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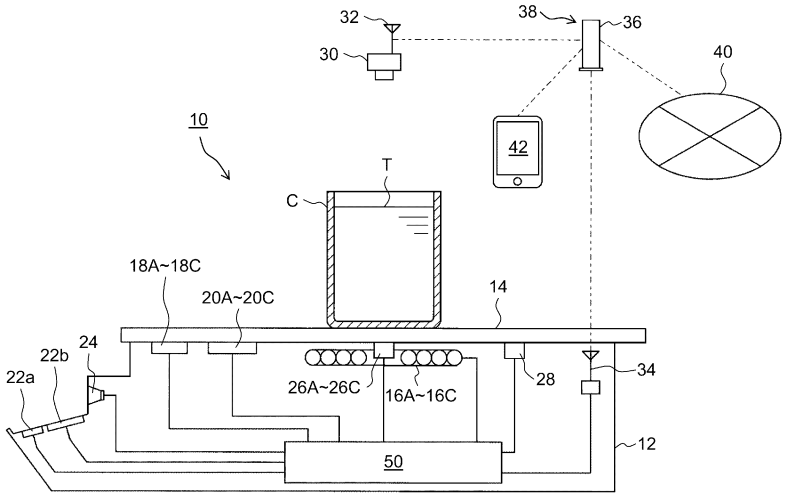
(54) HEAT-COOKING DEVICE

(57) Heating cooker (10) includes top plate (14) on which container (C) containing cooking object (T) is mounted. In addition, the heating cooker is provided with heaters (16A to 16C) which are provided in a lower side of top plate (14) and heat container (C) which is mounted on top plate (14) and camera (30) which is disposed on an upper side of top plate (14) and images top plate (14) from above. In addition, the heating cooker is provided with temperature sensors (26A to 26C) which are disposed on the lower side of top plate (14) and detect temperature of container (C) which is mounted on top plate (14). Further, the heating cooker is provided with controller (50) which estimates a state of cooking object (T) in the inside of container (C) based on a captured image of camera (30) and a detecting temperature of temperature sensors (26A to 26C) and controls output of heaters(16A to 16C) based on the estimation result.

FIG. 2



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Description

TECHNICAL FIELD

[0001] The present invention relates to a heating cooker for heating a container containing a cooking object.

BACKGROUND ART

[0002] In the related art, as a heating cooker, a configuration in which a heating coil which is disposed on a lower side of a top plate on which a container such as a pot containing a cooking object is mounted and inductively heats the container on the top plate is provided and which controls an output of the heating coil based on a detection temperature of a temperature sensor which is disposed on a lower side of the top plate and detects a temperature of a bottom side of the container on the top plate is known (see, for example, PTL 1).

Citation List

Patent Literature

[0003] PTL 1: Japanese Patent Unexamined Publication No. 2012-9199

SUMMARY OF THE INVENTION

[0004] However, since a temperature sensor of a heating cooker described in PTL 1 measures a temperature on a bottom side of a container, that is, a temperature of a lower side portion of a cooking object contained in the container, there is a case where the entirety of the cooking object cannot be preferably cooked by heating.

[0005] For example, in a case where the cooking object is stew or the like and thus the viscosity thereof is high and the container is a deep-bottom container, an upper side portion of the cooking object is unlikely to be sufficiently heated. Therefore, when the heating of the container is controlled based on a detection temperature of a temperature sensor, that is, the temperature of the lower side portion of the cooking object, there is a case where the entirety of the cooking object cannot be preferably cooked by heating. Therefore, for example, there is a possibility that the lower side portion of the cooking object is scorched.

[0006] The invention provides a heating cooker which can preferably cooks the entirety of the cooking object by heating, in the heating cooker which heats the container containing a cooking object from a lower side thereof and controls the heating of the container based on the detection temperature of the temperature sensor detecting the temperature of the bottom side of the container.

[0007] According to one aspect of the invention, there is provided a heating cooker including a top plate on which a container containing a cooking object is mounted, and a heater which is provided in the lower side of the top plate and heats the container mounted on the top plate. In addition, a camera which is disposed on an upper side of the top plate and images the top plate from above and a temperature sensor which is disposed on a lower side of the top plate and detects the temperature of the container mounted on the top plate, are included. Further, a controller which estimates a state of the cooking object in an inside of the container based on the captured image of the camera and the detection temperature of the temperature sensor and controls output of the heater based on the estimation result, is included.

[0008] With this configuration, the entirety of the cooking object contained in the container can be preferably cooked by heating, in the heating cooker which heats the container containing a cooking object from a lower side thereof and controls the heating of the container based on the detection temperature of the temperature sensor detecting the temperature of the bottom side of the container.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

FIG. 1 is a perspective view illustrating a heating cooker according to an exemplary embodiment of the invention.

FIG. 2 is a schematic view illustrating a configuration of the heating cooker according to the exemplary embodiment of the invention.

FIG. 3 is a block diagram illustrating a control system of the heating cooker according to the exemplary embodiment of the invention.

FIG. 4 is a flow chart illustrating an example of an operation of the heating cooker according to the exemplary embodiment of the invention.

FIG. 5 is a flow chart illustrating another example of the operation of the heating cooker according to the exemplary embodiment of the invention.

DESCRIPTION OF EMBODIMENT

[0010] Hereinafter, with reference to the drawings, an exemplary embodiment of the invention will be described.

(EXEMPLARY EMBODIMENT)

[0011] FIG. 1 is a perspective view illustrating a heating cooker according to an exemplary embodiment of the invention. In addition, FIG. 2 is a schematic view illustrating a configuration of the heating cooker according to the exemplary embodiment of the invention. Further, FIG. 3 is a block diagram illustrating a control system of the heating cooker according to the exemplary embodiment of the invention. In the drawings, an X-axis direction indicates a width direction of the heating cooker, a Y-axis direction indicates a depth direction thereof, and a Z-axis direction indicates a height direction thereof.

[0012] As illustrated in FIG. 1, heating cooker 10 has casing 12 and top plate 14 which is attached to an upper side of casing 12 and on which container C containing cooking object T such as stew or the like is mounted.

[0013] As illustrated in FIG. 1 and FIG. 2, heating coils 16A to 16C are disposed as heaters of the heating cooker 10 in a lower side of the top plate 14, that is, in an inside of the casing 12. Heating coils 16A to 16C inductively heat container C mounted on top plate 14.

[0014] A plurality of touch keys 18A to 18C for an operation of each of heating coils 16A to 16C by a user are provided on a portion of top plate 14 on front face 10a side of heating cooker 10. For example, heating of heating coil 16A is started or stopped by an operation of corresponding touch key 18A. In addition, the heating level (for example, four steps) of heating coil 16A can be adjusted by the operation of touch key 18A.

[0015] In addition, A plurality of output displays 20A to 20C for displaying the output states (heating levels) of heating coils 16A to 16C are also provided on the portion of top plate 14 on front face 10a side of heating cooker 10.

[0016] In order to set the heating by heating coils 16A to 16C in detail, setting portion 22 is provided on front face 10a side of heating cooker 10. Setting portion 22 can be put in and taken out from casing 12 and includes setting key 22a for setting the heating by heating coils 16A to 16C in detail and setting display 22b for displaying the setting contents, detailed states of heating coils 16A to 16C, or the like. Setting portion 22 sets a heating temperature, a heating time, a timer, or the like of heating coils 16A to 16C.

[0017] In addition, heating cooker 10 includes notifying portion 24 such as a speaker for notifying the user on front face 10a side of heating cooker 10.

[0018] Further, heating cooker 10 includes a plurality of temperature sensors 26A to 26C for detecting the temperature of container C mounted on top plate 14 and weight sensor 28 for detecting the weight of container C mounted on top plate 14.

[0019] In a case of the exemplary embodiment, the plurality of temperature sensors 26A to 26C are disposed in the lower side of top plate 14 and are disposed at the center of each of heating coils 16A to 16C. In other words, for example, temperature sensor 26A is disposed on the upper side of heating coil 16A and detects the temperature of a bottom side of container C which is inductively heated by heating coil 16A via top plate 14.

[0020] In a case of the exemplary embodiment, weight sensor 28 detects the weight of a mounting object on the top plate 14, that is, the sum of the weight of the plurality of containers C and the weight of the cooking object contained in each of containers C in a case where there are a plurality of containers C.

[0021] Further, heating cooker 10 is disposed in the upper side of top plate 14, and has camera 30 for imaging top plate 14 from upper side.

[0022] Camera 30 is a camera capable of capturing a still image, a moving image, an infrared image, or the like, for example, and images the entirety of top plate 14. Camera 30 is attached to a ceiling or a range hood (not illustrated) or the like positioned on the upper side of heating cooker 10. For example, camera 30 is attached to the range hood via a magnet. Alternatively, camera 30 may be attached to an arm (not illustrated) provided in heating cooker 10.

[0023] In a case of the exemplary embodiment, camera 30 is configured to wirelessly communicate with controller 50 of heating cooker 10. Therefore, as illustrated in FIG. 2, camera 30 has antenna 32 and antenna 34 is provided in the inside of casing 12 of heating cooker 10. In a case of the exemplary embodiment, camera 30 and controller 50 are connected via router device 36. In other words, camera 30 and controller 50 are connected to local area network 38 centered around router device 36 so as to enable wireless communication. In addition, router device 36 is connected to Internet 40.

[0024] Now, the operation of heating cooker 10, that is, the control performed by controller 50 will be described.

[0025] FIG. 3 is a block diagram illustrating a control system of heating cooker 10.

[0026] As illustrated in FIG. 3, controller 50 of heating cooker 10 is configured to receive signals corresponding to the operation of the user on touch keys 18A to 18C and setting key 22a of setting portion 22 therefrom. Controller 50 is also configured to receive signals corresponding to the temperatures detected by temperature sensors 26A to 26C, respectively. Controller 50 is further configured to receive a signal corresponding to the weight detected by weight sensor 28. Controller 50 is configured to receive the captured image (data) captured by camera 30 from camera 30.

[0027] In addition, controller 50 of heating cooker 10 is configured to control heating coils 16A to 16C, output displays 20A to 20C, setting display 22b, and notifying portion 24.

[0028] For example, controller 50 controls the outputs of heating coils 16A to 16C so that temperature sensors 26A to 26C continue to detect the heating temperature set by the user via setting key 22a of setting portion 22. Accordingly, for example, in a case where fried foods being cooked, the oil contained in container C can be maintained at a constant temperature.

[0029] In addition, for example, when temperature sensors 26A to 26C detect the boiling temperature in a case where water is contained in container C (in a case where the user sets an automatic boiling mode via setting portion 22), controller 50 stops heating coils 16A to 16C and notifies the user of completion of the boiling via notifying portion 24.

[0030] Further, controller 50 performs various controls based on the captured image of camera 30.

[0031] Therefore, controller 50 of heating cooker 10 includes image acquiring portion 52 for acquiring a captured image from camera 30, image processor 54 for processing the acquired image, and cooking object state

estimator 56 for estimating a state of the cooking object in the inside of container C based on the image processing result. Further, controller 50 includes heating coil controller 58 for controlling heating coils 16A to 16C based on the estimation result of cooking object state estimator 56, and storage portion 60.

[0032] Image acquiring portion 52 of controller 50 of heating cooker 10 acquires the captured image captured by camera 30, for example, the captured image showing a state of top plate 14 on which container C containing cooking object T during cooking by heating is mounted.

[0033] Image processor 54 performs image processing on the captured image of camera 30 acquired by image acquiring portion 52. For example, an image of container C mounted on top plate 14 is trimmed from the captured image showing the entirety of top plate 14 acquired. In addition, for example, image processor 54 performs processing such as removing noise from the captured image, adjusting the contrast of the captured image, emphasizing the edge of the captured image, or the like.

[0034] Based on the captured image of camera 30 after the image processing is performed by image processor 54, cooking object state estimator 56 estimates a state of cooking object T contained in the inside of container C based on at least one of the detection temperature of temperature sensors 26A to 26C and the detection weight of weight sensor 28 in some cases.

[0035] Heating coil controller 58 controls the outputs of heating coils 16A to 16C based on the signals from touch keys 18A to 18C and setting key 22a or based on the estimation result of cooking object state estimator 56.

[0036] Storage portion 60 stores a variety of information (data) although details thereof will be described below.

[0037] Controller 50 of heating cooker 10 described above performs various controls based on the captured image of camera 30.

[0038] For example, outputs of the heating coils 16A to 16C are controlled based on the state of the upper side portion of cooking object T captured in the captured image by camera 30.

[0039] For example, controller 50 estimates whether or not the cooking of cooking object T by heating is in a completed state and decreases or stops the outputs of heating coils 16A to 16C, based on tint or boiling state of the upper side portion of cooking object T captured in the captured image of camera 30. In addition to this, controller 50 notifies the user of the completion of the cooking by heating via notifying portion 24.

[0040] In a case where the completion of cooking of cooking object T by heating is estimated based on the tint of the upper side portion of cooking object T, for example, the finished color of cooking object T desired by the user is selected via setting portion 22. The completion cooking by heating is estimated by comparing the finished color selected by the user with the tint of the upper side portion of cooking object T captured in the captured image of camera 30.

[0041] In addition, in a case where the completion of cooking of cooking object T by heating is estimated based on the boiling state of the upper side portion of cooking object T, a plurality of captured images captured at different timings from each other are used. In a case where a plurality of captured images captured at different timings from each other are largely different from each other, generation of the boiling is estimated in the upper side portion of cooking object T, that is, the completion of cooking by heating is estimated.

[0042] In addition, for example, controller 50 determines whether or not a lid is disposed on container C based on the captured image of camera 30, and controls the output of heating coils 16A to 16C according to the presence or absence of the lid. For example, controller 50 determines that the lid is removed from container C by the user, based on a plurality of captured images captured at different timings from each other by camera 30. Based on the determination, the outputs of heating coils 16A to 16C are increased compared to the output before the lid is removed. Accordingly, cooking object T contained in container C after the lid is removed can be maintained at the temperature before the lid is removed.

[0043] In addition, controller 50 performs various controls based on the captured image of camera 30 and the detection temperature of temperature sensors 26A to 26C.

[0044] FIG. 4 is a flowchart illustrating an example of a flow of an operation of heating cooker 10 based on a captured image of camera 30. In particular, the flow illustrated in FIG. 4 is a flow of control of the heating coil which is suitable when cooking object T has a high viscosity, in particular, when curry, stew or the like is cooked by heating, for example. The control of the flow illustrated in FIG. 4 is continued while cooking object T in the inside of the container C is cooked by heating. In addition, here, an example using heating coil 16A will be described.

[0045] As illustrated in FIG. 4, first, cooking object state estimator 56 of controller 50 of heating cooker 10 calculates the temperature of the upper side portion of cooking object T contained in container C, based on the captured image of camera 30 (Step S100). For example, camera 30 captures an infrared image and calculates the temperature of the upper side portion of cooking object T based on the infrared image.

[0046] Next, controller 50 of heating cooker 10 acquires the detection temperature of temperature sensor 26A (step S110). In other words, the temperature of the lower side portion of cooking object T detected by temperature sensor 26A is acquired.

[0047] Next, cooking object state estimator 56 of controller 50 of heating cooker 10 calculates difference in temperature between the temperature of the upper side portion of cooking object T calculated in step S100 and the temperature of the lower side portion of the cooking object T acquired in step S110 (Step S120).

[0048] Next, cooking object state estimator 56 of con-

troller 50 of heating cooker 10 determines whether or not difference in temperature between the upper side portion and the lower side portion of cooking object T calculated in step S120 is higher than a predetermined difference in temperature (step S130).

[0049] In a case where the difference in temperature in step S130 is larger than the predetermined difference in temperature, cooking object state estimator 56 estimates that there is a possibility that cooking object T is scorched at the bottom of the container C. Based on the estimation result, heating coil controller 58 of controller 50 controls heating coil 16A so as to decrease the output in order to suppress scorching of cooking object T (step S140). The process returns to step S100.

[0050] On the other hand, in a case where the difference in temperature is smaller than the predetermined difference in temperature in step S130, cooking object state estimator 56 estimates that the possibility that cooking object T is scorched at the bottom of container C is low. Based on the estimation result, heating coil controller 58 controls heating coil 16A so as to output with the set value (step S150). The process returns to step S100. The "setting value" referred here is a value corresponding to the output level determined by the user via touch key 18A, or a value set by the user via setting key 22a.

[0051] According to the control illustrated in FIG. 4 and described above, the entirety of cooking object T in the inside of container C can be preferably heated while scorching being suppressed.

[0052] Specifically, in a case where container C containing cooking object T having high viscosity such as curry and stew particularly has a deep depth, the upper side portion thereof is unlikely to be heated sufficiently. Therefore, when the user stops the heating by the heating coil 16A after the upper side portion of the cooking object T is sufficiently heated, that is, after the upper side portion has sufficiently boiled, there is a possibility that the lower side portion of cooking object T is already scorched at this time.

[0053] As a countermeasure against this, as in the flow illustrated in FIG. 4, during the cooking of cooking object T by heating, while the difference in temperature between the upper side portion and the lower side portion of cooking object T is larger than the predetermined difference in temperature, the output of heating coil 16A is decreased. Accordingly, scorching of the lower side portion of cooking object T can be suppressed. In addition, the upper side portion of cooking object T is heated by the heat of the lower side portion moving to the upper side portion thereof. Therefore, when the user determines that the cooking by heating is completed by looking at the upper side portion of cooking object T and then heating of heating coil 16A is stopped, the entirety of cooking object T in the inside of container C is preferably heated.

[0054] In order to further suppress generation of scorching, in a state where the difference in temperature between the upper side portion and the lower side portion of cooking object T is larger than the predetermined difference in temperature and thus there is a possibility that scorching may generate, the state may be notified to the user via notifying portion 24. For example, it is notified to the user via notifying portion 24 that there is a possibility of scorching. Alternatively, in order to suppress the generation of scorching, notifying portion 24 notifies the user so as to stir cooking object T.

[0055] FIG. 5 is a flowchart illustrating a flow of another example of the operation of heating cooker 10 based on the captured image of camera 30. In particular, the flow illustrated in FIG. 5 is a control flow of a heating coil which is suitable when cooking object T such as grilled fish, steak, or the like has a front surface and a back surface and is turned upside down during cooking thereof by heating by the user. In addition, here, an example using the heating coil 16A will be described.

[0056] First, as illustrated in FIG. 5, cooking object state estimator 56 of controller 50 of heating cooker 10 calculates the cumulative amount of heat (heating amount) added to cooking object T from the start of heating (step S200).

[0057] In order to calculate the heating amount to cooking object T, cooking object state estimator 56 specifies the type and size of cooking object T based on the image of cooking object T captured in the captured image of camera 30, that is, specific heat and mass of cooking object T are specified. Therefore, data of specific heat and density is stored in storage portion 60 of controller 50 in advance for each type of cooking object T to be cooked by heating by using heating cooker 10.

[0058] In addition, cooking object state estimator 56 calculates change in temperature of the upper side portion of cooking object T and calculates change in temperature of the lower side portion of cooking object T (that is, the change in detecting temperature of the temperature sensor 26A), based on the captured image of the camera 30.

[0059] Cooking object state estimator 56 calculates the heating amount to cooking object T using the specific heat and mass of the specified cooking object T and the calculated change in the temperature between the upper portion and the lower portion of cooking object T.

[0060] In a case of cooking object T such as a fish of which three-dimensional shape is determined to a certain extent, mass thereof can be specified based on a two-dimensional image captured in the captured image of camera 30. In a case of cooking object T such as a steak of which the thickness (size in the height direction) is not defined, thickness thereof can be specified based on the time from the start of heating until the temperature of the upper portion starts to be changed. The mass of cooking object T can be specified based on the specified thickness and the two-dimensional image captured in the captured image of camera 30.

[0061] Next, storage portion 60 stores the heating amount to cooking object T calculated in step S200 (step S210).

[0062] Subsequently, cooking object state estimator

56 determines whether or not cooking object T is reversed upside down by being turned over by the user based on the plurality of captured images captured by camera 30 at different timings from each other (step S220).

[0063] In a case of fish or steak, the user confirms a baking state on the back surface (the surface in contact with container C). In a case where the baking condition on the back side is desired, the user next turns over cooking object T, that is, reverses cooking object T upside down in order to bake the next surface. The reversal of cooking object T performed at this arbitrary timing is detected in step S220.

[0064] When reversal of cooking object T is detected in step S220, the process proceeds to step S230, or otherwise, the process returns to step S200.

[0065] When reversal of cooking object T is detected, cooking object state estimator 56 calculates the heating amount to cooking object T as in step S200 (step S230). However, here, the heating amount for cooking object T after cooking object T is reversed upside down is calculated.

[0066] Next, cooking object state estimator 56 compares the heating amount to cooking object T after cooking object T is reversed upside down and the heating amount before the cooking object T is reversed (that is, stored in step S210) and then determines whether or not the heating amounts substantially agree with each other (step S240). For example, it is determined whether or not the heating amount after cooking object T is reversed is 0.8 to 1.0 times the heating amount before cooking object T is reversed. In other words, the heating amount for desirably baking the back surface of cooking object T substantially agrees with the heating amount for desirably baking the front surface of cooking object T, and as a result thereof it is determined whether or not both surfaces of the cooking object T is desirably baked.

[0067] In a case where the heating amount before the cooking object T is reversed and the heating amount after cooking object T is reversed substantially agree with each other, the process proceeds to step S250, or otherwise, the process returns to step S230.

[0068] In a case where the heating amount before cooking object T is reversed substantially agrees with the heating amount after the cooking object T is reversed, heating coil controller 58 stops heating coil 16A (that is, decreases the output) and cooking of cooking object T by heating is completed (step S250).

[0069] Controller 50 notifies of the completion of the cooking of the cooking object T by heating via the notifying portion 24 (step S260).

[0070] According to the control illustrated in FIG. 5 and described above, the entirety of cooking object T can be preferably heated while scorching is suppressed, in particular, the front surface and the back surfaces of cooking object T can be desirably and approximately equally baked.

[0071] Further, captured image of the camera 30 can be used for various purposes.

[0072] For example, cooking object T of which cooking by heating is completed, that is, a finished product of cooking object T may be captured by camera 30 and the captured image may be stored in storage portion 60 of controller 50 of heating cooker 10.

[0073] Accordingly, the cooking history of the user can be managed by using the image of the finished product of cooking object T. In addition, in a case of the exemplary embodiment, as illustrated in FIG. 1, since controller 50 of heating cooker 10 is incorporated in local area network 38 centered around router device 36 connected to Internet 40, the image of the finished product of cooking object T stored in storage portion 60 can be used for various purposes. For example, the image can be posted on the website.

[0074] In addition, for example, calorie or nutrient components of a finished dish is estimated and thus the estimation result may be preserved by the type of the dish being specified based on the captured image of camera 30 captured the finished dish or a dish during cooking and the weight of the specified dish being detected by the weight sensor. By referring to the stored calorie or nutritional information, the user can consider a dish menu which takes into account the health, and as a result, the user can have a healthy eating habit.

[0075] Further, for example, controller 50 of heating cooker 10 may record the process up to the completion of cooking object T based on the captured image of camera 30.

[0076] For example, controller 50 specifies the type of a plurality of food materials that the user has input into the inside of container C based on the captured image (captured moving image) of camera 30. In addition, the weight of each food material is specified based on the detection weight of weight sensor 28. At the same time, controller 50 acquires the change in the detection temperature of temperature sensors 26A to 26C, that is, acquires the history of operations (high-heat operation, medium-heat operation, low-heat operation) on heating cooker 10 by the user.

[0077] Accordingly, information on the cooking process of the user until cooking is completed can be acquired. In other words, controller 50 can acquire recipes of the user. The acquired recipes of the user are stored in storage portion 60.

[0078] The recipes of the user stored in storage portion 60 of controller 50 of heating cooker 10 can be used for various purposes.

[0079] For example, as illustrated in FIG. 2, heating cooker 10 can transmit recipe information (data) to portable terminal 42 of the user which is connected to local area network 38 centered around router device 36. Accordingly, the user can reproduce the same cooking as the cooking indicated by the recipe data while referring to the recipe data transmitted to portable terminal 42.

[0080] In addition, the heating cooker according to the exemplary embodiment can compare the recipe informa-

tion of the user with the ideal recipe information, and can advise the user on the ideal cooking method based on the comparison result. For example, controller 50 of heating cooker 10 acquires ideal recipe information regarding health, for example, via Internet 40, and compares the recipe information with the recipe information of the user. Based on the comparison result, for example, information on the type of food material to be decreased and appropriate weight thereof is transmitted to portable terminal 42 of the user via local area network 38. Accordingly, the user can create healthy dishes when performing the same cooking again. Based on recipe information of a plurality of users stored in storage portion 60, a deviation of nutrition may be examined and a recipe for improving the deviation may be provided to the user.

[0081] Further, for example, the dish which is arranged on a plate may be captured by camera 30. In addition, when the user arranges the dishes on the plate, the dish may be specified based on the captured image of camera 30 and the position on the plate on which the food material included in the dish should be mounted may be notified by the notifying portion 24. Accordingly, the cooked food material (dish) can be arranged to have a good appearance. In addition, the mounting position of the food material before cooking may be notified by the notifying portion 24 without being limited to the food material after cooking. For example, in a case of pizza, in order to improve appearance thereof after completion of cooking, the preferred position on dough of the food material to be topped to the dough before cooking may be notified by notifying portion 24.

[0082] When dish arranged on a plate is captured, the position of the top plate 14 which is well captured by the camera 30 may be indicated to the user. For example, a portion of the top plate 14 which is well captured by the camera 30 emits light. The light emission is performed by irradiating light from an LED disposed on a lower side of the portion of the top plate 14.

[0083] Here, if description of the camera 30 is supplemented, in a case of the exemplary embodiment, as illustrated in FIG. 2, camera 30 and controller 50 are connected via local area network 38 centered around router device 36. Therefore, the distance between camera 30 and top plate 14 of heating cooker 10 can be adjusted. Therefore, it is possible to install heating cooker 10 in various residences in which, the heights of the range hoods to which camera 30 is attached are different from each other, for example.

[0084] However, in this case, it is necessary to measure the distance between camera 30 and top plate 14. Therefore, a calibration mark of a predetermined size is drawn on top plate 14. By comparing the actual size of the calibration mark with the size of the image of the calibration mark captured in the captured image of the camera 30, the distance between camera 30 and top plate 14 can be calculated. By using the calculated distance, controller 50 can calculate the temperature of the upper side portion of cooking object T and the size of cooking object T with high accuracy, based on the captured image of camera 30. In addition, the type of cooking object T can be specified with high accuracy.

[0085] According to heating cooker 10 of the exemplary embodiment as described above, the entirety of cooking object T can be preferably heated.

[0086] Although the invention has been described with reference to the above exemplary embodiment, the invention is not limited to the above-described exemplary embodiment.

[0087] For example, in a case of the above exemplary embodiment, as illustrated in FIG. 1, although heating cooker 10 has one camera 30, the number of camera of the heating cooker according to the exemplary embodiment of the invention is not limited to one. For example, a camera may be disposed on the upper side of each of the plurality of heating coils.

[0088] In addition, in a case of the exemplary embodiment described above, as illustrated in FIG. 2, although camera 30 and controller 50 of heating cooker 10 are wirelessly connected via local area network 38, it is not limited to this. At least one of camera 30 and controller 50 may be wired to local area network 38. In addition, camera 30 may be wirelessly connected or wired directly to controller 50 of heating cooker 10.

[0089] Further, in a case of the exemplary embodiment described above, as illustrated in FIG. 1, although heating cooker 10 includes three heating coils 16A to 16C, the number of the heating coil of heating cooker 10 according to the exemplary embodiment of the invention is not limited to this. There may be one heating coil or three or more heating coils.

[0090] With respect to the number of heating coil, there is a multi-coil type of heating cooker in which a number of heating coils are arranged in a matrix shape on the lower side of the top plate. For example, there is a multi-coil type heating cooker in which 56 small heating coils are arranged in 7 rows and 8 columns. In a case of such a multi-coil type heating cooker, the container can be disposed on an arbitrary position of the top plate. The container disposed on the arbitrary position is inductively heated by at least one heating coil existing in the lower side thereof.

[0091] At this time, there may be also a heating coil which is entirely positioned in the lower side of the container and there may be also a heating coil which is partially positioned in the lower side of the container. In this case, the induction heating of the container by the heating coil which is partially positioned in the lower side of the container is inefficient. Rather than using such a heating coil, it is more efficient to increase the output of the heating coil which is entirely positioned in the lower side of the container.

[0092] Based on the captured image of the camera 30, the size of the container mounted on the top plate and the mounting position thereof are specified with high accuracy. Based on the specified size and position of the container, the overlapping amount between each heating

coil and container with each other is calculated, and the heating coil of which the overlapping amount exceeds a predetermined value is specified. The container is inductively heated by using the specified heating coil.

[0093] Furthermore, in a case of the exemplary embodiment described above, difference between the upper temperature and the lower temperature is calculated based on the temperature of the upper side portion of the cooking object T calculated based on the captured image of the camera 30 and the temperature of the lower side portion of the cooking object T detected by the temperature sensors 26A to 26C and a state where there is a possibility that the cooking object T is scorched is estimated based on the calculated difference between the upper temperature and lower temperature. In addition, based on the change in temperature of the upper side portion and the change in temperature of the lower side portion of cooking object T, the heating amount to cooking object T is estimated. However, in the exemplary embodiment of the invention, the state of the cooking object estimated based on the captured image of the camera and the detection temperature of the temperature sensor is not limited thereto.

[0094] For example, in a case where the cooking object is substantially liquid such as soup, a state in which the entirety of the cooking object is preferably uniformly heated can be estimated by the difference between the upper temperature and lower temperature being substantially zero. In addition, the same cooking object can be cooked by heating to the same state again, by the heating amount to the cooking object being stored. Further, based on the change in the upper side portion of the cooking object detected based on the captured image of the camera and the temperature of the lower side portion detected by the temperature sensor, the boiling state of the cooking object can be estimated. Accordingly, based on the captured image of the camera which captures the upper side portion of the cooking object and the detection temperature of the temperature sensor which detects the temperature of the lower side portion of the cooking object, various states of the cooking object can be estimated compared with a case where the temperature sensor is only used.

[0095] As described above, according to an aspect of the invention, there is provided a top plate on which a container containing a cooking object is mounted, a heater which is provided in a lower side of the top plate and heats the container which is mounted on the top plate, and a camera which is disposed on an upper side of the top plate and images the top plate from above. In addition, there is provided a temperature sensor which is disposed on the lower side of the top plate and detects a temperature of the container which is mounted on the top plate and a controller which estimates a state of the cooking object in the inside of the container based on a captured image of the camera and the detection temperature of the temperature sensor and controls output of the heaters based on the estimation result.

[0096] With the configuration, the entirety of the cooking object contained in the container can be preferably cooked by heating.

[0097] In addition, the controller may be configured to calculate a temperature of the upper side portion of the cooking object based on the captured image of the camera, and may be configured to estimate a state of the cooking object in the inside of the container based on the difference between the upper temperature and the lower temperature which is difference in temperature between the calculated temperature of the upper side portion of the cooking object and the detection temperature of the temperature sensor.

[0098] Further, the controller may be configured to estimate that there is a possibility that the cooking object is in a state where the lower side portion thereof is scorched and then decrease an output of the heater, when the calculated difference between the upper temperature and the lower temperature is greater than a predetermined difference in temperature. Accordingly, the entirety of the cooking object can be preferably cooked by heating while the generation of scorching is suppressed.

[0099] In addition, the controller may be configured to calculate a temperature of the upper side portion of the cooking object based on the captured image of the camera, and may be configured to estimate a heating amount to the cooking object in the inside of the container based on the change in calculated temperature of the upper side portion of the cooking object and change in the detection temperature of the temperature sensor.

[0100] Further, the controller may be configured to detect that the cooking object is reversed upside down by being turned over by the user based on the captured image of the camera, and may be configured to decrease the output of the heating section when the heating amount to the cooking object after the upside down of the cooking object is detected substantially agrees with the heating amount to the cooking object before the upside down of the cooking object is detected.

[0101] Accordingly, both surfaces of the cooking object can be baked as desired.

[0102] The heating cooker may have a notifying portion for notifying the user of the state of the cooking object estimated by the controller. Thus, the user can know the state of the cooking object.

INDUSTRIAL APPLICABILITY

[0103] The invention is applicable to any heating cooker which heats a container containing the cooking object.

REFERENCE MARKS IN THE DRAWINGS

[0104]

10	heating cooker
14	top plate

16A	heater (heating coil)
16B	heater (heating coil)
16C	heater (heating coil)
26A	temperature sensor
26B	temperature sensor
26C	temperature sensor
30	camera
50	controller
C	container
T	cooking object

Claims

1. A heating cooker, comprising:

a top plate on which a container containing a cooking object is mounted;
a heater which is provided in a lower side of the top plate and heats the container which is mounted on the top plate;
a camera which is disposed on an upper side of the top plate and images the top plate from above;
a temperature sensor which is disposed on the lower side of the top plate and detects a temperature of the container which is mounted on the top plate; and
a controller which estimates a state of the cooking object in an inside of the container based on a captured image of the camera and a detection temperature of the temperature sensor and controls output of the heater based on an estimation result.

2. The heating cooker of Claim 1,
wherein the controller is configured to calculate a temperature of an upper side portion of the cooking object based on a captured image of the camera, and
wherein the controller is configured to estimate a state of the cooking object in the inside of the container based on difference between an upper temperature and a lower temperature which is difference in temperature between the calculated temperature of the upper side portion of the cooking object and the detection temperature of the temperature sensor.

3. The heating cooker of Claim 2,
wherein the controller is configured to estimate that there is a possibility that the cooking object is in a state where a lower side portion of the cooking object is scorched and then decrease an output of the heater, when the calculated difference between the upper temperature and the lower temperature is greater than a predetermined difference in temperature.

4. The heating cooker of Claim 1,
wherein the controller is configured to calculate a temperature of an upper side portion of the cooking object based on a captured image of the camera, and
wherein the controller is configured to estimate a heating amount to the cooking object in the inside of the container based on change in the calculated temperature of the upper side portion of the cooking object and change in the detection temperature of the temperature sensor.

5. The heating cooker of Claim 2,
wherein the controller is configured to calculate the temperature of the upper side portion of the cooking object based on the captured image of the camera, and
wherein the controller is configured to estimate a heating amount to the cooking object in the inside of the container based on change in the calculated temperature of the upper side portion of the cooking object and change in the detection temperature of the temperature sensor.

6. The heating cooker of Claim 3,
wherein the controller is configured to calculate the temperature of the upper side portion of the cooking object based on the captured image of the camera, and
wherein the controller is configured to estimate a heating amount to the cooking object in the inside of the container based on change in the calculated temperature of the upper side portion of the cooking object and change in the detection temperature of the temperature sensor.

7. The heating cooker of any one of Claims 4 to 6,
wherein the controller is configured to detect that the cooking object is reversed upside down by being turned over by a user based on the captured image of the camera, and
wherein the controller is configured to decrease the output of the heater when the heating amount to the cooking object after upside down of the cooking object is detected substantially agrees with the heating amount to the cooking object before the upside down of the cooking object is detected.

8. The heating cooker of any one of Claims 1 to 6, further comprising:
a notifying portion which notifies a user of a state of the cooking object estimated by the controller.

9. The heating cooker of Claim 7, further comprising:
a notifying portion which notifies a user of a state of the cooking object estimated by the controller.

FIG. 1

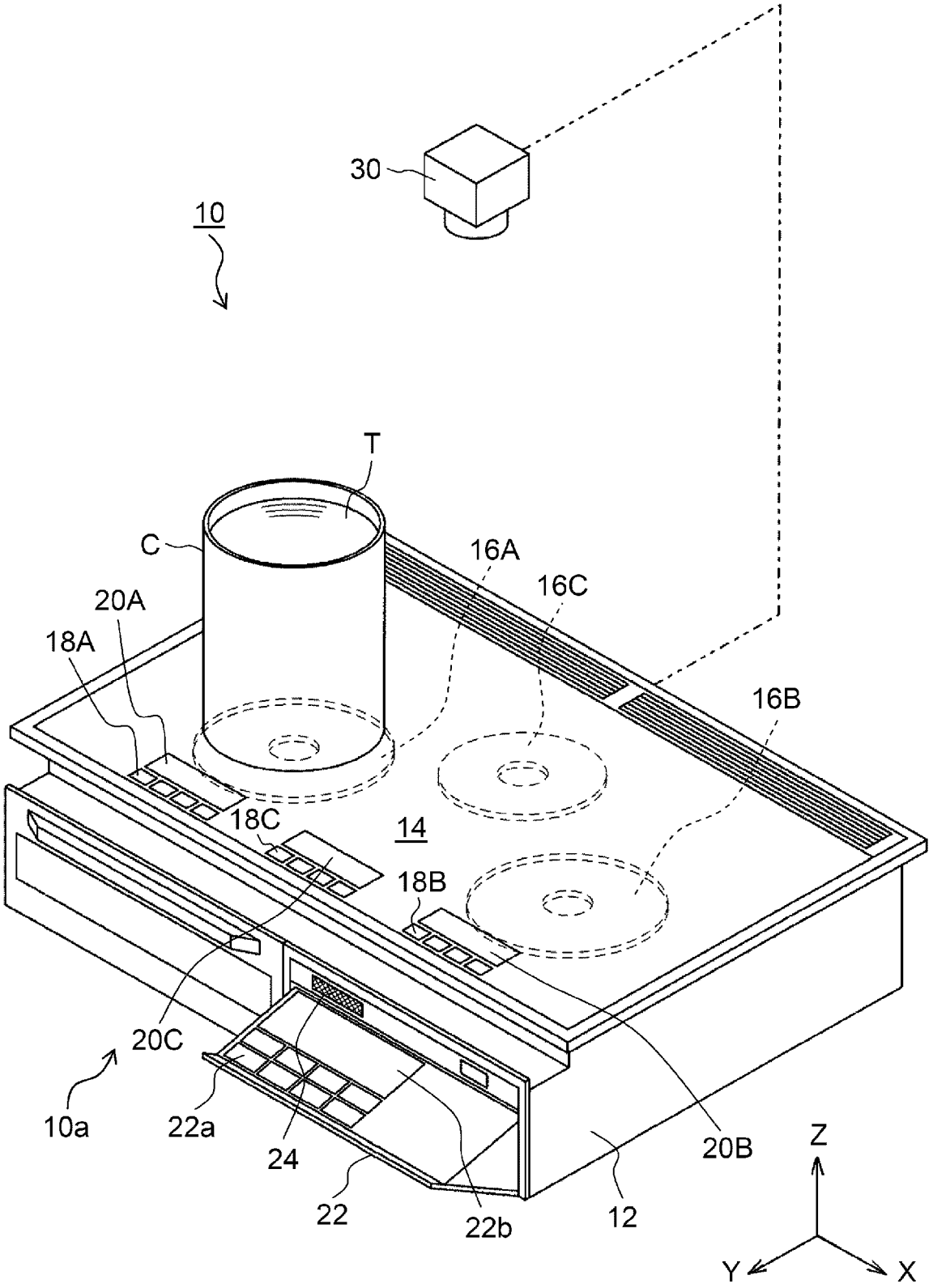

30
10
T
C
16A
16C
20A
18A
16B
18C
14
18B
20C
10a
22a
24
22
22b
12
20B
Z
Y
X

FIG. 2

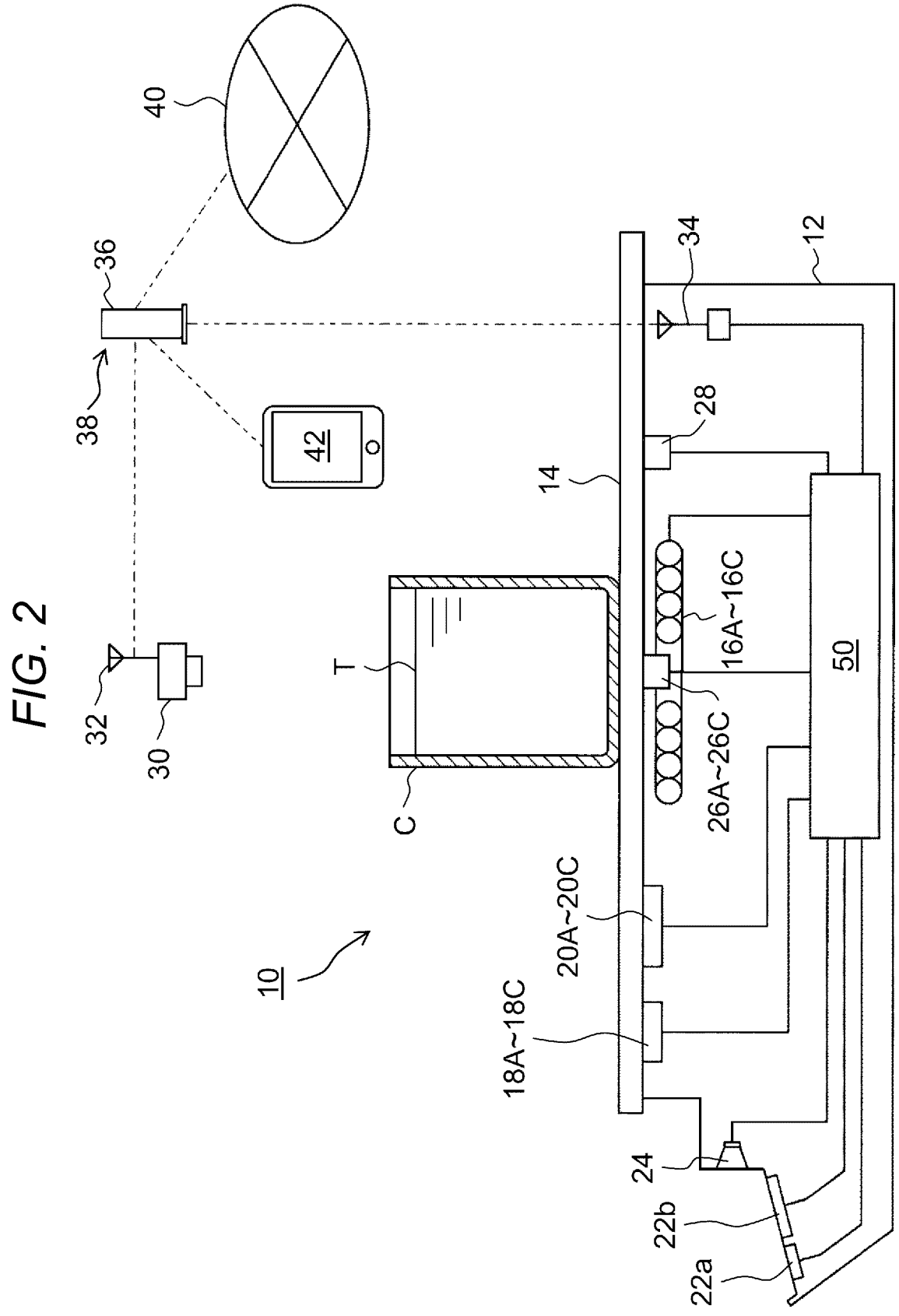

40
36
38
42
32
30
34
12
28
14
T
C
16A~16C
26A~26C
50
20A~20C
18A~18C
10
24
22b
22a

FIG. 3

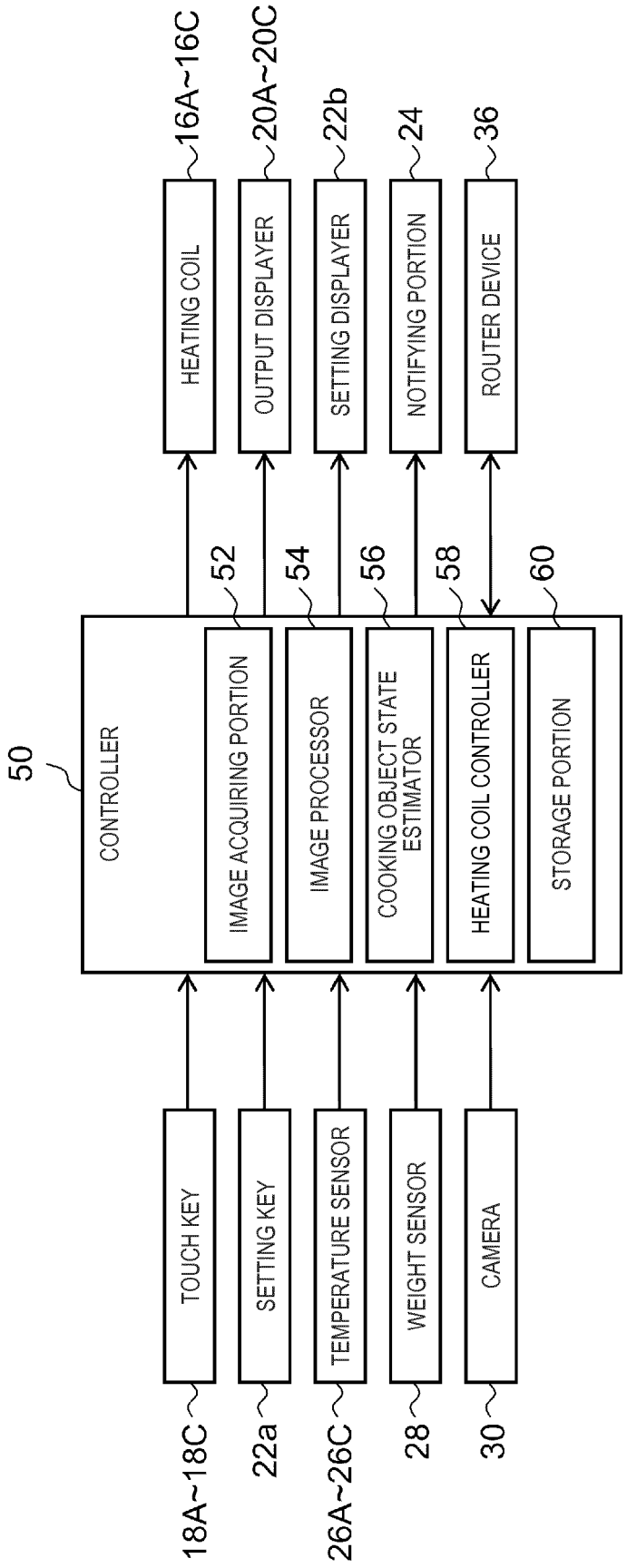

50
CONTROLLER
IMAGE ACQUIRING PORTION
IMAGE PROCESSOR
COOKING OBJECT STATE ESTIMATOR
HEATING COIL CONTROLLER
STORAGE PORTION
52
54
56
58
60
TOUCH KEY
SETTING KEY
TEMPERATURE SENSOR
WEIGHT SENSOR
CAMERA
18A~18C
22a
26A~26C
28
30
HEATING COIL
OUTPUT DISPLAYER
SETTING DISPLAYER
NOTIFYING PORTION
ROUTER DEVICE
16A~16C
20A~20C
22b
24
36

FIG. 4

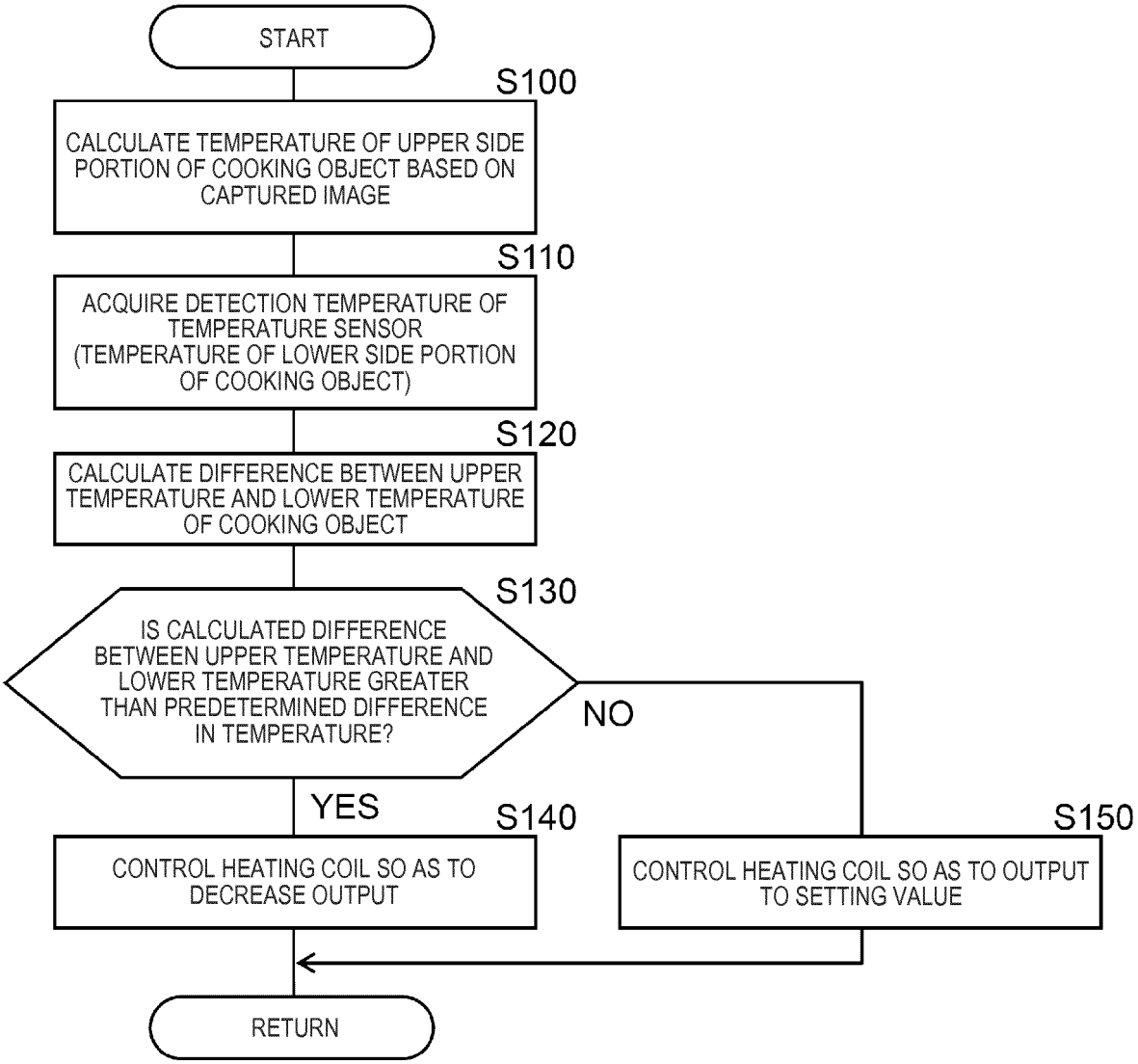
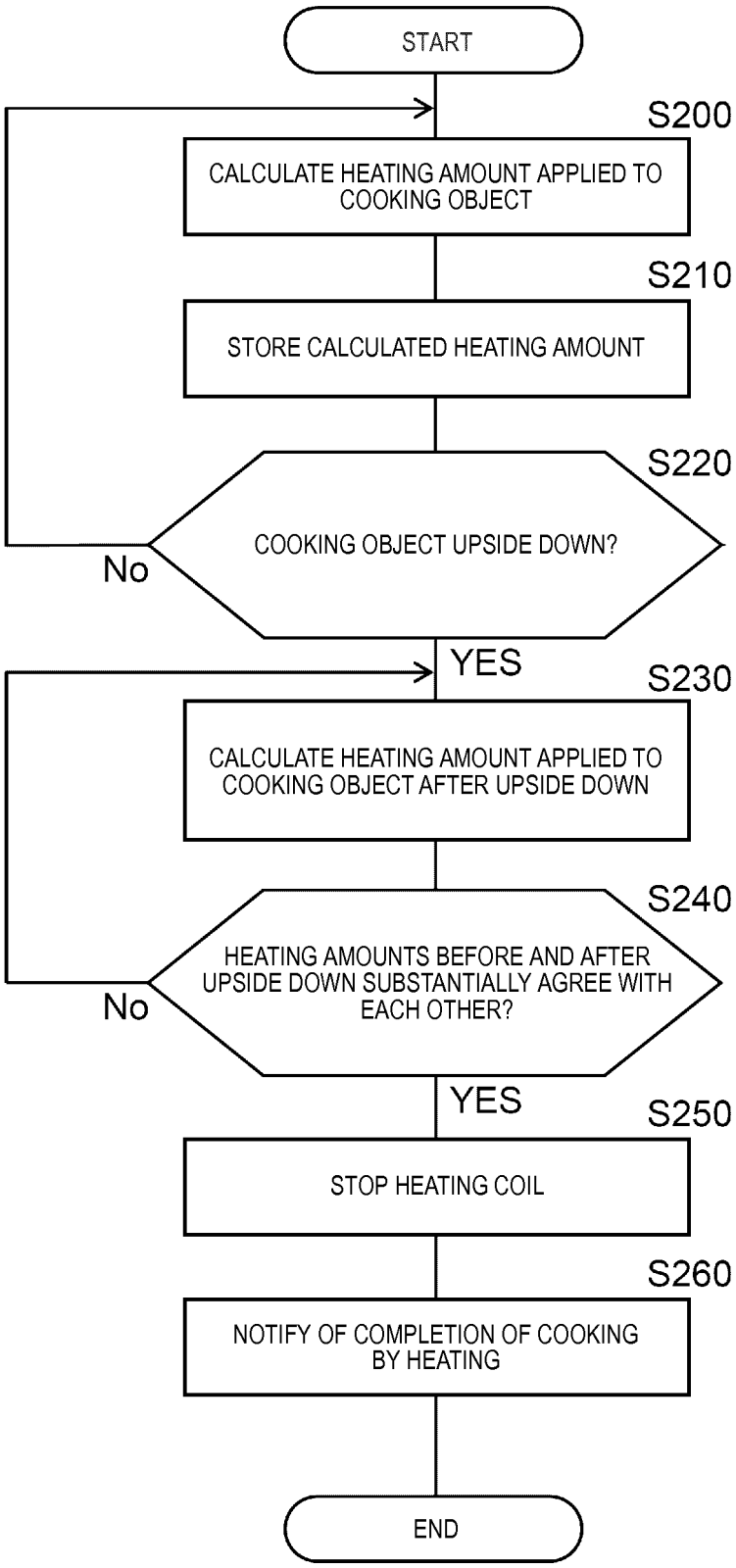

START
S100
CALCULATE TEMPERATURE OF UPPER SIDE PORTION OF COOKING OBJECT BASED ON CAPTURED IMAGE
S110
ACQUIRE DETECTION TEMPERATURE OF TEMPERATURE SENSOR (TEMPERATURE OF LOWER SIDE PORTION OF COOKING OBJECT)
S120
CALCULATE DIFFERENCE BETWEEN UPPER TEMPERATURE AND LOWER TEMPERATURE OF COOKING OBJECT
S130
IS CALCULATED DIFFERENCE BETWEEN UPPER TEMPERATURE AND LOWER TEMPERATURE GREATER THAN PREDETERMINED DIFFERENCE IN TEMPERATURE?
NO
YES
S140
CONTROL HEATING COIL SO AS TO DECREASE OUTPUT
S150
CONTROL HEATING COIL SO AS TO OUTPUT TO SETTING VALUE
RETURN

FIG. 5


START
S200
CALCULATE HEATING AMOUNT APPLIED TO COOKING OBJECT
S210
STORE CALCULATED HEATING AMOUNT
S220
COOKING OBJECT UPSIDE DOWN?
No
YES
S230
CALCULATE HEATING AMOUNT APPLIED TO COOKING OBJECT AFTER UPSIDE DOWN
S240
HEATING AMOUNTS BEFORE AND AFTER UPSIDE DOWN SUBSTANTIALLY AGREE WITH EACH OTHER?
No
YES
S250
STOP HEATING COIL
S260
NOTIFY OF COMPLETION OF COOKING BY HEATING
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/003568

A. CLASSIFICATION OF SUBJECT MATTER
H05B6/12(2006.01)i, *F24C7/04*(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)
H05B6/12, F24C7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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.
Y A	JP 2005-317305 A (Mitsubishi Electric Corp.), 10 November 2005 (10.11.2005), claims 1, 3; paragraphs [0001], [0019]; all drawings & KR 10-2005-0105428 A & KR 10-2006-0122797 A & CN 1691842 A	1,8 2-7,9
Y A	JP 2015-068542 A (Mitsubishi Electric Corp.), 13 April 2015 (13.04.2015), paragraph [0043] (Family: none)	1,8 2-7,9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 September 2016 (05.09.16)	13 September 2016 (13.09.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2012009199 A **[0003]**