PORTABLE WARMING ARRANGEMENT

Background

[0001] Some liquids require heating to a specific temperature in order to be used effectively. A particular example is milk for babies, which is most palatable to very young children within a specific temperature range. Such liquids may require transportation, for example if a baby and a carer are outside the home, and the baby requires feeding.

[0002] The nature of travel with a baby can require a number of items to be carried alongside the baby, such as toiletries, spare clothes, and toys. There is also an inherent level of unpredictability with young children regarding the precise time and place they require feeding. Therefore, if a liquid is to be provided amongst the other items required for the baby, a warmer for warming the liquid must be sufficiently robust and portable to function in a number of different environments.

Summary

[0003] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0004] A first aspect provides a portable liquid warming apparatus, comprising: a base, comprising a first heating element and a battery engagement element in electronic communication with the first heating element; and a second heating element, fixed to the base and in electronic communication with the battery engagement element, at least a portion of the second heating element arranged to protrude into a liquid in a container when in use. For example, the container may comprise a bottle; a bowl; a drinking glass; and/or a pan.

[0005] Some of the methods described herein, such as the timer mechanism may be performed by software in machine readable form on a tangible storage medium e.g. in the form of a computer program comprising computer program code means adapted to perform all the steps of any of the methods described herein when the program is run on a computer and where the computer program may be embodied on a computer readable medium. Examples of tangible (or non-transitory)

storage media include disks, thumb drives, memory cards etc and do not include propagated signals. The software can be suitable for execution on a parallel processor or a serial processor such that the method steps may be carried out in any suitable order, or simultaneously.

[0006] This acknowledges that firmware and software can be valuable, separately tradable commodities. It is intended to encompass software, which runs on or controls "dumb" or standard hardware, to carry out the desired functions. It is also intended to encompass software which "describes" or defines the configuration of hardware, such as HDL (hardware description language) software, as is used for designing silicon chips, or for configuring universal programmable chips, to carry out desired functions.

[0007] The preferred features may be combined as appropriate, as would be apparent to a skilled person, and may be combined with any of the aspects of the invention.

Brief Description of the Drawings

[0008] Embodiments of the invention will be described, by way of example, with reference to the following drawings, in which:

[0009] Figure 1 shows a portable warming apparatus in a plurality of orientations;

[0010] Figure 2A is an exploded view diagram of the portable warming apparatus;

[0011] Figure 2B shows alternative views of components from Figure 2A;

[0012] Figure 3 shows the portable warming apparatus being charged;

[0013] Figure 4 shows an enlarged view of an external heating rod; and

[0014] Figure 5 shows an enlarged view of the second heating element coupled to the base.

[0015] Common reference numerals are used throughout the figures to indicate similar features.

Detailed Description

[0016] Embodiments of the present invention are described below by way of example only. These examples represent the best ways of putting the invention into practice that are currently known to the Applicant although they are not the only ways in which this could be achieved. The description sets forth the functions of the example and the sequence of steps for constructing and operating the example. However, the same or equivalent functions and sequences may be accomplished by different examples.

[0017] In some alternative arrangements, portable warmers, such as those for warming bottles, function in the range of 20-30W of power being output as heat. Using a conventionally sized bottle filled with milk e.g. 150 ml, such a power output typically requires between 15 to 20 minutes of heating to bring the ambient liquid temperature from 25C to 45C. Such portable liquid warmers may require the bottle to be positioned vertically above the base in order to be able to heat the liquid.

[0018] The heating element of such an arrangement is typically found exclusively in the base of the arrangement, which restricts the heating capacity of the arrangement as a whole. Further, by requiring the specific positioning of the bottle to be positioned vertically above the base, the heating must be performed in a stationary environment where the arrangement is not disturbed. This may not be possible in some environments, for example when travelling.

[0019] Some alternative arrangements have attempted to remedy at least some of the abovementioned issues by increasing the power output of the heating element. Such arrangements, which may be labelled as “fast heating” liquid warmers can output power in the range of 150-300W, and require a mains electrical connection to an alternating current (AC) power source.

[0020] Unfortunately, such connection to an AC power source renders these fast heating liquid warmers as no longer portable. They can only be used where there is an outlet into which they can be connected. Battery power, as required for portability, uses a direct current (DC) arrangement, and so is not compatible with fast heating liquid warmers.

[0021] The inventors have developed a liquid warmer which is fully portable (i.e does not require a connection to mains power) and convenient to use while travelling. By using a combination of

two types of heating element a liquid in a bottle is conveniently and rapidly heated using only battery power.

[0022] Figure 1 shows a portable warming apparatus 100 in a plurality of orientations. The warming apparatus 100 comprises a base 102, the base 102 comprising a first heating element (not shown). The base 102 is operable to be connected to a bottle 104, dimensioned such that there is an empty space 106 within the bottle 104. The empty space 106 can be filled with a fluid, such as milk, which is to be warmed using the portable warming apparatus 100.

[0023] The base 102 further comprises a second heating element 108. The first and/or second heating element 108 comprises one or more of: a polyimide heating film, a polyester heating film, a thin film, a thick film, a positive temperature coefficient heater, a heating coil. The second heating element 108 of this example is a heating element at least partially embedded in a heater rod. The heater rod 108 is arranged to protrude from the base 102 such that, when the base 102 is connected to a bottle 104, the heater rod 108 protrudes into the empty space 106 within the bottle 104.

[0024] The base 102 of this example also comprises one or more light emitting diodes (LEDs) embedded within a light ring cover 114. The or each LED may be used to indicate a status of the portable warming apparatus 100. In one example, a running illumination of the LEDs indicates that the portable warming apparatus 100 is warming the liquid in the bottle 104. In another example, a continuous illumination of the LEDs indicates that the liquid in the bottle 104 has reached a predetermined temperature and so is ready to be used. In a further example, the or each LED is configured to flash repeatedly if the portable warming apparatus 100 requires charging, and so allow a user to charge the apparatus before the local electrical supply is exhausted.

[0025] A USB-C charging port 118, optionally provided with a protective cover, allows for an external electrical source, such as a DC outlet, to be put in electronic communication with one or more batteries. In such a way, the one or more batteries can be recharged. Other charging assemblies may be used. Alternatively or additionally, a docking station may be used to recharge the one or more batteries. Alternatively or additionally, the one or more batteries may be replaced with new batteries when required.

[0026] The base 102 and/or the bottle 104 may be shaped so as to support the portable warming apparatus 100 in the or each orientation shown in this figure. In the first orientation, the base 102 is vertically below the bottle 104, and in the second orientation, the base 102 is vertically above the bottle 104. Warming of liquid within the bottle 104 may take place in either orientation, as the first heating element remains in contact with the portion of the bottle 104 in contact with the base 102, and the second heating element 108 protrudes into the contents 106 of the bottle 104. In such a way, the portable warming apparatus 100 can be used in any and all orientations, for example while travelling and being carried inside a bag.

[0027] In one example, lithium batteries are used to provide power between 5-12V to the portable warming apparatus 100 in order to output 40-100W of power. In one example, the power distribution is such that twice as much power is output via the first heating element 222 than the second heating element 108. In this example, when 60W of power is output as heat, 40W is output via the first heating element 222 and 20W is output via the second heating element 108.

[0028] By using these batteries, the portable warming apparatus 100 does not require a tethered connection to an alternating current AC power outlet. Thus there is cordless portability. By providing 40-100W of power, rapid heating is provided for liquids within the cavity 106 of the bottle 104. Appliances which must be plugged in to an AC outlet in order to function cannot be considered portable as they must remain tethered in place during use.

[0029] Using immersion heater technology, such as the second heating element 108, provides a heater element submerged in the cavity 106 of the bottle 104 during heating. This provides a faster and more even heat distribution during warming of liquids inside the bottle 104 for portable warming. The immersion heater technology in the present liquid warmer also allows for the heating of liquids in the cavity 106 of the bottle 104 in both an upright and inverted orientation, which allows users to use the portable warming apparatus 100 in all directions and still able to have a normal heating function. Many alternative arrangements can only be used in one direction.

[0030] By using the first heating element alongside the second heating element 108, 150ml-330ml of liquid within the cavity 106 of the bottle 104 is able to reach a temperature of 45C from 25C in the range of 4-10 minutes, and less than 6 minutes for less than 150ml of liquid. The portable

warming apparatus 100 therefore provides a high heating performance, yet compact, warmer in the portable warmer space.

[0031] Optionally, the portable warming apparatus 100 comprises a timer mechanism. The timer may be used to pre-set a start time for the heating operation, for example if a user knows that they will need a warmed bottle of milk at a specific feeding time. The user can set that time when the milk is required, and the portable warming apparatus 100 will know to begin heating the contents of the bottle 104 such that the liquid will have reached the predetermined temperature at that user-specified time.

[0032] Figure 2A is an exploded view diagram of the portable warming apparatus 100, and Figure 2B shows an alternative view of some components included therein. There is shown in Figure 2A the second heating element 108. In this example, the second heating element 108 is arranged to fit to a support bracket 202. The support bracket 202 is underpinned by a layer of battery protective foam 204, which provides protection between the support bracket 202 and a battery engagement element 206. The battery engagement element 206 is operable to receive one or more batteries 236, and provide electronic communication between the one or more batteries 236 and one or more heating elements. The battery engagement element 206 may be further operable to provide electronic communication between the one or more batteries 236 and one or more other electronic components.

[0033] The base 102 of this example is coupled to a button connector 210, which provides electronic communication between electronic components. The base 102 of this example is also fitted with a light ring cover 114. The light ring cover 114 covers one or more LEDs , and offers a level of protection between the ambient environment surrounding the portable warming apparatus 100 and the LEDs 114 themselves. At least a portion of the light ring cover 114 is optionally covered by a lampshade 234, which further protects the LEDs 114 and/or diffuses and tints the light coming from the LEDs depending on the preferences of the user.

[0034] The base 102 of this example is also coupled to a display plate 214. The digital display plate 214 allows for a digital display on one side of the base 102 to be shown to a user, while remaining protected from the ambient environment surrounding the portable warming apparatus 100. The digital display, for example a 7segment display, may show a user information relevant

to the portable warming apparatus 100. The digital display may be configured to display: 1) an estimated time until the liquid in the bottle 104 reaches a predetermined temperature; 2) a temperature display; and/or 3) an error code, for example when the NTC or other heating element is broken, or when dry heating as there is no liquid detected in the bottle 104. Alternatively or additionally, a buzzer or other sound generator may be used to provide feedback regarding any features provided by the liquid warmer.

[0035] The base 102 of this example is also coupled to a negative temperature coefficient (NTC) thermistor 116. An NTC 116 comprises a resistor, wherein the resistance of the resistor varies according to the ambient temperature around the resistor. As the temperature increases, the resistance of the NTC 116 decreases. In such a way, an accurate determination of the temperature surrounding the NTC 116 may be deduced. In some examples, the NTC 116 can achieve a temperature reading to an accuracy of ±0.1C in a temperature range of 0C to 70C.

[0036] The NTC 116 is in electronic communication with a positive temperature coefficient (PTC) heater 218, itself equipped with a thermal cut-off 220 and a first heating element 222 in the form of a film heater. At least a portion of the PTC heater 218 is encased within the second heating element 108. This heating assembly allows the first heating element 222 to heat the liquid in the bottle 104 to a predetermined temperature. The use of a silicon insulation pad 224 provides insulation between the first heating element 222 and the bottle seal 226. The bottle seal 226 prevents leakage from the bottle 104, if and when the bottle 104 is connected to the base 102.

[0037] A printed circuit board (PCB) 232, a plan view of which is shown in Figure 2B, optionally comprises a processor 233, and is used in this example to provide a control mechanism between the plurality of electronic components. For example, the thermal cut off 220 is in electronic communication with the NTC thermistor 216 and the PTC heater 218. When the temperature in the bottle 104 reaches a predetermined value, for example 37C for baby milk, the thermal cut off 220 is activated and the PTC heater 218 is deactivated. A cut off at a temperature of up to 50C may also be implemented, to preserve the nutritional value of the milk. The first heating element 222 and the second heating element 108 may also work in tandem to preserve a predetermined temperature over a period of time, which may be referred to as a “keep warm” mechanism.

[0038] The PCB 232 comprises one or more buttons 238 and one or more LEDs 240. The or each of the buttons 238 and LEDs 240 are integrated into the PCB 232, and aligned with a specific area of the of the light ring cover 114. The alignment with the specific area of the of the light ring cover 114 allows for the or each LED to shine through a transparent or translucent section of the light ring cover 114, and hence provide visible light to the user. In an example, a continuous white glow is displayed to the user when the one or more batteries 236 are being recharged.

[0039] The alignment with the specific area of the of the light ring cover 114 also allows for the or each of the buttons 238 to be aligned with a pliable part 217 of the light ring cover 114, so that the buttons 238 can be pressed through the pliable part 217 of the light ring cover 114. The or each of these pressable areas 217 of the light ring cover 114 may comprise a symbol representing the effect that pressing each button would have, for example a single press of a particular button may be interpreted as an instruction to turn on the first 222 and/or second heating element 108 to begin the heating process.

[0040] Figure 3 shows the portable apparatus being charged. In this example, the base 102 is positioned vertically below the bottle 104. The bottle is connected to a charging wire 305, which is connected to the USB-C port 118. The charging wire of this example is a USB-C wire, comprising a head compatible with the USB-C port 118. In alternate examples, other charging wires and correspondingly compatible ports may be used. In such a way, an external electrical source can be put in electronic communication with the one or more batteries 236. The batteries 236 may be rechargeable batteries, and when connected to an outlet via the charging wire 305, are recharged over a period of time. Once recharged, the charging wire 305 can be disconnected from the base 102, and the warming apparatus 100 may once again be rendered portable.

[0041] Figure 4 shows an enlarged view of the second heating element 108, and Figure 5 shows an enlarged view of the second heating element 108 coupled to the base. In this example, the second heating element 108 is formed from a substantially cuboid metal body 405, with a flared base 410. The flared base 410 provides a larger surface area onto which the base 102 of the portable warming apparatus 100 is connected. This provides a more secure foundation for the second heating element 108, reducing the risk that it will unintentionally disengage from the base 102.

[0042] The cuboid body 405 of the second heating element 108 in this example has a substantially rectangular cross section which is found to be effective for warming fluids as well as safe for use by tired parents since there is no sharp point. It is also possible to have a circular or ellipsoid cross section. The length of the cuboid body 405 is approximately the same as the width of the flared base 410. The flared base 410 has a substantially square footprint. At the end of the cuboid body 405, remote from the flared base 410, is a rounded end 415. The rounded end 415 of the second heating element 108, along with the flared base 410, introduce a curved surface to the second heating element 108. The second heating element 108 is therefore a hybrid arrangement of flat and curved surfaces, and is coupled with the first heating element 222 in the form of a film heater in the base 102.

[0043] The second heating element 108 may also serve as a temperature regulator, and provide an extended heating surface area for the liquid warmer as compared to the other portable warmer arrangements, which only have a single heater coupled to the base 102.

[0044] Any range or device value given herein may be extended or altered without losing the effect sought, as will be apparent to the skilled person.

[0045] It will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several embodiments. The embodiments are not limited to those that solve any or all of the stated problems or those that have any or all of the stated benefits and advantages.

[0046] Any reference to 'an' item refers to one or more of those items. The term 'comprising' is used herein to mean including the method blocks or elements identified, but that such blocks or elements do not comprise an exclusive list and a method or apparatus may contain additional blocks or elements.

[0047] The steps of the methods described herein may be carried out in any suitable order, or simultaneously where appropriate. Additionally, individual blocks may be deleted from any of the methods without departing from the spirit and scope of the subject matter described herein. Aspects of any of the examples described above may be combined with aspects of any of the other examples described to form further examples without losing the effect sought.

[0048] It will be understood that the above description of a preferred embodiment is given by way of example only and that various modifications may be made by those skilled in the art. Although various embodiments have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from the spirit or scope of this invention.

CLAIMS

1. A portable liquid warming apparatus, comprising:

a base, comprising a first heating element and a battery engagement element in electronic communication with the first heating element; and

a second heating element, fixed to the base and in electronic communication with the battery engagement element, at least a portion of the second heating element arranged to protrude into a liquid in a container when in use.

2. The apparatus of claim 1, wherein the base is operable to interlock with a container.

3. The apparatus of claim 2, wherein at least a portion of the second heating element is arranged to protrude into an empty space of a container when interlocked with the base.

4. The apparatus of any preceding claim, wherein the first and/or second heating element comprises one or more of: a polyimide heating film, a polyester heating film, a thin film, a thick film, a positive temperature coefficient heater, a heating coil.

5. The apparatus of any preceding claim, wherein the second heating element comprises a heater rod.

6. The apparatus of claim 5, wherein the heater rod surface comprises a flat portion and a curved portion.

7. The apparatus of claim 5 or claim 6, wherein at least a portion of the heater rod has a substantially rectangular cross section.

8. The apparatus of any preceding claim, further comprising a battery in electronic communication with the battery engagement element.

9. The apparatus of claim 8, wherein the battery is operable to provide between 40-100W of power to the first heating element and the second heating element.

10. The apparatus of claim 8 or claim 9, wherein the battery is operable to provide power to the first heating element and the second heating element according to a 2:1 ratio.

11. The apparatus of any of claims 8 to 10, wherein the battery is operable to provide 40W of power to the first heating element and 20W of power to the second heating element.

12. The apparatus of any preceding claim, further comprising a timer mechanism.

13. The apparatus of claim 12, wherein the timer mechanism is in electronic communication with the first heating element and/or the second heating element.

14. The apparatus of any preceding claim, further comprising a plurality of light emitting diodes (LEDs) arranged around the base.

15. The apparatus of any preceding claim, further comprising a digital display.

16. The apparatus of any preceding claim, wherein the base is operable to interlock with a container via a screw mechanism.

17. The apparatus of any preceding claim, further comprising a processor in electronic communication with one or more of: the battery engagement element, the first heating element, the second heating element.

18. The apparatus of claim 17, further comprising a Negative Temperature Coefficient, NTC, thermistor in electronic communication with the processor.

19. The apparatus of any preceding claim, wherein the base is shaped so as to support the portable liquid warming arrangement on a substantially flat surface.