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(54) **COOKING APPLIANCE AND METHOD OF PROTECTING A COOKING APPLIANCE**

(57) A cooking appliance (100) has a frangible portion (101), a sensor arrangement (110) for detecting a crack or imminent formation of a crack in the frangible portion (101), and circuitry (120) for causing an airbag trigger (131) to activate an airbag (130) to deploy. The circuitry (120) is in communication with the sensor ar-

rangement (110) and is configured to cause the airbag trigger (131) to activate the airbag (130) to cover the frangible portion (101) in response to the sensor arrangement (110) detecting a crack or imminent formation of a crack in the frangible portion (101).

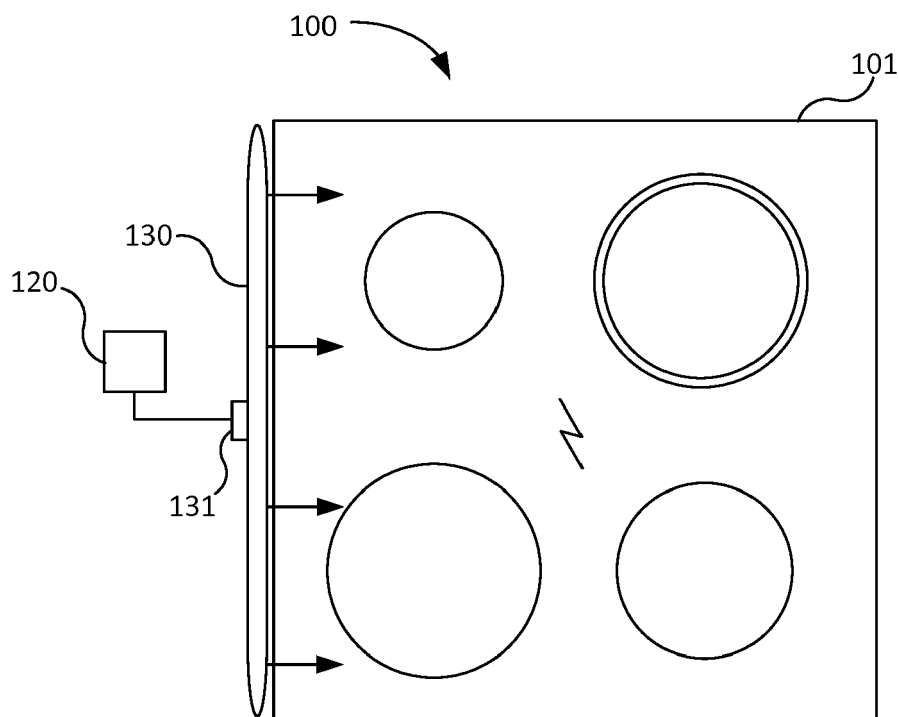


Figure 2

Description

Technical Field

[0001] The present disclosure relates to a cooking appliance and a method of protecting a cooking appliance.

Background

[0002] Examples of cooking appliances include conventional gas or electric ovens or stoves/cookers generally, convection ovens, microwave ovens, halogen cooktops, induction cooktops, hot plates, etc. Some cooking appliances comprise one or more frangible portions, i.e. portions that may be prone to cracking or breaking. Examples of frangible portions of cooking appliances include a glass door of an oven, a glass-ceramic cooktop or cooking surface, etc. Cracking or breaking of the frangible portion can be caused by for example either external force (e.g. impact by an object) or heat. Cracking or breaking of the frangible portion can present a serious risk of harm to any people in the vicinity of the appliance.

Summary

[0003] According to a first aspect disclosed herein, there is provided a cooking appliance comprising: a frangible portion; a sensor arrangement for detecting a crack or imminent formation of a crack in the frangible portion; and circuitry for causing an airbag trigger to activate an airbag to deploy; wherein the circuitry is in communication with the sensor arrangement and is configured to cause a said airbag trigger to activate a said airbag to cover at least a portion of the frangible portion in response to the sensor arrangement detecting a crack or imminent formation of a crack in the frangible portion.

[0004] In an example, the sensor arrangement comprises a light emitter constructed and arranged to emit light into the frangible portion, and a light sensor constructed and arranged to detect light emitted by the light emitter and passing through the frangible portion; and the circuitry is arranged such that a decrease in the intensity of light detected by the light sensor is taken as being indicative of a crack having formed or being about to form in the frangible portion.

[0005] In an example, the sensor arrangement comprises a heat sensor constructed and arranged to detect the temperature of one or more regions of the frangible portion; and the circuitry is arranged to determine that a crack is about to form in the frangible portion based on the detected temperature of one or more regions of the frangible portion.

[0006] In an example, the cooking appliance comprises an airbag and an airbag trigger in communication with the circuitry.

[0007] In an example, the airbag is mounted above the frangible portion.

[0008] In an example, the airbag is constructed and

arranged to cover all or substantially all of the frangible portion when deployed.

[0009] In an example, the cooking appliance comprises a plurality of airbags, each with a respective airbag trigger, the plurality of airbags being constructed and arranged to cover a respective portion of the frangible portion when deployed.

[0010] In an example, the frangible portion is a cooktop of the cooking appliance.

[0011] According to a second aspect disclosed herein, there is provided a method of protecting a cooking appliance having a frangible portion, the method comprising: detecting a crack or imminent formation of a crack in the frangible portion; and in response to detecting a crack or imminent formation of a crack in the frangible portion, causing an airbag to activate to cover at least a portion of the frangible portion.

[0012] In an example, the method comprises emitting light into the frangible portion and detecting an intensity of light passing through the frangible portion; and detecting a crack or imminent formation of a crack in the frangible portion comprises detecting a decrease in the intensity of light passing through the frangible portion.

[0013] In an example, the method comprises detecting the temperature of one or more regions of the frangible portion; and detecting a crack or imminent formation of a crack in the frangible portion is based on the detected temperature of one or more regions of the frangible portion.

[0014] In an example, the airbag is constructed and arranged to cover all or substantially all of the frangible portion when deployed.

[0015] In an example, the method comprises causing a plurality of airbags to active to each cover a respective portion of the frangible portion when deployed.

[0016] In an example, the frangible portion is a cooktop of the cooking appliance.

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 a perspective view of a cooking appliance in accordance with examples described herein and a user;

Figures 2 and 3 show schematically plan views from above of a cooking appliance in accordance with examples described herein respectively before and after an airbag has deployed;

Figures 4 and 5 show schematically plan views from above of a cooking appliance in accordance with examples described herein respectively before and after a crack has formed in a frangible portion; and

Figures 6 and 7 show schematically side elevations of cooking appliances in accordance with examples described herein to illustrate different examples of how the airbag and airbag trigger may be mounted.

Detailed Description

[0018] Figure 1 shows schematically a user 200 operating a cooking appliance 100. The cooking appliance 100 may in general be a gas or electric oven or stove/cooker (that is, a combined oven and cooktop), a convection oven, a microwave oven, a halogen or induction or other cooktop, a hot plate, etc.

[0019] The cooking appliance 100 comprises one or more frangible portions 101. The frangible portions 101 are parts of the cooking appliance 100 that are susceptible to cracking or fracturing. For example, the frangible portions 101 may be constructed of frangible material. Frangible materials can crack in response to for example external force, excessive heat or rapid changes in temperature. Examples of frangible materials include glass, glass-ceramic, some plastics, etc.

[0020] In this example, the cooking appliance 100 is a kitchen stove (also called a cooker or range) which has a cooktop and an oven. A saucepan 201 is shown resting on the surface of the cooktop as an example of a cookware item commonly placed on a cooktop. In this case, the frangible portion 101 is a surface of the cooktop. Other parts of the cooking appliance 100 may also be or include frangible portions 101 of the cooking appliance 100, such as a door of the oven.

[0021] During operation of the cooking appliance 100, the frangible portion 101 can be exposed to high temperatures: an oven may operate at a temperature around 200°C; and a cooktop can attain temperatures up to 300°C or more. This can cause the frangible portion 101 to crack. It can also exacerbate pre-existing cracks. Even when not exposed to heat, the frangible portions 101 can be cracked by external force (e.g. the user 200 may accidentally hit the glass door of the oven or drop an object onto the cooktop). A cracked or about-to-crack frangible portion 101 may be at risk of exploding, which is a serious health risk for any persons in the vicinity of the cooking appliance 100. There is therefore a problem of how to improve the safety of a cooking appliance.

[0022] Figures 2 and 3 show schematically plan views from above of a cooking appliance 100 in accordance with examples described herein respectively before and after an airbag 130 has deployed. An airbag 130 and associated airbag trigger 131 are shown. The cooking appliance 100 comprises circuitry 120 which is operatively coupled to an airbag trigger 131. The circuitry 120 may for example be part of and contained within the body of cooking appliance 100 itself.

[0023] The airbag 130 comprises a flexible bag which can be inflated by the airbag trigger 131 (also called an inflation module), e.g., using compressed air or via a pyrotechnic process. In the initial, undeployed state, the

airbag 130 is packaged into a housing which is mounted at a side of the frangible portion 101. This has the advantage that the airbag 130 does not interfere with normal operation of the cooking appliance 100. In the deployed state, the airbag 130 covers at least a portion of the frangible portion 101. When the airbag trigger 131 activates (as controlled by the circuitry 120), the airbag trigger 131 causes the airbag 130 to inflate. As the airbag 130 inflates, it expands to cover substantially all of the lateral extent of the frangible portion 101, as shown in Figure 3. In this context, "substantially" means that the inflated airbag 130 covers enough of the frangible portion 101 to prevent fragments of the frangible portion 101 escaping to injure the user 200. For example, parts of the frangible portion 101 such as the edges may be directly attached to the cooking appliance 100. In this case, the airbag 130 may need not cover these portions. Instead, the airbag 130 may only cover a portion of the frangible surface 101 which can separate from the cooking appliance 100 in case of the frangible portion 101 exploding.

[0024] Cookware items such as cookware item 201 shown in Figure 1 may be placed on top of the frangible portion 101. Examples of cookware items include saucepans, frying pans, woks, etc. It is therefore preferably that the airbag 130 deploys in such a way that it avoids the space above the frangible portion 101 which may be occupied by one or more cookware items. Example solutions to this are described below with reference to Figures 6 and 7.

[0025] Airbags and airbag triggers themselves are especially known in the context of automobiles. In this context, the airbag trigger causes the airbag to deploy in response to high acceleration (or deceleration) such as experienced during an automobile collision. Such airbag triggers are therefore unsuitable for use with a cooking appliance as described herein because cooking appliances do not move (and so are not subject to high acceleration or deceleration). Accordingly, some other technique is required.

[0026] To address this, in examples of the present disclosure, the circuitry 120 determines that the airbag 130 should deploy (via the airbag trigger 131) in response to detecting a crack or imminent formation of a crack in a frangible portion 101.

[0027] Figures 4 and 5 show a top view of the cooking appliance 100 in order to illustrate an example sensor arrangement 110. The sensor arrangement 110 of this example is provided for detecting a crack or imminent formation of a crack in a frangible portion 101 of the cooking appliance 100. The sensor arrangement 110 may monitor the frangible portion 101 and, in response to detecting a crack or imminent formation of a crack, generate an output indicating this to the circuitry 120.

[0028] The sensor arrangement 110 is operatively coupled to the circuitry 120. The circuitry 120 is configured to cause the airbag trigger 131 to activate the airbag 130 to cover at least a portion of the frangible portion 101 in response to the sensor arrangement 110 detecting a

crack or imminent formation of a crack in the frangible portion 101.

[0029] In the example of Figures 4 and 5, the sensor arrangement 110 comprises a light emitter 111 and a light sensor 112. The light emitter 111 is constructed and arranged to emit light through the frangible portion 101. The light emitter 111 may be for example a laser light source, such as for example a laser diode. The light sensor 112 is constructed and arranged to detect light emitted through the frangible portion 101 by the light emitter 111. The light sensor 112 may be, for example, a photodiode which generates an output which is a function of the measured intensity of the light.

[0030] In Figure 4, the frangible portion 101 is shown to be in good repair (that is, not cracked). The light sensor 112 in this case measures a baseline intensity of light coming from the light emitter 111. In particular, the light may pass substantially unimpeded through the frangible portion 101. This is particularly the case when the light emitter 111 is a laser as the coherent light from the laser is less likely to be deflected or diffracted or otherwise distorted as it passes through the frangible portion 101.

[0031] In Figure 5, a crack is shown having formed in the frangible portion 101. The crack deflects part of the light from the light emitter 111, causing the intensity of light received at the light sensor 112 to drop. Hence, a measured drop in intensity at the light sensor 112 is indicative of a crack having formed in the frangible portion 101. The circuitry 120 may use this to determine to cause the airbag trigger 131 to deploy the airbag 130. For example, if the intensity of light at the light sensor 112 drops by more than a threshold amount, the circuitry 120 may cause the airbag trigger 131 to activate.

[0032] In a specific example, the light sensor 112 may generate an output voltage proportional to the measured light intensity. The circuitry 120 may comprise a comparator having one input connected to the output voltage of the light sensor 112 and another input connected to a reference voltage. The circuitry 120 may then be configured to activate the airbag trigger 131 if the voltage from the light sensor 112 drops below the reference voltage. In other examples, the circuitry 120 may comprise a microcontroller or processor configured to monitor input from the sensor arrangement 110 and trigger the airbag 130 to deploy (via the airbag trigger 131) accordingly.

[0033] The sensor arrangement 110 may alternatively or additionally comprise one or more temperature sensors for detecting a temperature of the frangible portion 101 or at least one or more regions of the frangible portion 101. The or each temperature sensors may be for example an infrared heat sensor, a thermocouple, etc. In such cases, the circuitry 120 receives input from the temperature sensor(s) and can use this information to determine whether to cause the airbag 130 to deploy. The temperature sensor may detect localised temperature values across the area of the frangible portion 101. A localised hot spot in the frangible surface 101 having a temperature above a threshold temperature (e.g. a normal working

temperature of the frangible surface), or a temperature that is markedly different from the temperature of a neighbouring region, can increase the likelihood of the frangible surface 101 cracking and exploding. As another example, very rapid increases or decreases in temperature can increase the likelihood of the frangible surface 101 cracking and exploding. Hence, the circuitry 120 may determine to cause the airbag 130 to deploy in response to the sensor arrangement 110 indicating a hot spot in the frangible surface 101 that has a temperature above a threshold temperature or a temperature difference relative to a neighbouring region that is above a threshold or a temperature that is rapidly increasing or decreasing above a threshold rate of change.

[0034] Although the sensor arrangement 110 has been described with reference to Figures 4 and 5 which show a cooktop frangible surface, it is understood that similar arrangements could be used to detect a crack or imminent formation of a crack in other frangible portions, including for example a door of an oven or a part of a door of an oven.

[0035] Figures 6 and 7 show schematically side elevations of cooking appliances in accordance with examples described herein to illustrate different examples of how the airbag 130 and airbag trigger 131 may be mounted. A cookware item 201 is shown placed on the frangible portion 101. Common cookware items that might be placed on the frangible portion 101 typically do not exceed a maximum of around 30cm in height.

[0036] In Figure 6, the airbag 130 and airbag trigger 131 are mounted at the edge of the frangible portion 101, as in Figures 5 and 6. In the deployed state, as shown in the figure, the airbag 130 forms an enclosed space above the frangible portion 101 to contain the cookware item 201. To do so, the topological construction of the airbag 130 is such that it deploys "up and over" the volume that may be occupied by one or more cookware items.

[0037] In Figure 7, the airbag 130 and airbag trigger 131 are installed on a mount 140. The mount 140 is located at the edge of the frangible portion 101 and extends vertically upwards. The airbag 130 and airbag trigger 131 are installed at the top of the mount 140. In this example, the mount 140 is around twice the maximum height of the cookware item 210 that it typically used. The airbag 130 is constructed and arranged to avoid the volume which may be occupied by cookware items during deployment. In this example, the airbag 130 can deploy in a straight line from the top of the mount 140 to the opposite edge of the frangible portion 101 while still avoiding this volume. Hence, the airbag 130 in this example can have a simpler construction than that of Figure 6.

[0038] The cooking appliance 100 may comprise multiple airbags 130, each with a respective airbag trigger 131. For example, a separate airbag 130 and airbag trigger 131 may be provided at each edge of a cooktop frangible portion 101 of the cooking appliance 100. The circuitry 120 may be operatively coupled to each of the air-

bag triggers 131 and configured to cause one or more or all of the plurality of airbags 130 to deploy in response to the sensor arrangement 110 detecting a crack or imminent formation of a crack in the frangible portion 101.

[0039] In cases where a plurality of airbags 130 is provided, each of the plurality of airbags 130 may be constructed and arranged to cover a respective portion of the frangible portion 101 when deployed. The respective portions covered by the deployed plurality of airbags 130 may be different respective portions. The respective portions covered by the deployed plurality of airbags 130 may overlap.

[0040] It will be understood that the processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0041] 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 example 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 cooking appliance comprising:

a frangible portion;
a sensor arrangement for detecting a crack or imminent formation of a crack in the frangible portion; and
circuitry for causing an airbag trigger to activate an airbag to deploy;
wherein the circuitry is in communication with the sensor arrangement and is configured to

cause a said airbag trigger to activate a said airbag to cover at least a portion of the frangible portion in response to the sensor arrangement detecting a crack or imminent formation of a crack in the frangible portion.

2. A cooking appliance according to claim 1, wherein:

the sensor arrangement comprises a light emitter constructed and arranged to emit light into the frangible portion, and a light sensor constructed and arranged to detect light emitted by the light emitter and passing through the frangible portion;

the circuitry being arranged such that a decrease in the intensity of light detected by the light sensor is taken as being indicative of a crack having formed or being about to form in the frangible portion.

3. A cooking appliance according to claim 1 or claim 2, wherein:

the sensor arrangement comprises a heat sensor constructed and arranged to detect the temperature of one or more regions of the frangible portion;

the circuitry being arranged to determine that a crack is about to form in the frangible portion based on the detected temperature of one or more regions of the frangible portion.

4. A cooking appliance according to any of claims 1 to 3, comprising an airbag and an airbag trigger in communication with the circuitry.

5. A cooking appliance according to claim 4, wherein the airbag is mounted above the frangible portion.

6. A cooking appliance according to claim 4 or claim 5, wherein the airbag is constructed and arranged to cover all or substantially all of the frangible portion when deployed.

7. A cooking appliance according to claim 4 or claim 5, comprising a plurality of airbags, each with a respective airbag trigger, the plurality of airbags being constructed and arranged to cover a respective portion of the frangible portion when deployed.

8. A cooking appliance according to any of claims 1 to 7, wherein the frangible portion is a cooktop of the cooking appliance.

9. A method of protecting a cooking appliance having a frangible portion, the method comprising:

detecting a crack or imminent formation of a

crack in the frangible portion; and
in response to detecting a crack or imminent formation of a crack in the frangible portion, causing an airbag to activate to cover at least a portion of the frangible portion.

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10. A method according to claim 9, comprising emitting light into the frangible portion and detecting an intensity of light passing through the frangible portion; wherein detecting a crack or imminent formation of a crack in the frangible portion comprises detecting a decrease in the intensity of light passing through the frangible portion. 10
11. A method according to claim 9 or claim 10, comprising detecting the temperature of one or more regions of the frangible portion; wherein detecting a crack or imminent formation of a crack in the frangible portion is based on the detected temperature of one or more regions of the frangible portion. 15 20
12. A method according to any of claims 9 to 11, wherein the airbag is constructed and arranged to cover all or substantially all of the frangible portion when deployed. 25
13. A method according to any of claims 9 to 11, comprising causing a plurality of airbags to active to each cover a respective portion of the frangible portion when deployed. 30
14. A method according to any of claims 9 to 13, wherein the frangible portion is a cooktop of the cooking appliance. 35

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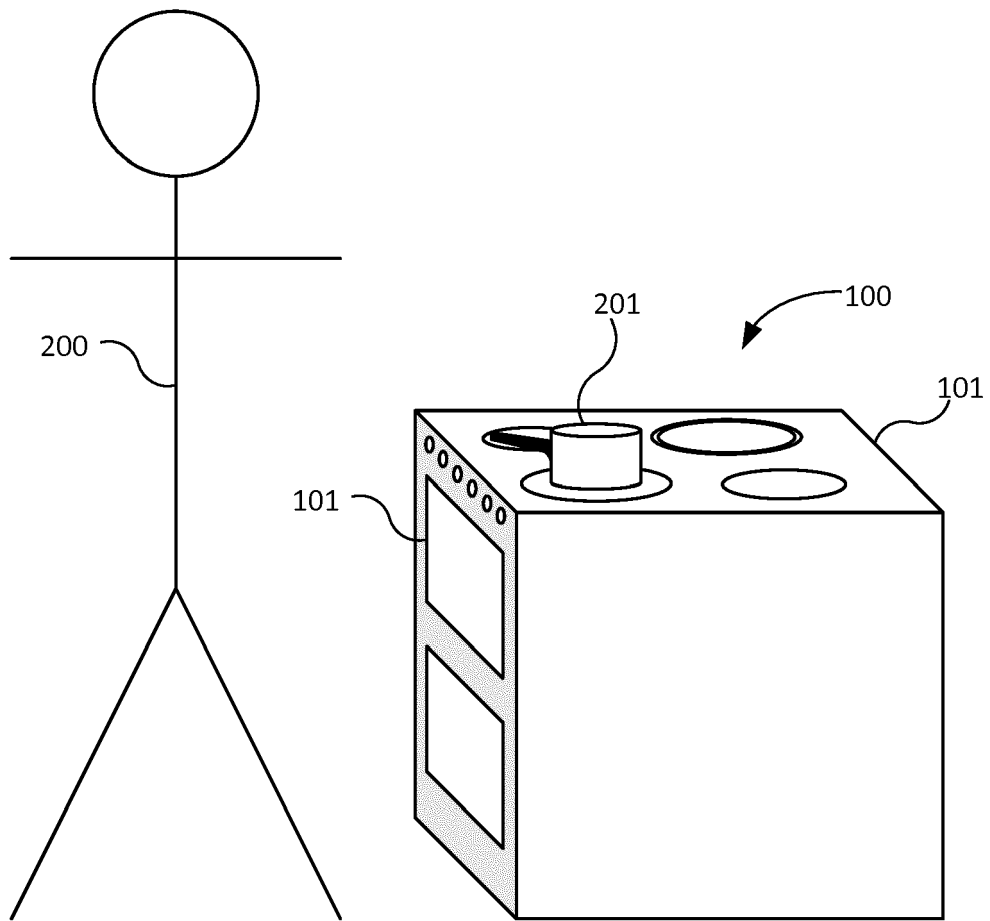


Figure 1

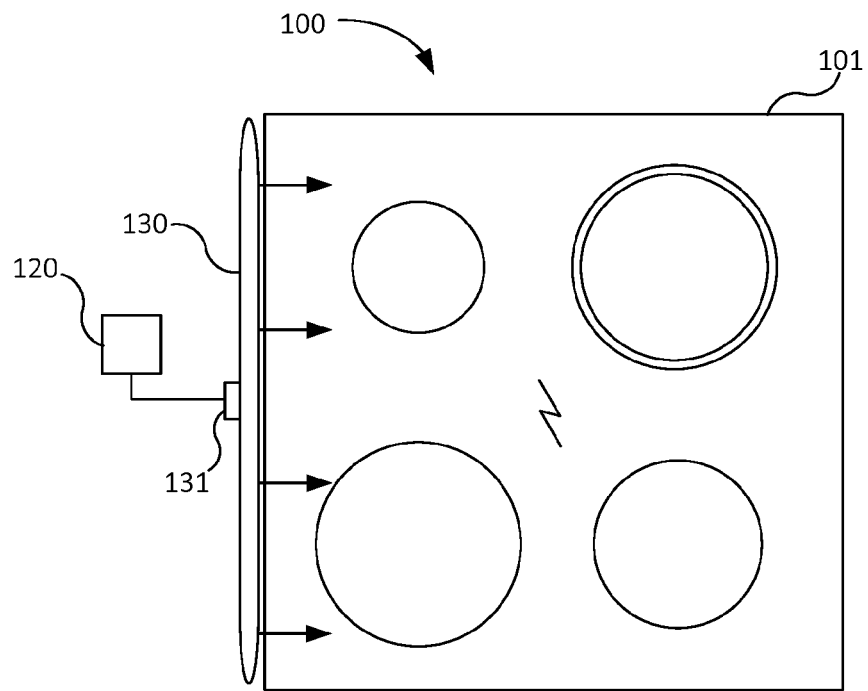


Figure 2

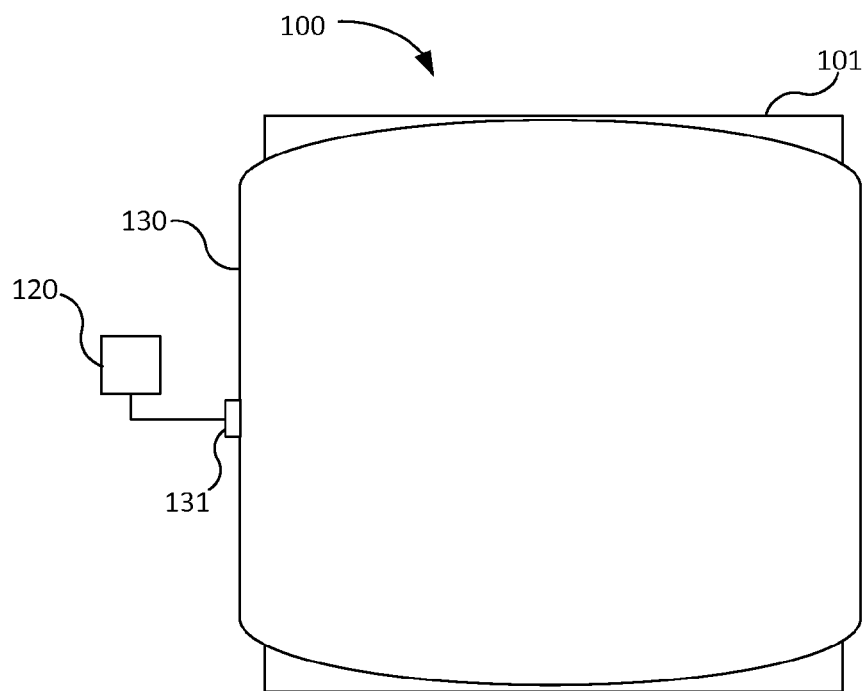


Figure 3

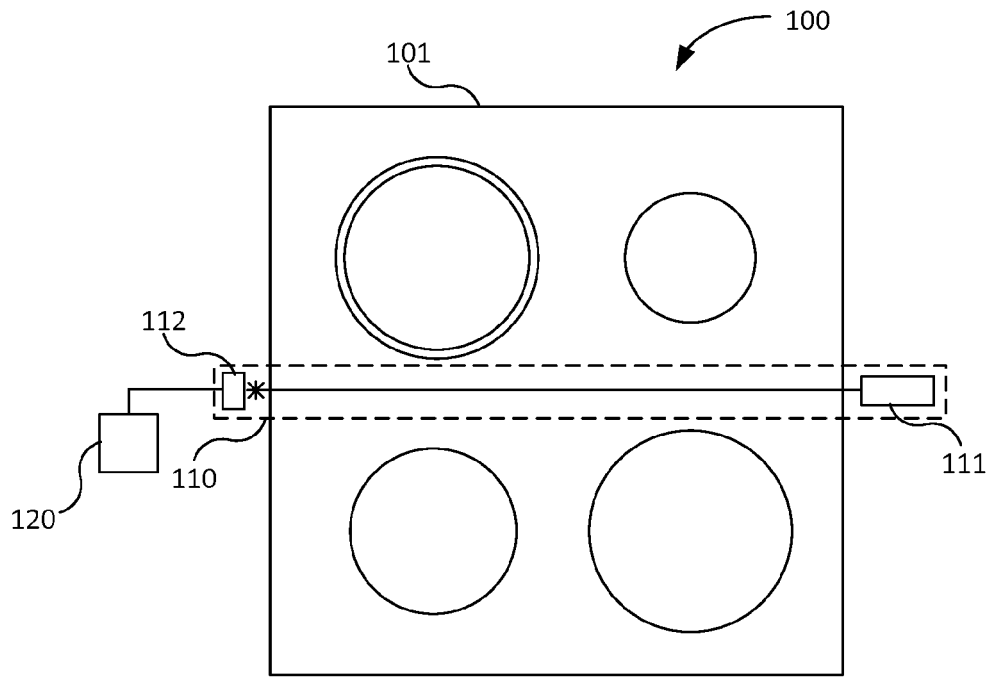


Figure 4

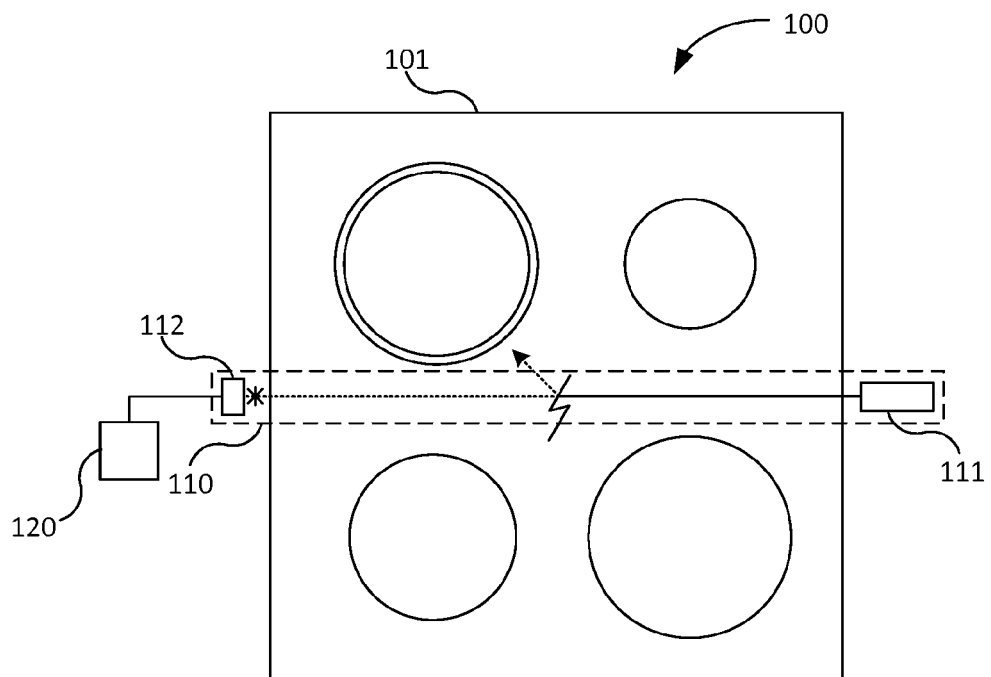


Figure 5

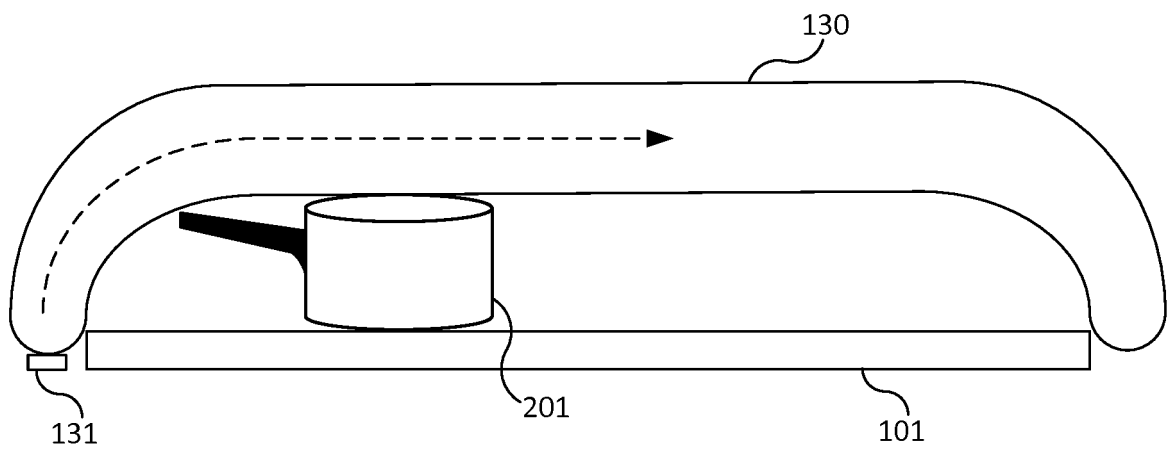


Figure 6

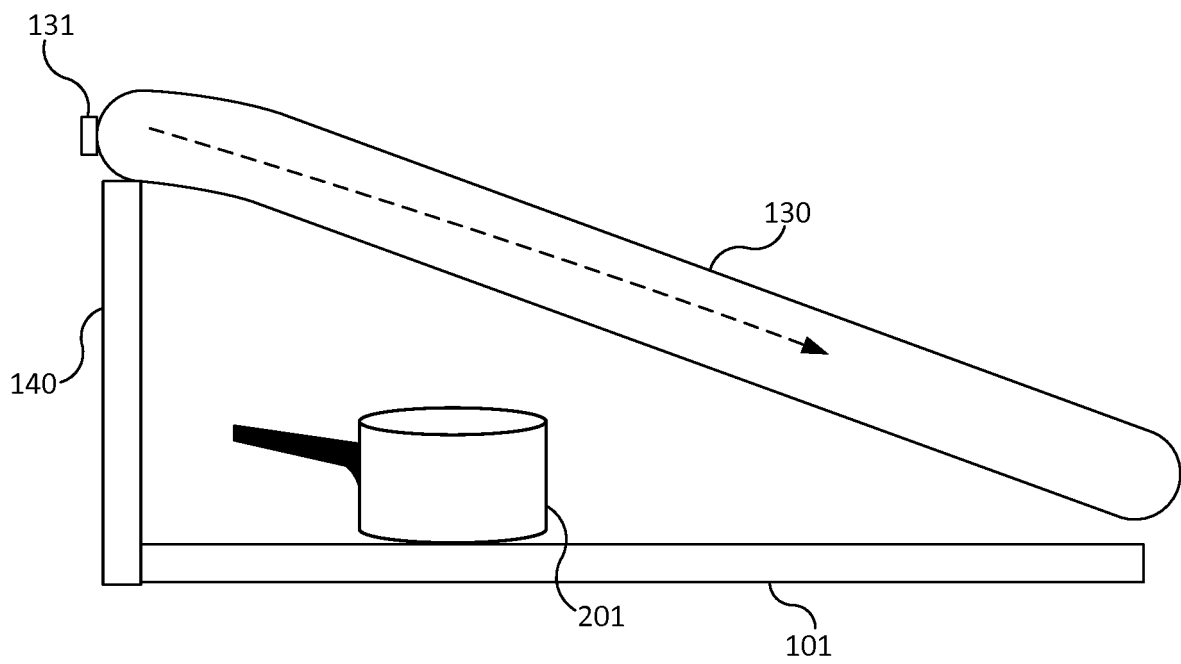


Figure 7



EUROPEAN SEARCH REPORT

 Application Number
 EP 19 15 8346

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	CN 108 758 713 A (HANGZHOU XIANLONG YUYING TECH CO LTD) 6 November 2018 (2018-11-06) * claim 2 *	1-14	INV. F24C7/08
A	----- CN 207 778 541 U (UNIV SICHUAN) 28 August 2018 (2018-08-28) * claim 1 *	1-14	
A	----- CN 109 028 170 A (SUZHOU SHANGFANSI TECH CO LTD) 18 December 2018 (2018-12-18) * claim 3 *	1-14	

			TECHNICAL FIELDS SEARCHED (IPC)
			F24C A21B H05B A47J
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 17 July 2019	Examiner Adant, Vincent
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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17-07-2019

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82