

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11)

Publication number:

0 120 681
A1

(12)

EUROPEAN PATENT APPLICATION

(21)

Application number: 84301943.1

(51)

Int. Cl.³: **F 23 N 5/10**
F 23 N 5/20

(22)

Date of filing: 22.03.84

(30)

Priority: 22.03.83 GB 8307852
28.09.83 GB 8325907

(43)

Date of publication of application:
03.10.84 Bulletin 84/40

(84)

Designated Contracting States:
AT BE CH DE FR IT LI LU NL SE

(71)

Applicant: **PEERLESS STAMPINGS LIMITED**
Priory Road
Aston Birmingham B6 7LF(GB)

(72)

Inventor: **Lewis, Gordon William**
45, Roach Close
Chelmsey Wood West Midlands B37 7UH(GB)

(72)

Inventor: **Walklate, John**
1, Chelford Crescent
Kingswinford West Midlands, DY6 8PB(GB)

(74)

Representative: **Harrison, Gordon Donald et al,**
FORRESTER & BOEHMERT Widenmayerstrasse 4/1
D-8000 München 22(DE)

(54)

A control circuit for use with a fuel control valve.

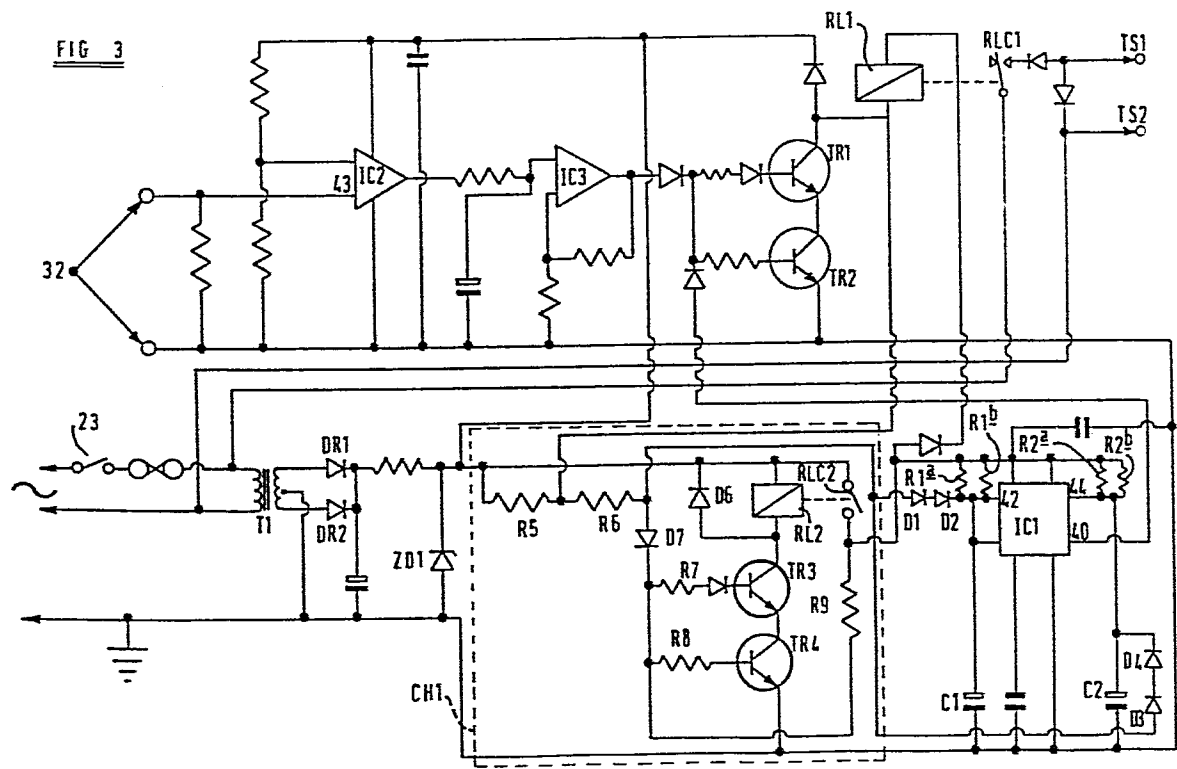
(57)

A control circuit 31 for use with valve means 30 for controlling the supply of fuel to a fuel using appliance e.g. a domestic or gas oven incorporates a switching circuit operative to send a signal to open said valve means 30, or prevent the sending of such signal, and a checking circuit, the checking circuit ensuring that prior to such a signal being sent, the switching circuit is initially in a condition such that the signal can not be sent so as to ensure that prior to fuel being supplied to the burner of the fuel using appliance, the circuit is in a fail-safe condition. Such a control circuit is of particular benefit for use with flueless gas using appliances.

EP 0 120 681 A1

./...

FIG 3



Title: "A Control Circuit for use with a Fuel Control Valve"

The present invention relates to a control circuit for use with valve means for controlling the supply of fuel along a pipe to a fuel using appliance such as a domestic or industrial oven, or a space or water heating appliance.

The invention is further primarily but not exclusively concerned with flame failure devices, that is devices capable of terminating a supply of fuel to a burner should the combustion of the fuel cease.

Fuel control means used in domestic ovens for example, may comprise a first sensing means to sense the temperature of the oven, which sensing means is capable of altering the amount of fuel supplied to a burner so as to maintain the temperature of the oven at a desired level. Such a device will hereafter be referred to as a thermostatic control.

A known type of flame failure device used in conjunction with such a thermostatic control comprises an on/off valve and combustion indicative means. When a flame is absent the valve will shut and the presence of a flame will cause the valve to be held open. The thermostatic control means allows control of temperature and the flame failure device is intended as a safety device to shut off the supply of fuel if for any reason combustion of fuel ceases.

Flame failure devices are essential from a safety aspect since if the fuel-using appliance is switched on and combustion ceases, unburnt fuel will continue to be supplied unless the lack of combustion is noticed and the fuel supply terminated. Obviously in the case of some fuels, for example gas, a very dangerous situation could develop and thus it is essential to terminate the supply of fuel as soon as combustion ceases.

In the case of appliances provided with a thermostatic control valve and a flame failure valve, the valves must be in series with each other.

In order for fuel to be supplied to a burner or pilot to enable ignition thereof, it is necessary that the flame failure valve is provided with by-pass means to the burner since the flame failure valve itself will be shut and hence prevent supply of fuel to the burner.

It is known to provide manually operable means whereby a by-pass or pilot valve is held open manually by a "push-button" until the ignition of the

fuel has taken place and then, after a predetermined time, the flame failure valve is held open due to sensing of combustion by the combustion sensing means. The "push-button" may then be released.

Problems occur however with automatically igniting devices intended to operate without manual operation.

It is known to provide a constantly open by-pass to the flame failure valve so that, irrespective of whether or not the combustion sensing means senses combustion, a small amount of fuel is permitted to pass to the burner to enable ignition to take place.

Such devices, which may be automatically controlled by clock operated valves opening at a predetermined desired time to enable the fuel to pass through the thermostatic valve and through the by-pass of the flame failure valve which fuel is then ignited by automatic igniting means.

Once the fuel passing to the burner through the by-pass is ignited such combustion is sensed and the flame failure device operates to open the main flame failure valve and allow full flow of fuel to pass to the burner.

It is usual for automatic ignition means to be powered from the mains supply of electricity. If therefore at any time after an automatically operated clock valve has permitted a supply of fuel to the burner, the burner is extinguished and no power is available for ignition or, for example, the ignition unit should fail, fuel will be supplied albeit at a slow rate, continuously through the by-pass to the burner.

In the case of some cookers which have provision for an automatically controlled timed period of cooking, which is a common feature for domestic ovens, if there is a temporary power cut during a timed cooking period assuming that the power cut takes place during combustion of fuel in the oven, the oven will continue to operate as normal however, the cooking time will be extended by the length of the power cut thus the food will be cooked for an indeterminate length of time.

It has been proposed in British patent specification 1,555,573 to provide means for opening a flame failure valve for a short period of time by, for example using a solenoid to enable gas to pass to the burner and so be ignited. Operation of the flame failure device then maintains the flame failure valve open. Similar arrangements are disclosed in British patent application 2013867A, U.S. specification 2962093, West German published application 2605461, French patent specification 2018613, French patent specification 2434342 and West German published patent application 2123458.

Whereas some of the devices described in the aforementioned patent specifications may operate satisfactorily a fault in the switching circuit which opens the flame failure valve may permit fuel to pass to the burner which fuel is not ignited, thereby creating a highly hazardous environment. If the appliance to which the fuel is to be supplied is for example an oven, or other gas using appliance without a flue, the arrangements proposed in the above mentioned specifications could be highly hazardous and in some countries would be prohibited for use on appliances without flues because of the potential hazard.

It is an object of the present invention to provide a new or improved control circuit for fuel using appliances.

According to one aspect of the present invention we provide a control circuit in or for a fuel using appliance of the type in which a valve means is opened to enable combustion of fuel to take place characterised in that said control circuit includes switching means operative to permit of or prevent said valve means being provided with a signal for opening said valve means, and in that said control circuit includes a checking circuit capable of ascertaining that, prior to the sending of said signal, said switch means is in a state to prevent said signal being sent, and, if said switching means is not in a signal sending preventing condition said control circuit prevents the sending of said signal.

Preferably said valve means comprises a flame failure valve.

The control circuit of the present invention overcomes the problems with devices heretofore proposed in that unless the control circuit is in a "fail-safe" condition then the signal, will not be sent to change the normally closed position of the flame failure valve.

Preferably the checking circuit is operative to check other parts of the control circuit as to their normal operation and condition and if any abnormality is sensed the checking circuit is operative to prevent the sending of a signal to open the flame failure valve.

Preferably said switching means comprises a switching circuit incorporated in said control circuit.

Preferably when the valve means comprises a flame failure valve the signal opens the valve for a predetermined short period of time. The short period enables ignition to take place, and, on ignition of the fuel the combustion sensing means enables said valve to be maintained in an open state.

Conveniently said short period of time is controlled by the length of time during which the signal from said control circuit is supplied to said valve, said short period of time may cease when combustion is sensed or it may continue for a predetermined short period of time irrespective of the sensing of combustion.

Preferably said combustion sensing means comprises means for generating or changing an electrical signal which electrical signal is supplied to said control circuit in order to enable generation of a second control signal to said flame failure valve to maintain said valve open during combustion.

It is envisaged that said valve means may comprise two or more valves but preferably said valve means comprises a single valve operable between an open and closed position its operational state being dependent on whether or not:-

- (a) combustion of fuel is sensed; or
- (b) a signal is received from a control circuit, which signal enables said valve to be opened for a short period of time.

The control circuit of the present invention thereby avoid the necessity of a by-pass and hence ensures that fuel cannot be continually supplied indefinitely without combustion taking place.

Further significant advantages are obtained with the control circuit of the present invention, in particular with fuel using appliances adapted to operate on an automatic mode. As aforementioned existing arrangements for automatic control generally comprises three valves, a thermostatic valve, a flame failure valve, and a clock controlled valve.

The control circuit of the present invention enables the flame failure valve and the clock valve to be incorporated as a single valve, the clock causing a signal to be sent to the control circuit at a desired time which causes opening of the flame failure valve allowing fuel to pass therethrough and so to be ignited. At the end of the short period of time when it is desired to turn off the appliance, the control circuit may be provided with a signal from the clock to close said valve.

Such an arrangement permits not only of elimination of a valve i.e. the clock operated valve but also elimination of a considerable quantity of connecting pipework.

Preferably said control circuit is provided with means for limiting the time for which said first valve opening signal is present and conveniently said means may comprise a resistor capacitor network the rate of charge to the

0120681

capacitor being determined by its value and that of an associated resistive component network.

Preferably said control circuit includes further timing means to prevent said first valve opening signal being subsequently regenerated until a predetermined time has elapsed.

Preferably said control circuit includes further means which, in the event of generation of said first valve opening signal and failure of receipt of any combustion indicative signal prevents regeneration of said first valve opening signal until a third signal is received by said control circuit. Conveniently said third signal may comprise disconnecting the control circuit from its power supply.

Preferably said valve means is provided in series with a thermostatically operated valve and conveniently may comprise a valve body incorporating said thermostatically operated valve.

Preferably said thermostatically operated valve is, when set to an in-use position, always at least partially open. Preferably said thermostatically operated valve may comprise a solenoid valve or other electrically controlled valve operated in accordance with a signal from the control circuit, said signal being varied in accordance with temperature from a temperature sensing device.

Conveniently, said temperature sensing device may comprise a thermocouple.

The present invention will now be described in more detail by way of example only with reference to the accompanying drawings wherein:-

FIGURE 1 is a diagrammatic illustration of one form of control means for use with the control circuit of the present invention.

FIGURE 2 is a diagrammatic illustration of an alternative arrangement of control means for use with the control circuit of the present invention.

FIGURE 3 is a detailed circuit diagram of the control circuit as shown in Figures 1, 2, and 5

FIGURE 4 is an illustration of one form of control valve.

FIGURE 5 is an illustration of another embodiment of control means for use with the control circuit of the present invention.

Referring first to Figure 1, a fuel control system operated by the control circuit of the present invention is illustrated, the control system being incorporated in a fluid fuel supply, which fuel will hereinafter be referred to for convenience as gas, to a domestic oven. A gas inlet 10 is

connected to a thermostatically controlled valve 11, which includes an on/off valve and which may be set by the manually operable control 12.

A temperature sensing device 13 will automatically operate the valve 11 depending on the temperature sensed thereby.

The manual contact 12 also operates an on off switch 23 connected by cable 15 to control circuit 31

The valve 11 is connected by a pipe 14 to a flame failure valve 30 which is operated electrically from a signal received from a control circuit 31.

The control circuit 31 has connected thereto a combustion sensing device 32 and it is also connected to clock timing unit 33. The output of the flame failure valve 30 is connected by a pipe 34 to the burner 21.

In operation of the device if it is required to work on a non-timed period, i.e. manual operation, the control 12 is turned on to the required temperature, simultaneously turning on the on/off "tap" valve, such operation opening valve 11 operating switch 23 and, since the switch in clock timing unit 33 will be closed causing operation of ignition unit 22 and switching on control circuit 31.

Control circuit 31 is connected via wires 35 to the flame failure valve 30. In the absence of any signal the flame failure valve 30 is maintained closed however, on receipt of a first valve opening signal on line 35 the flame failure valve 30 is opened, by a solenoid for example, and gas can flow through the valve 30 through pipe 34 to the burner 21 the gas being ignited by automatic igniter 22.

When ignition has taken place combustion is sensed by sensing unit 32 (thermocouple) which sends a signal to the electronic control circuit 31. This has the effect of replacing the first valve opening signal on line 35 with a second, combustion sensing signal, to maintain the flame failure device 30 in an open state. In practice the first and combustion sensing signals on line 35 are the same but are initiated and maintained by different "instructions" to the control circuit 31.

If ignition does not take place, for example due to a faulty ignition unit 22, then the signal on line 35, initiated by turning on switch 23, will, after a predetermined period of time, for example ten seconds, cease, hence closing the flame failure valve 30 to prevent further gas being supplied to the burner 21.

Safety provisions are built into the circuit 31 to prevent the flame failure valve being operated once again until the power supply to the electronic control circuit 31 has been switched off.

Such safety provisions ensure that if for example there is a gas failure the combustion sensing device 32 will sense the lack of combustion, the electronic control circuit 31 will change the signal on line 35 to flame failure valve 30 which will then close. If the gas supply is subsequently restored no gas can pass to the burner 21.

If a power failure occurs the flame failure valve 30 will immediately be switched off since the signal on line 35 from electronic control circuit 31 will cease.

Referring now to Figure 2 the control system shown is similar to that shown in Figure 1. However, the flame failure valve 30 has been incorporated in the body of thermostatic control valve 11'. The operation of the control circuit is exactly the same as described for Figure 1.

Referring now to Figure 3 the electronic control circuit 31 will be described in more detail. A mains supply of voltage is supplied to the primary of transformer T1 and transformed to a low voltage which is subsequently rectified by diodes DR1 and DR2.

The voltage is stabilised by zener diode ZD1 and supplied to a checking circuit CH1. Safety checking circuit CH1 comprises resistors R5 R9, transistors TR3 and TR4 diodes D6 and D7 and relay RL2 having contacts RLC2. The checking circuit will later be described in more detail.

Assuming the checking circuit CH1 has not sensed a fault in the control circuit the circuit will operate as follows.

Integrated circuit IC1 is supplied with a stabilised voltage and produces an output signal on an output terminal 40 which causes transistors TR1 and TR2 to turn on, relay RL1 to be energised thus switching contacts RC1 and causing a voltage to be applied to terminals TS1 and TS2 which are connected in circuit with a solenoid for operating the flame failure valve 30. The flame failure valve is thus opened and it permits gas to flow to the burner 21 so as to be ignited by ignitor 22.

As soon as the mains voltage is supplied to transformer T1 capacitor C1 will begin to charge through resistors R1a and R1b and, after a predetermined time, the voltage applied to terminal 42 of the circuit IC1 will cause the integrated circuit to terminate its output signal on output 40. The transistors TR1 and TR2 will thus switch off, relay RL1 de-energise and

contacts RLC1 open. The flame failure valve 30 will then close. Such action will take place if no ignition is sensed by a combustion sensing device 32. If combustion is sensed by combustion sensing device 32 a small voltage is supplied to the input 43 of IC2, which is a voltage comparator, generating a signal which integrated circuit IC3 (operational amplifier) amplifies and provides an output to switch on transistors TR1 and TR2. Thus, after switching on the gas appliance, and assuming combustion takes place, even though the signal from output 40 of IC1 ceases after a predetermined time, transistors TR1 and TR2 are maintained in an "on" state by the signal provided from the combustion sensing device 32 via integrated circuits IC2 and IC3. Thus relay RL1 will be continually energised hence maintaining flame failure valve 30 open.

If combustion ceases the signal from combustion sensing device 32 will cease and the signals from IC2 and IC3 will cease switching off transistors TR1 and TR2 and de-energising relay RL1. The flame failure valve 30 will then close.

Immediate re-ignition is not possible since resistor capacitor network R2a,R2b-C2 has enabled C2 to charge providing a signal on line 44 which inhibits operation of IC1 and prevents an output signal being provided at output 40.

In order to obtain a signal at output 40 of IC1 it is first necessary to remove the power supply i.e. switch off the supply to transformer T1 to allow C2 to discharge through R2a and R2b this also ensures that any unignited gas present in the vicinity of the burner has time to disperse.

When C5 has discharged, or at least discharged to a predetermined low value once power is provided to transformer T1, IC2 will produce a signal on output 40 for a predetermined length of time dictated by the rate at which C1 charges as afore explained.

The control circuit therefore permits opening of the flame failure valve 30 for a predetermined short period of time when requested i.e. by switching on the circuit, which switching on is carried out by manual switch 23 and, possibly timed by time control 33 and similarly may be switched off from time control 33, the flame failure valve 30 also being maintained open for an indefinite period providing combustion continues.

At the end of a predetermined "timed" period the gas supply must be terminated. The time control 33 therefore switches off the control circuit thus removing the potential across terminals TS1 and TS2 which closes the flame failure valve 30 even though combustion was still taking place.

Referring now in detail to the checking circuit CHI, the purpose of the checking circuit CHI is to inhibit operation of the control circuit should a fault in the switching circuit which comprises transistors TR1, TR2 by means of which the signal is provided to the flame failure valve 30, be detected. The checking circuit CHI which will hereinafter be described in detail also checks for the correct operation of other important parts of the circuit.

On application of power to the control circuit, initiated by turning on of the switch 23 or, if switch 23 is already turned on, by a clock operated time switch, a DC voltage from the transformer rectifier circuit incorporating transformer T1 and diode DR1 and DR2 is regulated by zener diode ZD1 and applied to comparator circuit IC2, amplifier circuit IC3 and also to the checking circuit CHI comprising resistors R5, R9, diode D6, D7 transistors TR3, TR4 and relay RL2 having contacts RLC2.

The DC voltage stabilized by zener diode ZD1 is not however applied directly to relay RL1 which is operative to open the flame failure valve 30 nor is the DC voltage applied to the timer circuit incorporated in integrated circuit IC1.

Power is supplied via resistor R5 to the collector junction of transistor TR1 and via resistors R5 and R6 to the junction between resistor R6, diode D1 and diode D3 and hence through diodes D1 and D2 to terminal 42 of integrated circuit IC1, and capacitor C1 and through diodes D3 and D4 to capacitor C2 to test for "short circuits" of the capacitors described in detail later.

On activation of the control circuit by switching on switch 23 for example, the comparator circuit IC2 and amplifier circuit IC3 is energised but the timer IC1 and main relay RL1 remains de-energised, thus the solenoid valve operating flame failure valve 30 is de-energised. If a fault exists in the comparator circuit IC2 or amplifier circuit IC3 which results in a power output from IC3 tending to turn-on transistor TR1 and/or TR2 the effect will be to reduce the potential at the collector of TR1 from its previous high level to a potential substantially the same as earth (provided by the conduction of transistors TR1 and TR2,). The current through diode D7 and resistors R7 and R8 tending to turn on transistors TR3 and TR4 will thus be insufficient preventing these transistors from turning on and hence preventing energisation of relay RL2. Contact RLC2 will thus remain open. When contact RLC2 is open then relay RL1 cannot be energised. Furthermore with relay RL2 de-energised power cannot be supplied to timer circuit IC1.

As aforementioned the voltage at terminal 42 of IC1 is, at the moment of switch-on, low. If capacitors C1 or C2 are faulty e.g. short circuited, then the potential of the junction of resistor R6 and diode D7 will not rise and hence will not be sufficient to drive transistors TR3 and TR4 into conduction thereby preventing energisation of relay RL2 and rendering flame failure valve 30 and timer circuit IC1 inoperative.

It will thus be understood that not only is the switching circuit comprising transistors TR1 and TR2 checked, the drive circuit IC2 and IC3 which cause operation of such transistors is checked, furthermore the functioning of capacitors C1 and C2 operative to stop the signal after a predetermined length of time in conjunction with timing circuit IC1 is also checked before the control circuit permits sending a signal to relay RL1 to open the flame failure valve 30.

If during normal operation of the control means of the present invention, there is disconnection of the control circuit from its power supply, for a period of for example a second or two, the circuit will be inhibited until the thermocouple cools to a predetermined temperature until relay RL1 is de-energised and the flame failure valve closed, after which assuming the power supply is reconnected, the timer circuit can re-cycle to open the flame failure valve and initiate ignition of the burner.

Some of the components in the circuit, such as transistors TR1 and TR2, R1a, R1b are present in duplicate where it will be appreciated only a single component may be used. However, the duplication of such important components ensures that if one component fails the control circuit will continue to operate safely or "fail safe" thus preventing the occurrence of a potentially hazardous condition.

Referring now to Figure 4, a thermostatic control valve incorporating a flame failure valve is illustrated the combined valve comprising a gas inlet 10, thermostatic valve 11, manual operating spindle 12 switch 23, thermostatic heat sensing device 13, flame failure valve 30 the flame failure valve operating solenoid 42 is connected by the line 43 to terminals TS1 and TS2 shown in Figure 3. The valve body may also include an on/off "tap" valve.

Referring now to Figure 5, a further alternative of the control means of the present invention is illustrated and comprises a gas burner 21 connected from valve means 54 by a supply pipe 34, the fuel being supplied to the valve means 54 through pipe 10.

The valve means 54 is provided with two solenoid valve 55 and 56, valve 55 comprising a flame failure valve operable from control circuit 50 in accordance with the method of operation as previously described with reference to Figures 1 and 2, the flame failure valve 55 being capable of being opened on instructions from the control circuit 50 either when the sensing device 32 senses combustion or for a short period of time to allow fuel to pass to the burner 21 and for ignition of the fuel by the ignitor 22.

The second solenoid valve 56 is a thermostatically operated valve and is controlled in accordance with the signal from control circuit 50, which signal is generated or modified in accordance with a temperature sensed by sensing means 53 which may comprise a thermocouple. A manually operable control 12 is connected to the control circuit 50 to provide an input function of the desired temperature and may be connected to, for example, a variable resistor 51 which is electrically connected to control circuit 50.

An important advantage is gained by the provision of an electronically controlled thermostatic valve 56 in that the manually operable control means 12 may be positioned remotely from the control valve 54 thus further eliminating pipework joints in the fuel supply system.

The control circuit of the present invention enables not only a safer more reliable system but also provides a considerable saving in the valves and pipework and joints necessary to provide the required control of an automatically timed fluid fuel burning device.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, or a class or group of substances or compositions, as appropriate, may, separately or any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A control circuit 31 in or for a fuel using appliance of the type in which a valve means 30 is opened to enable combustion of fuel to take place characterised in that said control circuit 30 includes switching means operative to permit of or prevent said valve means being provided with a signal for opening said valve means 30, and in that said control circuit 30 includes a checking circuit capable of ascertaining that, prior to the sending of said signal said switching means is in a state to prevent said signal being sent and, if said switching means is not in a signal sending preventing condition said control circuit prevents the sending of said signal.
2. A control circuit as claimed in Claim 1 characterised in that said valve means 30 comprises a flame failure valve and can be opened by said signal for a predetermined short period of time irrespective of the presence or absence of combustion.
3. A control circuit as claimed in Claim 1 or Claim 2 characterised in that said valve means 30 comprises a flame failure valve and in that said control circuit 31 includes an input from a combustion sensing means 32 operative to generate a signal to maintain said valve means 30 open when combustion takes place.
4. A control circuit as claimed in any one of the preceding claims characterised in that said checking circuit CHI is operative to check other parts of the said control circuit 31 as to their normal operation and condition and, on sensing abnormality, said checking circuit CHI is operative to either prevent the sending of a signal to open said valve means 30.
5. A control circuit as claimed in any one of the preceding claims characterised in that said control circuit 31 comprises timing means ICI operative after initiation of a valve means 30 opening signal to prevent re-generation of said signal until a predetermined time has elapsed.
6. A control circuit as claimed in any one of the preceding claims, and valve means 30 characterised in that said valve means 30 is closed to prevent supply of fuel in the absence of combustion of fuel and is open to allow a supply of fuel if:-

- (a) combustion of fuel is sensed, or
- (b) a signal is received from said control circuit 31 which signal enables said valve means 30 to be open for a short period of time;

and further valve means connected in series with said valve means 30 said further valve means comprising a thermostatically operated valve 56.

7. A control circuit as claimed in Claim 6 characterised in that said valve means 30, 55 and said thermostatically controlled valve 11, 56 are provided in a single valve body 54.

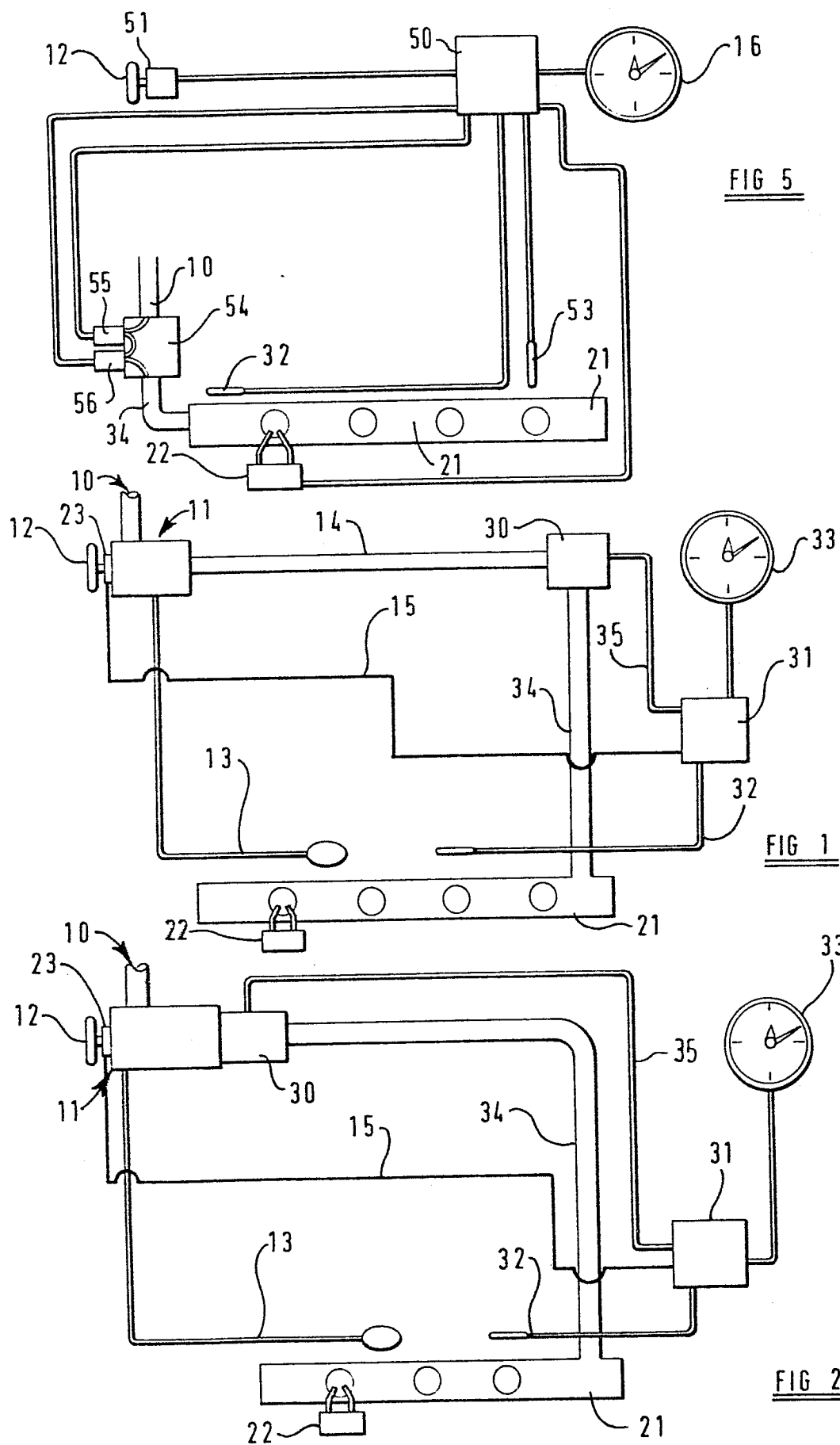
8. A control circuit as claimed in any one of the preceding claims characterised in that said control circuit 31 includes an input from a clock operated switch capable of initiating the generation of said signal.

9. A fluid fuel using appliance including valve means for permitting or preventing the flow of fuel to said appliance characterised in that said valve means 30 is controlled by a control circuit 31 as claimed in any one of the preceding claims.

10. An oven for heating or cooking foods, the oven being connected to a gas supply and having a burner 21 where such gas is burnt and wherein valve means 30 are provided, said valve means 30 being open if:

- (a) combustion of fuel is sensed by a combustion sensing means 32, or
- (b) a signal is received from a control circuit 31, said signal enabling the valve means 30 to be opened for a predetermined short period of time irrespective of the presence of, or absence of, combustion of fuel at said burner 21;

characterised in that the control circuit 31 is as claimed in any one of Claims 1 to 8.



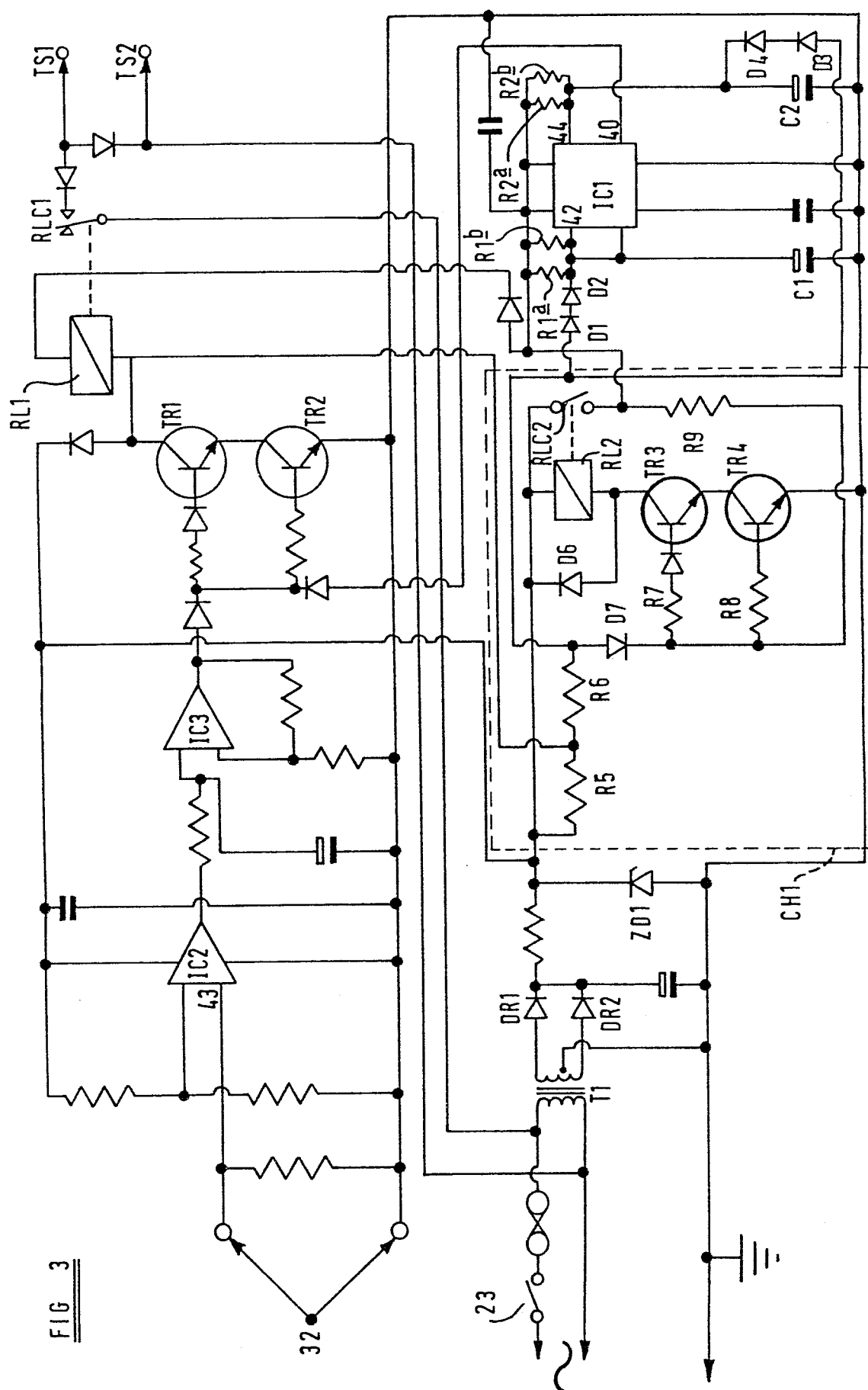


FIG 3

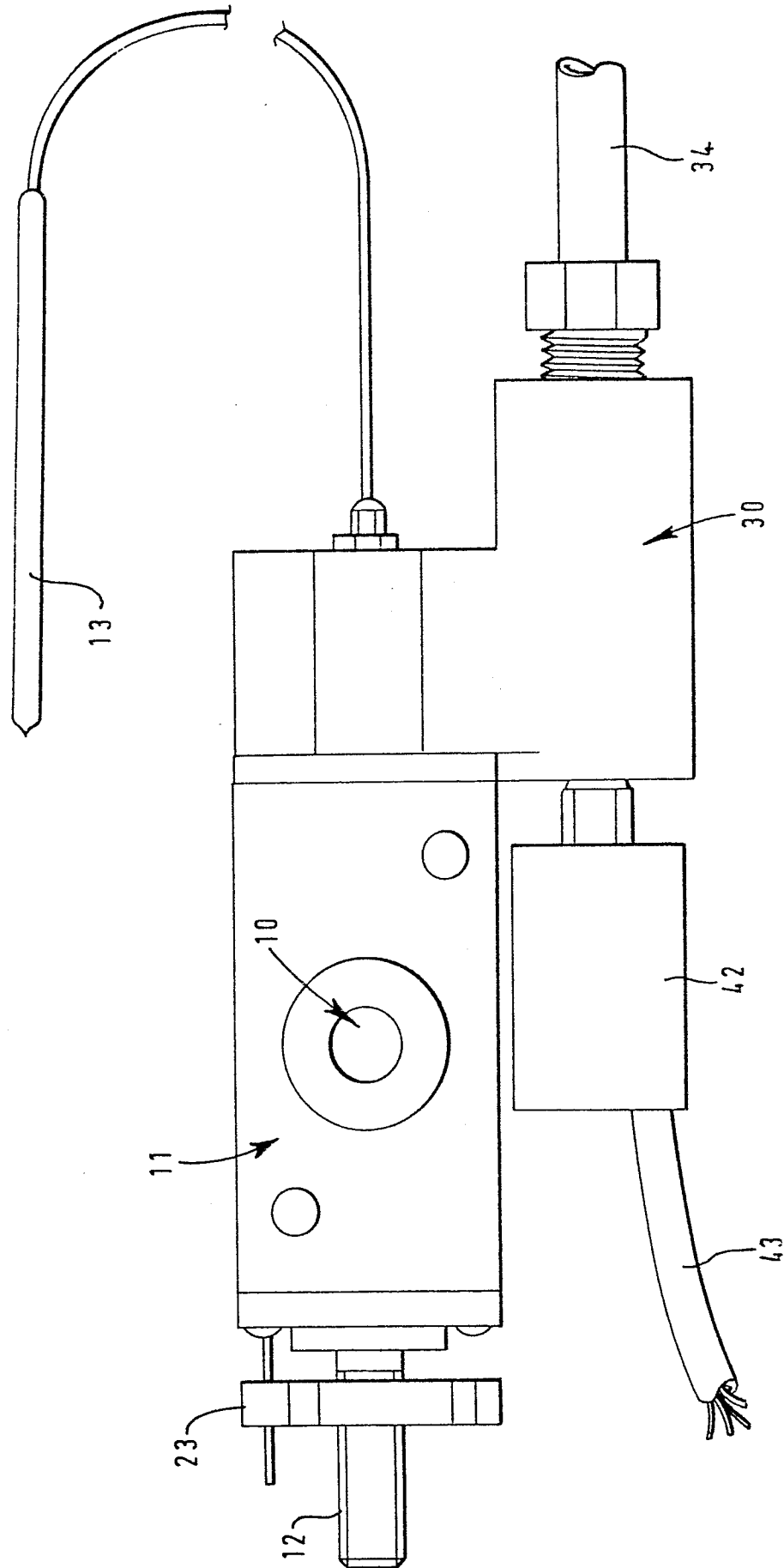


FIG 4



European Patent
Office

EUROPEAN SEARCH REPORT

0120681

Application number

EP 84 30 1943

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. 3)
X	US-A-4 226 581 (R.A. SCHILLING) * Figures; column 4, line 59 - column 5, line 18; column 4, lines 13-50 *	1,3	F 23 N 5/10 F 23 N 5/20
X	US-A-4 073 611 (C.L. KADUKI et al.) * Abstract; figures 1,2; column 5, line 55 - column 6, line 63 *	1,4	
X	US-A-4 076 487 (R.D. STONEKING) * Abstract; figures *	4	
D,X	US-A-2 962 093 (R.B. MATTHEWS) * Figure 1; column 2, lines 63-67; column 6, line 47 - column 7, line 24 *	2,3,6	
D,X	DE-A-2 123 458 (INDUSTRIE A. ZANUSSI S.p.A.) * Figures; page 4, line 11 - page 5, paragraph 3 *	2,6	
D,X	FR-A-2 434 342 (ET. EUGENE SCHOLTES) * Figures 1-4; page 6, lines 10-17; page 4, line 21 - page 5, line 14 *	2,6,8-10	
X	US-A-3 510 236 (W.F. POTTS) * Column 6, lines 51-72 *	5	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12-06-1984	Examiner THIBO F.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			



DOCUMENTS CONSIDERED TO BE RELEVANT				Page 2
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)	
A	US-A-3 705 783 (J.S. WARREN) * Column 5, lines 6-28; abstract * -----	5		
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)	
The present search report has been drawn up for all claims				
Place of search THE HAGUE		Date of completion of the search 12-06-1984	Examiner THIBO 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				