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(54) Title: AN INDUCTION HEATING COOKER AND THE CONTROL METHOD THEREOF

(57) Abstract: The present invention relates to an induction heating cooker (1) comprising a top plate (2); one or more than one induction coil which are disposed under the top plate (2) and which ensures the heating of the cooking vessel placed on the top plate (2) with the magnetic field generated; at least one temperature sensor (3) which measures the temperature of the cooking vessel; at least one light source (4) which is positioned under the top plate (2) and which emits beams towards the cooking vessel; and at least one light sensor (5) which detects the light reflected from the cooking vessel.



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AN INDUCTION HEATING COOKER AND THE CONTROL METHOD THEREOF

The present invention relates to an induction heating cooker with adjustable
5 temperature and the control method thereof.

The most commonly used devices in the cooking device category are cookers. Cookers are divided into three groups: gas, vitro-ceramic and induction.

In gas cookers, cooking is carried out with the heat released as a result of combustion. Vitro-ceramic cookers are generally known as electric cooktops. The
10 cooker surface is usually manufactured from glass material, and upon being operated, electric heaters heat the glass and the cooking vessel thereon. In the induction heating cooker, the cooking process is performed according to the principle of heating a cast iron or steel ferromagnetic cooking vessel with the magnetic field generated by the induction coil. Therefore, in this application, the
15 surface called the cooker glass, cooker plate or top plate is not heated, just like in vitro-ceramic cookers. The top plate is heated slowly, but only indirectly by the heat radiating from the vessel. Only cooking vessels with magnetic bottoms can be used on the induction heating cookers. Today, the induction heating cookers are preferred thanks to various advantages such as more efficient use of the
20 cooker, fast heating, energy saving, ease of use, easy cleaning and the applicability of new technologies.

The most critical parameter for healthy and quality cooking is the cooking temperature. Dishes cooked at higher or lower temperatures than the required temperature do not produce the desired results. In this case, the user cannot
25 measure the temperature directly. The health and quality of the cooking process is completely under the control of the user. The user can usually judge whether the temperature is sufficient or not based on his/her experience.

With the developments in technology and new usage habits, the users need cooking support to keep the temperature of the foodstuffs in the cooking vessel
30 (pot, pan, etc.) under control throughout the cooking process. In accordance with

this request of the users, when the temperature of the cooking vessel can be measured during the cooking process, the cooking process can be performed at the targeted ideal temperatures. By measuring the temperature of the cooking vessel or the foodstuffs therein, the foodstuffs can be cooked in a healthy manner while
5 ensuring the best cooking performance and the automatic cooking. Thus, significant improvements in the cooking quality, health and user comfort are provided. Moreover, energy efficiency increases and security risks are minimized.

In the state of the art induction heating cookers, a power level is generally selected from a range of 1 to 10. However, even if the power is kept at the selected level as
10 a result of this selection, the temperature cannot be controlled. Therefore, the temperature changes uncontrollably during the cooking process, and this change causes the foodstuffs to burn and/or be overcooked or not to be cooked as desired.

In the state of the art embodiments, the temperature is controlled by measuring the temperature of the cooking vessel by means of sensors. The temperature of the
15 cooking vessel can be detected by placing a sensor in or on the cooking vessel, on or inside the cooker. However, in embodiments where sensors are attached in or on the cooking vessel, various usage difficulties and safety hazards occur. In embodiments where sensors are attached in or on the cooker, losses in measurement sensitivity and application difficulties often occur due to
20 contamination on the cooker.

In the state of the art European Patent Application No. EP2124506, an induction heating cooker is disclosed, comprising an infrared sensor detecting the infrared rays emitted from the cooking vessel, a temperature sensor detecting the temperature of the cooking vessel, and a control unit deciding on the cooking
25 process by checking the values of said two sensors.

In the state of the art European Patent Application No. EP1704754, a cooker is disclosed, comprising a first temperature sensor which is disposed under the top plate and which detects the heat flow radiating upwards from the cooking plane and occurring only in the cooking area, a second temperature sensor which detects
30 the heat flow radiating upwards from the cooking plane and occurring in the cooking area and the cooking vessel, and a control unit which enables the cooking

process to be performed according to the information received from said two temperature sensors.

The aim of the present invention is the realization of an induction heating cooker where the temperature of the cooking vessel is accurately detected, and the control
5 method thereof.

The induction heating cooker realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises a top plate; one or more than one induction coil which are disposed under the top plate and which ensures the heating of the cooking vessel placed on
10 the top plate with the magnetic field generated; at least one temperature sensor which measures the temperature of the cooking vessel; at least one light source which is positioned under the top plate and which emits beams towards the cooking vessel; and at least one light sensor which detects the light reflected from the cooking vessel.

15 By means of the present invention, measurement errors caused by diffusion are prevented by collecting information about the color and/or surface parameters of the cooking vessel placed on the top plate, and the temperature of the cooking vessel, which is detected by the temperature sensor without any contact, is corrected accordingly, ensuring that the temperature of the cooking vessel is
20 detected in the most accurate manner. Thus, by means of the temperature sensor, measurement errors caused by the diffusion problem in detecting the temperature of the cooking vessel are minimized.

In the embodiment of the present invention, the cooking vessel is ferromagnetic. Thus, the induction coils generate an electromagnetic field on the cooking vessel,
25 which is converted into heat energy on the cooking vessel. Heating begins at the metal base of the cooking vessel, the heat is transferred to the foodstuffs in the cooking vessel and the cooking process is performed.

In the preferred embodiment of the present invention, the temperature sensor is an infrared sensor. Thus, the temperature of the cooking vessel can be measured
30 without any contact.

In the embodiment of the present invention, LED is used as the light source. Thus, light at the desired wavelength can be obtained.

The top table is manufactured from glass, ceramic and similar materials.

In an embodiment of the present invention, an LDR (light dependent resistance) is used as the light sensor. LDR is a photoresistor, and photoresistors are components where resistance changes depending on the intensity of the light received by the same. When the LDR receives light, the resistance thereof decreases, and in the dark, the resistance thereof increases. The resistance of the LDR is very high unless the same receives any light. As the intensity of the light received by the LDR increases, the resistance thereof decreases.

In an embodiment of the present invention, in the induction heating cooker, three different light sources and a light sensor are used. In this embodiment of the present invention, the light sensors are used to receive the rays emitted by the light sources of different colors and reflected from the cooking vessel and convert the same into color values. In this embodiment, in addition to the light sensor, three light sources, red, green and blue, are used to meet the RGB color codes. Said light sources and light sensor are preferably positioned on the plate, which has a black-matte surface, so as to be at the same distance from the light sensor.

In this embodiment of the present invention, three light sources are placed around the light sensor with an angle of 120° therebetween.

In an embodiment of the present invention, the induction heating cooker comprises a casing which surrounds the light sensor such that the light sensor is not directly affected by the rays in the environment, and a step where the light sensor is placed. The step and the casing surrounding the step and hence the light sensor have a telescopic structure and isolate the light sensor from the environment. Thus, more precise results can be achieved.

In the embodiment of the present invention, the red, green and blue light sources are turned on and off momentarily, sequentially. When each light source is turned on, the light sensor detects the light reflected from the cooking vessel. While said light sources are turned on and off sequentially, the values detected by the light

sensor change depending on the light reflected from the cooking vessel. This process is performed and recorded separately for red, green and blue light sources sequentially. The color of the cooking vessel is determined by comparing the data obtained with the data recorded in the calibration process. The temperature of the cooking vessel is corrected accordingly, ensuring that the temperature of the cooking vessel is determined in the most accurate manner. Thus, by means of the infrared sensor, measurement errors caused by the diffusion problem in detecting the temperature of the cooking vessel are minimized.

In an embodiment of the present invention, the light sources are turned on and off for 300 ms.

In the embodiment of the present invention, the calibration process is performed as follows. In the first step, the light sensor is positioned so as to face a black surface, all three light sources are turned on sequentially and the values obtained from the light sensor are recorded.

In the second step, the light sensor is positioned so as to face a white surface, all three light sources are again turned on sequentially and the values taken from the light sensor are subtracted from the data obtained above and recorded.

In the final step, all resulting values are normalized and a color code is generated.

In another embodiment of the present invention, there are three light sensors and one light source. In this embodiment of the present invention, the light source emits white light. In this embodiment, color filters are placed in front of each light sensor. The white light emitted from the light source hits the cooking vessel and the reflected rays pass through color filters and reach the light sensors. These values are read and converted into RGB color codes and the color of the cooking vessel is determined.

In another embodiment of the present invention, a light sensor which detects infrared rays and a light source which emits infrared light are used to determine the surface roughness of the cooking vessel. When a light source which emits infrared light is turned on, infrared rays reflected from the cooking vessel are detected by the light sensor, and based on the detected value, information about

the surface and/or roughness of the cooking vessel is collected and the temperature of the cooking vessel is corrected accordingly, ensuring that the temperature of the cooking vessel is determined in the most accurate manner. Thus, by means of the infrared sensor, measurement errors caused by the diffusion
5 problem in detecting the temperature of the cooking vessel are minimized.

By means of the present invention, the emissivity of the cooking vessel is classified using parameters such as color, surface and roughness, the emissivity is determined by identifying the color and surface type thereof, the temperature sensor measurement is corrected according to the emissivity value and the
10 temperature of the cooking vessel is determined in the most accurate manner.

An induction heating cooker realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 – is the perspective view of an induction heating cooker.

Figure 2 – is the perspective view of the inside of the induction heating cooker.

15 Figure 3 – is the top view of detail A in Figure 2.

Figure 4 – is the top detailed view of the light sources and the light sensor.

The elements illustrated in the figures are numbered as follows.

1. Induction heating cooker
2. Top plate
- 20 3. Temperature sensor
4. Light source
5. Light sensor
6. Step
7. Casing

25 The induction heating cooker (1) comprises a top plate (2); one or more than one induction coil which are disposed under the top plate (2) and which ensures the heating of the cooking vessel placed on the top plate (2) with the magnetic field generated; at least one temperature sensor (3) which measures the temperature of

the cooking vessel; at least one light source (4) which is positioned under the top plate (2) and which emits beams towards the cooking vessel; and at least one light sensor (5) which detects the light reflected from the cooking vessel (Figure 1).

By means of the present invention, measurement errors caused by diffusion are prevented by collecting information about the color and/or surface parameters of the cooking vessel placed on the top plate (2), and the temperature of the cooking vessel, which is detected by the temperature sensor (3) without any contact, is corrected accordingly, ensuring that the temperature of the cooking vessel is detected in the most accurate manner. Thus, by means of the temperature sensor (3), measurement errors caused by the diffusion problem in detecting the temperature of the cooking vessel are minimized.

In the embodiment of the present invention, the cooking vessel is ferromagnetic.

In the preferred embodiment of the present invention, the temperature sensor (3) is an infrared sensor.

In the embodiment of the present invention, the light source (4) is a LED.

In an embodiment of the present invention, the top table (2) is manufactured from glass, ceramic and similar materials.

In the embodiment of the present invention, the induction heating cooker (1) comprises an LDR (light dependent resistance) as the light source (5). LDR is a photoresistor, and photoresistors are components where resistance changes depending on the intensity of the light received by the same. When the LDR receives light, the resistance thereof decreases, and in the dark, the resistance thereof increases.

In an embodiment of the present invention, the induction heating cooker (1) comprises three light sources (4) at different wavelengths and a light sensor (5). In this embodiment of the present invention, the light sensor (5) is used to receive the rays emitted by the light sources (4) at different wavelengths and reflected from the cooking vessel and convert the same into color values. In this embodiment, the induction heating cooker (1) comprises three light sources (4), red, green and blue. In this embodiment of the present invention, the induction

heating cooker (1) comprises the light sources (4) and a step (6), preferably having a black-matte surface, whereon the light sensor (5) is placed. In this embodiment of the present invention, the light sources (4) are positioned at an equal distance from the light sensor (5) (Figure 2 and Figure 3).

- 5 In this embodiment of the present invention, three light sources (4) are placed around the light sensor (5) with an angle of 120° therebetween.

In an embodiment of the present invention, the induction heating cooker (1) comprises a casing (7) which surrounds the step (6), whereon the light sensor (5) is placed, such that the light sensor (5) is not directly affected by the rays in the
10 environment. The casing (7) surrounding the step (6) and the light sensor (5) thereon has a telescopic structure and isolates the light sensor (5) from the external environment. Thus, more precise results can be achieved (Figure 4).

The control method suitable for the induction heating cooker (1) of the present invention comprises a calibration process. In this embodiment of the present
15 invention, in the calibration process, the light sensor (5) is positioned so as to face a black surface, all three light sources (4) are turned on sequentially and the values obtained from the light sensor (5) are recorded. Then, the light sensor (5) is positioned so as to face a white surface, all three light sources (4) are again turned on sequentially and the values taken from the light sensor (5) are recorded and
20 subtracted from the data obtained in the previous step, and normalized to generate a color code.

In the control method suitable for the induction heating cooker (1) of the present invention, the light source (4) having three different wavelengths is turned on sequentially, and when each light source (4) is turned on, the rays reflected from
25 the cooking vessel are detected by the light sensor (5). For example, this process is performed separately for red, green and blue light sources (4) sequentially, and the reflected rays are recorded. The color of the cooking vessel is determined by comparing the data obtained with the data recorded in the calibration process. The temperature of the cooking vessel is corrected accordingly, ensuring that the
30 temperature of the cooking vessel is determined in the most accurate manner. Thus, by means of the temperature sensor (3), measurement errors caused by the

diffusion problem in detecting the temperature of the cooking vessel are minimized.

In an embodiment of the present invention, the light sources (4) are turned on and off for a period of 200 ms to 300 ms, preferably 200 ms.

- 5 In another embodiment of the present invention, the induction heating cooker (1) comprises three light sensors (5) and one light source (4). In this embodiment of the present invention, the light source (4) emits white light. In this embodiment, the induction heating cooker (1) comprises color filters which are placed in front of each light sensor (%). The white light emitted from the light source (4) hits the
10 cooking vessel and the reflected rays pass through color filters and reach the light sensors (5). These values are read and converted into color codes and the color of the cooking vessel is determined.

- In another embodiment of the present invention, the induction heating cooker (1) comprises a light sensor (5) which detects infrared rays and a light source (4)
15 which emits infrared light are used to determine the surface roughness of the cooking vessel. When a light source (4) which emits infrared light is turned on, infrared rays reflected from the cooking vessel are detected by the light sensor (5), and based on the detected value, information about the surface and/or roughness of the cooking vessel is collected and the temperature of the cooking vessel is
20 corrected accordingly, ensuring that the temperature of the cooking vessel is determined in the most accurate manner. Thus, by means of the infrared sensor, measurement errors caused by the diffusion problem in detecting the temperature of the cooking vessel are minimized.

- By means of the present invention, the emissivity of the cooking vessel is
25 determined according to parameters such as color, surface type and roughness, the temperature sensor (3) measurement is corrected according to the emissivity value and the temperature of the cooking vessel is determined in the most accurate manner.

CLAIMS

1. An induction heating cooker (1) **comprising** a top plate (2); at least one induction coil disposed under the top plate (2) and ensuring the heating of the cooking vessel placed on the top plate (2) with the magnetic field generated; and at least one temperature sensor (3) measuring the temperature of the cooking vessel, **characterized by** at least one light source (4) positioned under the top plate (2) and emitting beams towards the cooking vessel and at least one light sensor (5) detecting the light reflected from the cooking vessel.
2. An induction heating cooker (1) as in Claim 1, **characterized by** the temperature sensor (3) is an infrared sensor.
3. An induction heating cooker (1) as in Claim 1, **characterized by** the light source (4) is a LED.
4. An induction heating cooker (1) as in Claim 1, **characterized by** the light sensor (5) is an LDR.
5. An induction heating cooker (1) as in Claim 1, **characterized by** three light sources (4) at different wavelengths and a light sensor (5).
6. An induction heating cooker (1) as in Claim 5, **characterized by** three light sources (4), red, green and blue.
7. An induction heating device (1) as in any one of the above claims, **characterized by** the light sources (4) and a step (6) whereon the light sensor (5) is placed.
8. An induction heating cooker (1) as in Claim 1, **characterized by** the light sources (4) positioned at an equal distance from the light sensor (5).
9. An induction heating cooker (1) as in Claim 1, **characterized by** three light sources (4) placed around the light sensor (5) with an angle of 120° therebetween.
10. An induction heating cooker (1) as in Claim 7, **characterized by** a casing (7) surrounding the step (6), whereon the light sensor (5) is placed, such

that the light sensor (5) is not directly affected by the rays in the environment.

11. A control method for the induction heating cooker (1) as in any one of the above claims, **characterized by** a calibration process having the steps of
5 positioning the light sensor (5) so as to face a black surface, turning on all three light sources (4) sequentially and recording the values obtained from the light sensor (5), positioning the light sensor (5) so as to face a white surface and turning on again all three light sources (4) sequentially and recording the values obtained from the light sensor (5), subtracting said
10 values from the data recorded in the previous step and generating a color code by normalizing all values.
12. A control method as in Claim 11, **characterized by** turning on the light source (4) with three different wavelengths sequentially, and when each light source (4) is turned, detecting the rays reflected from the cooking
15 vessel by the light sensor (5), and determining the color of the cooking vessel by comparing the data obtained with the data recorded in the calibration process.
13. A control method as in Claim 11 and 12, **characterized by** the light sources (4) turned on and off for a period of 200 ms to 300 ms, preferably
20 200 ms.
14. An induction heating cooker (1) as in any one of the above claims, **characterized by** three light sensors (5) and a light source (4).
15. An induction heating cooker (1) as in any one of the above claims, **characterized by** a light sensor (5) detecting infrared rays and a light
25 source (4) which emits infrared light.

1 / 2

Figure 1

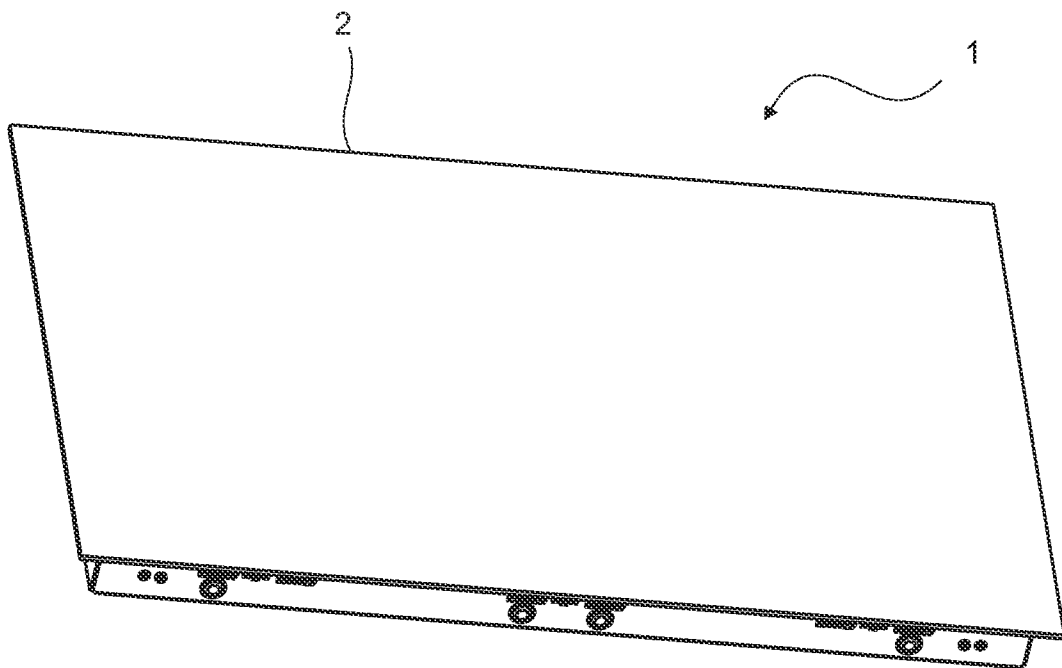
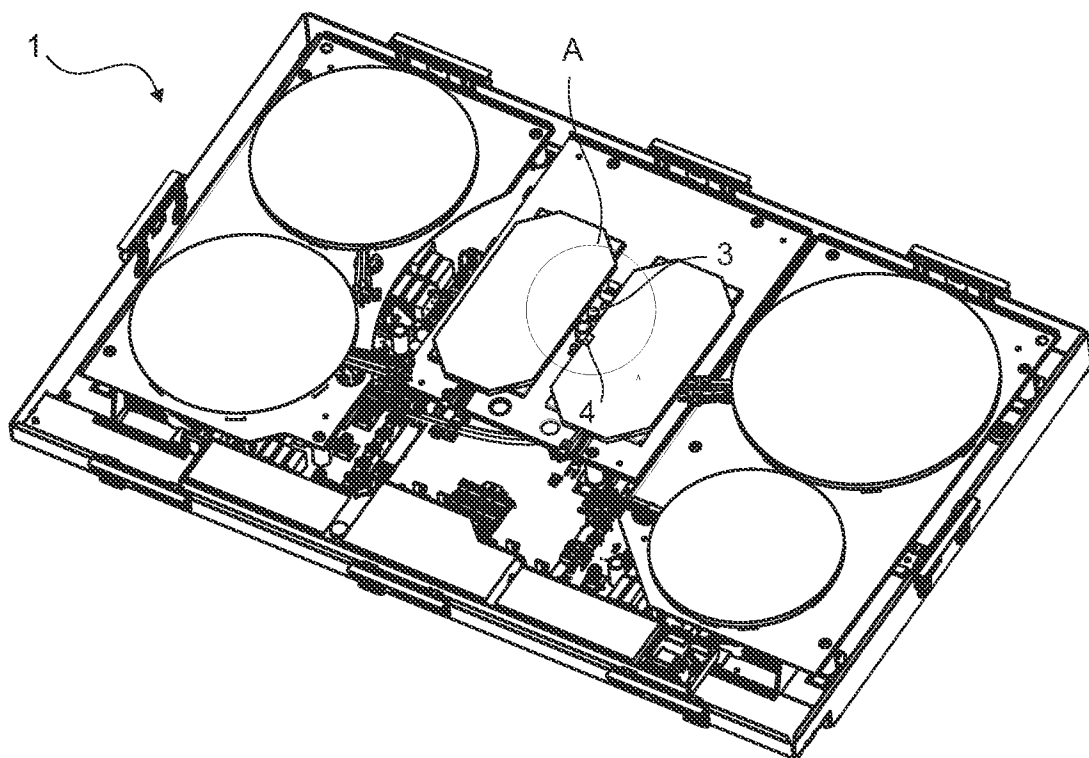


Figure 2



2 / 2

Figure 3

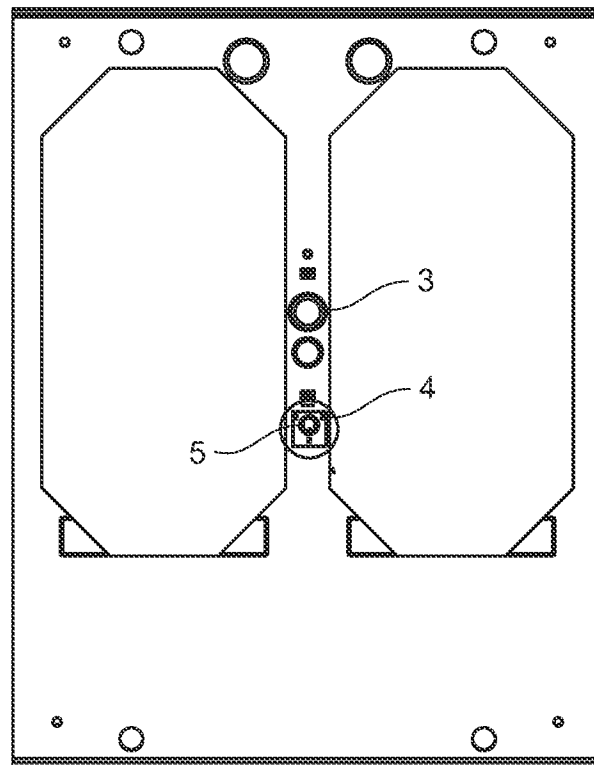
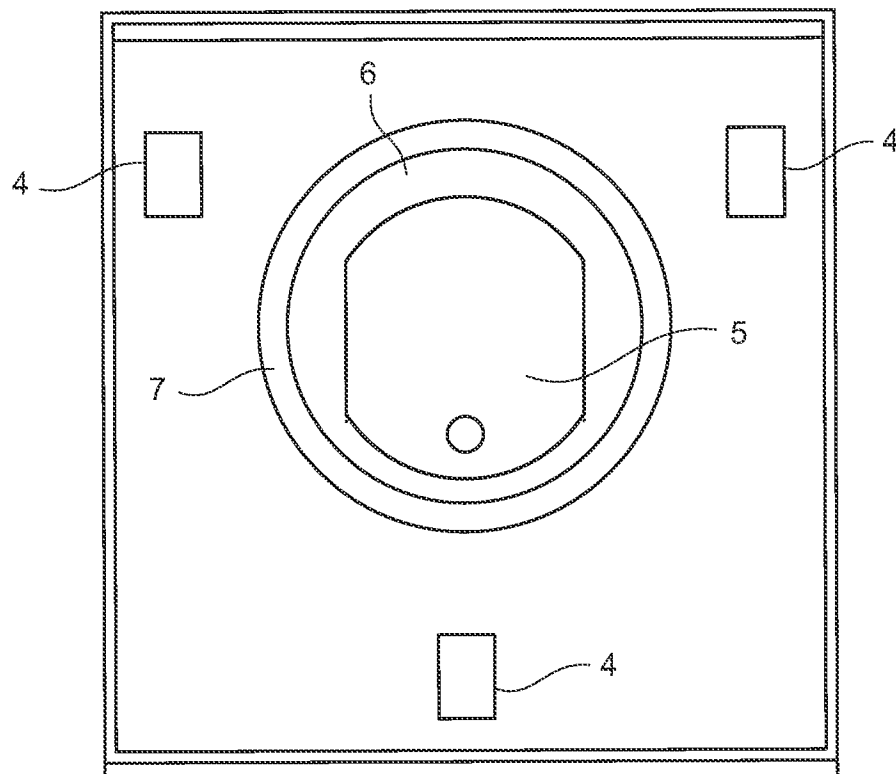


Figure 4



INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER**G01D 18/00(2006.01)i; H05B 6/02(2006.01)i; H05B 6/06(2006.01)i; H05B 6/12(2006.01)i**

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)

G01D 18/00; H05B 6/02; H05B 6/06; H05B 6/12

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 and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2007263583 A (OSAKA GAS CO LTD; MIKUNI KOGYO KK) 11 October 2007 (2007-10-11) Whole document	1-15
X	JP 2004227838 A (MATSUSHITA ELECTRIC IND CO LTD) 12 August 2004 (2004-08-12) Whole document	1-15
X	US 2015009500 A1 (MATTEL INC [US]) 08 January 2015 (2015-01-08) Whole document	11,12
X	JP 2011034742 A (HITACHI APPLIANCES INC) 17 February 2011 (2011-02-17) Whole document	1-15
X	JP 2010251332 A (HITACHI APPLIANCES INC) 04 November 2010 (2010-11-04) Whole document	1-15
A	CN 109059987 A (OPPO CHONGQING INTELLIGENT TECH CO LTD) 21 December 2018 (2018-12-21) Whole document	4,14



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INTERNATIONAL SEARCH REPORT

International application No.

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 3495790 A1 (LASER SYSTEMS & SOLUTIONS OF EUROPE [FR]) 12 June 2019 (2019-06-12) Whole document	1-15