom end of the heat-conducting cylinder **113**, and a one-way valve may be provided between the airbag assembly **12** and the heat-conducting cylinder **113** to prevent the liquid in the heat-conducting cylinder **113** from flowing to the airbag. When the airbag is squeezed, air flows into the heat-conducting cylinder **113** through the one-way valve and pushes the liquid inside the heat-conducting cylinder **113** to the mouth assembly **20**, thereby discharging the liquid for normal use.

As shown in FIG. **9** and FIG. **12**, in order to facilitate the air intake of the airbag assembly **12**, the air guide column **1106** is provided on the first sealing cover **110** and passes through a fixing hole **1116** of the cylinder fixing sleeve **111**. A lateral fixing column **1114** is provided on a lateral side of the cylinder fixing sleeve **111**. A waterproof and breathable film **22** is provided inside the lateral fixing column **1114**, and an intake member **14** is provided outside the lateral fixing column **1114**. A bottom end of the lateral fixing column **1114** is provided with an opening **1115**, which corresponds to the fixing hole **1116** of the cylinder fixing sleeve **111**. Air enters the intake member **14** and passes through the waterproof breathable film **22** into the lateral fixing column **1114**, and then enters the air guide column **1106** via the opening **1115**, and finally enters the airbag assembly **12**, resulting in better intake effect.

As shown in FIG. **4**, in order to facilitate the injection of liquid into the heat-conducting cylinder **113**, the mouth assembly **20** is arranged above the heating cylinder assembly **11**. The mouth assembly **20** includes a second sealing cover **201** coupled to the top end of the heat-conducting cylinder **113** and connected to the soft shell **13**. Top ends of the locking columns **1101** of the first sealing cover **110** may be inserted into corresponding holes defined in the second sealing cover **201**. Thus, the first sealing cover **110** and the second sealing cover **201** seal the top and bottom ends of the heat-conducting cylinder **113**, respectively. The second sealing cover **201** is provided with a liquid injection hole **2012**, which is communicated with the heat-conducting cylinder **113** for liquid injection. A bottle mouth **200** is detachably connected to the liquid injection hole **2012**, and a liquid discharge hole **2000** is provided on the bottle mouth **200**.

The liquid discharge hole **2000** corresponds to the liquid injection hole **2012**, and liquid can be discharged through the liquid discharge hole **2000**.

As shown in FIG. **4** and FIG. **5**, a top end of the soft shell **13** is provided with an annular flange **131**, which extends upwardly from an inner periphery of the soft shell **13**. The second sealing cover **201** is provided with an annular protrusion **2010** corresponding to the flange **131**. When the second sealing cover **201** is placed on the heating cylinder assembly **11**, the annular protrusion **2010** surrounds the annulet flange **131**, which can not only seal the top end of the heat-conducting cylinder **113**, but also keep the outer face of the mouth assembly **20** and the outer face of the soft shell **13** in a flat state.

A recess **2011** is provided at a top of the second sealing cover **201**, and a silicone pad **202** is installed inside the recess **2011**. Screw holes in the recess **2011** may be sealed by the silicone pad **202**, so as to prevent liquid from entering the heating cylinder assembly **11** through the screw holes and coming into contact with electronic components. An outer wall of a bottom end of the bottle mouth **200** is provided with longitudinal ribs **2001**, which can increase the friction force when the bottle mouth **200** is rotated. The bottle mouth **200** is configured as a conical structure with a small top end and a large bottom end, wherein the liquid discharge hole **2000** is defined at the smaller top end to control the liquid output. A sealing gasket **203** is provided in the bottle mouth **200**. When the device leaves the factory, the sealing gasket **203** seals the liquid injection hole **2012** at the top end of the second sealing cover **201**, and the bottle mouth **200** is screwed on to the second sealing cover **201** and around the liquid injection hole **2012**. When the device is in use, the bottle mouth **200** is open to remove the sealing gasket **203**, so as to facilitate the injection of liquid into the heating cylinder assembly **11** and discharging of liquid from the heating cylinder assembly **11** for normal use.

Referring to FIG. **14** and FIG. **15**, a portable liquid storage device according to a second embodiment of the present application is shown. In this embodiment, the portable liquid storage device includes a heating cylinder assembly **11***a* and a pump assembly **30***a* connected to the heating cylinder assembly **11***a*.

The heating cylinder assembly **11***a* includes a cylindrical-shaped heat-conducting cylinder **113***a* for accommodating liquid therein and a flexible electric-heating piece **112***a* mounted around and attached to an outer wall of the heat-conducting cylinder **113***a*. A battery **17***a* is electrically connected to the flexible electric-heating piece **112***a* through a circuit board, so as to provide electric power to make the flexible electric-heating piece **112***a* generate heat to warm up the liquid inside the heat-conducting cylinder **113***a*. Similar to the previous embodiment, the heat-conducting cylinder **113***a* is configured with top and bottom open ends, and sealing members **114***a* are provided at each open end of the heat-conducting cylinder **113***a*.

In this embodiment, a piston plate **115***a* is slidably arranged in the heat-conducting cylinder **113***a*, and the pump assembly **30***a* is configured to push the piston plate **115***a* to move upwardly, which in turn push the liquid inside the heat-conducting cylinder **113***a* to move. Specifically, the pump assembly **30***a* includes an air pump **32***a* and pipelines for connecting the air pump **32***a* to the heat-conducting cylinder **113***a*. Generally, a solenoid valve may be provided between the air pump **32***a* and the circuit board to control the operation of the air pump **32***a*. During operation, the air pump **32***a* supply air into the bottom end of the heat-conducting cylinder **113***a* to push the piston plate **115***a* and the liquid to move towards the top end, resulting in discharging of the liquid.

In this embodiment, the heating cylinder assembly **11***a* is fixed inside a cylinder fixing sleeve **40***a*, and the pump assembly **30***a* is fixed inside a pump fixing sleeve **42***a*, wherein a bottom end of the cylinder fixing sleeve **40***a* is coupled to a top end of the pump fixing sleeve **42***a*. The cylinder fixing sleeve **40***a* and the pump fixing sleeve **42***a* cooperatively form a housing of the portable liquid storage device. In other embodiments, the cylinder fixing sleeve **40***a* and the pump fixing sleeve **42***a* may be formed integrally as one piece.

In this embodiment, the bottom end of the cylinder fixing sleeve **40***a* is configured to be open, facilitating assembly of the heating cylinder assembly **11***a* into the cylinder fixing sleeve **40***a*. A partition plate **44***a* may be provided at the top end of the pump fixing sleeve **42***a* to seal the bottom end of the heat-conducting cylinder **113***a*. The bottom end of the pump fixing sleeve **42***a* may be open and covered by a bottom cap **50***a*, facilitating assembly of the pump assembly **30***a* into the pump fixing sleeve **42***a*. In other embodiments, the partition plate **44***a* may be provided at the bottom end of the cylinder fixing sleeve **40***a*, which can seal the bottom end of the heat-conducting cylinder **113***a* too.

In this embodiment, an air outlet **46***a* may be defined in the partition plate **44***a* for interconnecting the air pump **32***a* to the heat-conducting cylinder **113***a*, and an air inlet **48***a* may be defined in the pump fixing sleeve **42***a* for connecting the air pump **32***a* to the outside. In other embodiments, the air inlet **48***a* may be defined in the bottom cap **50***a*. In other embodiments, the top end and/or bottom end of the heat-conducting cylinder **113***a* may be closed, and the air inlet **48***a* may be defined in the heat-conducting cylinder **113***a*.

As shown in FIG. **15**, the top end of the cylinder fixing sleeve **40***a* is configured with a liquid injection hole **49***a* for inputting liquid into the heat-conducting cylinder **113***a*, and a bottle mouth **60***a* is coupled to the top end of the cylinder fixing sleeve **40***a* to cover the liquid injection hole **49***a*. In this embodiment, the bottle mouth **60***a* is screwed to the cylinder fixing sleeve **40***a*, and a liquid discharge hole **62***a* is defined in the bottle mouth **60***a* for discharging the liquid. The liquid discharge hole **62***a* is in communication with the liquid injection hole **49***a*.

Preferably, the liquid discharge hole **62***a* is much smaller than the liquid injection hole **49***a*. Thus, when the bottle mouth **60***a* is removed from the cylinder fixing sleeve **40***a*, the liquid can be quickly replenished into the heat-conducting cylinder **113***a* through the liquid injection hole **49***a*; when the bottle mouth **60***a* is screwed onto the cylinder fixing sleeve **40***a*, the liquid can be discharged from the heat-conducting cylinder **113***a* at an appropriate speed through the liquid discharge hole **62***a*. Similarly, a top cap **52***a* may be coupled onto the cylinder fixing sleeve **40***a* to cover the liquid discharge hole **62***a*.

In this embodiment, the discharge of liquid is controlled by the air pump **32***a*, which is more convenient and labor-saving compared to manually squeezing the airbag in the previous embodiment, and can accurately control the discharge amount of liquid. The discharged liquid is heated by the flexible electric-heating piece **112***a* to a predetermined temperature (which is generally close to or slightly higher than the body temperature), making it more comfortable to apply to the human body and enhancing the user experience.

Referring to FIG. **16** and FIG. **17**, a portable liquid storage device according to a third embodiment of the present application is shown. In this embodiment, the portable liquid storage device includes a heating cylinder assembly **11**b and a pump assembly **30**a connected to the heating cylinder assembly **11**b.

The heating cylinder assembly **11**b includes a cylindrical-shaped heat-conducting cylinder **113**b for accommodating liquid therein and an annular electric-heating piece **112**b mounted around and attached to an outer wall of the heat-conducting cylinder **113**b. A battery **17**b is electrically connected to the flexible electric-heating piece **112**b through a circuit board **18**b, so as to provide electric power to make the flexible electric-heating piece **112**b generate heat to warm up the liquid inside the heat-conducting cylinder **113**b.

In this embodiment, the pump assembly **30**a includes an air pump **32**b and pipelines for connecting the air pump **32**b to the heat-conducting cylinder **113**b. During operation, the air pump **32**b supply air into the bottom end of the heat-conducting cylinder **113**b to push the liquid in the heat-conducting cylinder **113**b to move towards the top end, resulting in discharging of the liquid. Compared with the second embodiment, the piston plate is omitted.

In this embodiment, the heating cylinder assembly **11**b is fixed inside a cylinder fixing sleeve **40**b, a space is defined between the heating cylinder assembly **11**b and the cylinder fixing sleeve **40**b to receive the pump assembly **30**b, the circuit board **18**b, the battery **17**a, and etc., wherein the battery **17**a may be arranged above the air pump **32**b, and the circuit board **18**b may be arranged at a side opposite to the battery **17**a. In this embodiment, the bottom end of the cylinder fixing sleeve **40**b is configured to be open, facilitating assembly of this portable liquid storage device. A bottom cap **50**b may be coupled to the bottom end of the cylinder fixing sleeve **40**b to seal the cylinder fixing sleeve **40**b.

In this embodiment, an air outlet **46**b may be defined in a support base coupled to the bottom end of the heat-conducting cylinder **113**b for interconnecting the air pump **32**b to the heat-conducting cylinder **113**b, and an air inlet may be defined in the cylinder fixing sleeve **40**b or the bottom cap **50**b for interconnecting the air pump **32**b to the outside.

As shown in FIG. **17**, the top end of the heat-conducting cylinder **113**b is open, which may be regarded as a liquid injection hole for inputting liquid into the heat-conducting cylinder **113**b. A bottle mouth **60**b is coupled to the top end of the heat-conducting cylinder **113**b and partly engaged into the liquid injection hole **49**b. A liquid discharge hole **62**b is defined in the bottle mouth **60**b for discharging the liquid at an appropriate speed. Similarly, a top cap **52**b may be coupled to the cylinder fixing sleeve **40**b to cover the liquid discharge hole **62**b.

Finally, it should be noted that: the above merely describes preferred embodiments of the present application without intention to limit the scope of the present application. Any modifications, equivalent replacements, improvements, and etc. made by those skilled in the art within the spirit and principle of the present application should be within the scope of the present application.

What is claimed is:

1. A portable liquid storage device, comprising:

a housing;

a heating cylinder assembly mounted in the housing, comprising a heat-conducting cylinder being configured for accommodating a liquid therein and an electric-heating piece attached to an outer wall of the heat-conducting cylinder, the heat-conducting cylinder comprising a first axial end and a second axial end that are opposite to each other;

an air pump mounted in the housing and connected to the first axial end of the heat-conducting cylinder, the air pump being configured for supplying air into the heat-conducting cylinder to push the liquid to move towards the second axial end of the heat-conducting cylinder; and

a battery and a circuit board mounted in the housing, the battery being electrically connected to the electric-heating piece through the circuit board, so as to supply electric power to make the electric-heating piece generate heat to warm up the liquid inside the heat-conducting cylinder.

2. The portable liquid storage device according to claim **1**, wherein the housing comprises a cylinder fixing sleeve mounted around the heating cylinder assembly and spaced from the the electric-heating piece of the heating cylinder assembly in a radial direction, and the air pump, the battery and the circuit board are arranged in a radial space defined between the cylinder fixing sleeve and the electric-heating piece of the heating cylinder assembly.

3. The portable liquid storage device according to claim **1**, wherein a piston plate is slidably mounted inside the heat-conducting cylinder, and the air pump is configured for supplying air into the heat-conducting cylinder to push the piston plate to slide relative to the heat-conducting cylinder to push the liquid to move towards the second axial end of the heat-conducting cylinder.

4. The portable liquid storage device according to claim **1**, wherein the housing comprises a cylinder fixing sleeve for receiving the heating cylinder assembly therein and a pump fixing sleeve for receiving the air pump, the battery and the circuit board therein, and the cylinder fixing sleeve and the pump fixing sleeve are arranged along an axial direction of the portable liquid storage device.

5. The portable liquid storage device according to claim **4**, wherein the first axial end of the heat-conducting cylinder is an open end facing towards the pump fixing sleeve, a partition plate is provided between the cylinder fixing sleeve and the pump fixing sleeve to seal the open end of the heat-conducting cylinder, and an air outlet is defined in the partition plate for intercommunicating the air pump with the heat-conducting cylinder.

6. The portable liquid storage device according to claim **1**, wherein the heat-conducting cylinder defines a liquid injection hole at the second axial end thereof, a bottle mouth is detachably connected to the second axial end of the heat-conducting cylinder to cover the liquid injection hole, and a liquid discharge hole is defined in the bottle mouth with a size less than that of the liquid injection hole.

7. The portable liquid storage device according to claim **1**, wherein the portable liquid storage device is configured for supplying lubricating oil to adult products.

8. The portable liquid storage device according to claim **1**, wherein the electric-heating piece is annular and flexible, and wrapped around an outer circumferential wall of the heat-conducting cylinder.

9. The portable liquid storage device according to claim **1**, wherein a plurality of heat-conducting fins extends inwardly from an inner circumferential wall of the heat-conducting cylinder for transferring the heat of the electric-heating piece to the liquid at a central portion of the heat-conducting cylinder.

10. A portable liquid storage device, comprising:

a housing;

a heating cylinder assembly mounted in the housing, comprising a heat-conducting cylinder being configured for accommodating a liquid therein and an electric-heating piece attached to an outer wall of the heat-conducting cylinder;

an airbag being connected to and communicated with the heat-conducting cylinder; and

a battery and a circuit board mounted in the housing, the battery being electrically connected to the electric-heating piece through the circuit board, so as to supply electric power to make the electric-heating piece generate heat to warm up the liquid accommodated inside the heat-conducting cylinder.

11. The portable liquid storage device according to claim **10**, wherein a one-way valve is provided between the airbag and the heat-conducting cylinder.

12. The portable liquid storage device according to claim **11**, wherein the heat-conducting cylinder comprises first and second open ends, a first sealing member is coupled to the first open end and defines a first through hole for suppling air from the air bag into the heat-conducting cylinder, and a second sealing member is coupled to the second open end and defines a second through hole for discharging of the liquid from the heat-conducting cylinder.

13. The portable liquid storage device according to claim **12**, wherein the housing comprises a cylinder fixing sleeve mounted around the heating cylinder assembly and a flexible shell covered on the cylinder fixing sleeve, and a portion of the flexible shell extending beyond the cylinder fixing sleeve and the first open end of the heat-conducting cylinder acts as the airbag.

14. The portable liquid storage device according to claim **13**, wherein a radial space is defined between the cylinder fixing sleeve and the heating cylinder assembly to accommodate the the battery and the circuit board therein, and a bottle mouth configured with a liquid discharge hole is coupled onto the second sealing member.

15. A portable liquid storage device, comprising:

a housing;

a heating cylinder assembly mounted in the housing, comprising a heat-conducting cylinder being configured for accommodating a liquid therein and an electric-heating piece attached to an outer wall of the heat-conducting cylinder, a liquid injection hole being defined in an end of the heating cylinder assembly;

a bottle mouth being detachably connected the housing to cover the liquid injection hole, a liquid discharge hole being defined in the bottle mouth with a size less than that of the liquid injection hole; and

a battery and a circuit board mounted in the housing, the battery being electrically connected to the electric-heating piece through the circuit board, so as to supply electric power to make the electric-heating piece generate heat to warm up the liquid inside the heat-conducting cylinder.

16. The portable liquid storage device according to claim **15**, further comprising an air pump or an airbag connected to another end of the heating cylinder assembly and communicated with the heat-conducting cylinder.

17. The portable liquid storage device according to claim **16**, wherein the heat-conducting cylinder comprises first and second open ends, the air pump or airbag is provided at the first open end of the heat-conducting cylinder, and the liquid injection hole is provided at the second open end of the heat-conducting cylinder; and

wherein the heating cylinder assembly further comprises a first sealing cover coupled to the first open end and defining a first through hole for suppling air from the air pump or airbag into the heat-conducting cylinder and a second sealing cover coupled to the second open end and defining a second through hole corresponding to the liquid injection hole, and the bottle mouth is coupled to the second sealing cover.

18. The portable liquid storage device according to claim **17**, wherein the bottle mouth is partly engaged into the second through hole of the second sealing cover and the liquid injection hole of the heat-conducting cylinder.

19. The portable liquid storage device according to claim **17**, wherein the housing comprises a cylinder fixing sleeve mounted around the heating cylinder assembly and a cap coupled onto the cylinder fixing sleeve, the battery and the circuit board are accommodated inside a radial space defined between the cylinder fixing sleeve and the heating cylinder assembly, and the cap seals the liquid discharge hole of the bottle mouth.

20. The portable liquid storage device according to claim **19**, wherein the battery and the circuit board are arranged at two opposite sides of the heating cylinder assembly, respectively.

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