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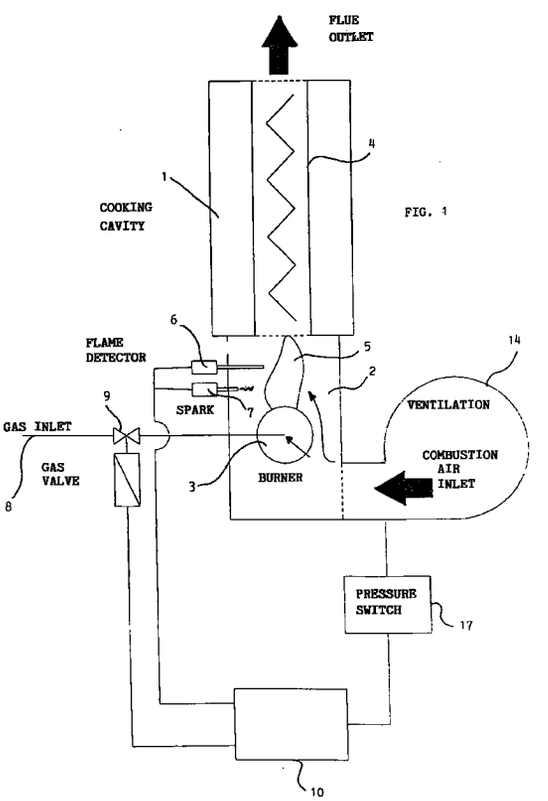
(54) Cooking apparatus with forced-draft burner

(57) Gas-fuelled apparatus for cooking food, in particular gas-heated oven, comprising a combustion chamber, a flue gas outlet conduit and a cooking cavity, blowing means being arranged so as to be directed towards said combustion chamber, said blowing means being capable of circulating, in a substantially open circuit made up by said combustion chamber and said flue gas outlet conduit, a flow of ambient air, wherein, upon turning on the electric installation of the oven, any possible unburnt fuel gas is permanently evacuated from said combustion chamber. In a preferred manner, the chamber housing the burner is provided with at least an opening communicating with the atmosphere, which is adapted to provide a natural evacuation passage for unburnt combustible gases. The first ignition to the burner occurs after a pre-determined time of ventilation, subsequently to the ignition command delivered by an appropriate control arrangement, and the following ignitions occur immediately after said ignition command.



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Description

The present invention refers to an apparatus for cooking food, adapted to perform cooking by means of a flow of flue gases which, generated by a plurality of heating elements, is forced by one or more fans to circulate in one or more heat exchangers arranged in a heat-exchanging relation with the cooking cavity in which the food to be cooked is arranged.

Apparatuses are known in the art, in which the burner, or the element provided to diffuse the flue gas in the air, is enclosed in a chamber forming the actual combustion chamber, into which a flow of air is forced which is taken in from the outside and blown against said burner by a normal fan.

Such apparatuses are in fact known in the art by the term "forced-draft" owing to exactly that flow of air blown towards the burner; they substantially differ from the so-called "atmospheric" apparatuses in that no forced air flow is provided in the latter type of equipment.

The main advantage of such apparatuses lies in the fact that a much greater heat output is generated and transferred here with respect to equally sized burners and heat exchangers not provided with said forced-draft feature.

The so blown air is used not only as both primary air and secondary air for combustion purposes, but also as "purging" air for the cavity in which the burner is housed, all such terms being well-known to all those who are skilled in the art, so that they shall not be explained any further here.

Current standards require a minimum ventialtion time to be provided in forced-draft systems before the burner is actually ignited.

Such a ventilation period is intended to "purge", ie to remove any possible presence of fuel gas that may be stagnating there due to possible leakages through the plug of the gas valve, in view of avoiding explosion risks.

Usually, the purging time shall be selected so as to ensure that the total volume of fresh air circulated in the period turns out to amount to at least five times the volume of the combustion chamber increased by the volume of the heat exchanger and the flue outlet conduit.

At present, such a-purging of these volumes with fresh air and the subsequent ignition of the fuel gas take place according to a definite procedure: in order to avoid the above mentioned risks of explosion, the ignition of the fuel gas is enabled by the system and carried out after a predetermined period of operation of the fan blowing fresh air into the chambers and conduits concerned. This practically means that, each time that the gas must be ignited, for instance owing to the commands sent by a thermostat controlling the operation, such an ignition is delayed by the time needed to perform such a purge and is actually carried out upon the conclusion of said purging phase.

It therefore ensues that the rapidity in the response to the commands sent in by a thermostat, ie. the effectiveness of the same thermostatic control, is seriously impaired, with clear disadvantages for both the quality of the cooking results and the total time needed for cooking, the latter resulting logically much longer.

The need therefore arises to provide a cooking apparatus of the forced-draft type, in particular for professional kitchens and catering applications, which overcomes the above cited drawbacks with a simple, reliable construction utilizing readily available techniques, and at the same time is capable of ensuring a maximum extent of safety against the risks of accidental gas explosions.

It therefore is a purpose of the present invention to disclose such a cooking apparatus having the characteristics as substantially recited with particular reference to the appended claims. It will anyway be more clearly and readily understood from the description that is given below by way of non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a schematic view of some among the main component parts of an oven according to the present invention;

- Figure 2 is a schematic view of a first embodiment of a cooking apparatus according to the present invention;

- Figure 3 is the wiring diagram of an electric control circuit according to a second embodiment of a cooking apparatus according to the present invention.

For reasons of greater practicalness, reference will be made in the following description to typical gas burners operating in an atmospheric ambient, being it clearly understood that any type of generally available gas, such as methane, town gas or LPG (various propane/butane mixtures) may be used therewith, whereas, in order to make it easier for the invention itself to be more readily understood, the example will be used of a food cooking oven as the cooking apparatus, while it will be appreciated that the invention itself equally applies to a number of even very different kinds of cooking apparatuses.

Referring now to Figures 1, 2 and 3, these are shown to illustrate a food cooking oven of the fan-assisted or forced-convection type used in professional kitchens, comprising a cooking cavity 1, a combustion chamber 2 provided with a gas burner 3, a heat exchanger 4 that doubles as a flue conduit for exhausting the products of combustion, the flame 5 generated by the burner also penetrating said heat exchanger arrangement.

There are also provided further normally used devices and means, such as a flame detector 6, the gas igniter 7 and the gas delivery conduit 8, in which an on-off valve 9 is arranged for actuation by a control unit 10.

The oven is also provided with a blower means 14 adapted to take in an air flow from the outside ambient

and blow the same flow into said combustion chamber 2.

All electric circuits of the oven are furthermore connected to the power supply line through a main on-off switch 13, as this is shown in Figure 3.

Upon starting a cooking operation, the oven is of course cold, or anyway at a lower temperature than actually needed, so that setting the thermostat to the desired cooking temperature value causes said thermostat to close and, therefore, the burner to be ignited by energizing the igniter 7.

Anyway, such an operation does not imply any risk of explosion, since ignition is only enabled after the closure of the main on-off switch 13, which in this way immediately and directly energizes the blower 14 that in this way is able to ventilate and, as a result, purge the combustion chamber.

Ignition is further prevented from taking place by the fact that, even if the thermostat 21 is closed, the same thermostat is however connected to the power supply line only through a delaying means 16, preferably a time-delay relay 16 which is in turn energized by a pressure switch 17 arranged on the mouth of the blower and actuated by the air flow brought about by such a blower.

Based on such explanations, it will now be possible to readily understand how such an oven actually operates. Upon closing the main on-off switch 13, the blower starts purging the combustion chamber and, at the same time, causes the pressure switch 17 to close, so that the latter will immediately energize also the time-delay means 16.

The related triggering terminals 19 and 20 are closed only after a predetermined period of time, during which the combustion chamber is purged, and their being closed causes a particular circuit 20 of the control unit 10 to be connected to the power supply line, so that it will be able to immediately operate the igniter 7 for the ignition of the burner. It will therefore be fully appreciated that such an igniter is by all means and positively operated only after such a delay time is elapsed and the combustion chamber has therefore been purged.

Upon reaching the pre-set cooking temperature, the thermostat 21 opens, but this has actually no effect on the time-delay relay 16, which therefore stays closed since it is being energized by the main on-off switch 13 on the one hand and, on the other hand, by the pressure switch 17 that is actuated by the still operating blower 14.

As a result, in the periods during which there is no combustion going on in the combustion chamber, ie. the burner is off, the ventilation thereof is anyway assured, regardless of the actual operation of the other functional parts of the oven.

When the temperature in the cooking cavity of the oven sinks back to the value at which the thermostat is set to trip, due to the fact that the time-delay relay 16 had been kept closed all the time, the circuit 25 is immediately energized, so that the igniter 7 is operated again.

It therefore can be noticed that such a circuit arrangement assures a proper pre-ventilation of the combustion chamber soon after the oven is turned on, but before the burner is actually ignited. It furthermore ensures that all subsequent ignitions, triggered by the thermostat, as well as the related extinctions of the burner occur instantaneously upon the tripping of said thermostat, thereby dramatically improving the control of the oven temperature, since the temperature in the interior of the cooking cavity is usually kept at a predetermined level by the setting of the thermostat, which provides for bringing about the appropriate sequence of ignition and extinction phases of the burner accordingly.

The only element that in this case intervenes to slow down such a sequence of ignition/extinction phases of the burner is the delay of the thermostat in tripping following a change in the oven temperature, but this is actually due to other causes that neither are of any relevance as far as the present invention is concerned nor impair the validity thereof.

According to a simplified variant of the invention, the purging of the combustion chamber is simply and fully obtained also under blower-off conditions, ie. with de-energized blower (see Figure 2), by the simple natural ventilating action of the atmospheric air flowing through said combustion chamber by passing through the heat exchanger 4 on the one side and, on the other side, through at least an adequately sized opening 26 that is provided in an appropriate position on one side of the combustion chamber.

For a correct, balanced operation of the oven it is of course necessary for said opening 26 to be sufficiently large so as to enable the combustion chamber to be correctly ventilated by said natural air flow within a predetermined time. On the other hand, the same opening 26 shall however not be too large, ie. so large as to become a possible way through which the air blown into the combustion chamber, which must be mainly used as primary air and secondary air for the combustion of the gas, can leak.

Anyway, the identification of the most appropriate position, shape and size of such an opening 26, or such openings 26 as the case may be, can effectively be obtained through a series of comparative experiments that are well within the capability of anyone skilled in the art.

The aim is in this manner reached of ensuring that, when the burner is off, the combustion chamber is anyway ventilated permanently and, as a result, purged by a modest, but sufficient natural flow of atmospheric air that enables the burner to be ignited immediately, so that the need no longer arises for a special preliminary phase of forced ventilation and purging of said combustion chamber to be provided before igniting the burner.

Although the invention has been described on the example of a preferred embodiment thereof and using a generally known terminology, it shall not be intended as being limited by these, since it will be appreciated that anyone skilled in the art may be able to use the teach-

ings of this invention to devise any number of variants and modifications thereto.

Claims

1. Gas-fuelled apparatus for cooking food, comprising a cooking chamber (1), a main on-off electric switch (13) connecting the electric system of the apparatus to the power supply line, a combustion chamber (2), a forced-draft gas burner (3), a heat exchanger (4) with possibly a flue exhaust conduit, and a cooking cavity, blower means (14) being associated to said combustion chamber and adapted to circulate a flow of atmospheric air in a substantially open loop formed by said combustion chamber and said heat exchanger, a thermostat (21) that must close to enable the igniter (7) to operate to ignite the gas burner (3), the opening of said thermostat causing a valve (9) provided in the gas delivery conduit (9) to be closed by the action of a control unit (10), **characterized in that** after the first closing/opening cycle of said thermostat (21) following the actuation of the main on-off switch (13), each subsequent closure of said thermostat allows for said igniter (7) to immediately ignite said gas burner.

2. Gas-fuelled apparatus according to the introductory part of claim 1, **characterized in that** it is provided with blower means (14) adapted to blow air taken in from outside and capable of starting the purging phase of said combustion chamber immediately upon said main on-off electric switch (13) being switched on, said blower means being activated as long as said main on-off electric switch is switched on.

3. Gas-fuelled apparatus according to claim 2, **characterized in that** said blower means are capable of completing the purging phase of the combustion chamber in a predetermined period of time.

4. Cooking oven according to claim 3, **characterized in that**:

   - the first ignition of the burner, after said main on-off switch (13) is switched on, occurs after a pre-determined ventilation time has elapsed subsequently to the closure of said thermostat (21), said pre-determined ventilation time being at least equal to the time neededfor said combustion chamber and the heat exchanger (4) to be purged,

   - said predetermined ventilation time is established by time-delay means (16).

5. Cooking apparatus according to claim 4, **characterized in that** said air for ventilating and purging said combustion chamber is exhausted through the same flue-gas heat exchanger (4).

6. Cooking apparatus according to any of the preceding claims 2 to 5, **characterized in that** all ignitions of the gas burner in said combustion chamber occurring after the first one following said main on-off electric switch having been switched on, take place immediately upon respective closures of said thermostat (21).

7. Cooking apparatus according to claim 5, **characterized in that** it is provided with means (17) adapted to detect the presence of an air flow generated by said blower means (14), and that, when such a presence is detected, an operating terminal of said time-delay means (16) is connected to one of the internal poles of said main on-off electric switch, the other operating terminal of said time-delay means being connected to the other of said internal poles of said main on-off electric switch.

8. Cooking apparatus according to claim 1, **characterized in that** the combustion chamber is provided with at least an atmospheric opening, preferably said heat exchanger (4) itself, adapted to provide a natural exhaust way to unburnt fuel gases.

9. Cooking apparatus according to claim 8, **characterized in that** said combustion chamber is provided with at least an opening (26) adapted to bring about a natural admission of a flow of external air into said chamber (2), and that each ignition of the gas in said combustion chamber taking place after said main electric on-off switch heving been switched on, occurs immediately upon respective closures of said thermostat (21).

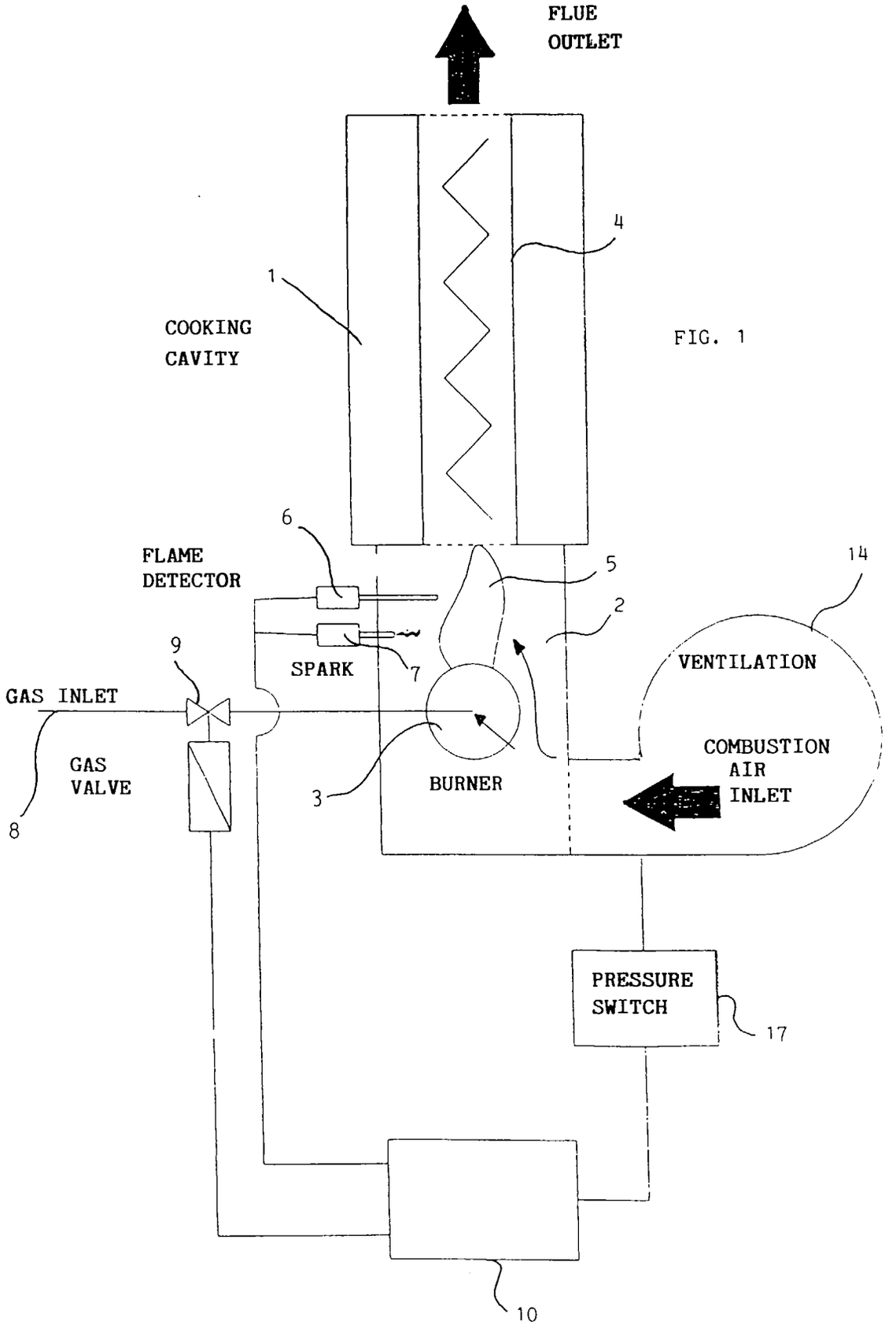
FLUE
OUTLET
4
1
COOKING
CAVITY
6
FLAME
DETECTOR
5
14
2
9
SPARK
7
VENTILATION
GAS INLET
COMBUSTION
AIR
INLET
GAS
VALVE
BURNER
3
8
PRESSURE
SWITCH
17
10

FIG. 1

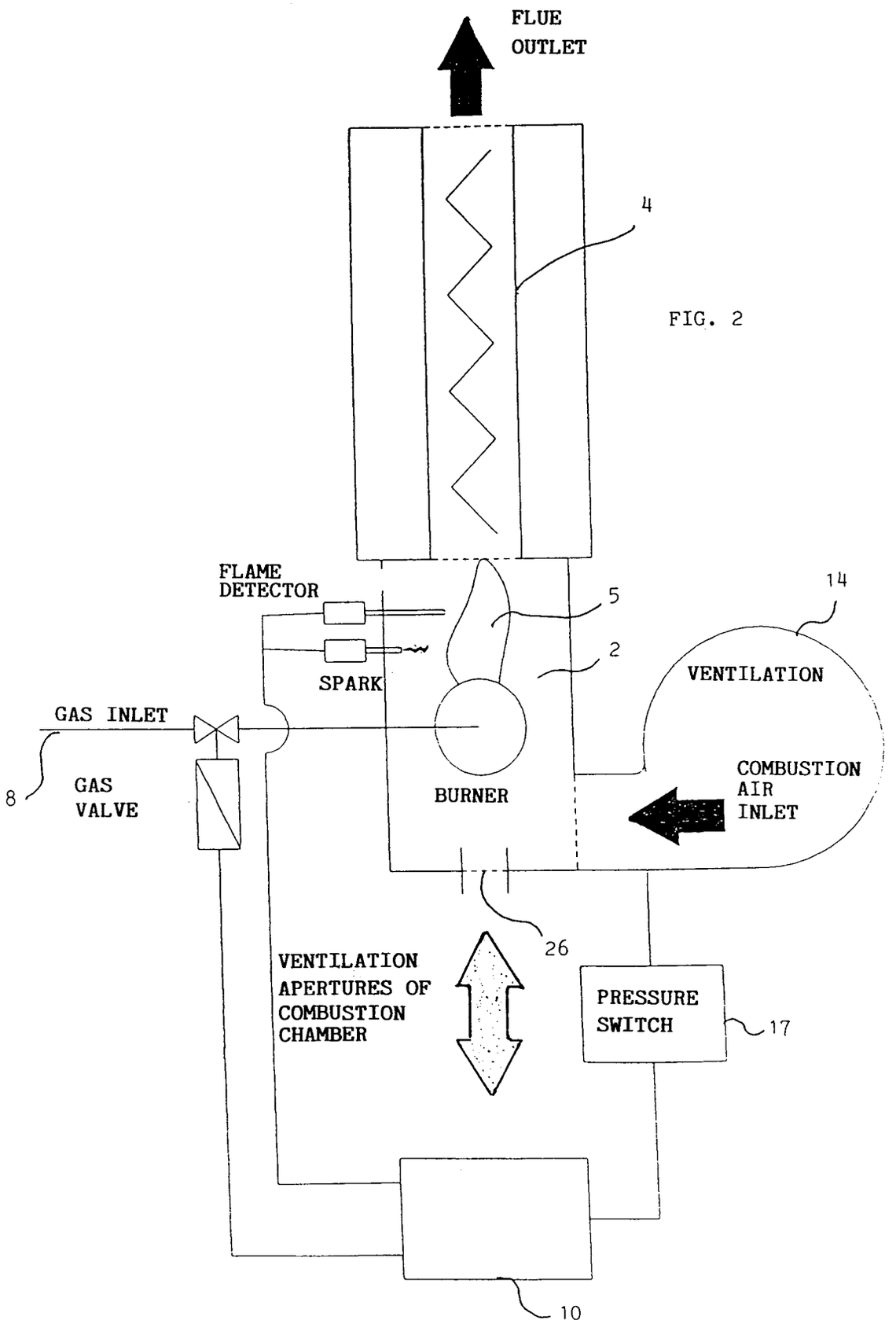
FLUE
OUTLET
4
FLAME
DETECTOR
5
14
2
VENTILATION
SPARK
GAS INLET
8
GAS
VALVE
BURNER
COMBUSTION
AIR
INLET
26
VENTILATION
APERTURES OF
COMBUSTION
CHAMBER
PRESSURE
SWITCH
17
10

FIG. 2

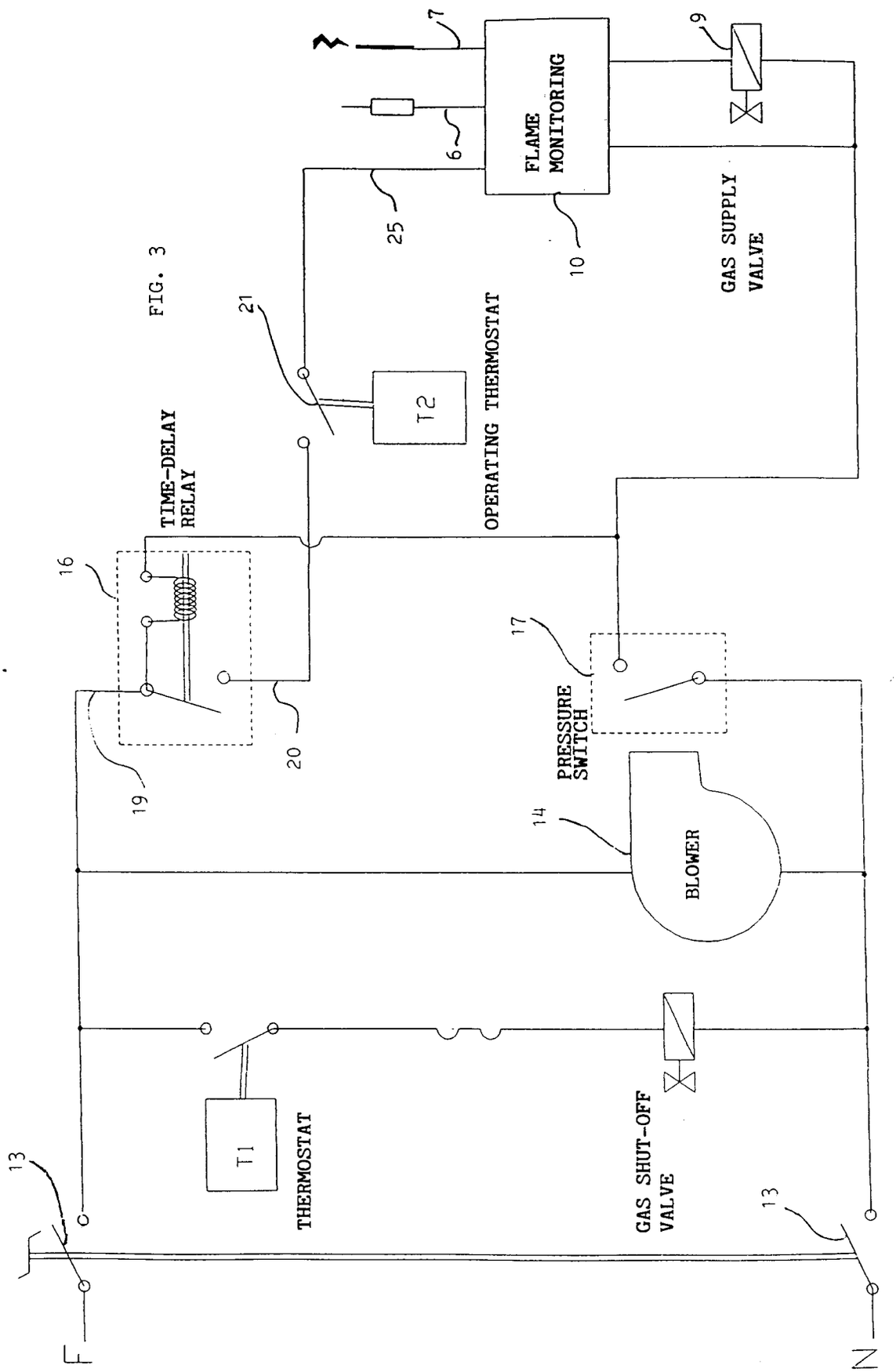
FLAME MONITORING
GAS SUPPLY VALVE
OPERATING THERMOSTAT
TIME-DELAY RELAY
PRESSURE SWITCH
BLOWER
THERMOSTAT
GAS SHUT-OFF VALVE
T1
T2
F
N
6
7
9
10
13
14
16
17
19
20
21
25

FIG. 3