(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 727 613 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.08.1996 Bulletin 1996/34

(51) Int Cl.[6]: **F23N 5/10**, F23N 5/00

(21) Application number: **96301115.0**

(22) Date of filing: **20.02.1996**

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **20.02.1995 NZ 27052895**

(71) Applicant: **Fleming, John Stuart**
Onehunga, Auckland (NZ)

(72) Inventor: **Fleming, John Stuart**
Onehunga, Auckland (NZ)

(74) Representative: **Leale, Robin George**
Frank B. Dehn & Co.,European Patent Attorneys,
179 Queen Victoria Street
London EC4V 4EL (GB)

(54) Method and apparatus for the control of flammable fluid heating apparatus

(57) This invention provides a sensor for the depletion of oxygen in a room in which a flammable fluid heater is housed. The heater is provided with a pilot burner which is sensitive to oxygen levels and a temperature sensor (2) which senses the output from the pilot burner. The output from the temperature sensor (2) itself can be used as an indicator of oxygen depletion within the room and compared against a stored value to close off the fuel supply to the heater should the temperature sensor (2) output fall below a predetermined level.

Additional features include the provision of a carbon monoxide sensor (9) linked to the heater so that the sensor is only in operation when the heater itself is turned on. Further, a second temperature sensor (14) to sense whether the appliance is in operation may be used to extinguish the pilot burner if it determines the appliance is not in use.

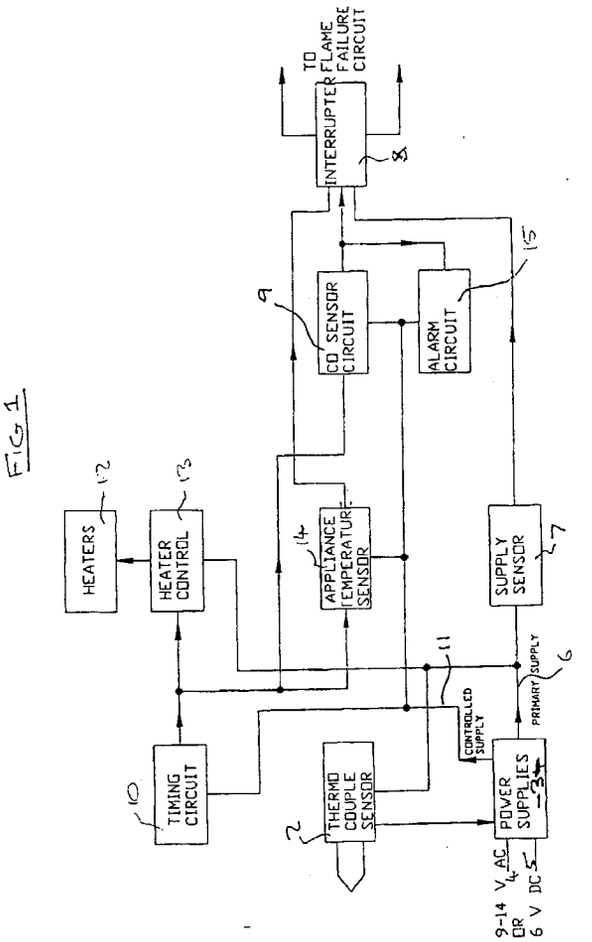


FIG 1

EP 0 727 613 A1

Description

BACKGROUND

(i) FIELD OF THE INVENTION

This invention relates to a method and apparatus for the control of flammable fluid fuelled heaters and, in particular, although not necessarily solely, a natural gas fuelled heater.

Examples of traditional heaters to which this technology may be applied can be seen in US patent application no. 08/361/761, US patent application no. 08/200414 and W093/19327.

Heaters of this type are often required to provide some form of sensor to sense the levels of carbon dioxide within the room in which the heater is housed and close the unit down should these levels exceed a permitted level. Such units are often provided in the form of a pilot burner which may or may not be used as part of the ignition system for the main burner in the heater.

The current pilot burners which include an oxygen depletion system to detect the depletion of oxygen in the atmosphere operate through the relationship between the energy produced from these burners and the carbon dioxide levels present in the atmosphere. As the carbon dioxide level increases, the energy produced falls until there is insufficient energy measured by a thermocouple or thermopile adjacent the pilot burner to hold a main gas valve open which is interconnected with the thermocouple or thermopile. Therefore, as the degree of carbon dioxide in the atmosphere increases, the flame characteristic from the pilot burner changes and will reduce the energy supplied to the thermocouple or thermopile and consequently shut off the main burner by closing the main gas valve.

Oxygen depletion pilot burners of this type require a great deal of precision in their fitment and adjustment. The temperature of the flame of the pilot burner may also be dependent upon the temperature of the pilot burner and, consequently, its proximity to the main burner as well as the physical orientation of the pilot burner and/or the manufacturing tolerances of the pilot burner assembly. With this pilot burning acting directly on a thermocouple driven valve, variations in such valve types lead to a variation in the output from the thermocouple which will determine valve closure. Further, the actual oxygen depletion of the room in which the heater is housed may be represented in varying manners in the output from the thermocouple sensor according to the placement of the pilot burner and associated sensor. As a result, such systems are highly dependent on the actual appliance to which it is fitted and it is often necessary to use specialised manufacturers of such systems to tune the oxygen depletion burners to suit particular appliances.

In addition to this costly manufacturing step, the current oxygen depletion systems also only measure the presence of carbon dioxide as a contaminant to control the main gas circuit. There is no independent assessment of the carbon monoxide level with carbon monoxide being the far more hazardous contaminant. Indeed, the oxygen depletion systems rely on an assumed relationship between the carbon dioxide levels and the carbon monoxide levels to keep the carbon monoxide levels in check. Such a relationship may be valid for particular appliances when new and change as the appliance suffers wear and tear. For example, a gas heater of this type with a break in the casing of the main burner or some other similar failure will greatly increase the carbon monoxide levels out of proportion of the traditional carbon monoxide relationship.

Some users of such appliances have had to resort to the purchase of separate carbon monoxide sensors to warn against this hazard which are themselves relatively heavy on power consumption. Additionally, such sensors are in no way tied with the heating appliance and, therefore, are likely to be left in operation even when the heater is not.

A further problem with current pilot burners is the gas consumption by the pilot burners when the heater is not in operation. This has lead to some territories to ban standing pilots or to provide such pilots with an inferior rating for energy consumption compared with equivalent heaters run by electronic ignition. Electronic ignition for such heaters is a relatively expensive solution compared with the cost of pilot burners.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a method and apparatus for the control of flammable fluid fuelled heaters which will overcome some of the disadvantages of the prior art and/or at least provide the public with a useful choice.

SUMMARY OF THE INVENTION

Accordingly, in a first aspect, the invention consists in apparatus for the control of flammable fluid fuelled heaters comprising:

a primary fuel burner;
a pilot fuel burner;
a temperature sensor adjacent said pilot burner such that the output of said sensor will vary upon changes in the output of said pilot burner; and
control means to control the fuel supply to the primary fuel burner upon the output of the temperature sensor falling below a predetermined level.

Accordingly, in a second aspect, the invention consists in a method for the control of flammable fluid fuelled heaters comprising:

supplying fuel to a primary burner for heating; pro-

viding a pilot burner;
sensing the output of the pilot burner; and
control the fuel supply to the primary burner to deny fuel to said primary burner once the output from said sensor drops below a predetermined level.

Accordingly, in a third aspect, the invention consists in a flammable fluid fuelled heater comprising:

a primary fuel burner for the burning of the flammable fluid;
a carbon monoxide sensor provided on said heater to turn said heater off should the carbon monoxide level exceed a predetermined level; and
control means to initiate said carbon monoxide sensor only when said heater is in operation.

Accordingly, in a fourth aspect, the invention consists in a flammable fluid fuelled heater comprising:

a primary fuel burner to burn said flammable fluid;
a pilot burner to ignite said primary fuel burner; and,
control means to switch said pilot burner off should the unit not be in operation.

Further aspects of this invention may become apparent to those skilled in the art to which the invention relates.

BRIEF DESCRIPTION OF THE DRAWINGS

The description will now be provided with reference to the following drawings in which:

Figure 1 shows a schematic view of a control means which may be provided in accordance with a preferred embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1, the invention relates to a method and apparatus for the control of flammable fluid fuelled heaters such as natural gas heaters.

In preferred forms, the invention may be provided in flueless heaters or heaters in which at least a portion of the exhaust is directed into the room in which the heater is housed.

It can be seen from the drawing in Figure 1 that the invention includes a thermocouple sensor 2 or other suitable form of temperature sensor which is placed adjacent a pilot burner (not shown). This thermocouple sensor receives energy from the pilot burner and the output from the sensor will be sensitive to the output from the pilot burner which itself is sensitive to the levels of carbon monoxide in the atmosphere. Therefore, the use of a thermocouple sensor 2 such as that shown in a control circuit can allow the thermocouple voltage from the sensor to be compared with a factory set value for that type of unit which should accurately reflect the oxygen depletion of the atmosphere. This control circuit can then close the main gas valve to the burner assembly when the oxygen level and resultant thermocouple voltage falls below this settable value.

As shown in the drawing in Figure 1, the control circuit will be supplied with a power supply which, in this preferred embodiment, may comprise a 9-14 volt AC supply or an alternative 6 volt DC supply. The alternative supplies allow the unit to run off mains power through a suitable transformer or, alternatively, battery powered when necessary.

The power supply 3 shown in Figure 1 receives the input current through inputs 4 or 5 and supplies a primary supply 6 to a supply sensor 7. This optional supply sensor 7 allows the control circuit to determine when the power supply voltage has dropped to a level at which the control circuitry is no longer reliable. The supply sensor may be connected to an interrupter 8 to shut the unit off and close the main valve (not shown) to ensure no further emission of gas.

Provided the supply sensor indicates that there is sufficient voltage from the primary supply, the remainder of the circuitry may come into operation. The thermocouple sensor 2 may itself have a built in delay controlled by some form of timing circuit to ensure that the thermocouple does not control the gas flow through the unit until the thermocouple has had sufficient time to reach an operating temperature. Although the particular value for this delay may be any suitable time limit, a delay in the region of 60 seconds may be sufficient. This start up procedure not only allows the thermocouple sensor and its associated voltage to account for the warming of the sensor itself but also for the voltage drop associated with the sensor and associated circuitry switching from an unloaded to a loaded condition leading to a temporary voltage drop. Such a delay allows the thermocouple sensor to reach a threshold voltage beyond which any falling off in that voltage below the threshold will close off the main supply to the primary burner. If the thermocouple sensor fails to reach the threshold value for voltage despite the delay, again the main gas valve will be turned off.

In addition to the thermocouple sensor for sensing of oxygen depletion and carbon dioxide levels, the heating apparatus may also include circuitry for the monitoring of carbon monoxide. This may comprise a carbon monoxide sensor 9 included in the circuitry and controlled by a timing circuit 10. An important aspect of this carbon monoxide sensor is that it is only in operation when the appliance itself is switched on. This may be through the use of a controlled supply 11 controlled by actual operation of the appliance and ensures that the carbon monoxide sensor does not draw power other than when needed. This reduces the normally high power requirements of such carbon monoxide sensors. In a preferred form of the invention, dual carbon monoxide

sensors are used. These allow each of the sensors to independently measure the carbon monoxide level and check it against a suitable safety level such as 50ppm. Should either of the sensors or both exceed this 50ppm level, the unit may be shut down through triggering the interrupter 8. In addition, the use of dual carbon monoxide sensors may allow the unit to be shut down should there be a difference between the carbon monoxide sensors of greater than, for example, 20ppm. This acts as a check on the carbon monoxide sensors accuracy. However, a single sensor may be used.

Typical carbon monoxide sensors rely on heaters 12 which are preferably controlled by a heater control 13. The heaters operate intermittently for a set period and heat the sensor immediately after which the resistances of the sensors are sampled and the carbon monoxide value can be determined. To regulate the timing of the circuit, the timing circuit 10 sets, in this preferred example, a period of 4 minutes between the heaters going into operation. The timing circuit controls the heaters and switches these on for a period of 1 minute after which the sampling and carbon monoxide values are determined. Typical carbon monoxide sensors may be heated by heaters drawing, for example, 30ma for the 1 minute period.

In addition to this heating of the sensors for the actual measuring of carbon monoxide values, this preferred embodiment also provides battery voltage to the carbon monoxide sensor heaters 12 for a period of 1 minute at repeat intervals of 64 minutes. This acts as a cleaning step to clean the sensors once every 64 minutes. Of course, the times mentioned in this preferred embodiment could be changed to any other suitable time period. To ensure the carbon monoxide sensors are cleaned upon initial start up of the unit, a cleaning cycle in which the battery voltage is supplied to the carbon monoxide sensor heaters is triggered immediately upon start up of the appliance. This start up of the appliance may be triggered by an suitable means including use of the thermocouple sensor. This heat cleaning cycle may occur during the first four minute cycle after starting the appliance.

To ensure that the carbon monoxide values and the associated heating of those sensors is not triggered during the cleaning cycle, this preferred form of the invention tests for the heater cleaning voltage prior to initiating the normal heating cycle which forms part of the sensing step.

In addition to the regular automated sensing cycles, a manual operation of the sensors may be included if desired.

It can be seen from Figure 1 that an appliance temperature sensor 14 is included other than the thermocouple sensor 2. This appliance temperature sensor may be included and the output sampled at regular intervals of, for example, every 64 minutes. If the temperature sensor indicates a temperature of, for example, less than a threshold of 40°C, this would indicate that the appliance is not in use and the appliance may be turned off. This preferably includes the switching off of the pilot burner (not shown) which operates adjacent the thermocouple sensor. This overcomes problems of standing pilot burners and their energy consumption by switching the pilot burner off once the appliance senses that it is no longer in operation. Furthermore, this sensor may be field selectable so that it may be changed for different operating conditions.

It should be noted that this sensing of the appliance temperature is preferably only performed at relatively large intervals such as the 64 minutes previously mentioned. This allows the unit if thermostatically controlled to shut down when dictated by the thermostat and leave the pilot burner in operation for re-ignition of the gas flow once the thermostat suggests the heater is again required. The relatively large periods between sampling of this appliance temperature sensor 14 and the relatively low threshold value of 40°C should ensure that the pilot burner is extinguished only when the unit is genuinely not in operation rather than between heating periods dictated by the thermostat.

Referring to Figure 1, it can also be seen that the circuit may control an alarm circuit 15. This alarm circuit may control the operation of an audible alarm such as a buzzer or a visual alarm such as warning lights or both to ensure that a suitable alarm is signalled upon any of the failures mentioned previously. This may be particularly important in the case of the carbon monoxide sensor due to the toxicity of carbon monoxide and the associated health risks.

To determine suitable cut off values for the output of the thermocouple sensor, units containing the pilot burner the thermocouple sensor may be placed in a controlled environment and the carbon dioxide or oxygen depletion levels monitored during operation of the appliance. The output from the thermocouple sensor can be mapped against these separately measured values and a suitable threshold voltage selected to correspond with a particular carbon dioxide or oxygen depletion level.

To avoid jittering and other very minor variations in the voltage output from the thermocouple sensor, a 1mv hyterisis may be included to account for these.

Thus it can be seen that the invention provides a control circuit which allows for monitoring of the carbon monoxide or oxygen depletion levels and allows for an easy method of determining the threshold voltages at which the unit should be shut down through a simple experiment in the factory. Once suitable levels have been determined, the correct relative position of the thermocouple sensor with the pilot burner should always provide equivalent results. This allows the manufacturer of the heater to control the thermocouple output at which the gas valve is shut off independent of the position or type of the gas valve. No longer is the position of the pilot burner or threshold value for the thermocouple determined by the valve characteristics.

Furthermore, the thermocouple sensor or other fea-

tures of the appliance may be used to control the operation of a carbon monoxide sensor provided as a separate unit. This carbon monoxide sensor allows for separate sensing and control of the unit as a result of carbon monoxide levels and saves the carbon monoxide sensor drawing power through the use of the heaters associated with such sensing when the appliance is not in operation.

A further appliance temperature sensor may be used to control all the above circuitry and ensure that the appliance is not drawing power and the pilot burner is not in operation when the appliance itself is switched off.

Additional features such as remote operation of the heater, automatic shut off after a selectable period of time and similar functions may be included in the control system. The use of mains voltage components may require the enclosure of the control system to decrease exposure of any gas to sparks. Such an outer housing would require construction to withstand heater temperatures. Plus fittings may be provided to external sensors and components.

Comparing apparatus in accordance with this invention with conventional heaters, the manufacturer is no longer faced with a valve and thermocouple unit which has predetermined characteristics for the threshold voltage from the thermocouple which will force closure of the valve. In such prior apparatus, the output voltage from the thermocouple which provides for valve closure may be, for example, 3mV. This known quantity in mind, it was then necessary for the manufacturer to place the pilot burner, thermocouple and valve in an appropriate position such that the threshold for oxygen levels within the room in which the heater is housed occurs at the same threshold value output from the thermocouple. In providing the present apparatus, the position of the pilot burner and thermocouple on the appliance need only be determined within the factory. Once a control test has been provided to determine the output from the thermocouple in that particular position related to the pilot burner and their comparative positions on the appliance which corresponds to the correct oxygen depletion level, whatever value that output is for the thermocouple may be set into the control circuitry to be the threshold value for that particular type of appliance. Subsequent substantially identical appliances with identical pilot burners, thermocouples and comparative positions of each should allow the accuracy to be maintained. Therefore, if the pilot burner and thermocouple are positioned well away from the main burner and near the front edge of the appliance and it is determined that a 9mV voltage from the thermocouple occurs at the lowest desirable oxygen levels, this may be set into the control means as the threshold value for all subsequent appliances manufactured to the same standards.

Where in the foregoing description reference has been made to specific components or integers of the invention having known equivalents then such equivalents are herein incorporated as if individually set forth.

Although this invention has been described by way of example and with reference to possible embodiments thereof it is to be understood that modifications or improvements may be made thereto without departing from the scope of the invention as defined in the appended claims.

Claims

1. Apparatus for the control of flammable fluid fuelled heaters comprising:

a primary fuel burner;
a pilot fuel burner;
a temperature sensor adjacent said pilot burner such that the output of said sensor will vary upon changes in the output of said pilot burner; and
control means to control the fuel supply to the primary fuel burner upon the output of the temperature sensor falling below a predetermined level.

2. Apparatus for the control of flammable fluid fuelled heaters as claimed in claim 1 wherein said predetermined level is settable.

3. Apparatus for the control of flammable fluid fuelled heaters as claimed in claim 1 or claim 2 wherein said control means includes storage means to store a value representative of said predetermined level; processing means to compare an output from said temperature sensor with said stored value and output means to output a signal controlling closure of a valve controlling the fuel supplied to the primary fuel burner.

4. Apparatus for the control of flammable fluid fuelled heaters as claimed in any one of the preceding claims wherein said control means includes a timing circuit to place a delay between ignition of the heater and the commencement of the control of the fuel supply to the primary fuel burner as a result of the temperature sensor output.

5. Apparatus for the control of flammable fluid fuelled heaters as claimed in any one of the preceding claims wherein a second temperature sensor is provided to compare the temperature of the appliance with a predetermined value and control means to extinguish said pilot burner when the appliance temperature is below said predetermined value indicating the heater is not in operation.

6. A method for the control of flammable fluid fuelled heaters comprising:

supplying fuel to a primary burner for heating;
providing a pilot burner;
sensing the output of the pilot burner; and
controlling the fuel supply to the primary burner to deny fuel to said primary burner once the output from said sensor drops below a predetermined level.

7. A method for the control of flammable fluid fuelled heaters as claimed in claim 6 wherein said predetermined level is a settable level.

8. A method for the control of flammable fluid fuelled heaters as claimed in claim 6 or claim 7 wherein said step of controlling the fuel supply to the primary burner comprises comparing the sensed output of the pilot burner with a temperature sensor and comparing the output from the temperature sensor with a stored value and, upon the output of the pilot burner dropping below the stored value for the temperature sensor, outputting the signal to control a valve in the fuel supplied to the primary burner.

9. A method for the control of flammable fluid fuelled heaters as claimed in any one of claims 6-8 wherein said method further includes a step of delaying a comparison of the temperature sensor output with a predetermined level to a predetermined delay after ignition of the apparatus.

8. A flammable fluid fuelled heater comprising:

a primary fuel burner for the burning of the flammable fluid;
a carbon monoxide sensor provided on said heater to turn said heater off should the carbon monoxide level exceed a predetermined level; and control means to initiate said carbon monoxide sensor only when said heater is in operation.

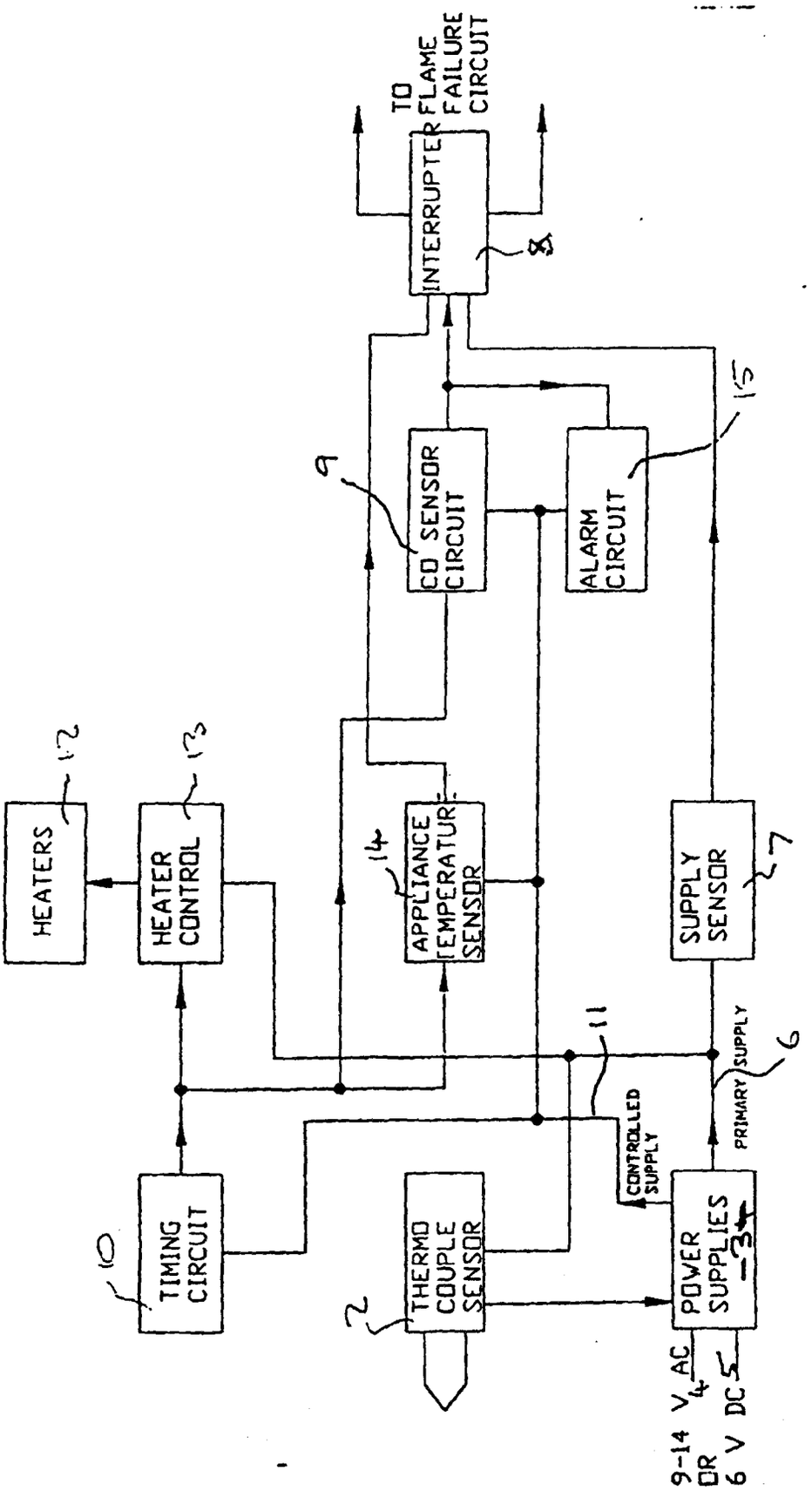
9. A flammable fluid fuelled heater as claimed in claim 8 wherein said control means comprises a controlled power supply to said sensor.

10. A flammable fluid fuelled heater comprising:

a primary fuel burner to burn said flammable fluid;
a pilot burner to ignite said primary fuel burner; and
control means to switch said pilot burner off should the unit not be in operation.

11. A flammable fluid fuelled heater as claimed in claim 10 wherein said control means comprises a temperature sensor to determine if the primary burner has not been in operation and the unit has cooled to a predetermined level.

FIG 1


TO FLAME FAILURE CIRCUIT
INTERRUPTER
8
CO SENSOR CIRCUIT
9
ALARM CIRCUIT
15
HEATERS
12
HEATER CONTROL
13
APPLIANCE TEMPERATURE SENSOR
14
SUPPLY SENSOR
17
11
CONTROLLED SUPPLY
PRIMARY SUPPLY
6
TIMING CIRCUIT
10
THERMO COUPLE SENSOR
2
POWER SUPPLIES
3
9-14 V AC OR 6 V DC
4
5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 1115

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 100 758 (OFFICINE DI PERNUMIA DI GIANCARLO DE STEFANI & C. S.A.S.) * the whole document * ---	1,2,6,7	F23N5/10 F23N5/00
X	DE-A-43 13 575 (WUNNER) * the whole document * ---	1,2,6,7	
X	PATENT ABSTRACTS OF JAPAN vol. 004, no. 088 (M-017), 24 June 1980 & JP-A-55 046328 (MATSUSHITA ELECTRIC IND CO LTD), 1 April 1980, * abstract; figure * ---	1,2,6,7	
X	PATENT ABSTRACTS OF JAPAN vol. 010, no. 044 (M-455), 21 February 1986 & JP-A-60 194228 (RINNAI KK), 2 October 1985, * abstract; figure * ---	1,4	
X	PATENT ABSTRACTS OF JAPAN vol. 010, no. 100 (M-470), 16 April 1986 & JP-A-60 235914 (TOKYO GAS KK;OTHERS: 01), 22 November 1985, * abstract * ---	8	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23N
X	PATENT ABSTRACTS OF JAPAN vol. 014, no. 121 (M-0946), 7 March 1990 & JP-A-01 318809 (MATSUSHITA ELECTRIC IND CO LTD), 25 December 1989, * abstract; figure * ---	10 5,11	
A	PATENT ABSTRACTS OF JAPAN vol. 95, no. 002 & JP-A-07 035341 (PALOMA IND LTD), 7 February 1995, * abstract * ---	1,2	
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 May 1996	Kooijman, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 1115

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US-A-5 179 933 (MCCRILLIS ET AL.) * column 5, line 10 - line 24; figures * ---	3,8	
A	GB-A-2 249 382 (TURNRIGHT CONTROLS) * abstract; figure * ---	5,9,10	
A	EP-A-0 573 222 (BLUE CIRCLE HEATING LIMITED) * the whole document * -----	5,9,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 May 1996	Kooijman, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)