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(54) **HOUSEHOLD APPLIANCE**

HAUSHALTSGERÄT

APPAREIL MÉNAGER

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**Description***Technical Field*

**[0001]** The present invention relates to a household appliance, particularly but not exclusively, a kitchen hood, an oven able to determine a cooking degree of a food item according to the preamble of claim 1.

*State of the Art*

**[0002]** They are known in the state-of-the-art household appliances provided with one or more sensors able to detect physical quantities of a sucked gas flow generated while cooking a food item.

**[0003]** For example, they are known vertical hoods (i.e. wall-mounted) or ceiling hoods which are provided with VOC, humidity and/or temperature sensors to assess the presence of smells, humidity and temperature in the gas flow that is generated while cooking a food item. An example of such a hood is known from document WO2018/080302 A1.

**[0004]** Such detected quantities are duly processed so as to consequently adjust the functioning rationale of the household appliance based on a program duly installed in a portion of memory of the control unit of the household appliance.

**[0005]** Other types of household appliances such as electric or gas or steam ovens are also known in the state of the art which are provided with one or more sensors to detect the physical quantities present in gases. Also, these household appliances may vary their functioning rationale based on the values detected in gases circulating and possibly discharged by the heating chamber.

**[0006]** In both these types of household appliances as well as in others, the common feature is that the plurality of sensors (namely of the sensors) is introduced in the gas flow and that the physical quantities measured are for adjusting the parameters belonging to the household appliance, such as the hood suction rate or the circulation rate of gases in the oven.

*Problem of the Prior Art*

**[0007]** These household appliances exploit the physical quantities detected by sensors to vary the behaviour of the household appliance wherein they are installed.

**[0008]** Such functioning that is in itself advantageous is not free from drawbacks as it does not allow to take full advantage of the possibility of interacting with the user and inform him on the progress status of the cooking of the food item.

*Object of the Invention*

**[0009]** The object of the invention is to provide a household appliance and a method able to overcome the above reported drawbacks according to the following claims.

*Advantages of the invention*

**[0010]** Advantageously, the household appliance according to the present invention is able to display by means of a display unit either incorporated into or remote from the household appliance itself an index of the cooking degree of a food item.

**[0011]** Furthermore, thanks to the present invention it is possible to obtain a household appliance which automatically notices the user about the cooking degree reached by a food item so as to promptly inform him if the desired cooking degree is reached.

**[0012]** Furthermore, thanks to the present invention it is possible to obtain a household appliance which interrupts cooking the food item in case the maximum foreseen cooking index is overcome.

**[0013]** A further advantage obtainable thanks to the household appliance according to the present invention is to make the household appliance more available and more enjoyable by the user.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**[0014]** Further characteristics and advantages of the present invention will appear more evident from the exemplary, and thus non-limiting, description of the preferred, but non-exclusive, embodiments of a household appliance able to display a cooking index of a food item, as illustrated in the enclosed drawings wherein:

- Figure 1 shows a block diagram view of an embodiment of the household appliance according to the present invention, such as for example a vertical hood, a ceiling hood or a cooktop provided with a downdraft incorporated hood or an electric oven;
- Figure 2 shows a set of graphs of physical quantities detected by sensors in a gas flow generated by cooking a food item in a predefined time range according to the present invention.

**DETAILED DESCRIPTION**

**[0015]** Even when not explicitly highlighted, the individual features described with reference to the specific embodiments must be considered as accessories and/or exchangeable with other features, described with reference to other embodiments.

**[0016]** Referring to the enclosed figure 1 there is shown in form of block diagrams a household appliance 1 according to the present invention.

**[0017]** Such block diagram of figure 1 is representative of a household appliance of the vertical hood, or ceiling hood or cooktop type with elements able to irradiate an electromagnetic field (i.e. provided with inductors or electrical resistors) provided with an incorporated downdraft hood or an electric oven or similar devices.

**[0018]** The household appliance 1 according to the present invention has the feature of generating a cooking

index or degree I of a food item.

**[0019]** To this end, the household appliance 1 comprises an electric motor and a fan (not shown in the figures) that is mechanically connected with the electric motor to channel a gas flow 2 along a predefined path 3.

**[0020]** Gases 2 comprise also cooking fumes that are generated by a food item 4 being cooked.

**[0021]** The predefined path 3 can be for example the funnel aspirating the fumes of a hood, or the path inside an oven chamber or the downward path performed by gases in case of a cooktop with a downdraft hood.

**[0022]** The step of cooking provides to supply a certain amount of heat C to the food item 4 for a first defined time range T1.

**[0023]** The household appliance comprises a plurality of transducers (or sensors) 5 to detect physical quantities present in the gas flow 2.

**[0024]** Each transducer can either be of the active type (i.e. generating a current or voltage signal, such as a thermocouple), and of the passive type (namely it outputs a variation of the electric parameter as resistance, capacity etcetera, such as potentiometers, extensometers, thermistors) so as to generate a signal S that is representative of a physical quantity.

**[0025]** To this end the household appliance comprises an interface 6 for converting the signal detected by the respective transducer.

**[0026]** According to an aspect, transducers 5 are arranged on one (or more) PCB (printed circuit board).

**[0027]** The PCB is supported by a frame, preferably made of plastic or the like (not illustrated in the figures).

**[0028]** Such frame has the function of serving as a support for fixing the PCB to an element of the household appliance 1.

**[0029]** The frame supporting the PCB is positioned so as to be concerned by the gas flow 2, namely it is arranged in the predefined path 3 along which gases are channelled.

**[0030]** In other words, the frame supporting the PCB is arranged in the path 3 and it is associated inside the household appliance (i.e. not visible to the user).

**[0031]** According to an aspect some of such transducers 5 may also be enclosed by a covering layer (or coating) so as to preserve the functions of the sensor even in case gases are contacted during possible cleaning operations by the user or possible maintenance operations.

**[0032]** According to an aspect, such covering layer (or coating) is provided with surface openings adapted to make gases pass through so as to concern transducers 5 and detect the concerned quantities.

**[0033]** It is worth noting that such openings must in any case be configured to prevent, for example, a user's fingers or a tool, for example the end of a screwdriver or similar tools from entering.

**[0034]** The plurality of sensors 5 is selected from the group comprising Volatile Organic Compound (VOC), Particulate Matter (PM), air relative humidity, tempera-

ture, carbon dioxide sensors.

**[0035]** For example, transducers for measuring the relative humidity, temperature are protected by the covering layer (or coating) whereas optical transducers, such as VOC or PM, are not provided with it.

**[0036]** It is worth noting that the PM transducer is intended to detect particulate matter quantities typically comprised between 0.1  $\mu\text{m}$  and 10  $\mu\text{m}$ .

**[0037]** In one embodiment, in order to generate the index of the cooking degree I of the food item 4, it is sufficient that the assembly comprises only VOC and PM sensors. Obviously, using also the other types of sensors the reliability level of the index of the cooking degree I of the food item 4 is higher.

**[0038]** It is worth noting here that in order to generate such index I of the food item 4 other information from other sensors can also be used such as for example information on the state of the household appliance (i.e. motor speed, power of the cooktop, preset cooking temperature etcetera).

**[0039]** The household appliance 1 comprises a processing unit 7 in signal communication with a plurality of sensors 5, through for example the interface 6, to process each signal S generated by each transducer.

**[0040]** The household appliance 1 comprises a memory 8 in signal communication with the processing unit 7.

**[0041]** Advantageously, the household appliance 1 comprises a program 9 residing in such memory 8 which is configured to determine the cooking degree I of the food item 4.

**[0042]** It is worth noting that in an alternative, not illustrated, embodiment the memory wherein the program resides may be that of a server arranged remote from the household appliance and the latter is connected to such server through for example a TCP/IP protocol-based communication. For example, one implementation may be the so called "cloud" system, where the household appliance may have a network card or a Wi-Fi module enabling it to interface directly or through a smartphone or a similar hardware/software instrument, provided with a suitable "app", with the remote server to execute the computational part of the program. In particular, a thus configured system would benefit from decentralising the heavy computational step so as to provide the household appliance with a particularly performing processing unit reducing the cost of the household appliance.

**[0043]** In particular, also referring to figure 2, the program 8 provides to establish a time correlation between the various signals processed by the processing unit 7.

**[0044]** In other words, the program 8 performs a time correlation between the various signals S so as to identify a peculiar pattern that allows to define in the time range T2 the cooking degree I, as explained in greater detail hereinafter.

**[0045]** It is worth noting that the second time range T2 has a time duration that may be lower, equal or higher than the range T1.

**[0046]** For example, time range T1 represents the

period when heat C is supplied to the food item 4 and range T2 represents duration of the circulation/suction step of gases. Such second range T2 may start and end exactly when T1 starts and ends but it may also start and end differently i.e. it may start before or after and end sooner or later the duration of range T1.

**[0047]** Referring now to figure 2, there is represented the trend during the range T2 of signals S generated by the various sensors once heat C is supplied to the food item 4 during the range T1.

**[0048]** In particular, the graphic portions:

- "a-d" respectively refer to the PM sensor which in portion "a" detects the PM up to 0.3  $\mu\text{m}$ , in "b" up to 0.5  $\mu\text{m}$ , in "c" up to 1  $\mu\text{m}$  and in "d" up to 10.0  $\mu\text{m}$ ;
- "e" refers to the VOC sensor which operates in a way that is inversely proportional to the concentration;
- "f" refers to the relative humidity sensor.

**[0049]** According to an aspect for comparison and correlation it is for example provided an open loop control (or feedback).

**[0050]** According to an aspect the cooking degree I may be defined, for example, by means of a variable arbitrary scale between a minimum identified by level 1 and a maximum indicated by level 5, where levels 4 and 5 indicate a state of overcooking the food item 4.

**[0051]** The index I is not static while periods T1 and/or T2 progress but varies according to the result of the correlation. However, at a specific moment of periods T1 and/or T2 the index I expresses a value that is representative of the cooking degree reached by the food item 4 at that determined moment.

**[0052]** According to an aspect, the program 8 is provided with a step able to perform a step of comparing each processed signal S with its own reference signal in order to determine the type of food item 4.

**[0053]** Such comparison provides comparing the signal S generated for example by the PM transducer (figure 2, graphic portion a-d), by the humidity transducer (figure 2, graphic portion f) and by the VOC transducer (figure 2, graphic portion e) with a respective reference signal so as to identify the type of food item being cooked and subsequently assess the cooking degree I of the food item 4.

**[0054]** The household appliance 1 comprises a display unit 10 in signal communication with the processing unit 7 to display the cooking degree I.

**[0055]** The display unit 10 may display other possible messages, for example warnings or other indications on the state of the household appliance 1 or of the food item 4.

**[0056]** For example, the type of food item 4 being cooked may be selected directly by the user through such display unit 10 so as to avoid the possible step of comparing to determine the type of food item being cooked.

**[0057]** The display unit 10 is made incorporated into or remote from the household appliance 1 and comprises a

display screen and a graphic interface (not illustrated in the figures) that are visible to the user on which the cooking degree scale I may be reported.

**[0058]** In case the display unit 10 is made remote from the household appliance 1, such display unit 10 is formed in a device selected from the group comprising a smart-phone, a tablet, a personal computer. In such scenario, the signal communication with the processing unit 7 and the display unit 10 comprises a wired or wireless connection. In case of wireless communication it is preferably provided to use communication protocols based on Wi-Fi or Bluetooth, ZigBee or Thread network.

**[0059]** In use, when the food item 4, which in the specific case of such figures is a hamburger, is being cooked during the T1 period, sensors 5 each detect their own type of physical quantity and generate, respectively, the signals S processed during the T2 range.

**[0060]** For example, after starting supplying heat C, and at the beginning of the T2 range, zone 11, it can be noted that there are no relevant variations as for signals except for humidity of the food item being heated (portion "f").

**[0061]** As time T1 passes by and during T2, it can be detected that the step of cooking the food item 4 has started in that, zones 12, particulate matter particles of increasingly growing size (portions "a-d") start to appear, that the signal relative to the presence of VOCs undergoes variations (portion "e") as well as the signal relative to humidity is irregular (portion "f").

**[0062]** As time T1 passes by and during T2, it can be noted that, zones 13, the presence of fine particulate matter (portions "a-c") increases, the slope of the VOC curve (portion "e") varies while humidity returns to the initial levels (portion "f"). In such case the program 8 generates on the display unit 10 the index I that is for example equal to value 1.

**[0063]** As time T1 keeps on passing by and during T2, it can be noted, zones 14, appearing higher-size particulate (portions "b-d"), saturation of the presence of the fine particulate (portion "a"), saturation of the VOC sensor (portion "e") and substantially absence of relative humidity (portion "f"). In such case the program 8 generates on the display unit 10 the index I that is for example equal to value 2.

**[0064]** In case the control unit monitoring, processing and managing all the above described functions detects that an overcooking step is occurring, i.e. that the index value I is higher than 4 or 5, then, if the concerned household appliance is a cooktop or an oven of the above identified type, it will activate a suitable program to interrupt the step of supplying heat C to the food item 4.

**[0065]** Obviously, an expert in the field may bring several modifications and variants to the aforementioned configurations for the purpose to fulfil contingent and specific needs. Such variants and modifications are all also contained within the scope of protection of the invention as defined in the following claims.

## Claims

1. A suction hood (1) selected from the group comprising a vertical hood, a ceiling hood or a cooktop provided with an incorporated downdraft hood, the suction hood (1) comprising:
- an electric motor;
  - a fan which is mechanically connected with said electric motor to channel a gas flow (2) along a predefined path (3), the gases being generated by a food item (4) being cooked,
  - a plurality of transducers (5) for detecting physical properties present in said gas flow (2), each transducer being configured to generate a signal (S) corresponding to a physical quantity, said plurality of sensors being selected at least from the group comprising VOC and PM sensors;
  - a PCB whereon at least a part of said plurality of sensors (5) is arranged, said PCB is supported by a frame which is positioned in the predefined path (3) along which gases are channelled;
- characterized in that** the suction hood (1) comprises:
- a processing unit (7) in signal communication with said plurality of sensors (5) to process each signal generated by each transducer;
  - a memory (8) in signal communication with said processing unit (7);
  - a program (9) residing in said memory (7), said program (8) being configured to determine a cooking degree (I) of a food item (4) based on a time correlation between the various signals (S) processed by the processing unit (7);
  - a display unit (10) in signal communication with said processing unit (7) to display said cooking degree (I).
2. The suction hood (1) according to claim 1, wherein one or more of said plurality of transducers (5) is enclosed by a coating layer.
3. The suction hood (1) according to claim 2, wherein said coating layer comprises surface openings adapted to allow the passage of gases but to prevent the passage of a tool.
4. The suction hood (1) according to claim 1, said plurality of transducers (5) comprises humidity, temperature, carbon dioxide concentration sensors.
5. The suction hood (1) according to claim 1, wherein said program (9), before said step of determining said cooking degree (I), performs a step of comparing each processed signal (S) with a reference signal thereof to determine the type of food item (4).

6. The suction hood (1) according to any one of the preceding claims, wherein said display unit (10) is incorporated into or remote from said household appliance and comprises a display screen and a graphic interface available to the user on which said cooking degree may be displayed.
7. The suction hood (1) according to claim 6, wherein said display unit that is remote from said household appliance is selected from the group comprising a smartphone, a tablet, a personal computer and said communication between said signal with said processing unit comprises a wired or wireless connection.
8. The suction hood (1) according to claim 1, wherein said processing unit (7) is incorporated into or remote from said household appliance.

## Patentansprüche

1. Abzugshaube (1), ausgewählt aus der Gruppe, umfassend eine vertikale Haube, eine Deckenhaube oder ein Kochfeld, bereitgestellt mit einer integrierten Downdraft-Haube, die Abzugshaube (1) umfassend:
- einen Elektromotor;
  - einen Lüfter, der mechanisch mit dem Elektromotor verbunden ist, um einen Gasstrom (2) entlang eines vordefinierten Pfads (3) zu leiten, wobei die Gase durch ein gekochtes Nahrungsmittel (4) erzeugt werden,
  - eine Vielzahl von Wandlern (5) zum Erfassen von physikalischen Eigenschaften, die in dem Gasstrom (2) vorhanden sind, wobei jeder Wandler konfiguriert ist, um ein Signal (S) zu erzeugen, das einer physikalischen Größe entspricht, wobei die Vielzahl von Sensoren zumindest ausgewählt ist aus der Gruppe, umfassend VOC- und PM-Sensoren;
  - eine Leiterplatte, auf der mindestens ein Teil der Vielzahl von Sensoren (5) angeordnet ist, wobei die Leiterplatte von einem Rahmen getragen wird, der in dem vordefinierten Pfad (3) positioniert ist, entlang dessen Gase geleitet werden; **dadurch gekennzeichnet, dass** die Abzugshaube (1) Folgendes umfasst:
  - eine Verarbeitungseinheit (7) in Signalverbindung mit der Vielzahl von Sensoren (5), um jedes Signal zu verarbeiten, das von jedem Wandler erzeugt wird;
  - einen Speicher (8) in Signalverbindung mit der Verarbeitungseinheit (7);
  - ein Programm (9), das in dem Speicher (7) residiert, wobei das Programm (8) konfiguriert ist, um die Abzugshaube (1) zu steuern.

- riert ist, um einen Kochgrad (I) eines Nahrungsmittels (4) basierend auf einer Zeitkorrelation zwischen den verschiedenen Signalen (S) zu bestimmen, die von der Verarbeitungseinheit (7) verarbeitet werden;
- eine Anzeigeeinheit (10) in Signalverbindung mit der Verarbeitungseinheit (7), um den Kochgrad (I) anzuzeigen.
2. Abzugshaube (1) nach Anspruch 1, wobei einer oder mehrere der Vielzahl von Wandlern (5) von einer Beschichtungsschicht umschlossen ist/sind.
  3. Abzugshaube (1) nach Anspruch 2, wobei die Beschichtungsschicht Oberflächenöffnungen umfasst, die angepasst sind, um den Durchgang von Gasen zu ermöglichen, aber den Durchgang eines Werkzeugs zu verhindern.
  4. Abzugshaube (1) nach Anspruch 1, wobei die Vielzahl von Wandlern (5) Feuchtigkeits-, Temperatur- und Kohlendioxidkonzentrationssensoren umfasst.
  5. Abzugshaube (1) nach Anspruch 1, wobei das Programm (9) vor dem Schritt eines Bestimmens des Kochgrads (I) einen Schritt eines Vergleichens von jedem verarbeiteten Signal (S) mit einem Referenzsignal davon durchführt, um die Art des Nahrungsmittels (4) zu bestimmen.
  6. Abzugshaube (1) nach einem der vorherigen Ansprüche, wobei die Anzeigeeinheit (10) in das Haushaltsgerät integriert oder davon entfernt ist und einen Anzeigebildschirm und eine grafische Oberfläche umfasst, die dem Benutzer zur Verfügung steht, auf der der Kochgrad angezeigt werden kann.
  7. Abzugshaube (1) nach Anspruch 6, wobei die Anzeigeeinheit, die von dem Haushaltsgerät entfernt ist, ausgewählt ist aus der Gruppe, umfassend ein Smartphone, ein Tablet, einen Personalcomputer, und die Kommunikation zwischen dem Signal und der Verarbeitungseinheit eine drahtgebundene oder drahtlose Verbindung umfasst.
  8. Abzugshaube (1) nach Anspruch 1, wobei die Verarbeitungseinheit (7) in das Haushaltsgerät integriert oder davon entfernt ist.
- un moteur électrique ;  
 - un ventilateur qui est relié mécaniquement audit moteur électrique pour canaliser un flux de gaz (2) le long d'un chemin prédéfini (3), les gaz étant générés par un aliment (4) en cours de cuisson,  
 - une pluralité de transducteurs (5) pour détecter les propriétés physiques présentes dans ledit flux de gaz (2), chaque transducteur étant configuré pour générer un signal (S) correspondant à une quantité physique, ladite pluralité de capteurs étant sélectionnée au moins dans le groupe comprenant les capteurs VOC et PM ;  
 - un PCB sur lequel au moins une partie de ladite pluralité de capteurs (5) est disposée, ledit PCB est supporté par un cadre qui est positionné dans le chemin prédéfini (3) le long duquel les gaz sont canalisés ;
- caractérisée en ce que** la hotte aspirante (1) comprend :
- une unité de traitement (7) en communication de signal avec ladite pluralité de capteurs (5) pour traiter chaque signal généré par chaque transducteur ;  
 - une mémoire (8) en communication de signal avec ladite unité de traitement (7) ;  
 - un programme (9) résidant dans ladite mémoire (7), ledit programme (8) étant configuré pour déterminer un degré de cuisson (I) d'un aliment (4) sur la base d'une corrélation temporelle entre les différents signaux (S) traités par l'unité de traitement (7) ;  
 - une unité d'affichage (10) en communication de signal avec ladite unité de traitement (7) pour afficher ledit degré de cuisson (I).
2. Hotte aspirante (1) selon la revendication 1, dans laquelle un ou plusieurs de ladite pluralité de transducteurs (5) sont enfermés par une couche de revêtement.
  3. Hotte aspirante (1) selon la revendication 2, dans laquelle ladite couche de revêtement comprend des ouvertures de surface adaptées pour permettre le passage de gaz mais pour empêcher le passage d'un outil.
  4. Hotte aspirante (1) selon la revendication 1, ladite pluralité de transducteurs (5) comprenant des capteurs d'humidité, de température et de concentration de dioxyde de carbone.
  5. Hotte aspirante (1) selon la revendication 1, dans laquelle ledit programme (9), avant ladite étape de détermination dudit degré de cuisson (I), effectue une étape de comparaison de chaque signal traité

## Revendications

1. Hotte aspirante (1) sélectionnée dans le groupe comprenant une hotte verticale, une hotte de plafond ou une table de cuisson munie d'une hotte à courant descendant incorporée, la hotte aspirante (1) comprenant :

(S) avec un signal de référence de celui-ci pour déterminer le type d'aliment (4).

6. Hotte aspirante (1) selon l'une quelconque des revendications précédentes, dans laquelle ladite unité d'affichage (10) est incorporée dans ou éloignée dudit appareil ménager et comprend un écran d'affichage et une interface graphique disponible pour l'utilisateur sur laquelle ledit degré de cuisson peut être affiché. 5 10
7. Hotte aspirante (1) selon la revendication 6, dans laquelle ladite unité d'affichage qui est éloignée dudit appareil ménager est choisie dans le groupe comprenant un smartphone, une tablette, un ordinateur personnel et ladite communication entre ledit signal et ladite unité de traitement comprend une connexion filaire ou sans fil. 15
8. Hotte aspirante (1) selon la revendication 1, dans laquelle ladite unité de traitement (7) est incorporée dans ou à distance dudit appareil ménager. 20

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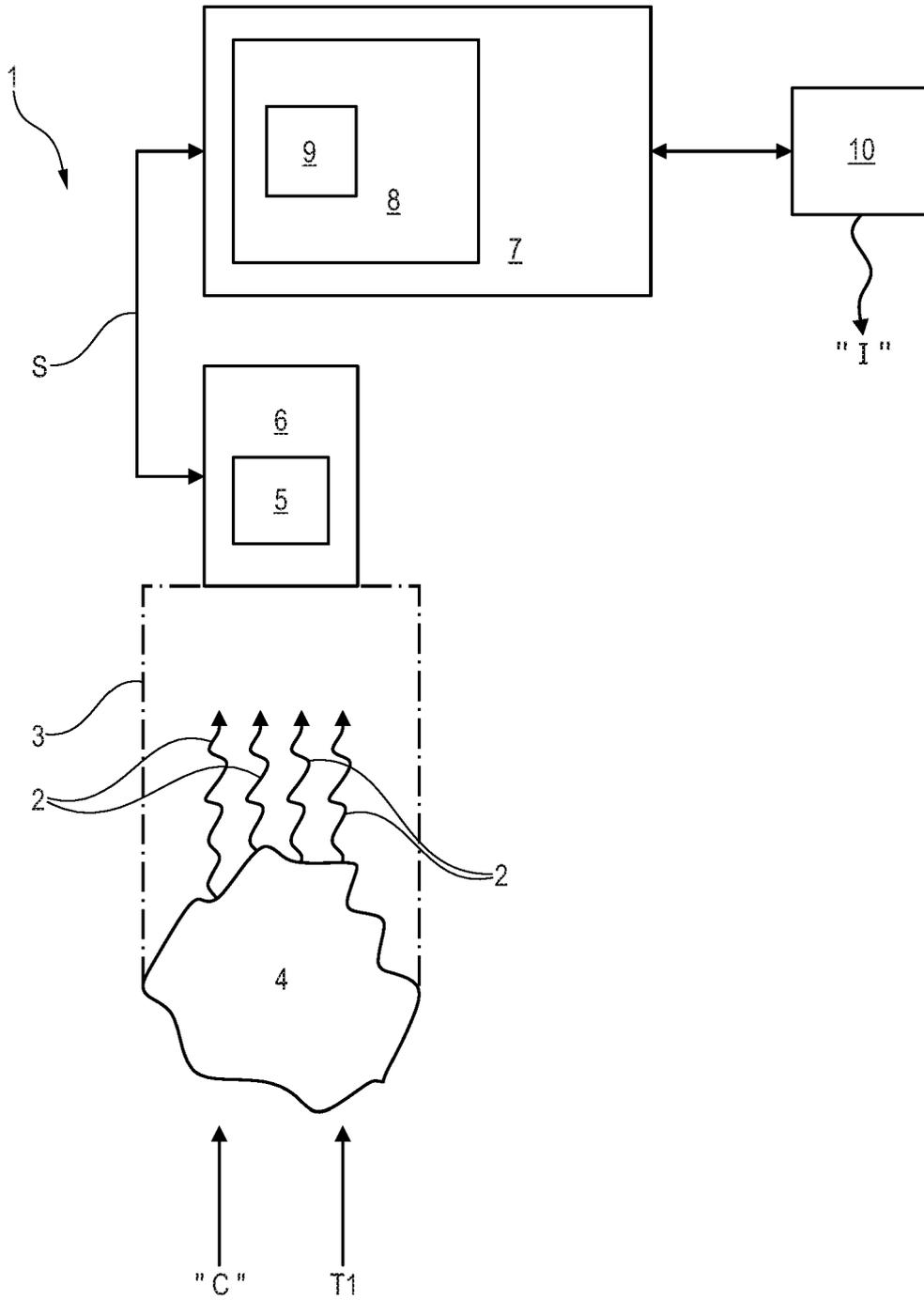


Fig. 1

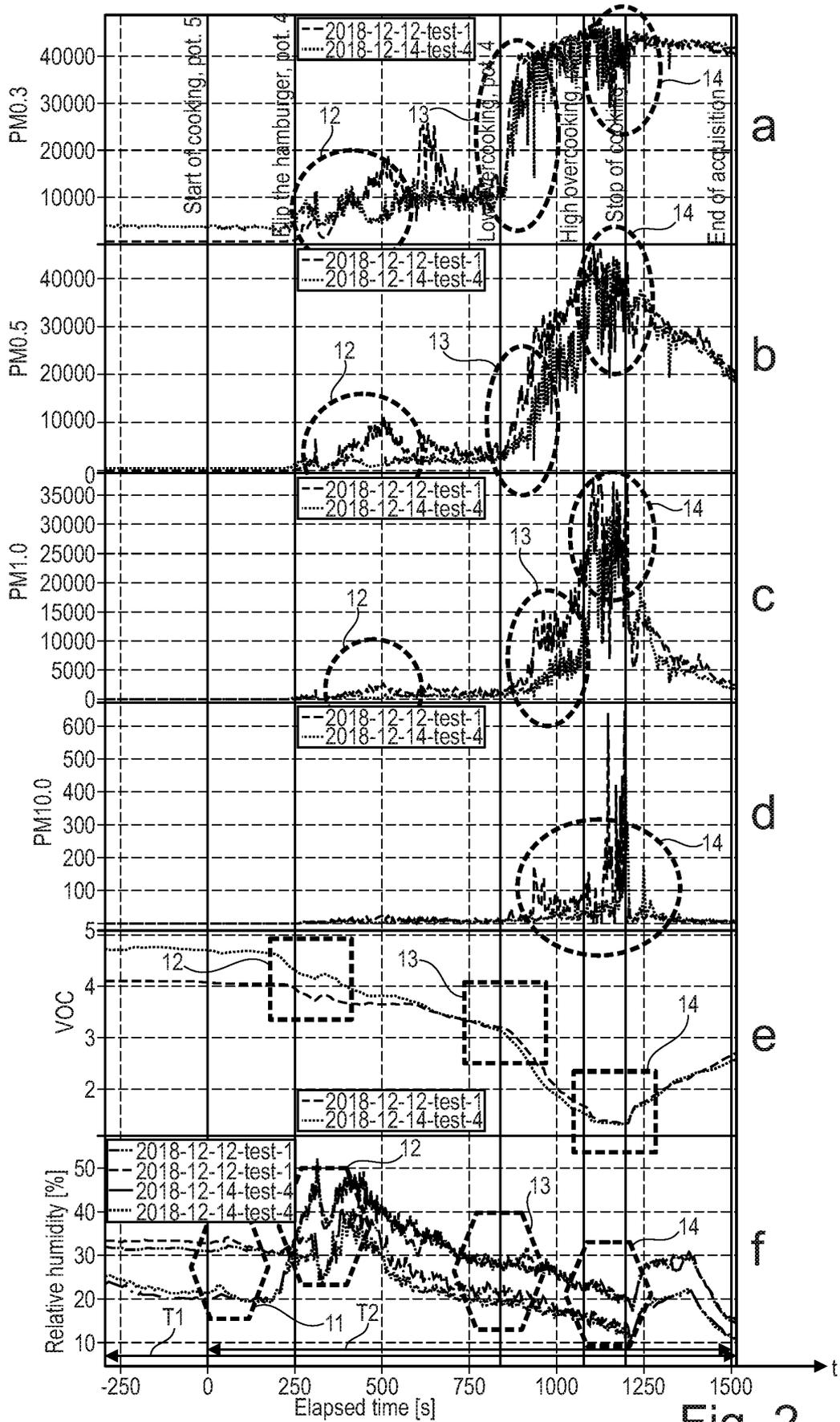


Fig. 2

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

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