Title: INDICATOR FOR LIQUID HEATING APPLIANCES

Abstract: An electrically heated kettle or hot water jug has a thick film heating element provided with PTCR portions which develop varying voltages as the heating element heats up in use, and these voltages are used to trigger the operation of respective diodes of an LED array so that the array lights up progressively as the temperature rises. The LEDs range in colour from green (cold) through yellow/orange (warm) to red (hot) and can illuminate a sight glass of the vessel or the vessel contents in which case the vessel wall has at least a portion which is transparent or translucent. The provision of such a display on a kettle or jug provided with bimetalllic controls provides a "high tech" look to an essentially low tech appliance and makes the appliance attractive in comparison to more expensive electronically controlled appliances.
INDICATOR FOR LIQUID HEATING APPLIANCES

Field of the Invention:

This invention concerns improvements relating to liquid heating appliances and more particularly concerns electrically heated water boiling appliances such as kettles and hot water jugs and the like. The invention relates to the provision of means for indicating to the user of such an appliance the status of the appliance.

Background of the Invention:

Electric kettles and hot water jugs commonly include controls for switching off or reducing the power to the heating element of the appliance when water boils in the appliance and also for protecting the appliance against heating element overtemperatures caused, for example, by switching on the appliance without first filling it with water. Such controls commonly employ bimetallic actuators set to respond to predetermined sensed temperatures, though electronic controls have also been proposed (see, for example, GB-A-2 228 634).

Small indicator lamps have commonly been provided in kettles and hot water jugs to indicate the status of the controls. Thus, for example, an indicator light may be associated with a boil sensing control, the light being switched off in response to operation of the control when the water in the
appliance boils. A further indicator light may be associated with an element protector (overtemperature) control, the light being switched on to provide a warning to a user of the appliance in the event of the heating element of the appliance overheating and the element protector control operating to switch off the appliance. Small neon bulbs (lamps) are commonly employed as such indicators, though LED’s have also been proposed in GB-A-2 228 634 which further proposes the use of indicators for other purposes such as to indicate the heating of water to a sub-boiling temperature better suited to making coffee or to indicate the build-up of scale on the appliance heating element.

Whereas bimetallic controls in kettles and hot water jugs readily enable the provision of some basic status indications, electronic controls provide increased possibilities, as is evident from GB-A-2 228 634. If the electronic control contains a logic element, functions other than simple automatic (switch off on boil) operation and dry boil (switch on empty) protection can readily be provided at little extra cost and all manner of status indications, timing and warning functions can readily be accommodated. Whilst electronic controls have not been competitive with bimetallic controls on account of their much higher cost, their ability to provide additional functions at little or no added cost narrows the competitive advantage of bimetallic controls.

**Objects and Summary of the Invention:**
It is the object of the present invention to provide a means of redressing the competitive balance in favour of bimetallic controls.

According to the present invention, an electric kettle or hot water jug or the like has an indicator comprising a series of light emitters which are arranged to be lit progressively as liquid is heated in the appliance. The effect of such an indication would be to provide a user with a measure of the progress of the heating of the appliance to boiling and of the time remaining before boiling is achieved, either as a function of the rate at which the light emitters were lit or as a function of the number of light emitters yet to be lit. Such an indication is believed to be useful and attractive to the user.

The series of light emitters are preferably arranged so that they collectively provide a unitary display area which is progressively illuminated. For example, the light emitters could be arranged in line, not necessarily a straight line, so that the progression of heating to boiling could be observed as the lit emitters advanced down the line. Ideally the light emitters would provide different colour outputs, for example green at low temperatures progressing through yellow or orange to red as the appliance heats to boiling. The sizes of the light emitters could increase throughout the series, so that the red, hot indication was more prominent than the green, cold indication, this being a useful reinforcement of the warning provided to the user by the red indication that the appliance contains hot, possibly scalding liquid.

The indicator proposed to be provided in accordance with the present invention could be additional to or integrated with other indicators provided
on the appliance. For example, an appropriate warning indicator, additional to
the heating progression indicator of the invention, could be associated with a
dry boil element protector control and would be lit quickly in the event of the
appliance being switched on empty.

The series of light emitters could for example be constituted by
multi-element LED arrays such as the 10 element bargraph modules (vertical
or horizontal) which are available from RS Components Ltd and include
monolithic integrated circuit display drivers which light successive LEDs as
an analogue input voltage level increases past prescaled threshold points. For
developing an appropriate analogue input voltage which varies as a function
of temperature, the heating element of the liquid heating appliance merely has
to have associated therewith appropriate temperature responsive means for
developing such a voltage. In the case where the heating element of the
appliance is of the thick film type, such means can conveniently comprise a
resistance element having an appropriate temperature coefficient of resistance,
such resistance elements being well known, printed on the heating element.
Alternatively a discrete temperature responsive resistance element could be
utilized.

The display that the present invention proposes to provide, particularly
when multi-coloured, can advantageously be employed to illuminate the liquid
column in a level indicating sight glass of the appliance so that it changes
colour as the water is heated. Alternatively, the light from the display could
illuminate the main body of liquid in the appliance and a large, transparent or
translucent wall area could be provided which acts as a sight glass window. The effect of this would be a glowing volume of water which changes colour as it heats up.

The foregoing and other features of the present invention are set forth in the appended claims and will be clearly understood by consideration of the following description of exemplary embodiments which are illustrated in the accompanying drawings.

**Description of the Drawings:**

Figure 1 is a schematic circuit diagram of a first exemplary embodiment of the invention; and

Figure 2 is a schematic circuit diagram of a second exemplary embodiment of the invention.

**Detailed Description of the Embodiments:**

Before considering in detail the embodiments of Figures 1 and 2, a discussion of preferred means of achieving the desired display will first be provided. According to a first possibility, a thick film heating element has a PTCR (a linear coefficient, not a Curie type device) section placed in series with the main heater track, or a part of it, the PTCR section having a low power density so that its temperature is closely related to the water temperature rather than being at an elevated temperature as is the main track. The voltage drop across this section would be no more than 5 volts, possibly
as low as 1 volt, so that any resistance change in the section would have an insignificant effect on the power of the heating element. The PTCR would have a temperature coefficient of resistance of at least 5000 parts per million, to give a significant change in resistance over the 80° temperature rise between cold and boiling. A 6000 ppm coefficient would give roughly a 50% rise in resistance, and hence a 50% rise in voltage. This voltage is then passed to a multi-element LED display as mentioned hereinbefore to progressively turn on the lamps from green through to red as the water temperature rises. A further red LED with a switch-on voltage arranged to correspond to a temperature above 100°C could be placed in parallel with the LED display to give an indication of dry boil. Alternatively, as described, a linear PTCR is placed on the track, or in contact with an element mounting plate in the case of a conventional heating element of immersed or underfloor type. The output voltage obtained from the PTCR is fed to a logic device, such as an ASIC, which provides an output at terminals connected to a series of LEDs to switch them on, either one at a time and switching off the previous light or in sequence and leaving the previous lights lit, as the temperature rises. A rate sensor in the logic device could detect the onset of dry boil by detecting an abnormally high rate of rise, and could switch on a red warning light much earlier than in the first possibility.

A disadvantage of the above proposals is that the cost of the integrated ladder LED displays is quite high. A standard LED array without integrated logic is also available from RS Components Ltd and could be used by
incorporating a number of tapping points on the printed heating element, the temperatures at which the LEDs light being set by the relative voltages at these tapping points. With this system it would be more difficult to arrange for the LEDs to be extinguished as the next in the sequence was lit, but this is not essential and it may in fact be preferable to the user that they are not. The circuit diagram of Figure 1 shows a simple layout wherein a thick film heating element has a main track portion in series with three parallel connected sections, each constituting a potential divider formed as a fixed resistance in series with a PTCR which provide output voltages to the LEDs. The values of the fixed resistances and the characteristics of the PTCRs are chosen so that the green LED would come on almost immediately on switch on of the appliance to show the water starting to warm up, the yellow one at around 40-50°C and the red one somewhere above 90°C, these being the temperatures at which the respective output voltages reach the striking voltages of the LEDs.

The circuit arrangement shown in Figure 1 would only illuminate the LEDs when the heating element was energised. This would not give any indication of hot water or dry boil after the element switched off. To overcome this the PTCR/fixed resistor arrangement could be placed in parallel with the main element and arranged to be supplied whenever the appliance was connected to the supply. In such an arrangement the fixed resistors would have much higher values to limit the power dissipated by the system, but in other respects the system would be very similar to that of Figure 1. Figure 2
shows a possible circuit, for which suitable values around 80 Ohms for the PTCR and 7.4 kOhms for the main resistance would switch on a 2.2V LED at about 60°C. It should be noted that this version would give a much lower (about half) change in output voltage because of the lower currents used, and therefore would be much more sensitive to tolerance variations in the printed track resistances and the LED strike voltages.

Although, in the case of thick film printed elements, it would be cheapest to simply print the PTC resistors, the limitations of available materials might create the tolerance problems referred to above. For the additional cost of a discrete PTCR, possibly a Curie type device with a suitable anomaly temperature or one with a higher coefficient, the tolerance problem could be reduced.

As mentioned hereinbefore, the coloured light sequence could be used to illuminate the liquid column in a sight glass so that it changed colour as the water was heated. An extension of this would be to shine the light into the main body of water in the jug or kettle body, and provide a large transparent wall area which acts as a sight glass window. An example of such a window may be seen on the Pifco Millennium jug, and many manufacturers are now using large transparent areas in this way. The effect would be to provide a glowing body of water whose colour changes as it heats up, which is a potentially attractive feature.

The invention having been described in the foregoing by reference to specific embodiments, it is to be well understood that the embodiments are
exemplary only and that modifications and variations are possible without departure from the spirit and scope of the invention.
Claims:

1. A liquid heating appliance having an indicator in the form of a series of light emitters which are arranged to be lit progressively as liquid is heated in the appliance.

2. An appliance as claimed in claim 1 wherein the light emitters provide different colour outputs.

3. An appliance as claimed in claim 1 or 2 wherein the different light emitters are arranged to be lit in response to the development of different voltages, and the appliance includes means for developing different voltages as the temperature changes in use of the appliance.

4. An appliance as claimed in claim 3 wherein said voltage developing means comprises resistances having temperature dependent values.

5. An appliance as claimed in claim 4 which has a thick film heating element and wherein said temperature dependent resistances are formed on the thick film heating element.
6. An appliance as claimed in any preceding claim which is provided with an electromechanical boil sensing and/or heating element overtemperature protection control.

7. An appliance as claimed in claim 6 wherein said control(s) include(s) a bimetallic actuator.

8. An appliance as claimed in any preceding claim wherein said light emitters are arranged to illuminate the liquid column in a sight glass of the appliance.

9. An appliance as claimed in any of claims 1 to 7 wherein said light emitters are arranged to illuminate the liquid contents of the appliance, and at least a portion of the wall of the appliance is transparent or translucent.

10. An appliance as claimed in any preceding claim and substantially as herein described with reference to Figure 2 or Figure 2 of the accompanying drawings.
Fig. 1
Fig. 2
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A47J/27/212

According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A47J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base ard. where practical, search terms used)

WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>Y</td>
<td>DE 39 04 859 A (ROBERT KRUPS STIFTUNG &amp; CO KG) 23 August 1990 (1990-08-23)</td>
<td>4, 6, 7</td>
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<td>X</td>
<td>WO 99 48331 A (STRIX LTD) 23 September 1999 (1999-09-23)</td>
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<td></td>
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<tr>
<td>A</td>
<td>DE 196 52 829 A (BOSCH-SIEMENS HAUSGERÄTE GMBH) 23 October 1997 (1997-10-23)</td>
<td>5</td>
</tr>
<tr>
<td>A</td>
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Patent family members are listed in annex.

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Date of the actual completion of the international search

9 May 2001

Date of mailing of the international search report

16/05/2001

Name and mailing address of the ISA

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<tr>
<td>Y</td>
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<td>GB 2332522 A</td>
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<td>DE 3904859 A</td>
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<td>EP 1064825 A</td>
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<td>DE 19652829 A</td>
<td>23-10-1997</td>
<td>DE 29623763 U</td>
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<td>FR 2747823 A</td>
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<td>GB 2312153 A,B</td>
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