

(21) Application No: 0721062.8  
(22) Date of Filing: 26.10.2007

(71) Applicant(s):  
**Kenwood Limited**  
(Incorporated in the United Kingdom)  
New Lane, Havant, Hants, PO9 2NH,  
United Kingdom

(72) Inventor(s):  
**Nigel Wilkinson**

(74) Agent and/or Address for Service:  
**QED Intellectual Property Limited**  
Harrow Exchange, 2 Gayton Road,  
HARROW, Middlesex, HA1 2XU,  
United Kingdom

(51) INT CL:  
**A47J 27/21** (2006.01) **H05B 1/02** (2006.01)  
**H05B 3/82** (2006.01) **A47J 27/21** (2006.01)

(56) Documents Cited:  
**GB 2363046 A** **GB 2290210 A**  
**GB 2153190 A** **EP 0170409 A1**  
**WO 1999/030536 A1** **JP 010086473 A**

(58) Field of Search:  
UK CL (Edition X ) **A4A, H5H**  
INT CL **A47J, H05B**  
Other: **ONLINE: WPI, EPODOC**

(54) Abstract Title: **Electrically heated domestic water vessels**

(57) An electrically heated domestic water vessel 10 comprises a receptacle which houses a flat-plate heater 30, supported above and spaced from the floor of the receptacle by legs 44 so that both major surfaces of the heater can contact the water so as to reduce energy consumption. Moreover, there is a significant reduction in the energy wastage associated with the transmission of thermal energy otherwise than into the water. The heater typically comprises an element 42 printed or otherwise deposited on a substantially rigid substrate, but it may alternatively comprise a distributed area metallic oxide coating on a substrate. Preferably, the heater is supported so as to accommodate the heating of relatively small amounts of water, such as a single cupful.

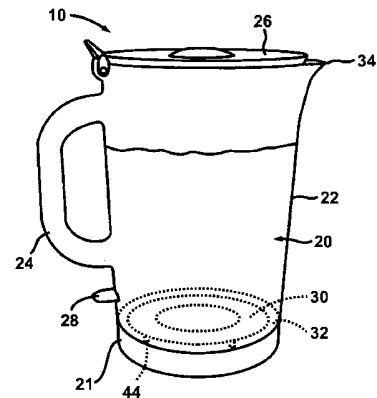


Fig 1

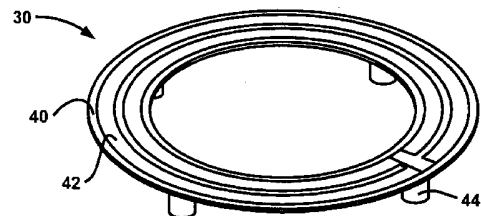


Fig 3

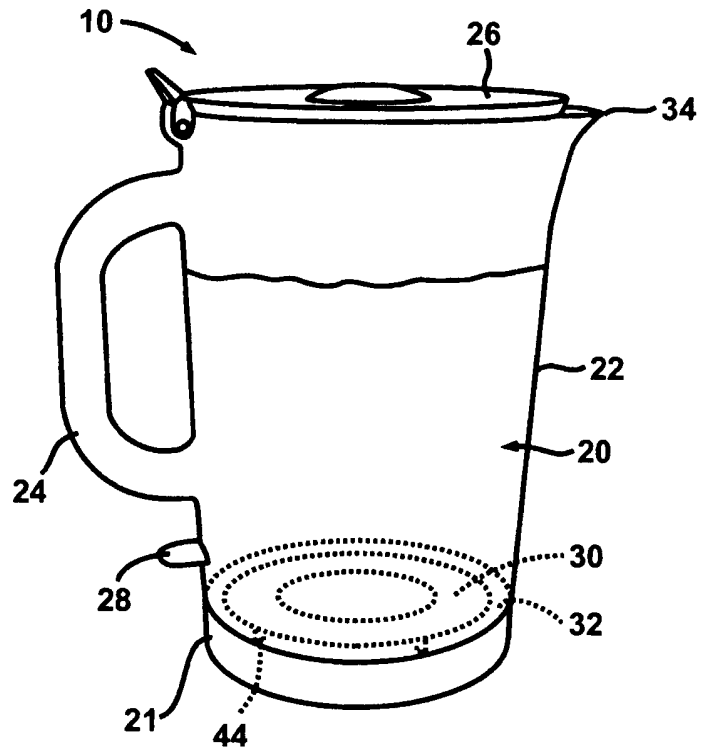


Fig 1

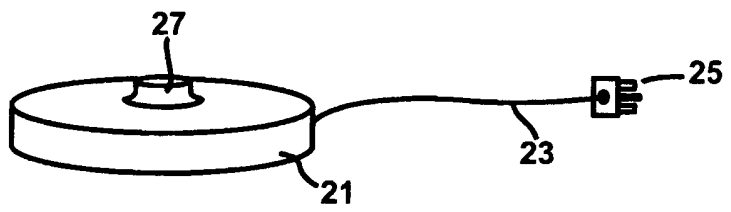


Fig 2

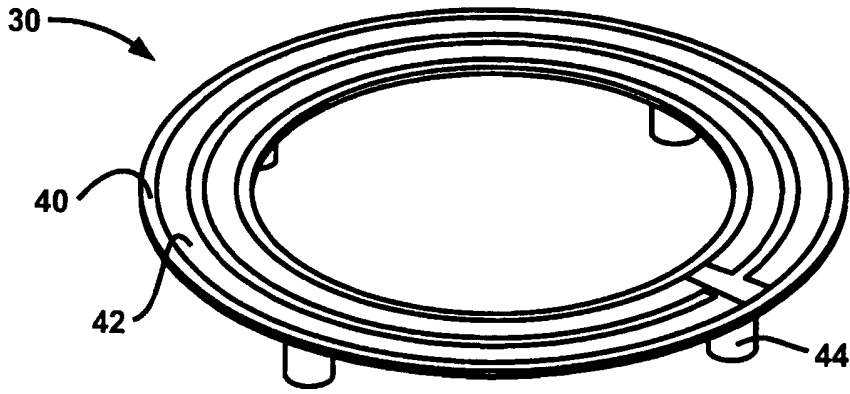


Fig 3

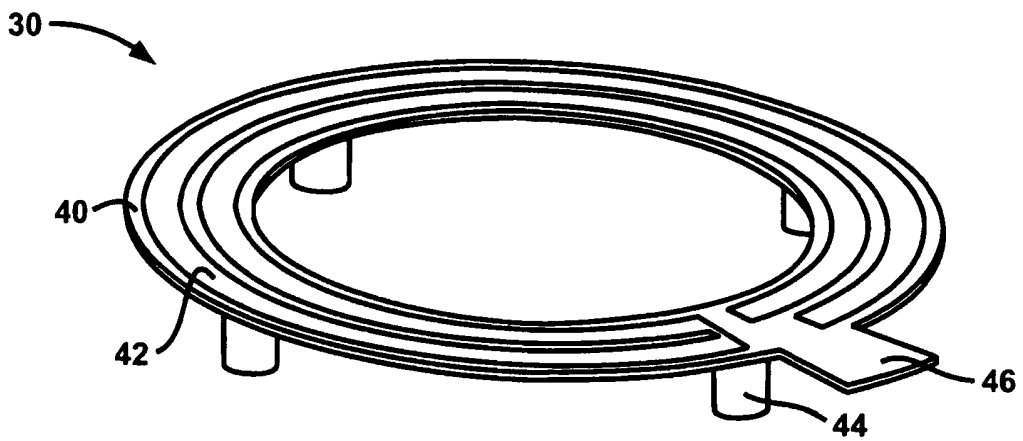


Fig 4

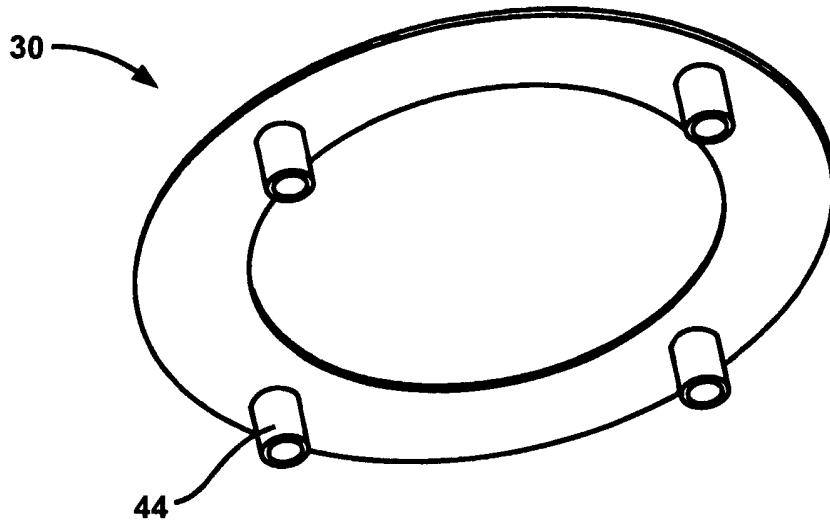


Fig 5

## ELECTRICALLY HEATED DOMESTIC WATER VESSELS

This invention relates to electrically heated domestic water vessels such as electric kettles.

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Electric kettles probably represent one of the most ubiquitous domestic appliances. They are available at a tremendous range of prices, and with a wide range of functionalities, and these days some of them also exhibit overt design features, such as illumination of the water during and/or after boiling, or illumination of the water and/or a water gauge with different colours at differing stages of the boiling process. They are available in design configurations ranging from contemporary jug kettles, usually formed of plastics materials, to traditional styles which, at least in appearance, are metallic.

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At one time, electric kettles were almost invariably fitted with sheathed heating elements, utilised as immersion heaters and supported from terminals affixed to headers located near the base of the kettle. Such elements typically followed a curved, re-entrant path lying substantially parallel to the base. This arrangement, whilst robust and (when new) efficient, suffered from the drawback that lime-scale tended to build up on the sheathed element, dramatically reducing its efficiency.

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The shape and design of the traditional heating elements made this lime-scale extremely difficult to remove and it has now become much more common to utilise substantially flat, plate-like heating elements disposed to form the floor or base of the heating compartment. Some such

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elements are simply created by securing a sheathed element to the underside of a plate-like metal disc. On the other hand, more advanced technology has provided substantially flat, plate-like heaters in which the element is printed or otherwise deposited on to a coating of resistive material, such as a ceramic material, formed on a rigid substrate such as a metallic plate; the element being covered with an overglaze of ceramic or other resistive material so as to resist the ingress of water.

Alternative technology replaces the printed element with a metallic oxide layer having a predetermined bulk resistivity providing, in effect, a heater resistance which is distributed over the entire heater, rather than focussed within a discrete printed element.

In any event, these substantially flat, plate-like heaters are significantly easier to maintain and clean than the immersion heater counterparts, and hence tend to retain their efficiency for longer operational periods. It is, moreover, convenient to provide temperature-sensing elements at strategic locations on such heaters; the sensors being connected to suitable electronic circuitry to provide boil-dry protection and other features too, if required.

Since the substantially flat, plate-like heater is used as the floor of the kettle's heating chamber, the associated electrical feeds and control circuitry can conveniently be mounted, beneath the floor, in a space provided above the outer base of the kettle, and such arrangements have now found wide acceptance.

Difficulties arise however since, unlike the older immersion heating elements, which were surrounded by water, only one face of the substantially flat, plate-like heater is exposed to the water to be heated. This means that, with users demanding rapid boiling performance,  
5 extremely high power-handling requirements are placed on such heaters.

Moreover, even if an under-floor reflective device is provided, a significant amount of the heat that radiates downwardly from the heater is lost. This is highly undesirable from the standpoint of efficiency,  
10 which is a most significant issue, especially as regards current concerns over energy conservation.

It is an object of this invention to provide an electrically heated domestic water vessel in which one or more of the difficulties mentioned above is  
15 substantially reduced or eliminated.

According to the invention there is provided an electrically heated domestic water vessel comprising a body part forming a receptacle for water and electrically powered heating means associated with the  
20 receptacle and capable, when powered, of heating the water therein, wherein the heating means comprises a plate-like heater having substantially smooth major surfaces, and wherein support means supports said heater within the receptacle such that both of said major surfaces are exposed to the water; means being provided for establishing electrical  
25 connections between said heater and a connector device supported by said vessel.

By this means, both major surfaces of the heater can be used to heat the water, thereby reducing power handling requirements for a given boiling time. Importantly, from the standpoint of energy conservation, however, there is a significant reduction in the energy wastage associated with the transmission of thermal energy otherwise than into the water.

Various other features of the invention will become clear from the following description of preferred embodiments and will be set out with particularity in the subsidiary claims hereof.

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In particular, however, in accordance with a special feature of the invention, the support for the element provides of itself, or further supports, the means whereby electrical connections can be made to the heater.

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In some preferred embodiments of the invention, the heater may be formed as an annulus, whereby the possibility of forming a trap for water between the heater and the floor of the receptacle is reduced, whilst positioning the heater sufficiently close to the floor of the receptacle to provide a capability to boil relatively small amounts of water. Alternatively, the heater may be formed, for example, as a solid disc or plate. Such a disc or plate may, moreover, be formed in at least one area thereof with a cut-out or indentation, or with a localised up-turn, in its outer edge, which cut-out, indentation or up-turn may be aligned with a spout of the receptacle so that water is encouraged to flow from beneath the heater when the kettle is tipped for pouring.



In other preferred embodiments of the invention, the somewhat conflicting requirements of avoiding water entrapment and providing the capability to boil relatively small amounts of water are addressed by configuring the internal shape of the receptacle whilst using a substantially flat heater of discoidal or annular form. In still further preferred embodiments of the invention, the said requirements are met by co-operatively configuring the shape of the plate-like heater and the internal shape of the receptacle.

10 The plate-like heater may be formed with a plurality of indentations or cut-outs extending around its outer perimeter to further reduce unwanted water retention and/or to modify the surface area of the heater. Alternatively, or in addition, the heater may be formed with corrugations or undulations extending at least partially there-around, in order to enhance rigidity of the heater.

The heater may comprise, for example, an element printed or otherwise deposited on a suitable substrate and insulated as necessary, or a distributed metallic oxide component.

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The plate-like heater may carry or be formed with, or otherwise support, thermal sensing means intended to provide a cut-off facility should the temperature exceed a predetermined level indicative of a boil-dry or other fault situation. In some preferred embodiments, the thermal sensing means comprises a track of material exhibiting a negative temperature coefficient of resistance, co-deposited with a heater track.

In other embodiments, a thermal sensor may be provided on, or under, the base of the receptacle.

The plate-like heater may be supported upon a plurality of pillar members extending from or secured to the base of the receptacle. In some preferred embodiments, connections to the heater and/or a thermal sensor if provided thereon are made via one or more of the pillar members.

In further preferred embodiments of the invention, the receptacle may be provided with a mesh filter, adjacent a spout thereof, for trapping unwanted solids that otherwise would remain entrained in the water when poured from the vessel.

The connector may receive directly a removable plug or socket device which connects via a cable to a mains plug.

Alternatively, and in most preferred embodiments of the invention, the connector is intended to mate with a co-operative connector formed on a separate base upon which the kettle can be placed and the co-operative connector on the base is connected via a cable to a mains plug. In such embodiments it is further preferred though not essential that the co-operative connectors on the kettle and the base provide for relative rotation between the kettle and the base, typically through 360 degrees, as such arrangements facilitate one handed usage of the kettle.

When such rotational connectors are used, there is further advantage to be had by utilising the arrangement described and claimed in our UK Patent No. GB 2328143-B, whereby certain functionalities for the kettle can be selectively implemented when the appliance is oriented at certain pre-selected angular positions with reference to the base.

In order that the invention may be clearly understood and readily carried into effect, certain embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 shows in side elevation a vessel in accordance with one example of the invention, comprising a jug kettle;

Figure 2 shows a base for the kettle of Figure 1; and

Figures 3, 4 and 5 show flat, plate-like heaters used in certain examples of the invention.

Referring now to Figure 1 of the drawings, a kettle 10 comprises a body part 20, comprising a receptacle 22 for water to be heated therein, a handle 24, a lid 26 and an on-off switch 28. The jug kettle also contains, within the receptacle 22, a flat-plate heater 30, which is shown only in outline in Figure 1 but is shown and described hereinafter in more detail with reference to Figures 3 to 5 hereof. The heater 30 is supported above and spaced from the floor 32 of the receptacle 22 so that both major

surfaces of the heater 30 are in contact with water to be heated in the receptacle part 22.

Part at least of the floor 32 may, if desired, be coated with, or otherwise support, a reflective material to further enhance the efficiency with which heat is transferred to the water in receptacle 22. Conveniently in this respect, the receptacle 22 is formed with a reflective, metallic floor 32.

The plate-like heater 30 may be of any convenient kind, such as a meandering heater track printed or otherwise deposited on a substantially rigid substrate, such as ceramic-coated stainless steel, and over-glazed with ceramic material to resist the ingress of water. Moreover, the heater 30 can be of any convenient shape, though it is preferred to utilise heaters of generally discoidal or annular configuration, as will be described more fully hereinafter.

The substantially flat, plate-like heater 30 and/or the volume of the receptacle 22 beneath and/or surrounding the heater are preferably shaped and configured such that, on the one hand, the vessel can accommodate the boiling of relatively small amounts of water, such as an amount sufficient for a single cup of tea or coffee, whilst on the other hand avoiding, so far as is practicable, the entrapment of water beneath or around the heater 30. In this latter respect, an outer surface portion of the heater may be indented or otherwise cut away to provide a water outlet in alignment with the spout 34 of the vessel 20. As mentioned above, further indentations or cut-outs may be provided if desired around the outer periphery of the heater 30; and moreover the heater may be

formed with corrugations or undulations for rigidity enhancement, if desired or necessary.

The kettle 10 also comprises a power base 21 which, as shown in Figure 2, is connectable by way of a power cord 23 to a plug 25 connectable to the mains electricity supply. The power base 21 also contains an upstanding connector element 27 which co-operates with a matching connector element (not shown) protruding downwardly from the underside of the base of the vessel 10 to form a coaxial connection of known kind which supplies power from the base 21 to the body part 20, in particular to energise the heater 30 when the switch 28 is turned on.

As is well known, the nature of the coaxial connection from the base 21 to the underside of the body part 20 permits the body part to be removed from the base merely by lifting it, so that the body part of the kettle can be removed from the base for filling or for pouring; thereby providing what is known as cordless operation of the kettle. In addition, it will be appreciated that the body part 20 can be freely rotated relative to the base, or placed thereon in any angular position without affecting the ability of the kettle to operate.

Referring now to Figures 3 to 5, the plate-like heater 30 comprises, in one example, an annular member 40 which typically comprises a stainless steel substrate, coated with ceramic material to provide electrical insulation and with a heating element or track 42 printed or otherwise deposited upon the ceramic-coated steel substrate. The element or track 42 is then over-glazed with ceramic material to provide

insulation between the electrical element or track and the water to be heated. Various alternative forms of substantially flat, plate-like heater can be utilised, however, as has been mentioned previously, and the invention is not limited to heaters constructed as just described.

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In this example, the annular plate-like heater 40 is supported close to the floor 32 of the receptacle 22; practical considerations as regards the mounting including the need to accommodate the facility to boil relatively small amounts of water, such as an amount sufficient for a  
10 single cup of tea or coffee, on the one hand, and the need to avoid entrapment of water beneath or around the heater 40 on the other hand.

In general, the shape and configuration of the heater plate itself and/or the adjacent region of the receptacle 22 are configured in a convenient  
15 manner to address such considerations, and in general, in this respect, it is preferred to provide a clear region between the outer periphery of the heater 40 and the surrounding wall of the receptacle 22.

In this particular example, the heater 40 is mounted close to and  
20 substantially parallel to the floor of the receptacle and is supported on a plurality of pillar members such as 44 upstanding from the floor. One or more of the pillar members may be hollowed to carry electrical connections through the floor to the element and/or to a thermal sensor (not shown) which may be deposited or otherwise provided on the  
25 annular plate 40.

In an alternative configuration, as shown in Figure 4, some or all of the electrical connections to the plate 40 may be made by way of a transversely extending tongue-like member 46 which is intended to be formed into and pass through a lateral wall of the receptacle 22 near its base, so as to communicate with the under-floor base area of the vessel 20.

It will be appreciated that the heater 40 can comprise elements or tracks such as 42 on one or both of its major surfaces; an advantage of providing elements or tracks on both major surfaces being that it is possible to reduce the power handling requirements for the individual elements, as compared with the requirements for a single surface heater with the same power output. In one example, 3kW of heating power is achieved by providing respective 1.5kW heaters on the two major surfaces of the heater plate 30. Of course, the heating elements may be designed to provide any selected power output. Moreover, if heating elements or tracks such as 42 are provided on both major surfaces of the heater plate 30, it is not necessary for them to be of equal heating power, and it may be preferred in some instances to provide the upper surface with greater heating power than the lower surface, for example in a ratio between 2:1 and 3:1.

Instead of forming the heater 30 as an annular plate 40, the heater 30 may be formed, for example, as a solid plate. In such circumstances, the plate may be formed, in at least one region thereof, with an up-turned edge oriented so that water is encouraged to flow from beneath the heater when the kettle is tipped for pouring. Again, corrugations or undulations

may be provided over a significant part of the area of the heater if necessary to enhance its rigidity.

As has previously been mentioned, however, the somewhat conflicting requirements of avoiding water entrapment and providing the capability to boil relatively small amounts of water may be addressed by configuring the internal shape of the receptacle whilst using an unmodified substantially flat, plate-like heater of discoidal or annular form. As a further alternative, those requirements may be met by co-operatively configuring both the shape of the plate-like heater and the internal shape of the receptacle.

In any event, the plate-like heater such as 30 may be formed with one or more indentations or cut-outs in its outer perimeter to further reduce unwanted water retention, and in preferred embodiments of the invention at least one such cut-out is aligned with the spout 34 (Figure 1) of the kettle 10, formed at the upper lip of the receptacle 22.

As referred to above, the plate-like heater such as 30 may carry, or be formed with, or otherwise support, thermal sensing means intended to provide a cut-off facility should the temperature exceed a predetermined level indicative of a boil-dry or other fault situation. In some preferred embodiments, the thermal sensing means comprises a track of material exhibiting a negative temperature coefficient of resistance, co-deposited with a heater track. In other embodiments, a thermal sensor is provided on, or under, the base 32 of the receptacle 22.



As is well known and conventional, the receptacle 22 may be provided with a mesh filter, adjacent the spout 34, for trapping unwanted solids that otherwise would remain entrained in the water when poured from the vessel.

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The vessel may be provided with a fixed connector intended to receive directly a removable plug or socket device which connects via a cable to a mains plug. Alternatively, and in most preferred embodiments of the invention, the connector is intended to mate with a co-operative connector such as 27 (Figure 2) formed on a separate base 21 upon which the kettle can be placed. In such embodiments it is further preferred though not essential that the co-operative connectors on the kettle and the base provide for relative rotation between the kettle and the base, typically through 360 degrees, as such arrangements facilitate one handed usage of the kettle.

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When such rotational connectors are used, there is further advantage to be gained by utilising the arrangement described and claimed in our UK Patent No. GB 2328143-B, whereby certain functionalities for the kettle can be selectively implemented when the appliance is oriented at certain pre-selected angular positions with reference to the base.

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As disclosed in the aforementioned UK Patent No. GB 2328143-B, significant adaptability and flexibility in operation of kettles of the kind described hereinbefore is achievable by switching certain functions into or out of operation, in dependence upon the angular relationship between the body part 20 and the base part 21.

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In our co-pending UK patent application No. GB 2430138-A (WO2007/031763) significant extensions of such capability are described, in operation of which one or more of the following functions  
5 may be selected:

1. Internal illumination of the water in the receptacle for as long as the power switch 28 is turned on. In this respect, it will be appreciated that, once the water in the receptacle has boiled, a steam-actuated switch  
10 (so-called "steam-stat") will, in known fashion, trip the switch 28 to its OFF position. The illumination may be provided in any chosen colour, and by any convenient means, such as neons, LEDs or other lamps, mounted in any convenient manner to illuminate the water in the receptacle 22;

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2. The heater may be operated in a keep-warm mode, active post-boiling to maintain water in the receptacle at a predetermined temperature, and/or to cut off before boiling at a predetermined maximum temperature, and/or to provide an extended boiling period for  
20 use where water of suspect purity is available. These functions are all known of themselves and are readily implementable by those skilled in the art. For example, with regard to a keep-warm function, it is known to provide two elements of relatively high and relatively low wattage respectively, and to run both elements whilst the water is being heated,  
25 but to have the steam-stat switch out only the higher wattage element when boiling occurs, so that the lower wattage element continues to run. Imposition of a maximum temperature is readily achieved, for example

by means of a thermostat control, and likewise the extended boil facility is readily implemented by the interposition of a delay into the operation of the steam-stat.

5 3. The receptacle 22 may be internally illuminated with differing colours at differing stages of the heating and/or a subsequent keep-warm or extended-boiling process. Thus, the illumination may be of a cool colour, such as blue or green, at switch-on, gradually changing through yellow and orange to red at boiling; possibly changing to a pulsed mode  
10 if a keep-warm facility is used. Alternatively, mixtures of colours, or even random colour sequences may be used if desired.

4. An ultra-violet (UV) source may be activated to provide a degree of water treatment; such source being of any convenient kind and further  
15 provided, in some embodiments, with optical beam-shaping means, such as dispersive or faceted devices, to spread the UV energy out so as to ensure, so far as possible, coverage of the entire water content of the receptacle. The UV source may be independently operated, or it may be associated with one or more other functions, such as a keep-warm  
20 function and/or an illumination function.

In order that the improved functionality of the invention may be provided without compromising the inherent convenience of the cordless operation, it is preferred that the kettle 10 is configured to operate  
25 entirely normally unless a function selector on the base part 21 is pressed by the user, and moreover that any selected functionality is automatically cancelled when the body part 20 is lifted off of the base part 21. By this

means, the user can elect to utilise the kettle 10 in an entirely conventional way; the normal, or default condition of the kettle 10 being set up to permit this.

- 5 It will be clearly appreciated from the foregoing that the term “plate-like heater” as used herein is intended to embrace solid or annular members which may be formed with indentations, cut-outs and/or undulations, and which may be dished or otherwise contoured, as well as substantially planar members. Moreover the plate-like heaters provided hereby need  
10 not be generally circular, and can adopt any shape that is convenient to use in the context of any given vessel.

## CLAIMS:

1. An electrically heated domestic water vessel comprising a body part forming a receptacle for water and electrically powered heating means associated with the receptacle and capable, when powered, of heating the water therein, wherein the heating means comprises a plate-like heater having substantially smooth major surfaces, and wherein support means supports said heater within the receptacle such that both of said major surfaces are exposed to the water; means being provided for establishing electrical connections between said heater and a connector device supported by said vessel.
2. A vessel according to claim 1, wherein the support for the heater provides of itself, or further supports, a means whereby electrical connections can be made to the heater.
3. A vessel according to claim 1 or claim 2, wherein the heater is so supported within the receptacle to accommodate the heating of relatively small amounts of water therein, such as an amount sufficient to fill a single cup.
4. A vessel according to any preceding claim, wherein the heater is formed as an annulus, whereby the possibility of forming a trap for water between the heater and the floor of the receptacle is reduced.
5. A vessel according to any of claims 1 to 3, wherein the heater is formed as a solid, discoidal member.

6. A vessel according to claim 5, wherein the discoidal member is formed, at least over part of its area with an up-turned edge positioned so that water is encouraged to flow from beneath the heater when the kettle is tipped for pouring.

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7. A vessel according to any preceding claim, wherein the plate-like heater is formed with one or more indentations or cut-outs in its outer perimeter.

10 8. A vessel according to claim 7, wherein at least one indentation or cut-out is aligned with a pouring spout formed at the upper lip of the compartment.

15 9. A vessel according to any preceding claim, wherein the internal shape of the receptacle, in the vicinity of the heater, is configured to assist in or provide accommodation for the heating of relatively small amounts of water therein, such as an amount sufficient to fill a single cup, and/or to reduce a possibility of forming a trap for water between the heater and the floor of the receptacle.

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10. A vessel according to any preceding claim, wherein the heater comprises an element printed or otherwise deposited on a substantially rigid substrate.

25 11. A vessel according to any of claims 1 to 10, wherein the heater comprises a distributed area metallic oxide component.

12. A vessel according to any preceding claim, wherein the heater plate carries, or otherwise supports, thermal sensing means to provide a cut-off facility should the sensed temperature exceed a predetermined level indicative of a boil-dry or other fault situation.

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13. A vessel according to claim 12, wherein the thermal sensing means comprises a track of material exhibiting a negative temperature coefficient of resistance.

10 14. A vessel according to any of claims 1 to 11, wherein a thermal sensor is provided on, or under, the base of the receptacle.

15 15. A vessel according to any preceding claim, wherein the plate-like heater is supported upon a plurality of pillar members extending from or secured to the base of the receptacle.

16. A vessel according to claim 15, wherein one or more electrical connections to the heater are made via one or more of the pillar members.

20 17. A vessel according to any preceding claim, wherein the receptacle is provided with a mesh filter, adjacent a spout thereof, for trapping unwanted solids that otherwise would remain entrained in the water when poured from the vessel.

25 18. A vessel according to any preceding claim, wherein said connector is adapted to receive directly a removable plug or socket device which connects via a cable to a mains plug.

19. A vessel according to any of claims 1 to 17, wherein the connector is provided to mate with a co-operative connector formed on a separate base upon which the vessel can be placed, and the co-operative connector  
5 on the base is connected via a cable to a mains plug.

20. A vessel according to claim 19, wherein the co-operative connectors on the vessel and the base provide for relative rotation between the vessel and the base, typically through 360 degrees.

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21. A vessel according to claim 20, configured such that at least one operational function of the vessel can be selectively implemented by orienting the vessel at a pre-determined angular position with reference to the base.

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22. A vessel according to any preceding claim, wherein heating elements are provided on both major surfaces of the plate-like heater.

23. A vessel according to claim 22, wherein the heating elements  
20 provide similar heat outputs.

24. A vessel according to claim 22, wherein the heating elements provide different heat outputs; the difference lying in the range from 2:1 to 3:1.

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25. An electrically heated domestic water vessel substantially as herein described with reference to the accompanying drawings.



**Application No:** GB0721062.8

**Examiner:** John Cockitt

**Claims searched:** 1-25

**Date of search:** 26 February 2008

## Patents Act 1977: Search Report under Section 17

### Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-3,5,10	GB2153190 A EMI - see whole document
X	1-3, 5.9.10	GB2290210 A STRIX - see whole document
X	1-3,5,12 at least	JP01086473 A MATSUSHITA - see figs esp fig 2
X	1-3,5,6,12 at least	EP0170409 A1 NIPPON - see figs and EPODOC/WPI abstracts
X	1-4,9 at least	WO99/30536 A1 KONINKL - see whole document
X	10,12,13	GB2363046 A OTTER - example of sensor track and NTC control/sensing track

### Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

### Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC<sup>X</sup>:

A4A; H5H

Worldwide search of patent documents classified in the following areas of the IPC

A47J; H05B

The following online and other databases have been used in the preparation of this search report

ONLINE: WPI, EPODOC

### International Classification:

<b>Subclass</b>	<b>Subgroup</b>	<b>Valid From</b>
A47J	0027/21	01/01/2006
H05B	0001/02	01/01/2006
H05B	0003/82	01/01/2006
A47J	0027/21	01/01/2006