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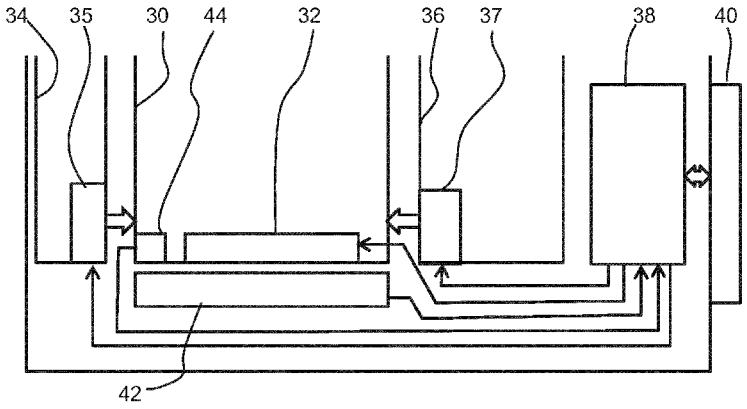

FIG. 3

(57) Abstract: A device for cooking a starch-based food item takes account of the type and quantity of the food item, in order to determine a required water quantity and/or a required oil quantity for a cooking cycle which maximizes the generation of the amylose-lipid resistant starch complex. In this way the energy intake from the food item is reduced and the amount of fiber consumed is increased, as part of a healthier diet.

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COOKING APPLIANCE AND METHOD FOR COOKING STARCH-BASED FOODSTUFFS

FIELD OF THE INVENTION

This invention relates to the cooking of starch-based foodstuffs.

BACKGROUND OF THE INVENTION

Nutrients are chemicals found in foods that are critical to human growth and function. There are six groups of essential nutrients: carbohydrates, lipids, proteins, vitamins, minerals and water. Carbohydrates together with lipids and proteins provide energy for the body, particularly for the brain and for physical exercise.

Starch food including rice, wheat, and potato is a staple food for almost all the world and is the main source of carbohydrates. Our bodies easily digest most cooked starches, in which alpha bonds link the numerous glucose units together. Starch food, like rice, bread, pasta and potato are thus important for health and generally eaten daily as a primary food source.

One of the concerns associated with the consumption of starch-based food is the high glycemic property and its relationship to diabetes. For a balanced healthy diet, a reduced intake of digestible food is desired to avoid over-intake of energy and reduce the risk of obesity or diabetes.

Cooking starch-based food normally makes the starch fully gelatinized which can be quickly digested and absorbed. This then increases the blood glucose level and insulin response after consumption. The quick increase of blood glucose may promote metabolic diseases such as obesity and diabetes. Indeed, studies have shown a close relationship with the incidence of diabetes.

Starch that is slowly digested (i.e. "slow digestion starch") or which is resistant to the human digestive system (i.e. "resistant starch") may reduce the incidence of metabolic diseases and at the same time promote gut health.

Starch accounts for about 90% of the dry weight of potato and milled rice. The starch granule can be divided into several levels according to the dimensions, as shown in Fig. 1 which is copied from Gilbert R. G. et al., (2013): "Improving human health through understanding the complex structure of glucose polymers", Analytical and Bioanalytical

Chemistry. 405:8969–8980. In Fig. 1, the image 1 represents starch at the nm scale which is defined as level 1. Amylose 2 and amylopectin 3 have dimensions of the order 10nm which is defined as level 2. Clusters 4 have dimension of the order 10 to 100nm which is defined as level 3. Lamellae which are crystalline 5 and amorphous 6 have dimension of the order μm, and are defined as level 4. Granules 7 have dimension of the order 10μm, which is defined as level 5 and grains 8 have dimension of the order mm, which is defined as level 6.

During cooking of potatoes and rice, several stages occur to transform raw starch into easily digestible starch. These stages include glass transition, gelatinization, swelling, pasting and leaching of amylose and retrogradation.

The glassy (amorphous) region of the starch first becomes soft and rubbery followed by the melting of the crystalline regions within the starch granule. After full or partial starch gelatinization, the starch granules begin to swell and this is accompanied by leaching of amylose from the starch granules. The gelatinized starch contains no crystalline region and therefore is readily attacked by the digestive enzymes.

The starch that is un-digestible is called resistant starch ("RS"). Currently, resistant starches are divided into five groups:

RS1: physically inaccessible – starch embedded in protein and in cell wall matrices in cereal grains;

RS2: raw starch such as in a banana;

RS3: Retrograded amylose;

RS4: Chemically modified, such as cross-linked to form a structure that is not easily accessible for enzymes;

RS5: Amylose-lipid complex.

RS1 and RS2 are naturally occurring raw starches and disappear and are fully gelatinized by cooking. RS3 is only formed if the cooked starch-based food is cooled for a certain period (i.e. a starch retrogradation process). RS4 is formed by chemical modification in industry.

The starch granule is constituted by two types of molecules: amylose and amylopectin. One of the interesting physical changes during cooking is that amylose could form inclusion compounds with lipids (e.g. free fatty acids) to form the amylose-lipid complex, RS5. This gives the opportunity to generate RS5 during starch food cooking/preparation in particular by adding oil to the gelatinized/cooked starch food. Some evidence has shown that RS5 is non-digestible in the human small intestine but partially fermented in the large intestine. Therefore, consuming food containing the RS5 starch food

reduces the food calorie density, and increases the dietary fiber intake. This slow digestion of RS5 could reduce obesity, alleviate diabetes symptoms, and promote gut health. During the intestinal bacteria fermentation of resistant starch, a short-chain fatty acid called butyrate is produced. Some research has also suggested that butyrate reduces the risk of cancer Therefore, consuming resistant starch may be beneficial for this reason also.

The amount of resistant starch in a cooked food item can be measured. For example, Fig. 2 shows a resistant starch measurement method known as a differential scanning calorimetry (DSC) thermogram. It shows the heat flow into the starch-based food product as a function of temperature. It is adapted from Paton, David. (1987). Differential scanning calorimetry of oat starch pastes, Cereal chemistry. 64(6): 394-399. The first valley 10 corresponds to gelatinization and the second valley 12 corresponds to amylose-lipid melting. This method thus can be used to detect the presence of RS5. Two scans are shown to confirm the amylose-lipid formation.

Modern diets do not provide enough dietary fiber, which is an important component for gastrointestinal health. Reports have indicated that the average intake (13 – 15 g per day) is much lower than the recommended value (25 g and 38 g per day for women and men, respectively).

In the food industry, complex physical and chemical procedures are used to generate resistant starch which require professional processing methods such as high pressure and long processing time. Some methods also involve using various harmful chemical reagents/elements.

There is therefore a need for a method to increase the dietary fiber (i.e. resistant starch) component of starch food during cooking for normal consumers and using home kitchen appliances. This is not achieved with conventional cooking processes because amylose is “locked” inside the starch food. Simply put, starch food with oil together do not efficiently generate enough RS5 because the amylose which is locked inside the starch food is not free to form an inclusion complex with the lipids. The lipids ,may also stick to the surface of the food which may prevent further amylose leaching out of the starch granule. There is therefore a need for a cooking process which encourages the amylose to leach from the grain or other starch food, so that lipids then enable the desired resistant starch complex to be formed.

SUMMARY OF THE INVENTION

The invention is defined by the claims.

According to examples in accordance with an aspect of the invention, there is provided a device for cooking a starch-based food item, comprising:

a vessel for receiving a volume of water and a quantity of the starch-based food item;

an oil reservoir;

a heater for heating the vessel contents; and

a controller,

wherein the controller comprises an input for receiving an identification of the type of food item, and a quantity of the food item, and an output for providing a required water quantity and/or a required oil quantity,

wherein the controller has a cooking cycle setting for which the required water quantity and/or the required oil quantity maximizes the generation of the amylose-lipid resistant starch complex for the particular food item or provides generation of a target amount of amylose-lipid resistant starch complex for the particular food item.

This device has a setting for maximizing or otherwise setting the amount of resistant starch to assist in reducing energy intake. To do this, the water and oil quantity used in the cooking process is controlled in dependence on the type and quantity of the food item being cooked.

The device is preferably a domestic cooking appliance (e.g. rice cooker, multi-cooker, bread maker, noodle maker, etc.) and it is able to efficiently generate more resistant starch which functions as dietary fiber.

The input may be for receiving the identification of the type of food item from the user of the device. Alternatively, the device may comprise a sensor for sensing the type of food item and reporting to the controller. For example, near infra-red sensing may be used to detect the amylose content. This is the information of interest to the controller. The user input may also provide an indication of the amylose content, but it will be more simple for the user to indicate the type of food (e.g. particular rice type) and the device converts this using a look up table into the required starch content information. Alternatively, the user may scan a barcode on the packaging of the food item, which encodes the information required by the device. Of course, the device may be provided with all of these alternative options.

The input may be for receiving the quantity of the food item from the user of the device or the device may comprise a weight sensor for sensing the quantity of the food item and reporting to the controller. In both cases, the controller is made aware of the quantity of the food item being cooked.

The controller may determine the both the required oil quantity and the required water quantity. This provides the best options for maximizing the resistant starch content.

However, as a first alternative, the controller may have an input for receiving the desired quantity of water from the user of the device and the controller determines the required oil quantity. In this case, the user may for example have a preference for the amount of water to be used, and the controller then determines the oil quantity with the water amount as a constraint.

As a second alternative, the controller may have an input for receiving the desired quantity of oil from the user of the device and the controller determines the required water amount. In this case, the user may have a preference for the amount of oil to be used, and the controller then determines the water quantity with the oil amount as a constraint.

The controller may also comprise an input for receiving an identification of the type of oil.

The controller is preferably adapted to set a cooking cycle using the heating temperature and heating time and optionally the time during the cooking cycle at which oil is added to the vessel from the reservoir. The controller may also comprise an input for receiving an indication of a desired doneness or stickiness or level of fiber content. The controller can then take these additional parameters into account in forming a suitable cooking cycle.

The device may simply instruct the user to add a specified amount of water. However, it may comprise a water delivery system for delivering water to the vessel. In this case, the controller can control as well as calculate the water amount. The water delivery system may be fed from a continuous water supply, or it may be fed from a water reservoir which is filled and then contains more water than is needed for all cooking cycles and food quantities handled by the device.

The device may also simply instruct the user to add a specified amount of oil, either at the same time as providing the water or at a specific time. However, it may comprise an oil delivery system for delivering oil to the vessel from the oil reservoir. In this case, the controller can control as well as calculate the oil amount. The oil reservoir may in fact be the same vessel as for the water and food item, or it may be a separate reservoir. In the latter case, the user may simply fill the reservoir, and the controller can then control the amount and timing of delivery of the oil to the main cooking vessel.

The type of food item comprises an identification of the category of food item (e.g. Kind Edward Potatoes, or Japonica Rice …) and/or the amylose content of the food item (e.g. a dry weight percentage).

Note that the controller is defined above as having various possible inputs for receiving information from the user. In practice, these together form a single user interface, such as a touch screen or keypad input.

Examples in accordance with another aspect of the invention provide a method for cooking a starch-based food item, comprising:

providing an identification of the type of food item, and a quantity of the food item to a controller;

receiving from the controller a required water quantity and/or a required oil quantity for cooking the food item; and

using a heater to heat a volume of water and oil and a quantity of the starch-based food item in a cooking vessel using a cooking cycle for which the required water quantity and/or the required oil quantity maximizes the generation of the amylose-lipid resistant starch complex for the particular food item or provides generation of a target amount of amylose-lipid resistant starch complex for the particular food item.

The identification of the type of food item is provided by the user of the device or the device comprises a sensor for sensing the type of food item and reporting to the controller; and

the quantity of the food item is provided by the user of the device or the device comprises a weight sensor for sensing the quantity of the food item and reporting to the controller.

The controller may determine the required oil quantity and the required water quantity; or

the desired quantity of water is received from the user of the device and the controller determines the required oil quantity; or

the desired quantity of oil is received from the user of the device and the controller determines the required water quantity.

The method may be implemented at least in part by software.

BRIEF DESCRIPTION OF THE DRAWINGS

Examples of the invention will now be described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows the structure of a starch-based food product at different scales;

Fig. 2 is used to explain a method of determining the quantity of certain resistant starch types;

Fig. 3 shows a cooking device;

Fig. 4 shows first experimental results to demonstrate the operation of the cooking device;

Fig. 5 shows second experimental results to demonstrate the operation of the cooking device;

Fig. 6 shows third experimental results to demonstrate the operation of the cooking device;

Fig. 7 shows a cooking method; and

Fig. 8 shows a general computer architecture for implementing the processor of the cooking device.

DETAILED DESCRIPTION OF THE EMBODIMENTS

The invention provides a device for cooking a starch-based food item which takes account of the type and quantity of the food item, in order to determine a required water quantity and/or a required oil quantity for a cooking cycle which maximizes or controls the level of the amylose-lipid resistant starch complex generated. In this way the energy intake from the food item is reduced and the amount of fiber consumed is increased, as part of a healthier diet.

In addition to the amounts of oil and water, the cooking profile is controlled, including parameters such as temperature, time and adding moment during the cooking phase. The food type or the starch composition of the food (e.g. amylose content) is taken into account and optionally also the oil type. The cooking profile may also take account of the target sensory characteristics of the food item (i.e. doneness or rice stickiness for example).

Fig. 3 shows a cooking device. Some of the features shown are optional, and this will become apparent from the discussion below. This example is based on a cooking device which boils the starch based food item in water, but the approach of the invention may be applied to other types of cooking device.

This example of the device comprises a vessel 30 for receiving a volume of water and a quantity of the starch-based food item. There is a heater 32 for heating the vessel contents. An oil reservoir 34 is for receiving cooking oil. This reservoir may in fact be the

vessel 30 itself i.e. the oil is added to the cooking vessel 30, or else it may be a separate reservoir as shown so that the device can control the quantity and time at which oil is supplied to the main vessel 30.

The water may be added directly to the vessel, or there may be a separate water reservoir 36 so that the device can control the quantity (and time) at which water is supplied to the main vessel 30. In this case, the reservoir 36 may have a larger capacity than the maximum amount needed by the vessel 30.

A controller 38 controls the cooking cycle.

A user interface 40 enables the controller to receive input from the user, and to provide output information to the user.

The controller receives an identification of the type of food item, and a quantity of the food item. The type of the food item may be a name of the food product (a particular rice grain or potato type for example) or it may be an indication of the starch composition. The controller preferably also receives an indication of the type of oil (olive oil, sunflower oil, ground nut oil etc.).

In a first example, this information all comes from the user interface 40. However, an alternative is for the device to weigh the food item using weighing scale 42. Also the device may in theory detect the type of food item for example using food sensor 44. This may comprise near infrared sensing to detect the amylose content.

The detection of amylose content in rice is for example discussed in Indian patent application number 1266/CHE/2012. The use of near infrared reflectance spectroscopy is presented as one example technique.

The information may also be input by the user, but by scanning a barcode on the food item packaging or oil bottle, or presenting an RFID tag on the food item packaging or oil bottle to an RFID reader of the device for example. This provides a partially automated process by removing the burden on the user.

The controller 38 has an output for providing a required water quantity and/or a required oil quantity. This information may be provided to the user via the user interface 40 as a set of user instructions, or it may be used to control the device operation directly. For example, the water reservoir 36 has a pump 37 used to feed water into the vessel, and the oil reservoir 34 has a pump 35 to feed oil into the vessel 30.

There may be multiple cooking modes for the user to choose. However, controller 38 has at least a cooking cycle setting for which the required water quantity and/or the required oil quantity maximizes the generation of the amylose-lipid resistant starch

complex for the particular food item or a cooking cycle which controls the generation of the amylose-lipid resistant starch complex to a target level. The target level may be minimum, normal or maximum for example.

The user may also input a target sensory quality for the cooked food or an expected dietary fiber level. The controller also takes these factors into account when determining a cooking profile. The cooking profile includes the oil and water parameters (amount, temperature, adding moment, etc.). The factors used to determine the cooking profile are not limited to these. For example, the device may take into account of other factors such as the ambient temperature, the freshness of the starch food, or other specific details relating to the starch food.

Table 1 below provides an example to explain the process. The device receives the type of food item (in this example, three different rice types), the food item weight and the oil type. The device then addresses a look up table of which Table 1 is a portion.

Table 1

Input info			**Cooking Parameter of water, oil**			**Cooking profile**
Rice Type	Rice weight	Oil Type	Rice: Water	Oil: Rice	Oil adding moment	
Indica rice (amylose content=18%)	320g (or 2cups)	Coconut oil	1: 2	15%	2mins after rice's temperature reached 80°C	CP_Indica_1
Japonica rice (amylose content=12%)	320g (or 2cups)	Coconut oil	1: 1.8	10%	1mins after rice's temperature reached 80°C	CP_Japonica_1
Carnaroli rice (amylose content=24%)	150g	Coconut oil	1:3	20%	4mins after rice's temperature reached 80°C	CP_Carnaroli_1

As shown, the cooking parameters define the amount of water relative to the amount of rice and the amount of oil relative to the amount of rice. The timing and/or temperature, at which the oil is added, is also defined. These parameters form the cooking cycle.

Optionally, the input information may also contain target sensory requirement (e.g. hardness, or stickiness, etc.), or target dietary fiber level (e.g. max, medium, low). The device could then give different cooking profiles as well as cooking parameters of oil and water during the cooking process based on these requirements.

In one example, the controller thus calculates the required total amount of water and oil it will need for cooking. The cooking profile also includes the heating temperature or even a heating temperature profile over time. This is the preferred mode of operation of the device, since it gives the device the greatest freedom to control the generation of resistant starches.

In other examples, the user may specify some of the cooking parameters.

For example, the user may select the water ratio (or the water amount). In this way, the user may select a desired texture preference (for example rice which is soft, hard or watery).

The device will then determine the required oil ratio (and oil amount given the known amount of the food item) and select the best cooking profile for the maximum dietary fiber or for the preferred sensory generation or for the consumers target dietary fiber level. Thus, the additional user input becomes a further constraint.

In another example, the user may select the oil ratio (or the oil amount). In this way, the user may select a desired taste preference based on the amount of oil.

The device will then determine the required water ratio (and water amount given the known amount of the food item) and select the best cooking profile for the maximum dietary fiber or for the preferred sensory generation or for the consumers target dietary fiber level. Thus, the additional user input again becomes a further constraint.

A number of experiments have been conducted to show the effect of the various cooking cycle parameters, in particular different rice : water ratio, oil: rice ratio and the moment to add oil during a rice cooking process. It is shown that these parameters can influence the generation of different dietary fiber amounts (i.e. resistant starch) even for the same type of rice. Thus, proper management of these parameters with suitable cooking profiles can generate consumers preferred target dietary fiber levels or maximize the fiber levels which can help to increase the daily dietary fiber intake.

Fig. 4 shows the result of an experiment to show the impact of the timing at which oil is added during cooking. In this experiment, the rice : water ratio was fixed to 1:1.6, and oil : rice ratio was fixed to 15%. Three rice samples were made as shown in Table 2.

Table 2

Sample No.	**Ratio of rice/water**	**Ratio of oil: rice**	**Oil adding moment**
Sample 1	1: 1.6	no oil added	-
Sample 2		15%	at the beginning of the rice cooking
Sample 3			When rice temperature > 80°C

The dietary fiber is measured. The height of the three bars in Fig. 4 is the % of dietary fiber content compared to the cooking without oil (hence sample 1 has a value of 100%). It can been seen that Sample 3 generated more dietary fiber than Sample 2.

Fig. 5 shows the result of an experiment to show the impact of the amount of oil added. In this experiment, the rice: water ratio was fixed to 1:1.6, and the oil with different amount is added when the rice temperature is above 80°C. Four cooked rice samples were made as shown in Table 3.

Table 3

Sample No.	**Ratio of rice/water**	**Ratio of oil: rice (%)**	**Oil adding moment**
Sample 1	1: 1.6	no oil added	-
Sample 2		10%	When rice temperature > 80°C
Sample 3		15%	
Sample 4		30%	

The dietary fiber is measured. The height of the three bars in Fig. 5 is again the % of dietary fiber content compared to the cooking without oil (hence sample 1 has a value of 100%). It can been seen that Sample 3 generated more dietary fiber than the others, for an otherwise identical cooking profile.

Fig. 6 shows the results of an experiment to show the impact of the amount of water added. In this experiment, the oil : rice ratio was fixed to 1:10, and the oil is added when the rice temperature is above 80°C. Four cooked rice samples were made as shown in Table 4.

Table 4

Sample No.	**Ratio of rice/water**	**Ratio of oil: rice**	**Oil adding moment**
Sample 1	1: 1.6	no oil added	-
Sample 2	1:1.6	10%	When rice temperature > 80°C
Sample 3	1: 2		
Sample 4	1:2.5		

The dietary fiber is again measured. The height of the three bars in Fig. 6 is again the % of dietary fiber content compared to the cooking without oil (hence sample 1 has

a value of 100%). It can been seen that Sample 3 generated more dietary fiber than the others, for an otherwise identical cooking profile.

Fig. 8 shows the cooking method to be implemented by the cooking device.

In step 80, an identification is provided of the type of food item, and a quantity of the food item to a controller. The information may be provided by a user of the system, or some or all of the information may be sensed by the cooking device. Optionally, a preferred cooking style (doneness or stickiness) is input to the controller, and/or an oil type, and/or a target amount of amylose-lipid resistant starch complex for the cooked food item.

In step 82, a required water quantity and/or a required oil quantity for cooking the food item is determined by the the controller. The controller may determine one or or both of these parameters. Thus, the user may preselect a water quantity or an oil quantity, or the user may leave both determinations to the device.

In step 84, a heater is used to heat a volume of water and oil and a quantity of the starch-based food item in a cooking vessel using a cooking cycle for which the required water quantity and/or the required oil quantity maximizes the generation of the amylose-lipid resistant starch complex for the particular food item or provides generation of a target amount of amylose-lipid resistant starch complex for the particular food item.

The system described above makes use of a controller or processor for processing data.

Fig. 8 illustrates an example of a computer 80 for implementing the controller or processor described above.

The computer 80 includes, but is not limited to, PCs, workstations, laptops, PDAs, palm devices, servers, storages, and the like. Generally, in terms of hardware architecture, the computer 80 may include one or more processors 81, memory 82, and one or more I/O devices 83 that are communicatively coupled via a local interface (not shown). The local interface can be, for example but not limited to, one or more buses or other wired or wireless connections, as is known in the art. The local interface may have additional elements, such as controllers, buffers (caches), drivers, repeaters, and receivers, to enable communications. Further, the local interface may include address, control, and/or data connections to enable appropriate communications among the aforementioned components.

The processor 81 is a hardware device for executing software that can be stored in the memory 82. The processor 81 can be virtually any custom made or commercially available processor, a central processing unit (CPU), a digital signal processor (DSP), or an auxiliary processor among several processors associated with the computer 80,

and the processor 81 may be a semiconductor based microprocessor (in the form of a microchip) or a microprocessor.

The memory 82 can include any one or combination of volatile memory elements (e.g., random access memory (RAM), such as dynamic random access memory (DRAM), static random access memory (SRAM), etc.) and non-volatile memory elements (e.g., ROM, erasable programmable read only memory (EPROM), electronically erasable programmable read only memory (EEPROM), programmable read only memory (PROM), tape, compact disc read only memory (CD-ROM), disk, diskette, cartridge, cassette or the like, etc.). Moreover, the memory 82 may incorporate electronic, magnetic, optical, and/or other types of storage media. Note that the memory 82 can have a distributed architecture, where various components are situated remote from one another, but can be accessed by the processor 81.

The software in the memory 82 may include one or more separate programs, each of which comprises an ordered listing of executable instructions for implementing logical functions. The software in the memory 82 includes a suitable operating system (O/S) 84, compiler 85, source code 86, and one or more applications 87 in accordance with exemplary embodiments.

The application 87 comprises numerous functional components such as computational units, logic, functional units, processes, operations, virtual entities, and/or modules.

The operating system 84 controls the execution of computer programs, and provides scheduling, input-output control, file and data management, memory management, and communication control and related services.

Application 87 may be a source program, executable program (object code), script, or any other entity comprising a set of instructions to be performed. When a source program, then the program is usually translated via a compiler (such as the compiler 85), assembler, interpreter, or the like, which may or may not be included within the memory 82, so as to operate properly in connection with the operating system 84. Furthermore, the application 87 can be written as an object oriented programming language, which has classes of data and methods, or a procedure programming language, which has routines, subroutines, and/or functions, for example but not limited to, C, C++, C#, Pascal, BASIC, API calls, HTML, XHTML, XML, ASP scripts, JavaScript, FORTRAN, COBOL, Perl, Java, ADA, .NET, and the like.

The I/O devices 83 may include input devices such as, for example but not limited to, a mouse, keyboard, scanner, microphone, camera, etc. Furthermore, the I/O devices 83 may also include output devices, for example but not limited to a printer, display, etc. Finally, the I/O devices 83 may further include devices that communicate both inputs and outputs, for instance but not limited to, a network interface controller (NIC) or modulator/demodulator (for accessing remote devices, other files, devices, systems, or a network), a radio frequency (RF) or other transceiver, a telephonic interface, a bridge, a router, etc. The I/O devices 83 also include components for communicating over various networks, such as the Internet or intranet.

When the computer 80 is in operation, the processor 81 is configured to execute software stored within the memory 82, to communicate data to and from the memory 82, and to generally control operations of the computer 80 pursuant to the software. The application 87 and the operating system 84 are read, in whole or in part, by the processor 81, perhaps buffered within the processor 81, and then executed.

When the application 87 is implemented in software it should be noted that the application 87 can be stored on virtually any computer readable medium for use by or in connection with any computer related system or method. In the context of this document, a computer readable medium may be an electronic, magnetic, optical, or other physical device or means that can contain or store a computer program for use by or in connection with a computer related system or method.

The invention is of interest for multi-cookers, rice-cookers, bread-makers, noodle makers, etc. In particular, it can be a domestic kitchen appliance for home use.

The example above is for a water cooker, namely one in which the food is cooked in water. The invention may also be applied to a steam cooker, such as a rice steamer. In such a case, the generated steam mainly performs the heating function. The rice still simmers within a certain amount of water in a basin on top of the boiling water which generates the steam. Thus, there are two water components for steaming rice: one is mixed with the rice for water absorption, and the other is for generating the steam. The amount of water to be mixed with the rice is then controlled in the manner as discussed above. The amount of this water during steaming is normally less than for boiling rice, for instance a water: rice ratio of (1~1.3): 1 for streaming compared to a water: rice ratio of (1.3~2): 1 for boiling rice. Boiling rice consumes more water because of evaporation. For steaming rice, the water mixed together with the rice will generally not become steam.

The invention is also not limited to the cooking of rice, as has been explained above.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A device for cooking a starch-based food item, comprising:

a vessel (30) for receiving a volume of water and a quantity of the starch-based food item;

an oil reservoir (34);

a heater (32) for heating the vessel contents; and

a controller (38),

wherein the controller comprises an input for receiving an identification of the type of food item, and a quantity of the food item, and an output for providing a required water quantity and/or a required oil quantity,

wherein the controller has a cooking cycle setting for which the required water quantity and/or the required oil quantity maximizes the generation of the amylose-lipid resistant starch complex for the particular food item or provides generation of a target amount of amylose-lipid resistant starch complex for the particular food item.

2. A device as claimed in claim 1, wherein:

the input is for receiving the identification of the type of food item from the user of the device; or

the device comprises a sensor (44) for sensing the type of food item and reporting to the controller.

3. A device as claimed in claim 1, wherein:

the input is for receiving the quantity of the food item from the user of the device; or

the device comprises a weight sensor (42) for sensing the quantity of the food item and reporting to the controller.

4. A device as claimed in any preceding claim, wherein the controller (38) determines the required oil quantity and the required water quantity.

5. A device as claimed in any one of claims 1 to 3, wherein the controller has an input for receiving the desired quantity of water from the user of the device and the controller determines the required oil quantity.

6. A device as claimed in any one of claims 1 to 3, wherein the controller has an input for receiving the desired quantity of oil from the user of the device and the controller determines the required water quantity.

7. A device as claimed in any one of claims 1 to 3, wherein the controller (38) comprises an input for receiving an identification of the type of oil.

8. A device as claimed in any one of claims 1 to 3, wherein the controller is adapted to set a cooking cycle using the heating temperature and heating time and optionally the time time during the cooking cycle at which oil is added to the vessel from the reservoir.

9. A device as claimed in one of claims 1 to 3, wherein the controller comprises an input for receiving an indication of a desired doneness or stickiness or level of fiber content.

10. A device as claimed in any one of claims 1 to 3, comprising a water delivery system (37) for delivering water to the vessel and/or an oil delivery system (35) for delivering oil to the vessel from the oil reservoir.

11. A device as claimed in one of claims 1 to 3, where the type of food item comprises an identification of the category of food item and/or the amylose content of the food item.

12. A method for cooking a starch-based food item, comprising:

(70) providing an identification of the type of food item, and a quantity of the food item to a controller;

(72) receiving from the controller a required water quantity and/or a required oil quantity for cooking the food item; and

(74) using a heater to heat a volume of water and oil and a quantity of the starch-based food item in a cooking vessel using a cooking cycle for which the required

water quantity and/or the required oil quantity maximizes the generation of the amylose-lipid resistant starch complex for the particular food item or provides generation of a target amount of amylose-lipid resistant starch complex for the particular food item.

13. A method as claimed in claim 12, wherein:

the identification of the type of food item is provided by the user of the device or the device comprises a sensor for sensing the type of food item and reporting to the controller; and

the quantity of the food item is provided by the user of the device or the device comprises a weight sensor for sensing the quantity of the food item and reporting to the controller.

14. A method as claimed in claim 13, wherein:

the controller determines the required oil quantity and the required water quantity; or

the desired quantity of water is received from the user of the device and the controller determines the required oil quantity; or

the desired quantity of oil is received from the user of the device and the controller determines the required water quantity.

15. A computer program comprising code means adapted, when said program is run on a computer, to implement the method of any one of claims 12 to 14.

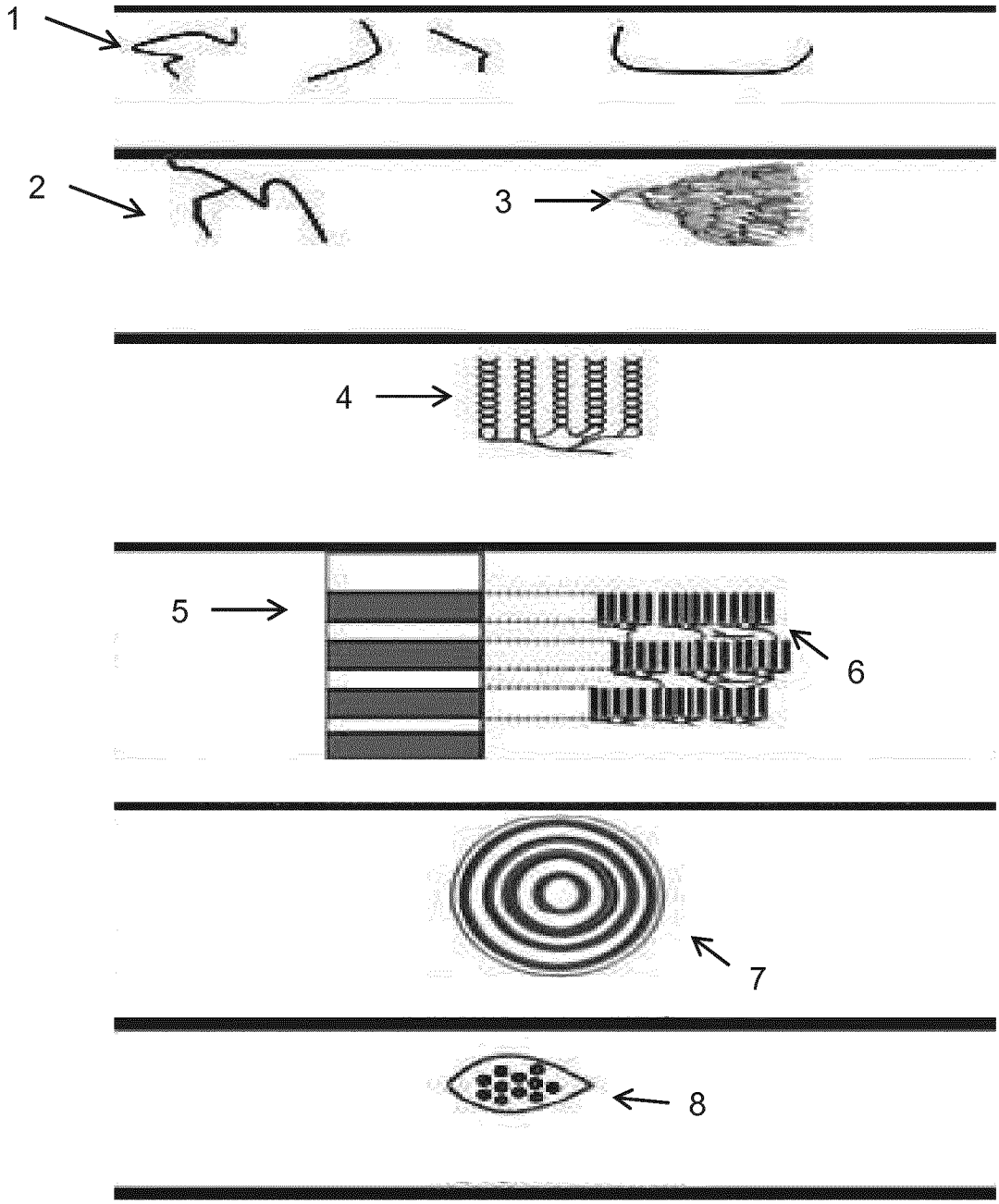
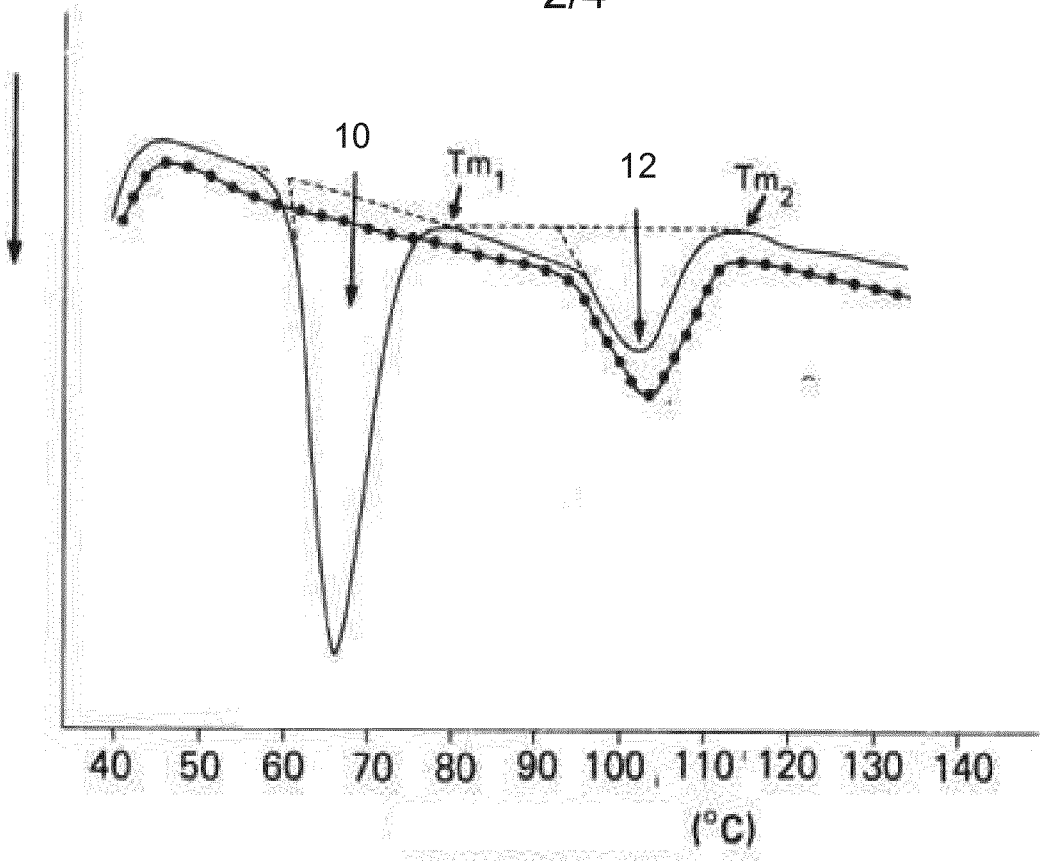


FIG. 1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Tm1
12
Tm2
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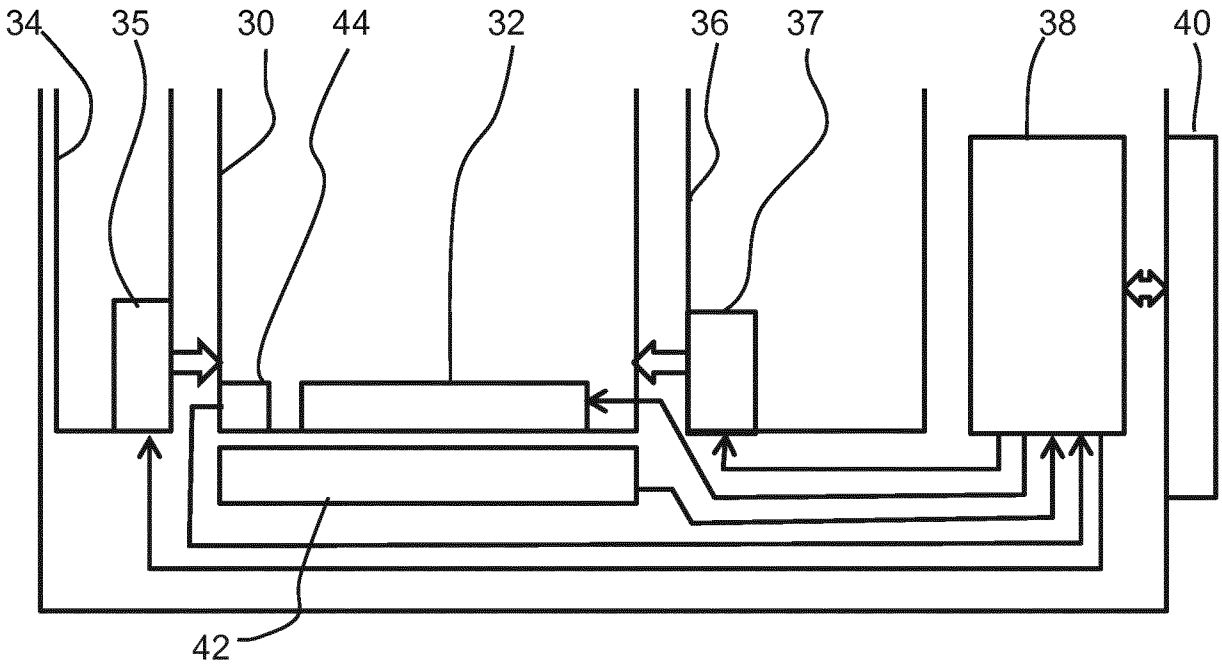
(°C)

FIG. 2


34
35
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44
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36
37
38
40
42

FIG. 3

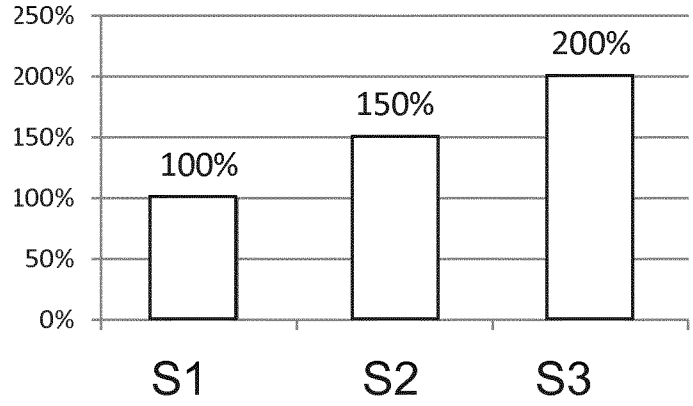

FIG. 4

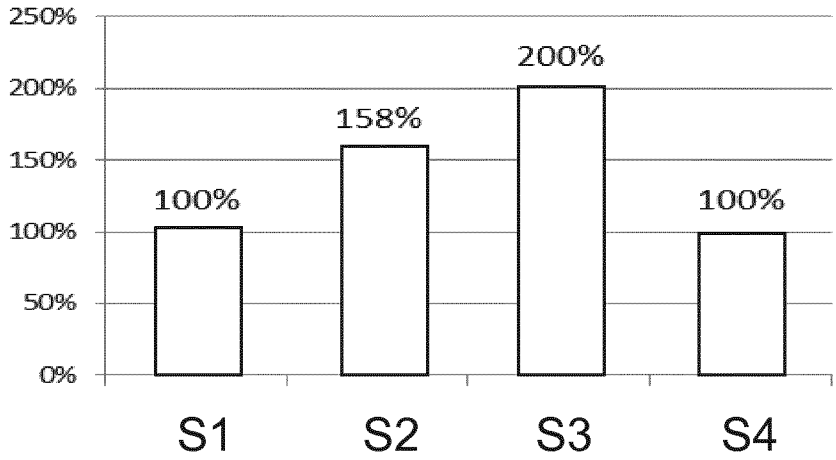

FIG. 5

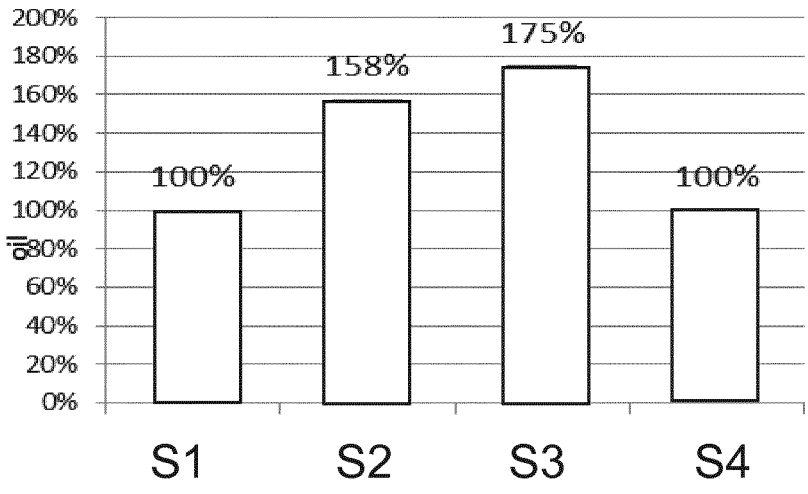

FIG. 6

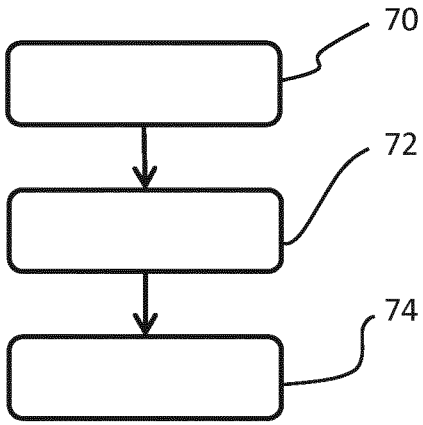

FIG. 7

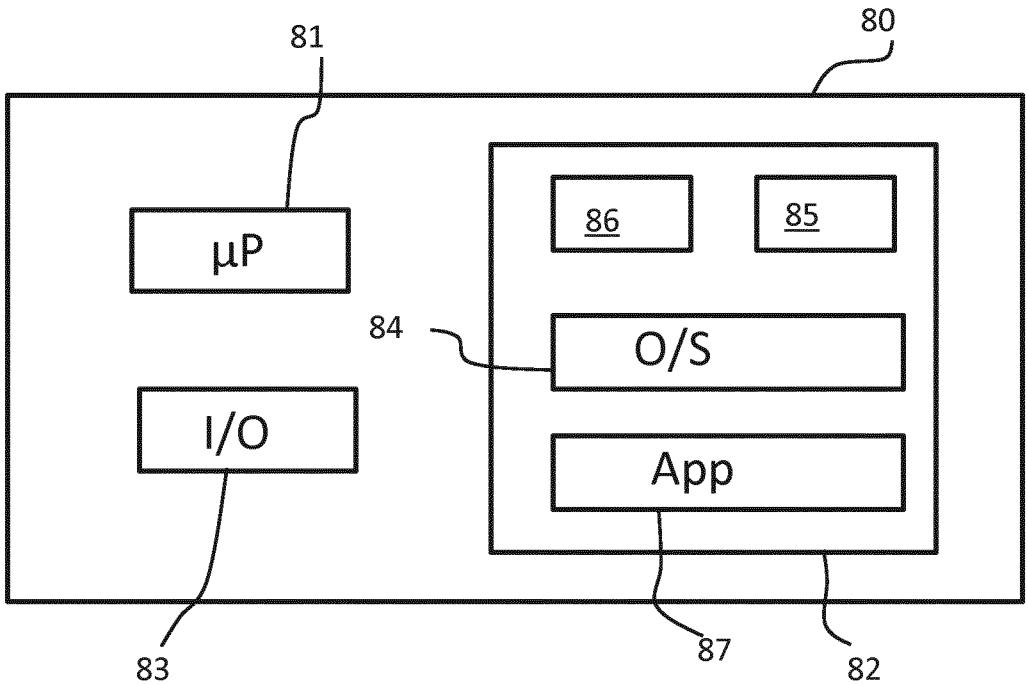

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/059067

A. CLASSIFICATION OF SUBJECT MATTER
INV. A23L5/10 A47J27/00 A47J27/08 G05D23/00 A47J27/04
ADD.

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)
A23L A47J G05D

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)
EPO-Internal, WPI Data, EMBASE, FSTA

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	paragraphs [0060], [0063] - [0068], [0093] - [0096], [0107], [0121], [0122], [0124], [0128]; claims 1,2,4,7-12,14,15; figures 2-6,10	1-14
Y	JP 2008 154660 A (MATSUSHITA ELECTRIC IND CO LTD) 10 July 2008 (2008-07-10) abstract	1-14
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 May 2017	24/05/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Muller, Isabelle

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/059067

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 2009/016566 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]; SLOOT ERIC M [NL]; FRAIJ FRED [NL]) 5 February 2009 (2009-02-05) pages 8,9; claims; figures 3,4	1-11
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Information on patent family members

International application No
PCT/EP2017/059067

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