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(54) Method of operating a domestic oven and cooking oven having a cooling fan

(57) In a domestic oven having a cooling fan, a chimney for discharge of vapours from a cooking chamber in which such discharge is substantially driven by the cooling fan by means of Venturi effect, the cooling fan is switched on/off according to a predetermined sequence in order to improve the energy efficiency of the oven.

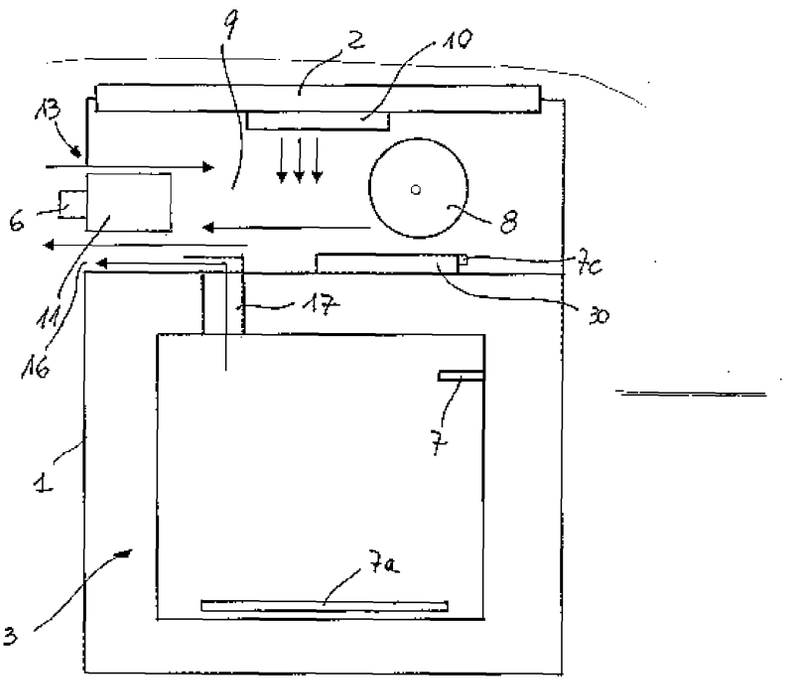

Fig. 1

EP 1 457 740 A1

Description

[0001] The present invention relates to a method for operating a domestic oven for cooking of food, such oven having a cooling fan and a chimney for discharge of vapours from a cooking chamber, such discharge being substantially driven by said cooling fan.

[0002] The cooling fan is used for cooling a zone outside the cooking chamber where electronic components of the oven are placed, and/or for producing a flow of cooling air exiting in the front part of the oven, in order to cool the door of the oven and/or its handle and/or the control panel of the oven. It is also well known that the flow of vapours and/or gaseous residues across the chimney is driven by the flow of cooling air by means of Venturi effect.

[0003] The technical field of cooking ovens is now facing the new environmental challenge of increasing the energy efficiency of the appliances, also in view of the related energy efficiency labelling. The main purpose of the European regulation underlying the energy efficiency labelling is to provide the consumers with efficient ovens in order to use the available energy in a better way, therefore saving customer's money. From a customer perspective, the present technology trend is to have an oven that cooks properly, with low temperature on touchable parts (knobs, handle, etc.) and with no side effect such as steam condensation on door and control panel; that means cooling the oven in an effective way. The above mentioned last problems, i.e. steam condensation, leads to the above mentioned steam exhaust chimney, an air duct that allows the steam generated in the cavity to leave it without having condensation on cold parts of the oven. While steam goes out, part of the heat goes out too, decreasing in that way the overall efficiency of the oven.

[0004] Cooling effectiveness and oven efficiency represent two opposite needs and one of the objects of the present invention is to provide a method and a domestic oven that allow to satisfy both needs.

[0005] In ovens with steam exhaust chimney, the chimney itself is one of the major sources of heat loss: the chimney in fact is getting the steam out the cavity, bringing out a big part of heat also. In a medium size oven, that heat loss can be quantified in 10%-20% during a "code Energy Efficiency test" carried out with brick as load in the oven chamber. The steam flow in the chimney is activated by the Venturi effect applied at one end of the chimney, using a restriction in the air channel utilised for cooling. The air used to cool the oven passes through the Venturi that activates a sucking effect in the cooking chamber that extracts the steam (and the heat) from the chamber itself. The steam is then mixed with the cooling air flow, diluted by it and dispersed in the ambient far from the oven, avoiding in that way condensation on cold oven parts.

[0006] If the cooling fan is switched off, the Venturi effect is no more existing and therefore also the steam-heat extraction is stopped. Heat loss can be thus reduced but the negative effect are that the steam would just get out following natural convection rules with condensation on esthetical visible parts (such as handles, knobs, control panel) and giving a low perceived quality impression to the customer. Tests carried out by the applicant have demonstrated also that an excess of steam extraction results also in a decreased heat transfer coefficient. In other words the presence of steam helps in transferring heat at the food surface (and at the brick surface in energy efficiency test conditions), improving the heat transfer and the result of efficiency tests.

[0007] The present invention teaches how to optimise steam extraction without loosing too much energy efficiency. Another goal of the invention is to provide a cheap implementation design that allows using the above teaching on all production ovens without cost limitation. Another object of the invention is to provide a type of ventilation, depending on the cooking function, which enables to optimise the cooling capacity without losing energy efficiency and preserving low temperature on components and aesthetic parts. Such aim is reached according to a method for operating a domestic oven and to an oven performing such method according to the annexed claims.

[0008] Basically, the applicant has discovered that by operating the cooling fan in an on/off mode, preferably with a control period of 30-90 second and a duty cycle from 10% to 60%, there is a surprising sensible increase of energy efficiency without the drawbacks of vapour condensation on cold part of the oven. The above-preferred values of control period and duty cycle are related to a medium size oven and can change with oven configuration and size. According to the invention, the on/off operation is selected instead of a continuos speed reduction of the fan motor because it gives additional advantages. In particular, while the cooling fan is off, there is a steady air situation in the cooking chamber or cavity and the steam can operate as a heat transfer mean to the food (or to the brick in an energy efficiency test configuration). On the contrary, the reduced speed operation mode (which can be obtained by means of a variable speed motor of the cooling fan) is not appropriate because it keeps always a flow of steam, even when the fan speed is set to very low values. A final consideration is that to get the minimum steam exhaust effect required, the fan should turn at a very low speed, speed that is not obtainable with a low cost fan motor used in usual tangential fans for ovens. In fact to get 10% of the nominal rotational speed, a DC motor or an inverter would be needed, with a cost that is from four to twenty time higher than an usual motor used for tangential fans.

[0009] Further aims and advantages of the present invention will result form the following detailed description and from the annexed drawings, supplied purely as an explanatory and non-limiting example, wherein:

- figure 1 is a schematic section view of a cooking

oven according to the invention, coupled with a cooking hob, and

- figure 2 is a block diagram of the electric/electronic control of a cooking oven according to figure 1.

[0010] With reference to the drawings, the appliance shown in figure 1 comprises an outer casing 1 with an electrical cooking hob 2, for example of glass ceramic type, and an underlying electric oven 3. Within the casing 1 between the oven and cooking hob there is a compartment 9 in which a tangential or radial fan 8 is positioned together with the electronic controls 10 and 11 and power components 30 of the appliance. When in operation, the fan 8 creates within the compartment 9 an air flow along the paths indicated by the arrows, to limit the temperature within the compartment 9.

[0011] The air stream enters the compartment 9 from front apertures 13, strikes the electronic components 10, 11, and discharges to the outside through a delivery duct 16. A chimney 17 gets the steam out the cavity, bringing out a part of heat. The steam flow in the chimney 17 is activated by the Venturi effect applied at the end of the chimney, using a restriction (not shown) in the air channel utilised for cooling. The air used to cool the oven passes through the Venturi that activates a sucking effect in the cavity that extract the steam (and the heat) from the cavity itself. The steam is then mixed with the cooling air flow of the cooling, diluted by it and dispersed in the ambient far from the oven, avoiding in that way condensation on oven parts.

[0012] Referring now to figure 2, it is assumed that the cooking hob comprises four conventional heating elements 6a, 6b, 6c, and 6d, each being activated by the hob power module 10. The cooking hob power module 10 and the cooking hob user interface 11 are connected together via a serial communication 20 allowing information relative to the system to be mutually exchanged. The cooking hob user interface 11 and oven power control 30 are connected together via a serial communication allowing the exchange of information relative to the working of the appliance. In this example it is assumed that the cooking hob comprises four conventional heating elements 6a, 6b, 6c and 6d, each one activated by a series of setting knobs 5a, 5b, 5c, 5d, 5e and 5f, each one connected in series with a safety switch 25, for instance a so called "klixon", which opens the power circuit on reaching a temperature dangerous for the conventional hob plate provided with the cooking hob. In the example the oven user interface 4 consists of 2 knobs 5a, 5b and a push button 5p .The knob 5a is used to set the required oven temperature and/or cooking time, the knob 5b serves to set the oven function, while the button 5p is used to confirm the settings. The actual temperature is measured by a sensor 7 positioned within the oven.

[0013] During the operation of the oven, after temperature and function are selected by the user, the oven control 30 analyses and drives the on-off cycles of the heating elements 7a (this analysis being based on the temperature value acquired by a probe 7 that is positioned in the oven cavity) and the on/off cycle of the cooling fan 8. The on/off cycle of the cooling fan 8 can be specific of the function selected by the user. A probe 7c measures the ambient temperature of the compartment 9. If temperature of the probe 7c or 7 is too high for electronics components, cooling fan 8 is activated continuously, i.e. with a 100% duty cycle.

[0014] Even if it has been described a combination of cooking hob 2 and the oven 3, which defines a space or compartment 9 lying between the cooking hob and the oven and within which the cooling fan 8 is positioned (so called under the counter configuration), it is obvious that the same system can be used also when there is no cooking hob (so called split level configuration), the purpose of the fan 8 being the same, i.e. to provide a cooling air flow through compartment 9.

Claims

1. Method for operating a domestic oven for the cooking of food, such oven having a cooling fan, a chimney for discharge of vapours from a cooking chamber, such discharge being substantially driven by said cooling fan, **characterised in that** the cooling fan (8) is switched on/off according to a predetermined sequence in order to improve the energy efficiency of the oven (3).

2. Method according to claim 1, **characterised in that** the on/off sequence is optimised according to the cooking program selected by the user.

3. Method according to claim 1, **characterised in that** the cooling fan (8) is switched on/off according to a cycle with a control period comprised within 30 and 90 seconds and a duty cycle comprised between 10% and 60%.

4. Method according to any of the preceding claims, **characterised in that** the cooling fan (8) is switched on, independently on the predetermined on/off sequence, if the temperature of an outside zone (9) of the oven (3) is higher than a predetermined value.

5. Domestic cooking oven comprising a cooling fan (8), a chimney (17) for discharge of vapours from a cooking chamber, such discharge being substantially driven by said cooling fan (8), **characterised in that** it further comprises an electronic control unit adapted to switch on/off the cooling fan (8) according to a predetermined sequence in order to improve the energy efficiency of the oven.

6. Oven according to claim 5, **characterised in that**

the electronic control unit is adapted to receive information on the actual cooking program selected by the user and to optimise the on/off sequence of the cooling fan (8) accordingly.

7. Oven according to claim 5, **characterised in that** the electronic control unit is adapted to switch on/off the cooling fan (8) according to a cycle with a control period comprised within 30 seconds and 90 seconds and a duty cycle comprised between 10% and 60%.

8. Oven according to any of claims 5 to 7, **characterised in that** it comprises a temperature sensor (7c) in at least a zone (9) outside the cooking chamber and linked to the electronic control circuit, such circuit being adapted to switch on the cooling fan (8), independently on the predetermined on/off sequence, if the temperature of such zone (9) outside the cooking chamber is higher than a predetermined value.

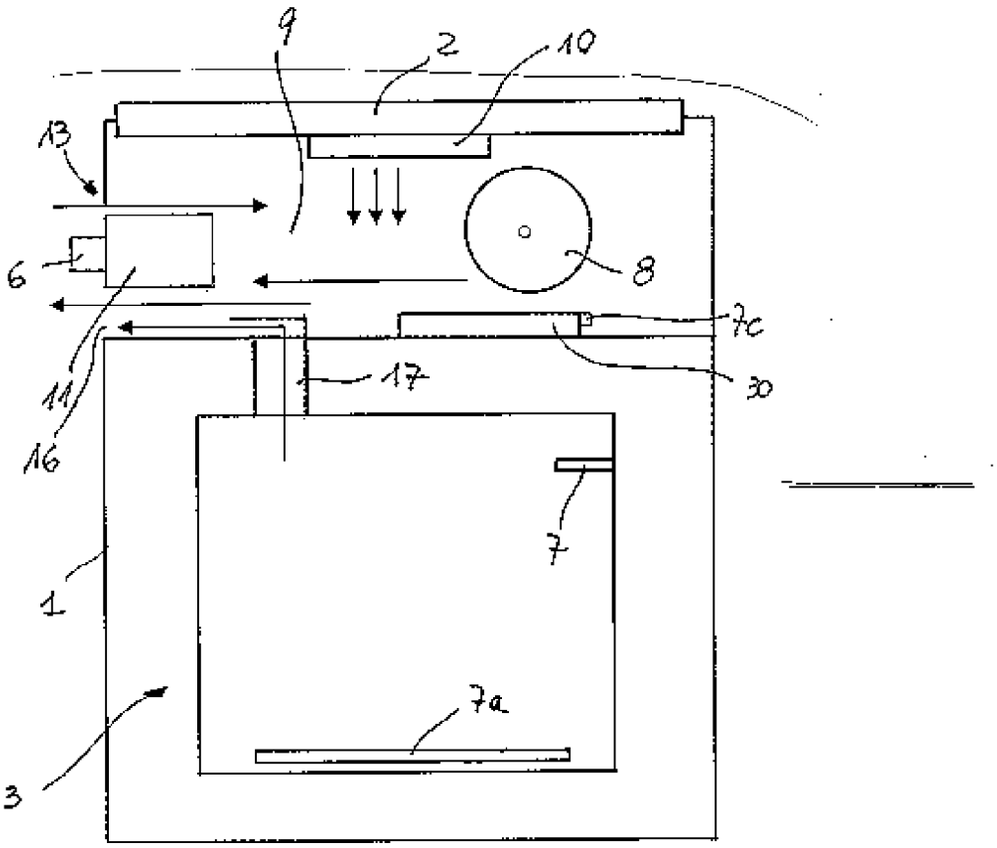

Fig. 1

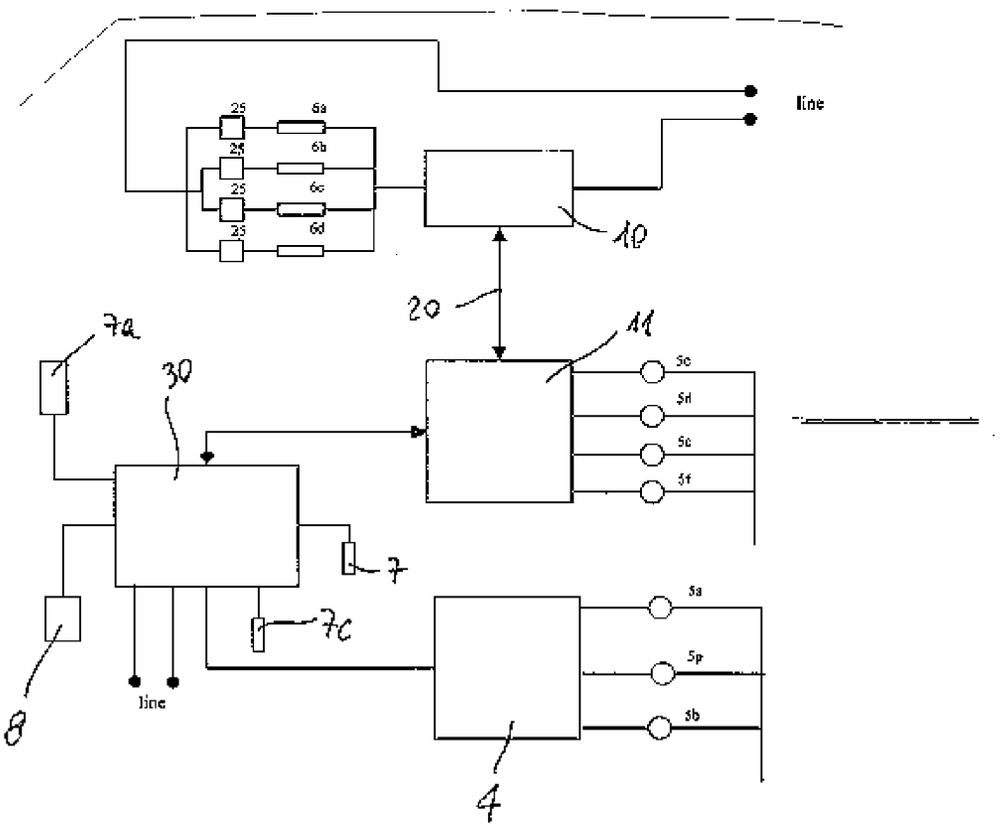
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Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 10 0631

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	30 July 2003	Merkt, A

CATEGORY OF CITED DOCUMENTS

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