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(54) **A METHOD FOR OPERATING A COOKER, A CONTROL SYSTEM AND A COMPUTER PROGRAM**

(57) A method is provided for operating a cooker to detect overflow events. Overflow sensing elements(22,24,26,28) , for example bimetallic strips (22-28),surround a heating element on a cooking surface (10) of the cooker. The overflow sensing elements each complete an electrical circuit. When an overflow event occurs, for example hot liquid overflowing a vessel which

is on the cooker, the overflow sensing element is affected in such a way as to cause a break in the electrical circuit. For example, a heated bimetallic strip curls up. The break in electrical circuit can be detected and cause a safety action to the implement to prevent further overflow events. A cooker and a control system for detecting overflow events in a cooker are also described.

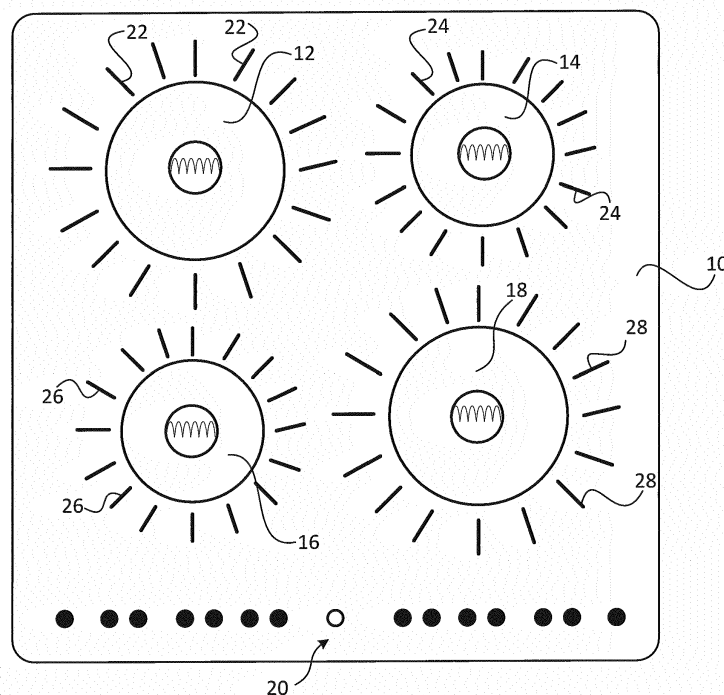


Figure 1

## Description

### Technical Field

**[0001]** The present disclosure relates to a method for operating a cooker, a cooker, a control system for a cooker and a computer program.

### Background

**[0002]** When using a cooker to heat food, if the food being heated is left unattended it may overflow. It is desirable to detect such overflow events or events for safety. Overflow detection techniques are known, but they may be complex and hard to implement in cookers. This may be particularly the case in induction cookers.

**[0003]** For example, capacitive cooker overflow detection devices are known.

**[0004]** CN 202432566 U describes the use of a capacitive cooker overflow detection device, for an induction cooker in particular, surrounding a heating area of a cooker surface onto which a cooking vessel would be placed. In this way, a dedicated overflow detection arrangement is provided separately from a touch-sensitive cooker control panel.

**[0005]** US 2008/0150705 A1 describes a capacitive contamination detection element provided in addition to, but normally isolated from, a capacitive touch sense element on a cooking surface, for example. Detection of an overflow from a cooking vessel comprises detecting a coupling of signals from the touch sense element to the contamination detection element or vice-versa, caused by a contaminant overlaying both elements, as may typically occur with an overflow. It is known to provide capacitive touch sense elements in regions of a cooking surface for the purpose of detecting an overflow of liquid or other cooking ingredients from a cooking vessel, for example. However, such regions of a cooking surface may also be likely to accumulate other contaminants such as moisture or limescale which reduces the reliability of detecting an overflow by those elements.

**[0006]** A failure to detect an overflow and to take action to switch off the respective heating element or warn the user may result in the cooking vessel overheating and spoilage or messing of the cooking surface. Furthermore, any touch-sensitive controls provided to control functions of the cooker may also be over-run by an overflowing liquid before any action can be taken by the user to disable the heating elements of the cooker, with unpredictable and potentially dangerous results.

**[0007]** It would therefore be beneficial to have a reliable way to detect an overflow of liquid from a cooking vessel.

### Summary

**[0008]** According to a first aspect disclosed herein there is provided a cooker comprising:

a cooking surface;  
at least one overflow sensing element associated with the cooking surface and located to complete an electrical circuit; and

a controller that is arranged to detect a break in the electrical circuit indicative of an overflow event affecting the overflow sensing element, and implement a safety action to prevent further overflow events.

**[0009]** The cooking surface may comprise at least one heating element with which the overflow sensing element is associated.

**[0010]** In the described embodiment the overflow sensing element is a bimetallic strip.

**[0011]** The embodiments of this invention are particularly useful when the heating element is an induction heating element. In normal operation, the surface of the cooker around the heating elements does not heat up in an induction cooker. Instead, the heating element operates in cooperation with cooking vessels to heat the food inside the cooking vessels. Therefore in normal operation the area of the cooking surface around the heating elements remains sufficiently cool that the bimetallic strip will normally lie flat. In a flat condition, it completes the electrical circuit. However, when an overflow event occurs and liquid or other food stuff drops onto the bimetallic strip, it is heated up and this causes it to curl and to break the electrical circuit.

**[0012]** The safety action may deactivate the heating element associated with the at least one overflow sensing element responsive to detecting a break in the electrical circuit. Alternatively, the safety action could comprise issuing a warning to a user of the cooker so that they may be alerted and go and turn off the heating element manually. Alternatively, the cook could remove the vessel from the cooker.

**[0013]** By use of an overflow sensing element which normally completes an electrical circuit, and is arranged to break the electrical circuit when affected by a hot liquid or other foodstuff, the risk of fire caused by liquid/food overflow can be mitigated.

**[0014]** Another aspect of the disclosure provides a method of operating a cooker having at least one overflow sensing element associated with a heating element on a cooking surface of the cooker and located to complete an electrical circuit, the method comprising:

detecting a break in the electrical circuit indicative of an overflow event affecting the overflow sensing element; and  
implementing a safety action to prevent further overflow events.

**[0015]** Another aspect of the disclosure provides a control system for detecting overflow events in a cooker, the control system comprising:

at least one electrical circuit having a first conductive

portion and a second conductive portion, with an overflow sensing element arranged between the first and second conductive portions to complete the electrical circuit in a normal condition, and to break the circuit in an overflow event, the overflow sensing element configured to be accommodated on the surface of the cooker, and

a controller arranged to detect a break in the electrical circuit indicative of an overflow event affecting the overflow sensing element and to implement a safety action to prevent further overflow events.

**[0016]** A further aspect of the disclosure provides a computer program which when installed and executed by a digital processor causes the digital processor to implement the method according to any of the above defined steps.

#### Brief Description of the Drawings

**[0017]** To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically an example of a cooking surface according to the present disclosure;

Figure 2 shows schematically operation of a bimetallic strip;

Figure 3 shows an overflow detection control system in a state where there is no overflow event;

Figure 4 shows the overflow detection control system in a state when an overflow event has been detected;

Figure 5 is a flow chart showing steps of a method according to the present disclosure.

#### Detailed Description

**[0018]** An example implementation of the present invention will be described in the context of an induction cooker or other type of cooker having a flat glass or ceramic cooking surface.

**[0019]** Referring to Figure 1, a cooking surface 10 of an induction cooker, for example, is shown schematically in a plan view. The cooking surface includes four heating regions 12, 14, 16 and 18 for placing cooking vessels to be heated. A region of touch-sensitive cooker controls 20 may also be provided. Each of the regions 12-18 for placing cooking vessels is surrounded by a respective group of one or more overflow sensing elements 22, 24, 26 and 28 intended to detect an overflow from a cooking vessel placed on the respective heating region 12-18. Each overflow sensing element takes the form of a bimetallic structure or bimetallic strip. Operation of bime-

tallic strips are known, but for the sake of completeness is described herein with reference to Figure 2.

**[0020]** Figure 2 shows a bimetallic strip 22 composed of a first metal layer 22a and a second metal layer 22b. In the presence of heat, the metal layer 22a expands more than the metal layer 22b, that is the expansion coefficient of metal layer 22a is greater than that of metal layer 22b. When the metal layers are fixedly joined together by fixed connections 22c the expansion of the metal layer with the higher expansion coefficient is constrained and this causes the bimetallic strip to bend as shown on the right hand side of Figure 2.

**[0021]** Reverting to Figure 1, bimetallic strips 22-28 are placed around the heating regions so that multiple strips extend radially from each heating region. In normal operation, each bimetallic strip lies flat within or on the cooker surface. This is because in the case of induction cookers only a vessel on the heating region is heated, and not the surrounding area. The surface temperature of the area around the heating element does not increase during a cooking process.

**[0022]** In the event of an overflow from a vessel being heated (that is, hot liquid or other foodstuff spilling over the top of the vessel and landing on the bimetallic strip), the bimetallic strip will start to heat up. Any bimetallic strip in the overflow region will therefore start to curl. This property is used herein to allow them to be used as a switch inside an electrical circuit. In a normal condition (at room temperature) the bimetallic strips are flat and the electrical circuit containing them is closed. However, in the state of an overflow event, bimetallic strips in the overflow region will curl and break the circuit, causing the circuit to become open circuit.

**[0023]** Figure 3 shows an overflow detection system which comprises an overflow detection control unit 30 configured to detect breaks in the electric circuit. Figure 3 illustrates the overflow detection system in a condition where no overflow has occurred. Four electrical circuits are shown, each comprising a bimetallic strip. In reality there may be many such circuits. Each circuit has a conductive portion 32 connected to a voltage source 34 and to the bimetallic strip 22. Another conductive portion 36 connects the bimetallic strip 22 to the overflow detection control unit 30. In practice, the bimetallic strip may lie on the surface of the cooker, and the conductive portions 32, 36 may extend beneath the cooking surface. Each bimetallic strip may be contained within its own respective electrical circuit. Alternatively, the bimetallic strip surrounding the same heating region may be connected in series in a single electrical circuit for that heating region. Any break in that circuit would indicate an overflow event around that heating region. The overflow detection system comprises a cooker controller 38 which can be activated by the overflow detection control unit 30 in the event of a break being detected to turn off the affected heating element. This is one type of safety action that may be taken to prevent further overflow events and to prevent a fire etc.

**[0024]** Another action which may be additionally or alternatively taken is to issue a warning to a user that an overflow event has occurred. The warning could take the form of a flashing light or an audible sound etc.

**[0025]** Figure 4 shows the overflow detection system in a state where one of the bimetallic strips has been subject to an overflow event. In this case, the bimetallic strip 24 has been affected by hot food or liquid and has curled, breaking the circuit in which it normally completes. This is detected by the overflow detection control unit which now identifies an open circuit condition in that electrical circuit and can issue a warning and/or cause the cooker controller to turn off the heating element.

**[0026]** Any known circuit can be utilised within the overflow detection control unit for detecting an open circuit condition on a pin. The overflow detection control unit may comprise a processor which is suitably programmed to issue a warning and/or cause the cooker controller 38 to turn off the heating elements when such an event is detected.

**[0027]** Figure 5 shows a sequence of steps in accordance with a method of one embodiment of the invention. At step S50, an overflow occurs at a hob of the cooker. At step S52 the bimetallic strip in the region of the overflow is caused to curl by the increase of its temperature as a result of the overflow event. At step S54 it is shown that the curling of this bimetallic strip causes the circuit containing the bimetallic strip to become open circuit. At step S56 this is detected by the control unit 30 and at step S58 the control unit acts on the cooker controller to cause it to turn off the hob which was subject to the overflow event.

**[0028]** The overflow detection control unit can associate each circuit with its associated hob, such that it can identify to the cooker controller the hob which needs to be turned off as a result of an overflow event.

**[0029]** Although at least some aspects of the embodiments described herein with reference to the drawings comprise computer processes performed in processing systems or processors, the invention also extends to computer programs, particularly computer programs on or in a carrier, adapted for putting the invention into practice. The program may be in the form of non-transitory source code, object code, a code intermediate source and object code such as in partially compiled form, or in any other non-transitory form suitable for use in the implementation of processes according to the invention. The carrier may be any entity or device capable of carrying the program. For example, the carrier may comprise a storage medium, such as a solid-state drive (SSD) or other semiconductor-based RAM; a ROM, for example a CD ROM or a semiconductor ROM; a magnetic recording medium, for example a floppy disk or hard disk; optical memory devices in general; etc.

**[0030]** The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one ex-

ample or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

## Claims

### 1. A cooker comprising:

a cooking surface;  
at least one overflow sensing element associated with the cooking surface and located to complete an electrical circuit; and  
a controller arranged to detect a break in the electrical circuit indicative of an overflow event affecting the overflow sensing element, and to implement a safety action to prevent further overflow events.

2. A cooker according to claim 1 wherein the cooking surface comprises at least one heating element with which the overflow sensing element is associated.

3. A cooker according to claim 2 wherein the safety action deactivates the heating element associated with the at least one overflow sensing element responsive to detecting a break in the electrical circuit.

4. A cooker according to any preceding claim wherein the overflow sensing element comprises a bimetallic strip which is normally flat and which completes the circuit when it is flat, the bimetallic strip responsive to an overflow event to curl and to break the circuit.

5. A cooker according to claims 2 and 4 wherein each heating element is associated with multiple bimetallic strips arranged at different locations around the heating element, wherein each heating element is in a respective electrical circuit and a break in any of the electrical circuits indicates an overflow event for that heating element.

6. A cooker according to claim 5 wherein the multiple strips are arranged to extend radially from the circumference of each heating element.

7. A cooker according to claim 2 or any of claims 3 to 5 when dependent thereon wherein the heating element is an induction heating element.

8. A method of operating a cooker having at least one overflow sensing element associated with a heating

element on a cooking surface of the cooker and located to complete an electrical circuit, the method comprising:

detecting a break in the electrical circuit indicative of an overflow event affecting the overflow sensing element; and  
implementing a safety action to prevent further overflow events.

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9. A method according to claim 8 wherein the safety action comprises generating a warning for a user of the cooker.
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10. A method according to claim 8 wherein the safety action comprises deactivating the associated heating element responsive to detecting a break in the electrical circuit.
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11. A method according to claim 8, 9 or 10 wherein the overflow sensing element comprises a bimetallic strip.
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12. A control system for detecting overflow events in a cooker, the control system comprising:
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- at least one electrical circuit having a first conductive portion and a second conductive portion, with an overflow sensing element arranged between the first and second conductive portions to complete the electrical circuit in a normal condition, and to break the circuit in an overflow event, the overflow sensing element configured to be accommodated on a surface of the cooker;
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- and
- a controller arranged to detect a break in the electrical circuit indicative of an overflow event affecting the overflow sensing element and to implement a safety action to prevent further overflow events.
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13. A control system according to claim 12 comprising multiple such electrical circuits wherein the controller is configured to detect a break in any of the electrical circuits.
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14. A computer program which when installed and executed by a digital processor causes the digital processor to implement a method according to any of claims 8 to 11.
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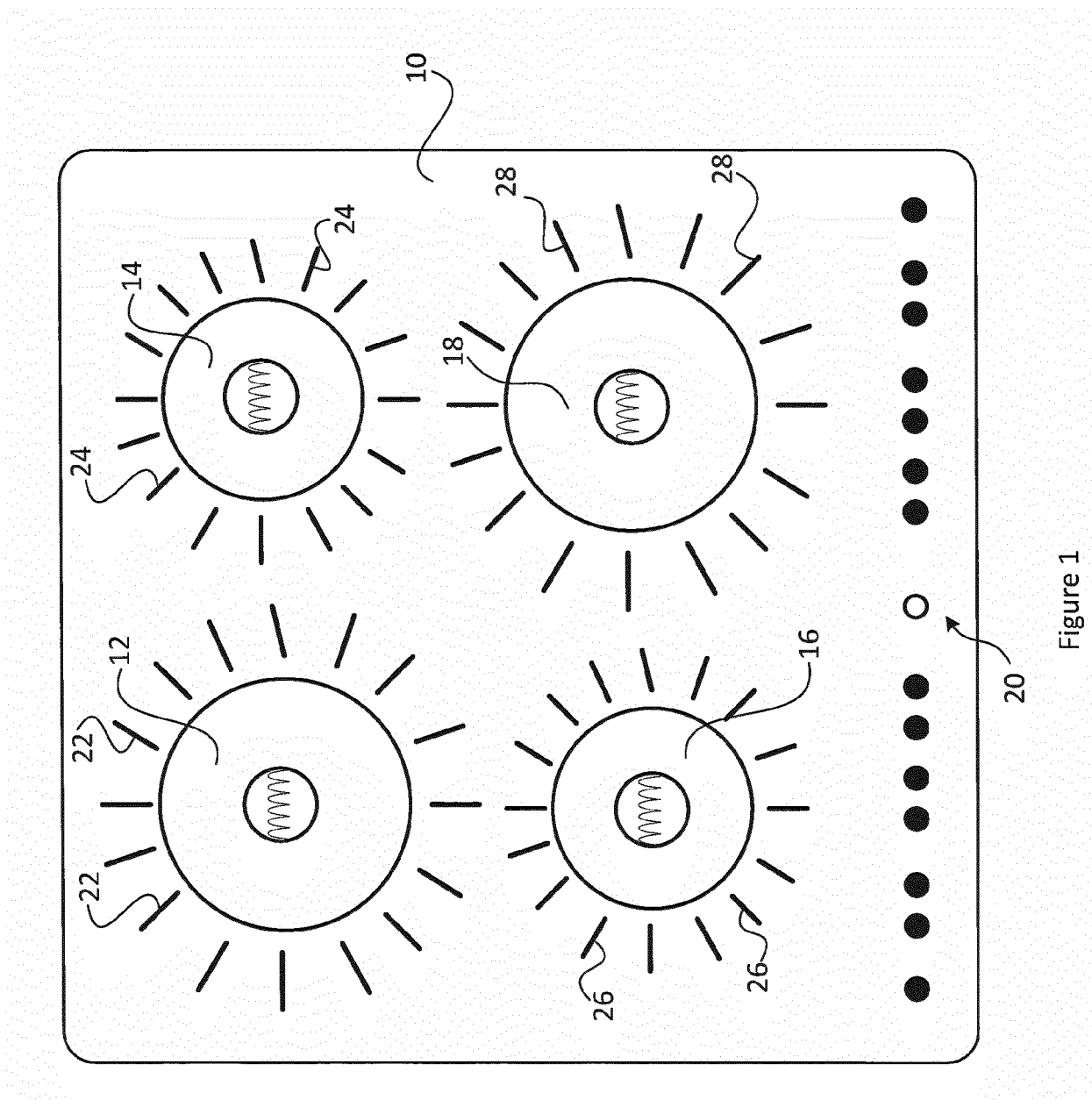


Figure 1

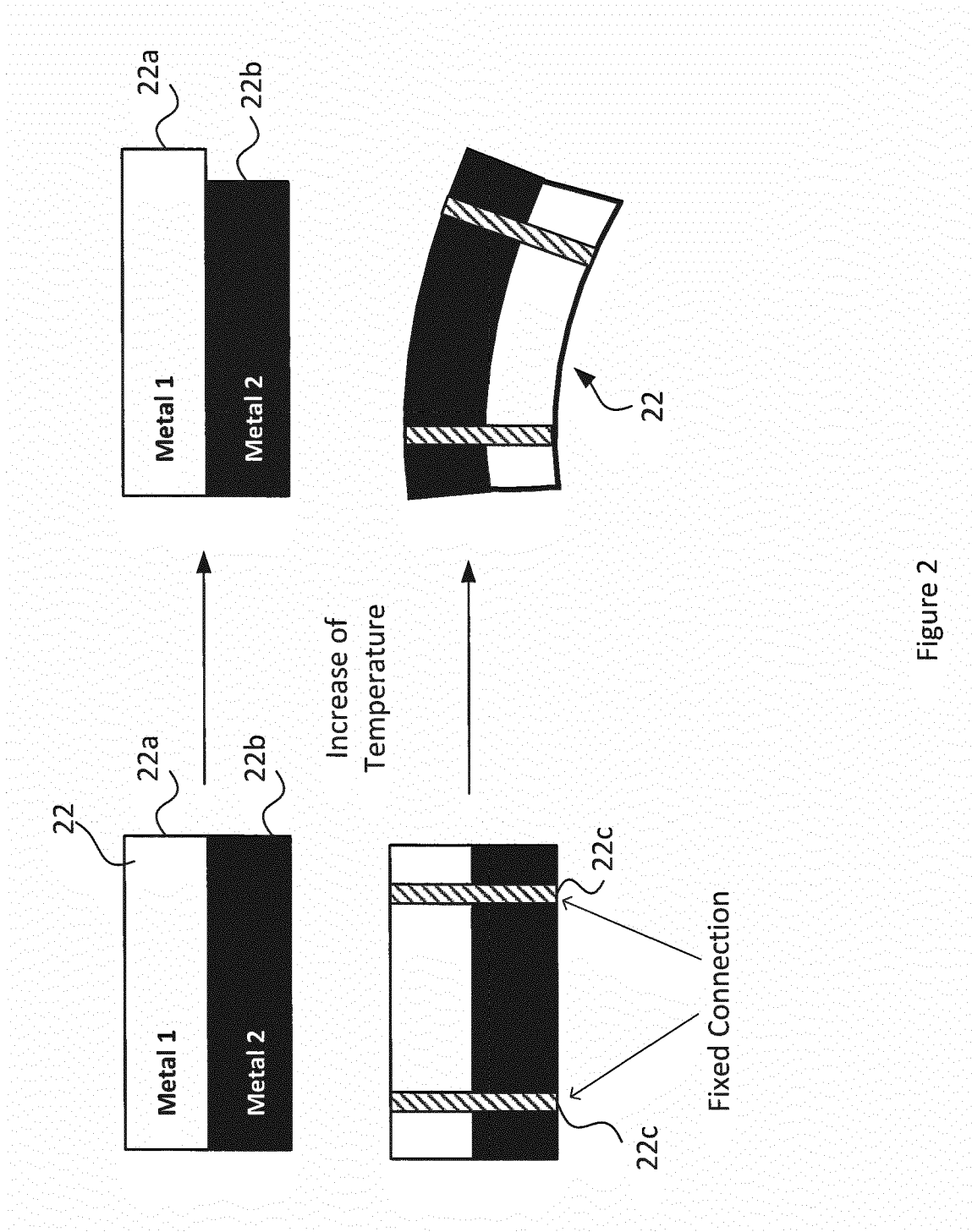


Figure 2

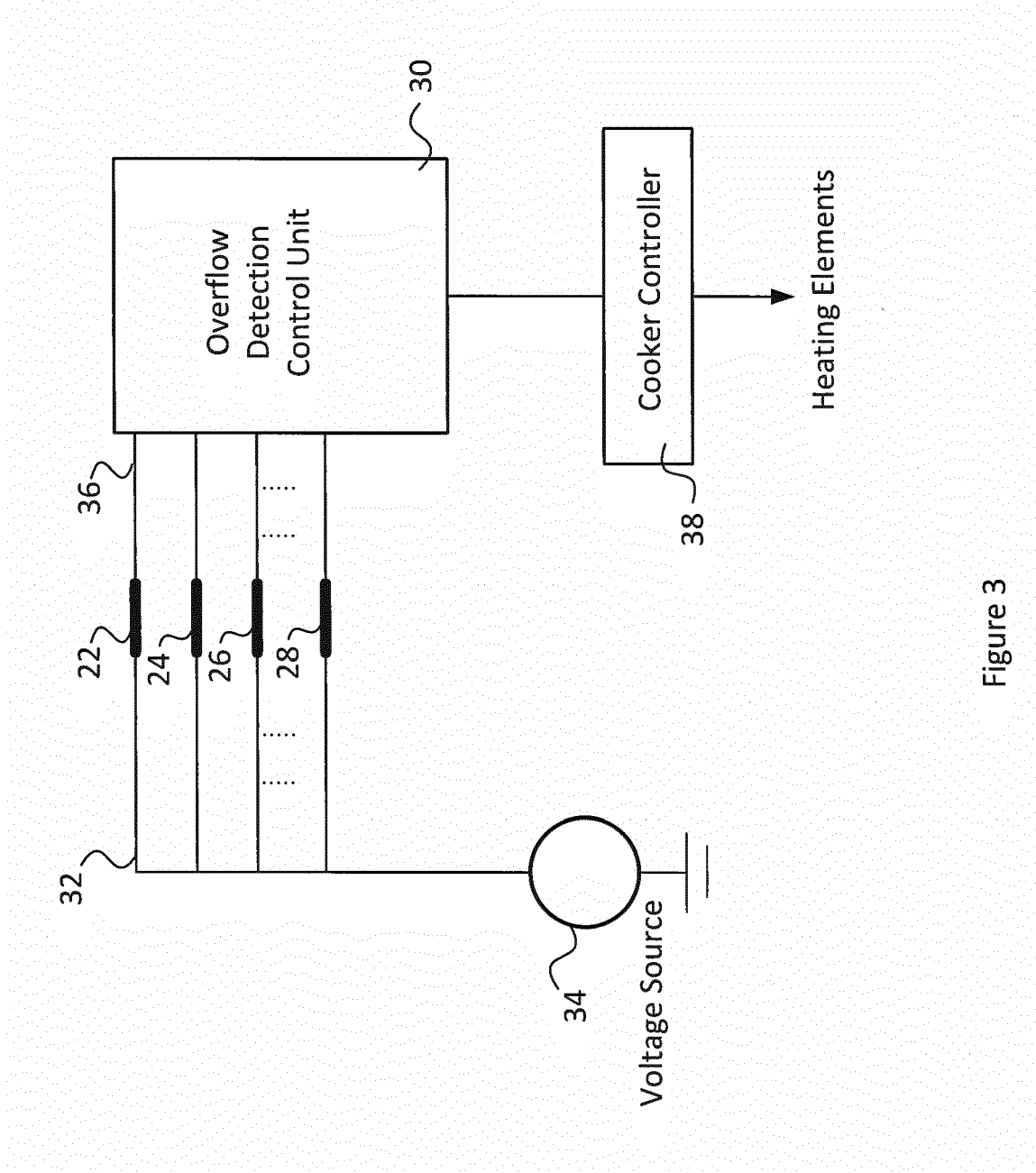


Figure 3

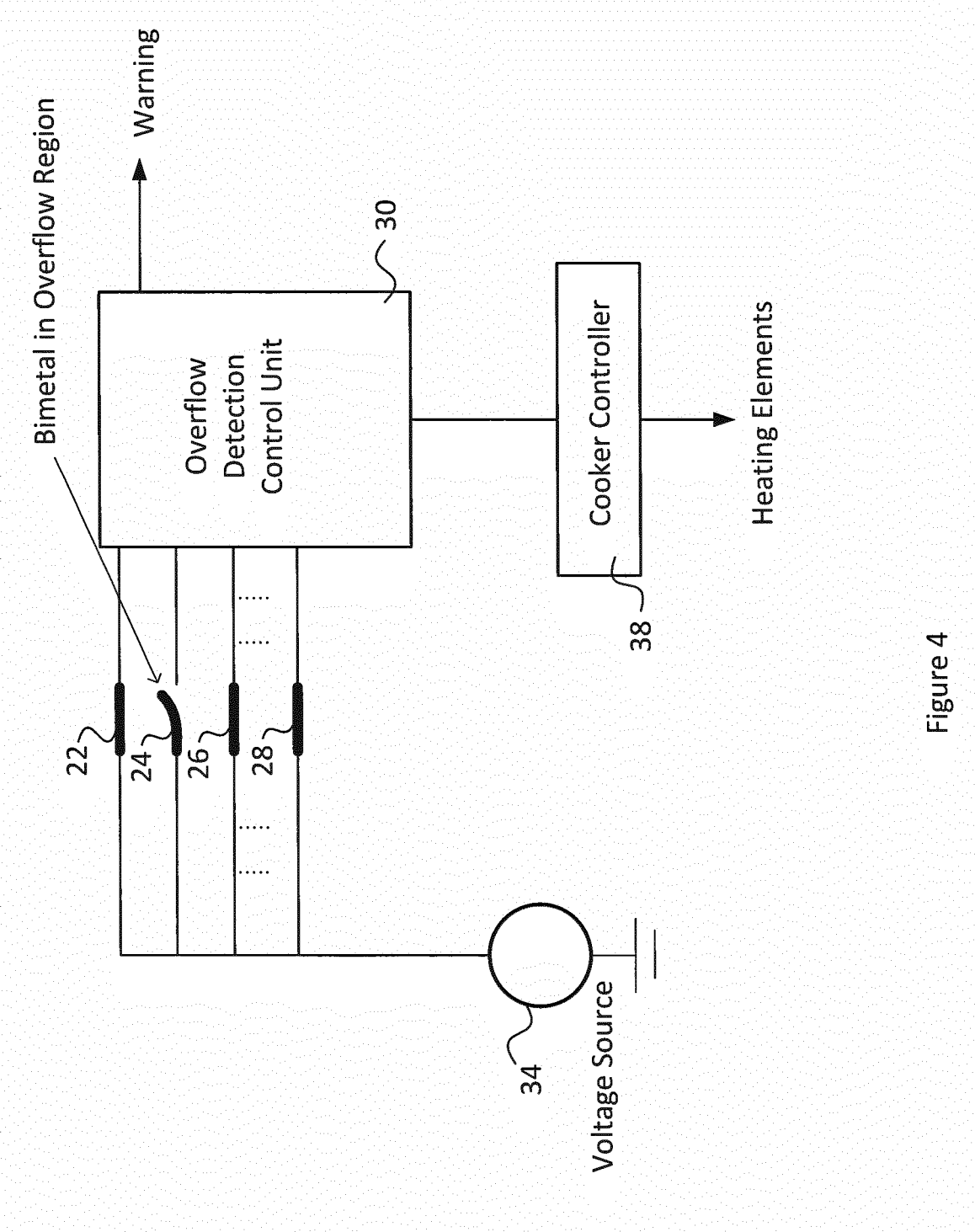


Figure 4

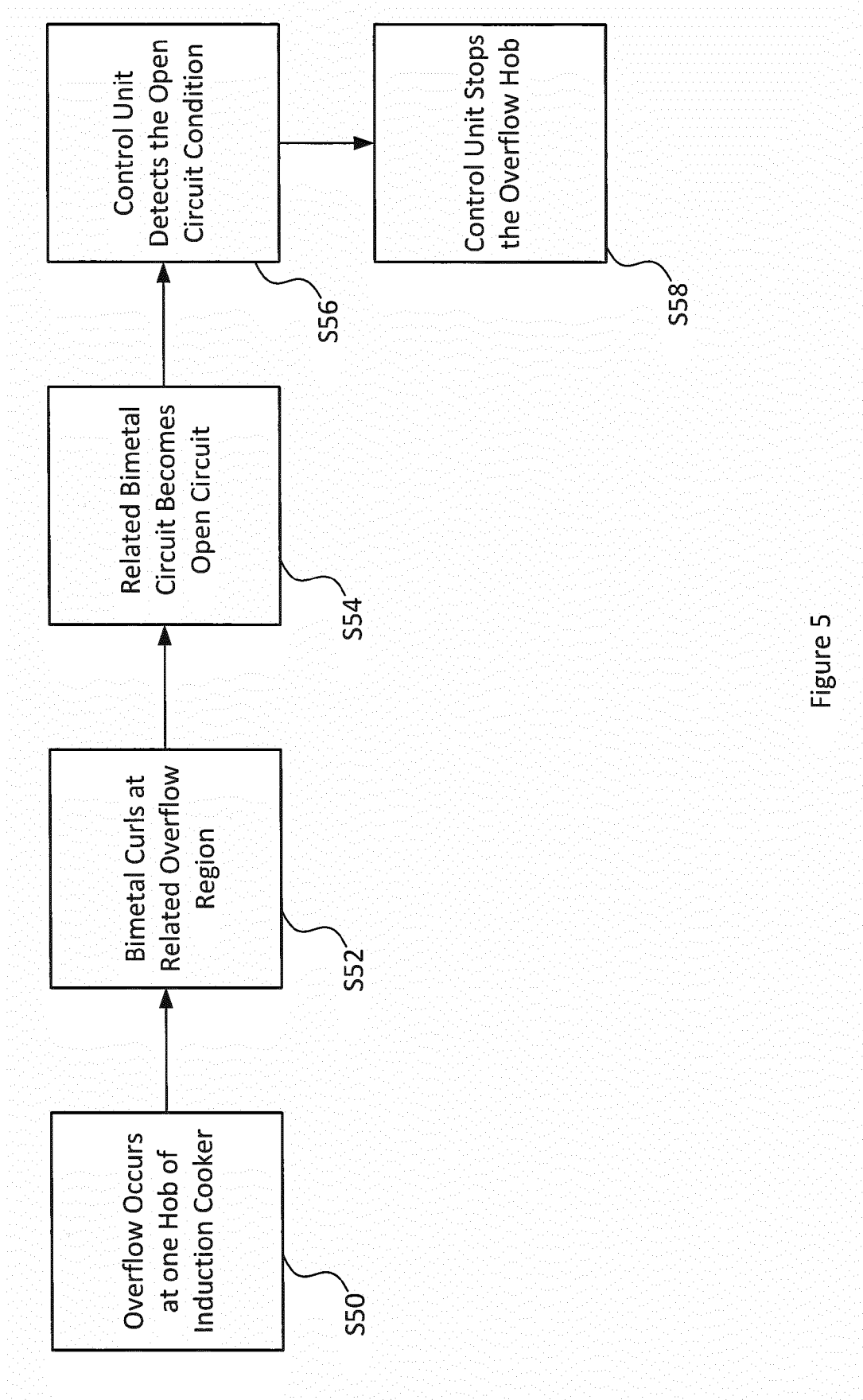


Figure 5



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Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                              |                                                        |                                         |
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| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                              |                                                        |                                         |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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