

COOKING APPLIANCE WITH A CATALYTIC BURNER

The present invention relates to a cooking appliance with a catalytic burner.

The document EP-A-0 520 913 described a heating
5 appliance comprising in general terms:

- a catalytic burner consisting of at least one member for mixing or admixing primary combustive air with a stream of fuel gas in order to obtain a mixture to be burnt; the flow rate of fuel gas being controlled
10 by a valve or other equivalent control means, and the primary air being carried along by the stream of fuel gas; at least one chamber for distributing the mixture to be burnt, and a catalytic combustion structure, through which the mixture passes from its face which is upstream in relation to the distribu-
15 tion chamber to its downstream face, discharging the combustion smoke;
- a thermal receiver located at a distance from the catalytic combustion structure, extending on the
20 inside opposite one of the faces of this structure, in this particular case opposite its upstream face, over virtually the entire surface of the said structure, and arranged and designed to dissipate on the outside at least some of the thermal energy received
25 from the actual catalytic burner mainly by radiation and additionally by convection.

The document EP-A-0 469 251 described and provided a heating appliance with a catalytic burner, of the same type as that defined above, but differing from the
30 latter in the following main technical characteristics:

- the primary combustive air is pulsated by a fan and is mixed with the fuel gas in order to obtain the mixture to be burnt;
- the thermal receiver extends on the inside opposite
35 the downstream face of the catalytic combustion structure, via which face the combustion smoke is

discharged;

- by virtue of a suitable arrangement insulating the cooking appliance, and particularly the catalytic burner, from the outside, there is a chamber for collecting the combustion smoke discharged by any suitable means.

According to the present invention, by "cooking appliance" is meant, in general terms, any appliance, portable or not, integral or connected to a source of fuel gas, for example town gas under low pressure or reduced pressure, and utilizing the combustion heat generated by the catalytic burner for cooking purposes. Various cooking devices for domestic or professional use, for example a cooking top, conform to the above definition. Such a cooking appliance comprises, where appropriate, other elements or members allowing it to be used for the adopted function or intended purpose, for example means for integration into a cooking surface, if the cooking appliance in question is a cooking hob of the domestic type.

The following description will, by way of non-limiting example, introduce, define, present and explain the present invention by reference to a cooking hob integrated into a domestic cooking top or surface.

By "catalytic structure" or "catalytic combustion structure" is meant any structure permeable to the mixture to be burnt and generating a pressure drop during the passage of this mixture from the upstream face to the downstream face of the structure in question. This structure extends, in area, transversely or perpendicularly to the direction of passage of the mixture to be burnt. This structure comprises a support inert towards the mixture to be burnt, the fuel gas and combustion gases and mechanically or chemically resistant to the high temperatures generated as a result of catalytic combustion. This support is covered, at least on its inner surface or inner surfaces, directly or indirectly by an actual catalytic material, such as platinum or platinum salts, which catalyzes combustion. The above

definition embraces, on the one hand, the so-called "honeycomb" catalytic structures consisting of a slab or core of refractory material, such as ceramic or metal, through which passes a plurality of adjacent transverse ducts, and, on the other hand, structures of the catalytic fabric or catalytic screen type.

The object of the present invention is to provide means enabling the user to carry out a fine adjustment or setting of the heating power of the cooking appliance continuously within a relatively wide range or interval of values, without any interruption in the functioning of the catalytic burner and whilst maintaining the performance of catalytic combustion at an optimum level.

According to the present invention, in combination:

- on the one hand, the member for the manual control of the flow of fuel gas, for example the valve, is arranged so as to allow a continuous and independent variation of the said flow;
- and, on the other hand, the appliance comprises a member for controlling the rate of aeration of the mixture to be burnt, the said member being arranged so as not to act on the flow of fuel gas under normal operating conditions, that is to say so as not to command the member for controlling the said flow, but being arranged so as to act at least on the flow of combustive air pulsated by the fan, as a function of the flow of fuel gas controlled independently by the user by means of the manual control member, [sic]; under normal operating conditions, the control mode increases the flow of combustive air when the flow of fuel gas increases and, conversely, decreases the said flow of combustive air when the flow of fuel gas decreases.

By virtue of the invention, a cooking appliance is obtained which has both great flexibility and high accuracy in the heating power available for cooking, simply by setting the flow of fuel gas manually. This allows all kinds of cooking, from "simmering" to full

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cooking, on the one hand, whilst making it possible to carry out a relatively fine adjustment of the power of the catalytic burner on each cooking area, including simmering, on the other hand.

5 Another object of the present invention is to improve the functioning of a cooking appliance, as defined above, by maintaining the performance of catalytic combustion at an optimum level, whatever the heating power of the appliance which, moreover, is set by
10 the user.

According to the present invention, a cooking appliance comprising a fan pulsating the primary combustible air comprises, furthermore, a member for controlling the rate of aeration of the mixture to be burnt, as a
15 function of the flow of fuel gas controlled by the valve, and acting on the flow of combustible air pulsated by the fan, in order, under normal operating conditions, to increase the latter when the flow of fuel gas increases and, conversely, decrease it when the flow of fuel gas
20 decreases.

Preferably, but as an example, the control member is arranged so as, under normal operating conditions, to maintain the rate of aeration of the mixture to be burnt within a range of between 0.8 and 1.5.

25 The present invention is now described with reference to the accompanying drawing in which:

- Figure 1 shows a general diagram of a cooking hob according to the invention, completed by a member and various control means;
- 30 - Figure 2 shows an embodiment, of the electromechanical type, of the member and control means of the cooking hob shown in Figure 1.

The cooking hob shown in Figure 1 is integrated into or belongs to a horizontal cooking top or surface illustrated diagrammatically by the reference numeral 31;
35 this cooking top 31 may comprise one or more cooking hobs, such as those described below. The or each hob is associated with a member or valve 4 for the manual control of the fuel gas 3, a safety solenoid :



ling the supply of fuel gas, and a member 11 for controlling the rate of aeration of the mixture 7 to be burnt, all these components or means being located under the cooking top 31 in any suitable arrangement, whilst the control handwheel 18 of the valve 4 and the axial button 32 for the manual actuation of the solenoid 22 are mounted above the cooking top 31 so as to be accessible to the user or operator of the cooking hob.

As shown in Figure 1, the complete cooking appliance or cooking hob according to the invention comprises:

- an actual catalytic burner 1 fitted into the cooking top 31;
- a thermal receiver 10 which is arranged horizontally just above the cooking surface 31 and the upper or outer face or side of which can thus receive or support a thermal load, for example a saucepan;
- the valve 4 for the manual control of the flow of fuel gas 3 and the safety solenoid 22, mounted and integrated coaxially in the valve 4, as described below, of which the respective manual control members 18 and 32 are arranged outside and above the cooking top 31; the valve 4 makes it possible to vary the flow of fuel gas continuously, for example from a zero value to a maximum value, by the sole action of the user or operator, independently of the control member 11 defined below;
- a fan 6 which is driven by an electric motor (not shown), pulsates the primary combustive air 5 and is itself arranged below the cooking surface 31;
- and the member 11 for controlling the rate of aeration of the mixture to be burnt 7, comprising any suitable control means 12 of the electric, electronic, electromechanical or microelectronic type, arranged suitably for carrying out the control procedure adopted according to the invention and defined below; according to Figure 2, the control means 12 explained are of the electromechanical type; the control member 11 and its various auxili-

ary elements described below are integrated into the cooking top 31 so as to be concealed from the user or operator.

The catalytic burner 1 consists of a member 2 for
5 mixing the fuel gas 3, controlled by the valve 4 and/or the solenoid 22, and the primary combustive air 5 pulsed by the fan 6, in order to obtain at its outlet a stream of the mixture 7 to be burnt. The fuel gas under low pressure, for example natural gas, may be introduced
10 into the member 2 by any suitable means, for example a simple injector.

According to a suitable arrangement not described in detail, and with reference to Figure 1, it is possible to see in the actual catalytic burner 1:

- 15 - a chamber 8 for distributing the mixture to be burnt, the inlet of which chamber communicates with the mixing member 2;
- a catalytic combustion structure 9 which is arranged transversely or perpendicularly relative to the
20 direction of circulation of the gases and through which the mixture to be burnt passes from its upstream face 9a in relation to the distribution chamber 8 to its downstream face 9b discharging the combustion smoke;
- 25 - a chamber 33 for collecting the combustion smoke, the said chamber being in relation to the downstream face 9b of the catalytic combustion structure 9 and discharging the smoke towards the outside and above the cooking top 31 around the distribution chamber
30 8.

In view of the arrangement described above, during operation the flameless radiant catalytic combustion front is established in the vicinity of the upstream face 9a of the catalytic structure 9.

35 The thermal receiver 10, consisting of a circular glass-ceramic plate, is supported above the cooking top 31 by a thermally insulated ring 34 and closes the chamber 8 for distributing the mixture to be burnt. This receiver 10 is arranged horizontally at a distance from

the catalytic structure 9 and extends on the inner or lower side, opposite the upstream face 9a of the structure 8 [sic], over virtually the entire surface of the latter, so as to receive the heat generated by the catalytic burner 1, mainly by radiation. The thermal receiver 10 dissipates on the outer or upper side at least some of the thermal energy received by radiation and convection from the catalytic burner 1, towards any thermal load, for example, a saucepan arranged substantially horizontally in the position of use on the receiver or glass-ceramic plate 10 which is itself horizontal.

The valve 4 for the manual control of the flow of fuel gas 3, the safety solenoid 22 controlling the supply of fuel gas 3 and their respective control means 18 (control handwheel) and 32 (pushbutton) form one and the same component which is conventional in that several manufacturers, for example the French company Sauter, manufacture and sell them, for example in a cooking top sold under the commercial reference LINEAFLAMME in 1995, as regards the abovementioned company. The description of this component will therefore be limited below to its elements or parts essential for the functioning or control of the cooking appliance according to the invention.

The valve 4 is of the plug type and comprises a body 16 with an axial bore 16a, and a rotary element or plug 17 which is fitted in an adjusted manner in the bore 16a and of which the rotational position in relation to the body 16 determines the flow of fuel gas passing through the valve 4, and of which the rotation in relation to the body 16 varies the same flow continuously. The control handwheel 18 is connected in terms of rotation to the rotary element or plug 17.

The safety solenoid 22 is mounted coaxially in the valve 4, more specifically coaxially relative to the plug 17, in order to control the supply of fuel gas 3 in the open or closed position. This solenoid comprises:

- a shutter 24 cooperating with a seat made in the

body 16 of the valve 4;

- a control tappet 32 emerging at the centre of the control handwheel 18 of the valve 4 and movable in translational motion relative to the handwheel 18 in order to bring the shutter 24 manually into the open position;
- a return means or spring 27 which is mounted between a shoulder made inside the plug 16 and the tappet 32, in order to return the latter away from the shutter 24;
- an electromagnet 23 arranged coaxially relative to the shutter 24, opposite the tappet 32, and making it possible, when energized, to keep the shutter 24 in the open position.

15 The main function of the control member 11 is to command the rate of aeration of the mixture 7 to be burnt, as a function of the flow of fuel gas 3, itself controlled manually and independently by means of the valve 4 by the user or operator, depending on the operating mode and heating power desired by the latter. For
20 this purpose, the control member 11 acts on the flow of combustive air 5 pulsated by the fan 6, in order, under normal operating conditions, to increase the flow of pulsated combustive air when the flow of fuel gas
25 increases and to decrease the flow of pulsated combustive air when the flow of fuel gas decreases.

Preferably, but in a non-limiting way, the control member 11 is arranged so as, under the normal operating conditions of the cooking appliance, to keep
30 the rate of aeration of the mixture to be burnt 7 within a range of between 0.8 and 1.5.

Preferably, but in a non-limiting way, the flow of pulsated combustive air 5 is increased or decreased discontinuously, in particular in successive stages.

35 For this purpose, the control member 11 communicates:

- by means of a control line 13 with a means for controlling the speed of the fan 6, in particular the supply voltage of the electric motor driving it;

- and by means of a detection line 14 with a sensor 19 sensing the relative rotational position of the rotary element or plug 17 in relation to the body 16 of the valve 4; preferably, as shown in Figure 1, the sensor 19 comprises, on the one hand, a traveller 20 integral in terms of rotation with the rotary element or plug 17 or with the control handwheel 19 [sic] and, on the other hand, a series of fixed studs 21a to 21d for electrical contact with the traveller 20 during its own rotation, the said studs being connected electrically to switching means inserted in the electrical supply circuit of the electric motor of the fan 6.

Preferably, the valve 4 and the various elements composing it are arranged to correspond with the control handwheel 18 and the various studs of the sensor 19, in such a way that:

- the position 15 corresponds to the complete stop of the flow of fuel gas or a zero flow of the latter;
- 20 - the relative rotational position corresponding to contact between the traveller 20 and the first stud 21a, corresponds to the starting of the catalytic burner 1, on the one hand, and to the full flow of fuel gas 3;
- 25 - the continuation of the rotation of the handwheel 18 corresponds to a progressive decrease in the flow of fuel gas, with the traveller 20 passing over the studs 21b, 21c and 21d respectively, corresponding to successive stages in the decrease of the flow of pulsated combustive air 5.

The said control means 11 are also arranged so as to keep the rate of aeration of the mixture to be burnt within a range of between 0.8 and 0.9 during a starting phase of the catalytic burner 1, the said phase being marked or detected, for example, by the passage of the valve 4 from its stop position 15 to its open position corresponding to the stud 21a.

Moreover, the control member 11 comprises a sensor 25 for sensing the temperature within and in the

vicinity of the catalytic combustion structure 9, the said sensor being connected by means of a line 36 to the said member 11. The latter is also arranged so as to control the solenoid 22, and more specifically the electromagnet 23, into the open position, if the operating temperature of the said structure is at least equal to a nominal value, and into the closed position, if this same operating temperature is below this nominal value. This same control member 11 is also arranged so as to control the keeping of the solenoid 22, and more specifically the electromagnet 23, in the open position for a predetermined time corresponding to the abovementioned starting phase of the catalytic burner 1, the said phase being marked, as before, by the passage of the valve from its stop position 15 to its open position indexed by the stud 21a.

This control of the solenoid 22 under normal operating conditions makes it possible to improve safety in the use of a heating appliance according to the invention, in that, on the one hand, the extinguishing of catalytic combustion and, on the other hand, any catching fire upstream of the catalytic structure 9, in particular in the distribution chamber 8, lead automatically to the closing of the solenoid 22.

The above arrangements associated with the detection of the operating temperature of the catalytic structure 9 may be completed by an indicator light 26 which is connected by means of a line 37 to the control member 11 and is controlled by the latter so as to light up if the operating temperature is at least equal to the nominal value and be extinguished if the operating temperature is below this nominal value.

The control member 11 is also arranged so as to keep the flow of pulsated combustive air 5 at a non-zero value, for example by controlling the supply voltage of the motor driving the fan 6, this being for a predetermined period during the stopping of the catalytic burner 1, the said period being marked or detected by the return passage of the traveller 20 over the stud 21a, the flow

of fuel gas 3 consequently having a zero value during the said period.

In conclusion, the appliance also comprises a generator 28 for generating at least one electrical spark, in the vicinity of the downstream face 9b of the catalytic combustion structure 9, with the generator being connected to the control member 11 by means of a line 38. This member 11 is arranged so as to control the generator 28 temporarily during the starting phase of the catalytic burner, the said phase being marked, as mentioned above, by the passage of the valve 4 from the stop position 15 to the open position commencing at the stud 21a.

As an example, the electromechanical design 12 of the above-described control member 11 in relation to its various auxiliary elements is shown by the circuit diagram of Figure 2, in which the same reference numerals as those used in Figure 1 indicate the same elements, components or members.

This electromechanical design is characterized by the assembly of the following main elements:

- a trip relay 39 comprising two contacts 391 and 392, and connected to the stud 21a, in relation to the control handwheel 18;
- three trip relays 40, 41, 42 connected, on the one hand, to the three studs 21b to 21d respectively, in relation to the control handwheel 18, and, on the other hand, by means of a single contact 401, 411, 421, to three variable resistors 43, 44, 45 respectively;
- a slow-closing relay 46, the output of which communicates, according to the position of its electrical contact, with one or other of two different variable resistors 48 and 49 arranged in parallel in the supply circuit of the electric motor of the fan 6;
- a slow-opening relay 47 with two electrical contacts, controlling the supply of the relay 46 and of its contact;

- a comparator 30 connected to the operating temperature sensor 25, to the operating indicator light 26 and to the electromagnet 23 of the solenoid 22 and making it possible to subject the operation of the indicator light 26 and of the electromagnet 23 to the operating temperature of the catalytic structure 9;
- an electrical circuit supplied by a battery 75 and connecting the abovementioned elements to one another and to the motor of the fan 6.

The sequential operation of the cooking appliance or hob described above stems from the explanations given above and may be set out as follows.

Pressing on the control button 32 and rotating the control handwheel 18 manually from its stop position 15 as far as the stud 21a triggers the following operations:

- complete manual opening of the solenoid 22, with the shutter 24 kept in the open position, by the energization of the electromagnet 23;
- passage of a flow of fuel gas 3 from a zero value to a maximum value;
- discharge of a train of sparks from the generator 28;
- supply of the electronic comparator 30 as a result of the closing of the contact 391 of the relay 39; from this moment, on the one hand, during a starting phase delayed, for example, for 30 s, the solenoid 22 is kept in the open position, and, on the other hand, beyond the starting phase, the electromagnet 23 of the solenoid 22 remains energized, if the operating temperature detected by the sensor 25 is at least equal to the nominal value, or is deenergized, if the operating temperature becomes lower than this nominal value; in parallel with the energization or deenergization of the electromagnet 23, the indicator light 26 lights up or is distinguished;
- supply of the relay 46, delayed by the relay 47, as

a result of the closing of the contact 392 of the relay 39, the said supply of the relay 46 causing the motor of the fan 6 to be supplied, with the resistor 49 being interposed in series, thus bringing about a lower flow of pulsated combustive air 5, and then with the resistor 48 being interposed in series, thus bringing about the full flow of pulsated combustive air 5.

The delay time of the comparator 30 may be set according to the delay time of the relay 47.

Once the time of the starting phase has elapsed, and if the catalytic burner 1 is operating correctly, the indicator lamp 26 lights up, the solenoid 22 is in the open position and the control valve 4 is in the maximum flow position.

Rotating the handwheel 18 from the position corresponding to the stud 21a reduces the flow of fuel gas 3, thereby correspondingly and simultaneously reducing the speed of the fan 6, for example in stages, as set out below:

- when the traveller 20 passes over the stud 21b, the relay 40 is supplied, as a result of which the resistor 43 is inserted in the supply circuit of the fan 6 in series with the battery 75, and so on and so forth when the traveller passes over the studs 21c and 21d, the resistors 44 and 45 respectively being inserted in addition;
- between two consecutive studs, for example 21a and 21b, the speed of the fan 6 remains fixed, but the variation in the flow of fuel gas is sufficiently low to remain within the admissible range of the rate of aeration required for the catalytic burner.

Finally, rotating the control handwheel 18 in the opposite direction successively removes the resistors 45, 44, 43 from the supply circuit of the fan 6. When the traveller 20 passes over the stud 21a again, the relay 39 is switched to cause the contacts 391 and 392 to pass into the open position. However, the delay relay 47 maintains the connection to the resistor 49 for a few

seconds, the effect of this being to continue the circulation of pulsated combustive air at full power in the catalytic burner 1, and thus making it possible to bleed the latter and expel any gas or combustible mixture
5 capable of being reignited.



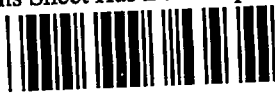
CLAIMS

1. Cooking appliance comprising:

- a catalytic burner (1) consisting of at least one member (2) for mixing a fuel gas (3), the flow of which is controlled by a manual control member (4),
5 and primary combustive air (5) pulsated by a fan (6), in order to obtain a mixture (7) to be burnt, at least one chamber (8) for distributing the said mixture, and a catalytic combustion structure (9),
10 through which the said mixture passes from its upstream face (9a) in relation to the distribution chamber to its downstream face (9b), discharging the combustion smoke;
- a thermal receiver (10) located at a distance from
15 the catalytic combustion structure (9) extending on the inside, opposite one of the faces (9a) of the said structure, over virtually the entire surface of the latter, and arranged and designed to dissipate on the outside at least some of the thermal energy
20 received from the said catalytic burner (1) by radiation and/or convection;

characterized in that, on the one hand, the member (4) for the manual control of the flow of fuel gas is arranged so as to allow a continuous and independent
25 variation of the said flow, and, on the other hand, the said appliance comprises a member (11) for controlling the rate of aeration of the mixture to be burnt, the said member being arranged so as not to act on the flow of fuel gas under normal operating conditions, but to act at
30 least on the flow of combustive air (5) pulsated by the fan (6), as a function of the flow of fuel gas (4) controlled independently by the user by means of the said manual control member (4), in order, under normal operating conditions, to increase the said flow of combustive
35 air when the flow of fuel gas increases and, conversely, to decrease it when the flow of fuel gas decreases.

2. Appliance according to Claim 1, characterized in that the control member (11) is arranged so as, under normal operating conditions, to keep the rate of aeration



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of the mixture to be burnt (7) within a range of between 0.8 and 1.5.

3. Appliance according to Claim 1, characterized in that it comprises at least one means (13) for controlling the speed of the fan (6), in particular the supply voltage of the electric motor driving it, the said means being controlled by the said control member (11).

4. Appliance according to Claim 1, characterized in that the control member (11) is arranged so as to keep the rate of aeration of the mixture to be burnt (7) within a range of between 0.8 and 0.9 during a starting phase of the catalytic burner (1), in particular marked by the passage of the manual control member (4) from a stop position (15) to an open position.

5. Appliance according to Claim 1, and in which the manual control member (4) is, for example, of the plug-valve type and comprises a body (16) with a bore (16a), and a rotary element (17) which is fitted in an adjusted manner in the said bore and of which the rotational position in relation to the said body continuously determines the flow of fuel gas (3) passing through the member (4), and a manual control handwheel (18) connected in terms of rotation to the said rotary element, characterized in that the control member (11) comprises a sensor (19) for sensing the said relative rotational position of the said rotary element (17).

6. Appliance according to Claim 5, characterized in that the sensor (19) for sensing the relative rotational position of the said rotary element (17) comprises, on the one hand, a traveller (20) integral in terms of rotation with the rotary element and, on the other hand, a series of fixed studs (21a to 21d) for electrical contact with the traveller (20) during its own rotation, the said studs being connected electrically to switching means inserted in the electrical supply circuit of the electric motor of the fan (6).

7. Appliance according to Claim 1, characterized in that the flow of pulsated combustive air (5) is increased or decreased discontinuously, in particular in successive



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stages.

8. Appliance according to Claim 1, characterized in that it comprises a safety solenoid (22) controlling the supply of fuel gas (3), and the control member (11) comprises, on the one hand, a sensor (25) for sensing the operating temperature within or in the vicinity of the catalytic combustion structure (9), and the control member (11) is arranged so as to control the solenoid (22) into the open position, if the said operating temperature is at least equal to a nominal value, and into the closed position, if the operating temperature is below the nominal value.

9. Appliance according to Claim 8, characterized in that the control member (11) is arranged so as to control the solenoid (22) into the open position for a predetermined time corresponding to a starting phase of the catalytic burner (1), the said phase being marked, in particular, by the passage of the manual control member (4) from a stop position (15) to an open position.

10. Appliance according to Claim 9, characterized in that it comprises an indicator light (26) indicating the operation of the catalytic burner (1), the said indicator light being controlled by the said control member (11) in order to light up, if the said operating temperature is at least equal to the nominal value, and be extinguished, if the operating temperature is below the nominal value.

11. Appliance according to Claim 1, characterized in that the control member (11) is arranged so as to keep the flow of pulsated combustive air (5) at a non-zero value during a stopping phase of the catalytic burner (1), during which stopping phase the flow of fuel gas (3) is controlled to a zero value manually by the user.

12. Appliance according to Claim 1, characterized in that it comprises a generator (28) for generating at least one spark in the vicinity of the downstream face 9b of the catalytic combustion structure (9), and the control member (11) is arranged so as to control the said generator temporarily during a starting phase of the catalytic burner (1), the said phase being marked, in





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particular, by the passage of the manual control member (4) from a stop position (15) to an open position.

13. Cooking appliance according to Claim 1, characterized in that, since the flameless radiant combustion front is located, during operation, in the vicinity of the upstream face (9a) of the catalytic combustion structure (9), the thermal receiver (10) extends on the inside, opposite the said structure, so as to receive the heat generated by the catalytic burner (1), mainly by radiation.

14. Cooking appliance according to Claim 1, arranged substantially horizontally in the position of use, with the thermal receiver (10) substantially horizontal, for supporting the outside of a thermal load, for example a saucepan.

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