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(54) Safety device for boilers.

(57) A boiler comprises: a burner (1) connected to a stoking piping (2) fitted with a solenoid valve (3) which closes or opens the stoking; a combustion chamber (4) open toward the room housing the burner; a hood (6) for a chimney (7) with a cavity (8) open toward said room; a first temperature sensor (10) located below the burner (1); a second temperature sensor (11) is located near the cavity (8); the first and second sensors (10,11) are electrically connected to a safety device (12) for boilers, via a first conductor (13) and a second conductor (14), respectively. The device (12) is connected to a generator (15) and to solenoid valve (3) by means of a third conductor (15) and of a fourth conductor (17), respectively.

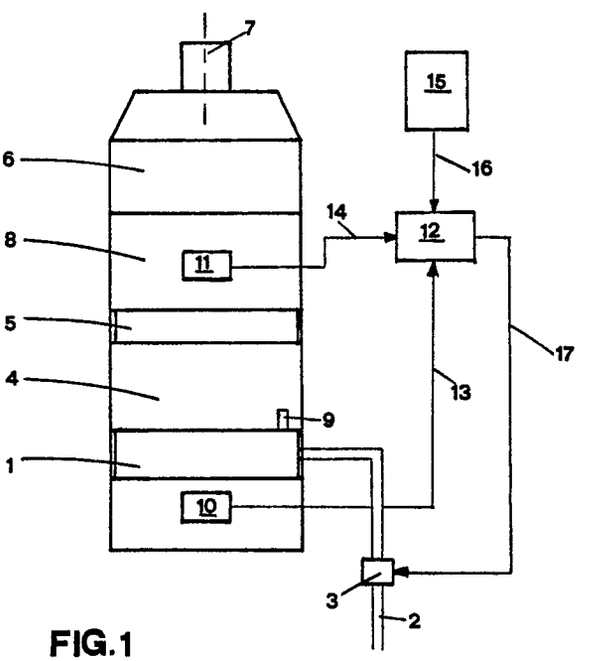

FIG.1

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SAFETY DEVICE FOR BOILERS

The present invention refers to a safety device for boilers, in particular for domestic heating equipments, sectional boilers or the like.

More particularly, the present invention refers to a safety device adapted to stop the stoking of a boiler of the above mentioned kind in case that the products of combustion, shot by the burner of the boiler, be not blew off by the chimney outward but tend to invade the room housing the boiler.

A boiler of the above kind comprises a burner, a combustion chamber, a heat exchanger fitted with a pilot flame nozzle and located upstream the combustion chamber and in which, as known, a part of the heat of the gases coming from said combustion chamber is transmitted to an intermediate heating fluid (water, oil and the like); a hood for a chimney, located upstream said heat exchanger, via which the gases passed through the exchanger are sent to the chimney.

When the exchanger is clogged by the solid residuals of the combustion, the gases coming from the burner excape from the combustion chamber toward said room; in the same manner, when the chimney is clogged, the gases direct themselves toward the room instead than toward the chimney. In both cases, the combustion is imperfect and the room is polluted by the products of this combustion.

Detecting instruments are known which are able to detect the quality and the quantity of the usual pellutants coming from a com bustion such as carbon monoxide or carbon dioxide, methane and other gaseous hydrocarbons. These instruments, besides being portable and not adapted to invervene directly on the stoking of the boiler, have the following disadvantages:

1- their sensors are not selective with respect to all the pollutants shot during an imperfect combustion, therefore they might signal the presence of pollutants in case that a gaseous substance interferring with the sensors is present in the room;

2- the response times of the sensors are relatively long with respect to the variations of the concentrations of a pollutant which, thence, is allowed to invade the room before the sensors intervene to signal it;

3- they are expensive and they may not be easily used in a device adapted to stop the stoking of the burner, due to their above mentioned features;

4- the devices fitted with sensors of the above kind have irreversible interventions on the stoking of the boiler's burner, that is they are not able to reset the stoking after they have stopped it; this entails the necessity of interventions on the same devices and on the stoking elements even in the case of an incorrect detection by the sensors for that described in above item 1.

The invention is intended to remedy these drawbacks. The invention, as claimed, solves the problem of how to create a safety device for boilers. By using a device according to the present invention, the following result is achieved: the stoking of the burner is stopped in case that the products of the combustion tend to invade the room housing the boiler and it is reset in case that the tendency is momentary.

The advantages offered by the device according to the present invention consist essentially in that fact that it is very simple to assembly it near boilers, even already built; the assembly being further very reliable.

In one embodiment, the safety device for boilers according to the present invention consists of: a temperature sensor located down-stream the boiler's burner, so that it is invested by the gases coming from the burner when the exchanger is clogged, or near the hood of the chimney, so that it is invested by the residual combustion gases passed through the exchanger when the chimney is clogged; said sensor being able to emit a first electrical signal when it is not invested by said gases and a second electrical signal when it is invested by said gases; an element, electrically connected to said sensor to receive said first and second electrical signals, said element being able to compare the value of said first and second electrical signals with an electrical reference value stored in said element and to send a third and a fourth electrical signals to a solenoid value electrically connected to said element when said element receives said first or said second signal, respectively; said solenoid value being able to maintain the stoking of the burner when it receives said third signal and to stop said stoking when it receives said fourth signal; as known said burner being fitted with an auxiliary lighting nozzle adapted to reset automatically the combustion of the burner when said solenoid value receives said third signal.

The invention will be described in great detail below be referring to the drawings which represent not limiting embodiments in which:

Fig.1 is a schematic view of a boiler fitted with a device according to the present invention;

Fig.2 shows an embodiment of the invention in a block diagram.

Figs.3-7 show further embodiments of the invention.

The boiler shown schematically in Fig.1 comprises a burner 1, connected to a stoking piping 2 for a gaseous fuel, fitted with a solenoid valve 3 able to permit or to stop the gas flow toward the burner 1; a combustion chamber 4 being located between the burner 1 and a heat exchanger 5; said chamber 4 being opened toward the room housing the boiler. A hood 6 for a chimney 7 is located upstream the exchanger 5; the hood 6 has a cavity 8 open toward the room. The burner 1 is fitted with a pilot flame nozzle 9 which ensures the lighting and the stability of the combustion of burner 1 under any condition.

A first temperature sensor 10 is located downstream the burner 1 where a temperature value close to the ambient temperature establishes when the boiler is on.

A second temperature sensor 11 is located near the cavity 8 in a zone which divides the inner space of said cavity from the room; a temperature value close to the ambient temperature establishes in said zone when the boiler is on.

The first and second sensors 10 and 11 are electrically connected to a safety device 12 for boilers via a first conductor 13 and a second conductor 14, respectively. The device 12 is connected to a generator 15 and to the solenoid 3 via a third conductor 16 and a fourth conductor 17, respectively.

In the block diagram of Fig.2 the sensors 10 and 11 are connected to a first and a second safety devices for boilers 12a and 12b, respectively, identical to said device 12 of Fig.1, via the conductors 13 and 14; the devices 12a and 12b are connected to a generator 15 via the conductors 15a and 15b and to the solenoid valve 3 via the conductors 16a and 16b.

In the block diagram of Fig.3 the sensors 9 and 10 are connected to a first and a second safety devices for boilers 12a and 12b, respectively, identical to said device 12 of Fig.1, via the conductors 13 and 14; the devices 12a and 12b are connected to a generator 15 via the conductors 16a and 16b and to the solenoid valve 3 via the conductors 17a and 17b. Furthermore, the devices 12a and 12b are connected to a first and to a second audio or visible signaller 18a and 18b, respectively, via conductors 19a and 19b. In this manner it is possible to identify immediately which of the two sensors 10 or 11 has emitted the signal indicating the flow of the burnt gases toward the room housing the boiler and to eliminate the obstacle which has caused this flow.

If the signaller 18a begins working, it means that the signal comes from sensor 10 and therefore the exchanger 5 must be cleaned; if the signaller 18b begins working, it means that the signal comes from sensor 11 and that the chimney 7 must be cleaned.

The sensors 10 and 11 may be both thermocouples and thermisters; the latter may be both P.T.C. and N.T.C..

As known, the trend of an e.m.f. at the terminals of the thermocouple, expressed as a function of the temperature, is a monotonic curve not much different from a stright-line, besides, the increment of the tension is very low for a small increment of the tem perature considered as an independent variable. Such trend is expressed in the graph of Fig.4.

A safety device fitted with temperature sensors made of thermocouples is shown in Fig.5. A sensor 10 or 11 is connected to a proportional amplifier 20 having an electric parameters gain which is very high and which has no distorsions in the output signal. The amplifier 20 sends electrical pulses, proportional to the pulses received from the sensors 10 or 11, to an hysteresis network 21, which defines two intervention thresholds T_1 and T_2 of the device on the solenoid valve 3; T_1 being greater than T_2. The hysteresis network 21 sends output signal to an extinguishing network 22 connected to a power stage 23, fed by a rectifier transformer group 24.

Between the stage 23 and the group 24 a diode 25 is opportunely located. The stage 23 is connected to a solenoid 26 of the solenoid valve 3 which is earthed via a resistance 27; a diode 28 earths a first node 29 to void overcurrents linked to solenoid 26. A second node 30 is conected to stage 23 via solenoid 26 and to a delay network 31, whose output signal is sent to a chopper network 32, which contains a reference signal of the current intensity I_{ref} and whose output signal is sent to the stage 23.

A lamp 33 is connected to node 30 and to earth for lighting up when the solenoid is energized. When the temperature detected by one of the sensors 10 or 11 is above a value T_1, the hysteresis network 21 sends a signal to the stage 23 to act on the solenoid 26 such that the solenoid valve 3 steps the fuel stoking to burner 1; contemporaneously, lamp 33 lights up. When, vice-versa the tem perature detected by one of the sensors 10 or 11 is below a value T_2, the hysteresis network 21 sends a signal to stage 23 to act on solenoid 26 such that the solenoid 26 opens the fuel stoking to burner 1 and contemporaneously lamp 33 puts out.

The hysteresis $S = (T_1 - T_2)$ between the intervention thresholds of the network 21 serves to void the regulation instability due to useless interventions when the gases burnt by the burner tend to excape toward the room because of momentary pressure drops in said room for example when one lights a fireside.

Fig.6 shows an electric network enables to control a safety device according to the present invention in which the sensors 10 and 11 consist of thermistors both P.T.C. and N.T.C. The network consists of a mesh having four resistance sides R_1, R_2,R_3, R_4; between nodes A and B the rectifier transformer group 24, shown in Fig.5, is inserted to generate a low tension e.m.f. Between nodes C and D a safety device 12 is inserted which is fed by the group 24 and which is connected to solenoid 3.
Sensors 10 or 11 are represented by the variable resistance R_4, which is arranged in series with a rheostat R_5.

In order that nodes C and D are at the same potential, it is necessary that the following relation is valid:

$A_1\ R_4 + R_5 = R_3 \times (R_1/R_2)$

The rheostat R_5 serves to determine the value of the temperature T_2, for which nodes C and D are at the same potential.
For a temperature T_m lower than T_2, the conductor 35, located between nodes C and D, would be crossed by a current I_n directed toward the direction of arrow F_2 which could damage the device 12. For this reason the conductor 35 is fitted with a diode 34 which voids the passage of the current I_n but not the passage of the current I_m, directed toward the direction of arrow F_1; For a temperature value T_M greater than T_2, the current I_m establishes in the conductor 35. The current I_m enables the device 12 to send an electrical signal to solenoid valve 3 to stop the stoking to burner 1.

Since sensors 10 and 11 are away from the device 12, one can not overlook the problems caused by the variations of the resistance of the conductors necessary for electrical connection between the sensors and the device.
To overcome this disadvantage, the structures shown in Fig.7 are used; in said figure, the electrical feeding of the solenoid valve 3 is accomplished by connecting electrically the solenoid valve 3 to the high tension distribution network 36, while the regulation of said feeding is carried out in low tension. This expedient allows to decrease the falls of pressure along the feeding conductors.

The rectifier transformer group 24 is fitted with an inlet I_R connected to the distribution network 36 and with three outlets U_1, U_2, U_3, connected to a first operating network 37, to a second operating network 38 and to the power stage 23, respectively; said networks 37 and 38 being identical.

The power stage 23 is connected to the solenoid valve 3 to determine the opening and the closing states thereof. The sensor 10 is connected, via a conductor 41, at one end to the terminal 39 of the first operating network 37 and at the other end to earth 40. Two calibration rheostats 42 and 43 are arranged in series in the conductor 41. The outlet of the network 37 is connected to the inlet of a shielding network 44 able, amongst other, to void the effects of the high tension which acts on a light signaller 45, connected to network 44 and to earth 40. The outlet of network 44 is connected to a first inlet of the power stage 23.

The network 37 contains a current or tension reference signal R_{ref}. In operation, when, for example, the current I_a which crosses a detection line of network 37 is less than R_{ref}, the network 37 sends a first signal to network 44 enabling it to light the signaller 45 and to send a signal to the power stage 23 for which the stage 23 keeps the solenoid valve 3 open; vice-versa, when the current I_a is greater than R_{ref}, the network 37 sends to network 44 a second signal which enables it to put out the signaller 45 and to send a signal to the power stage 23 for which the power stage 23 closes the solenoid 3.
The variation of the current or of the tension in the network 37, depends on the value of the resistance of the sensors, the value being a function of the temperature to which the sensors undergo and on the calibrations to which the rheostats 40 and 41 have undergone.

The sensor 11 is connected via a conductor 46, at one end to the terminal of the second operating network 38 and at the other end to the earth. Two calibration rheostats 48 and 49 are arranged in series in the conductor 41.
The outlet of the network 38 is connected to the inlet of a shielding network 50 which is able, amongst other, to void the ef fects of the high tension acting on a light signaller 51 connected to network 50 and to earth 40. The outlet 50 is connected to a second inlet of the power stage 23.
The network 38 contains a current or tension reference signal R_{ref}. In operation, when for example, the current I_a, which crosses a detection line of network 38, is less than R_{ref}, the network 38 sends a first signal to network 50 enabling it to light the signaller 51 and to send a signal to power stage 23 for which the power stage 23 keeps the solenoid valve 3 open; vice-versa, when the current I_a is greater than R_{ref}, the network 38 sends a signal to network 50 enabling it to put out the signaller 51 and to send a power signal to the power stage 23 for which the power stage 23 closes the solenoid valve 3.

The current or tension variation inside the network 38 depends on the value of the resistance of the sensor 11; the value being a function of the temperature to which the sensor 11 undergoes and on the calibrations to which the rheostats 48 and 49 have undergone.

The closure of the solenoid valve 3, upon an overheating of one of the sensors 10 or 11, may be caused by the obturation of the exchanger 5 or of

the chimney 7. In these cases the signallers 45 and 51 indicate which of the two sensors is involved in the failure of the boiler so that the failure may be removed.

Claims

1. Safety device for boilers comprising: a temperature sensor (10,11) characterized by the fact that the sensor (10,11) is located below the burner (1) of the boiler, so that it is invested by the gases coming from the burner (1) when the exchanger is clogged, or near the hood (6) of the chimney (7), so that it is invested by the residual combustion gases passed through the exchanger (5) when the chimney (7) is clogged; said sensor (10,11) being able to emit a first electrical signal when it is not invested by said gases and a second electrical signal when it is invested by said gased and by the fact that it comprises further: an element (12) electrically connected to said sensor (10,11) to receive said first and second electrical signals; said element being able to compare the value of said first or second electrical signals with a reference electrical signal stored in said element (12), and to send a third and a fourth electrical signals to a solenoid valve (3) electrically connected to said element (12) when said element (12) receives said first or said second signal, respectively; said solenoid valve (3) being able to maintain the stoking of burner (1) when it receives said third signal and to stop said stoking when it receives said fourth signal; as known, said burner (1) is fitted with an auxiliary lighting nozzle (9) adapted to reset automatically the combustion of burner (1) when said solenoid valve (3) receives said third signal.

2. Safety device as in claim 1, characterized by the fact that it comprises a first and a second sensor (10,11) connected to a first and to a second safety devices (12a,12b) for boilers, respectively, via the conductors (13,14), the devices (12a,12b) being iden tical each other and being connected to an electrical generator (14) via the conductors (15a,15b) and to the solenoid valve (3) via the conductors (16a,16b).

3. Safety device as in claims 1 and 2, characterized by the fact that said first and second safety devices (12a,12b) are connected to a first and to a second acustic or visible signaller (18a,18b), respectively.

4. Safety device as in claim 1, characterized by the fact that the temperature sensors (10,11) include the thermocouples, each one of said sensors (10,11) being connected to a proportional amplifier (20) having a gain of electrical parameters high and void of distorsion in the output signal; the amplifier (20) being able to send electrical signal, proportional to the pulses received from the sensors (10, 11) to an hysteresis network (21) able to define two intervention thresholds (T_1, T_2) of the device on the solenoid valve (3); the hysteresis network (21) being able to send output signals to an extinguishing network (22), connected to a power stage (23), fed by a rectifier transformer group (24); a diode (25) being arranged between the group (24) and the stage (23); the stage (23) being connected to a solenoid (26) of the solenoid valve (3) earthed with a resistance (27); a diode (28) earthing a first node (29) to void overcurrents linked to solenoid (26); a second node (30) being connected to stage (23) via the solenoid (26) and to a delay network (31) whose output signal is sent to a chopper network (32) which contains a reference signal of the current intensity (I_{ref}) and whose output signal is sent to stage (25).

5. Safety device as in claims 1 and 4, characterized by the fact that it is fitted with a lamp (33) connected to node (30) and to earth; said lamp (33) being suited to be lighted when the solenoid (26) is energized.

6. Safety device as in claim 1, characterized by the fact that the sensors (10,11) consist of thermistors both P.T.C. and N.T.C.; the sensors (10,11) being inserted in a network consisting in a mesh having four resistance sides (R_1, R_2, R_3, R_4); between nodes (A) and (B) of the mesh the rectifier transformer group (24) is inserted and is able to generate a low tension e.m.f.; the safety device (12) being inserted between nodes (C) and (D) of the mesh; said device (12) being fed by said group (24) and being connected to solenoid valve (3); the sensors (10,11) corresponding to the variable resistance (R_4) located in series with a rheostat (R_5); said rheostat (R_5) being able to determine the temperature value (T_2) for which nodes (C) and (D) are at the same potential; a conductor (35), arranged between nodes (C) and (D) is fitted with a diode (34) able to void the passage of current (I_n) directed toward the direction of arrow (F_2) but not the passage of current (I_m) directed toward the direction of arrow (F_1); the current (I_m) establishing in the conductor (35) for a temperature value (T_M) greater than (T_2); the current (I_m) enabling the device to send an electrical signal to solenoid valve (3) to stop the stoking to burner (1).

7. Safety device as in claim 1, in which the sensors (10,11) consist of P.T.C. or N.T.C. thermistors, characterized by the fact that it comprises a rectifier transformer group (24) having an inlet (I_R) connected to a distribution network (36) and three out lets (U_1, U_2, U_3) connected to a first operating network (37) and to a second operating network (38) and to the power stage (23), respectively; said networks (37,38); by the fact that the power stage (23) is connected to solenoid valve (3) to determine

the opening and closing states thereof; by the fact that one of the two sensors (10,11) is connected, via a conductor (41,46) at one end to the terminal (39,47) of the operating network (37,38) and at the other end to the earth (40); two calibration rheostats (42,43,48,49) are inserted in series in the conductors (41,46); the outlet of the network (44,45) being connected to the inlet of a shielding network (44,50) and to the earth (40); the outlet of the network (44,50) being connected to a first inlet of the power stage (23); the network (37,38) containing a current or tension reference signal (R_{ref}).

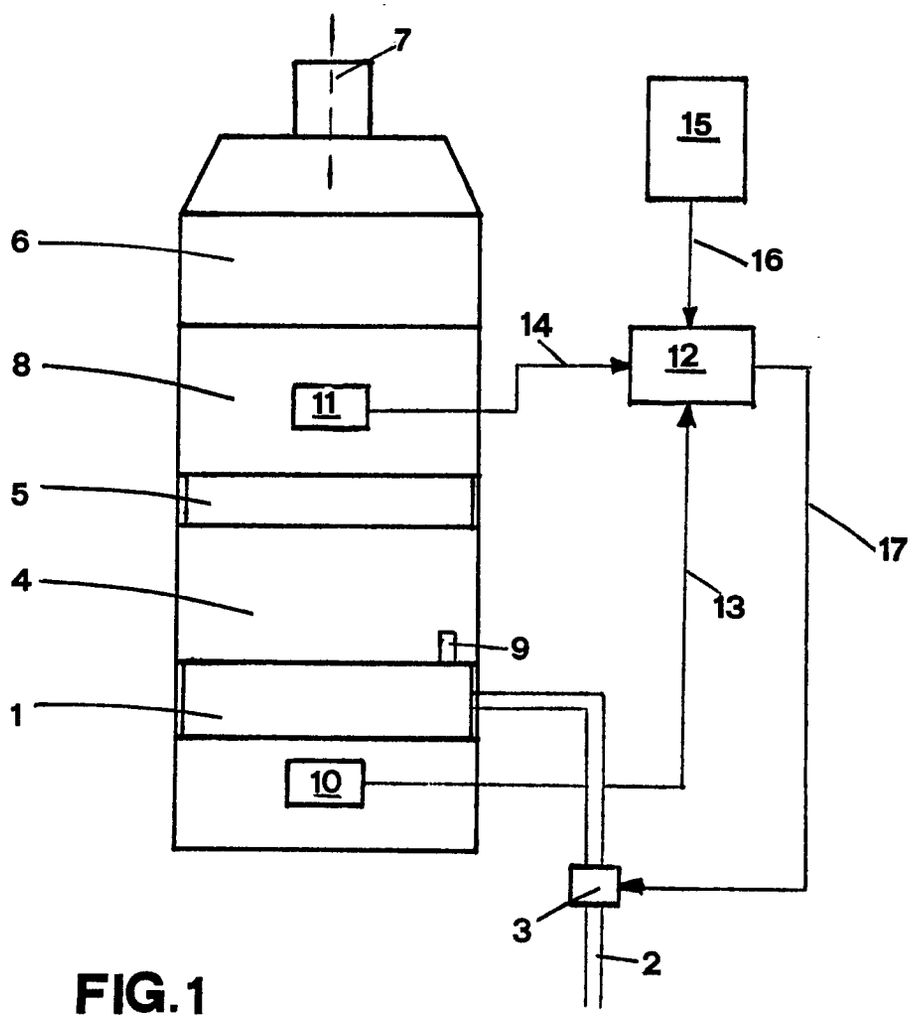

FIG.1

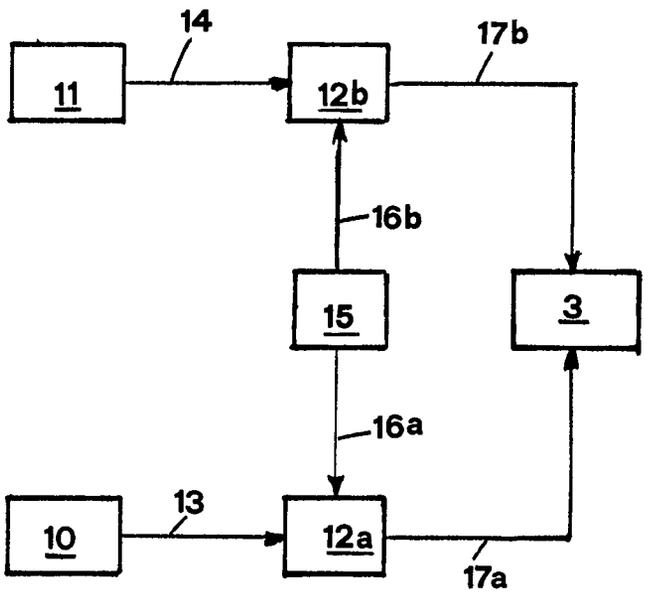
14
17b
11
12b
16b
15
3
16a
13
10
12a
17a

FIG.2

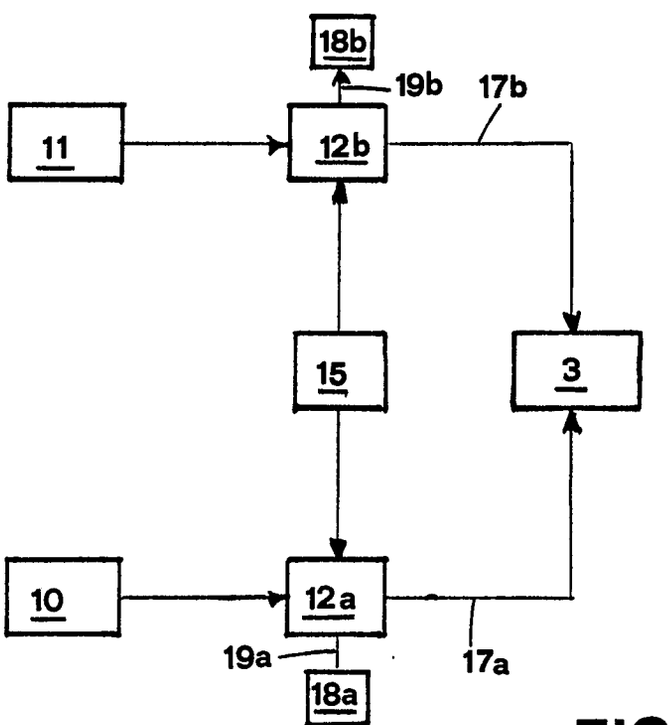
18b
19b
17b
11
12b
15
3
10
12a
19a
17a
18a

FIG.3

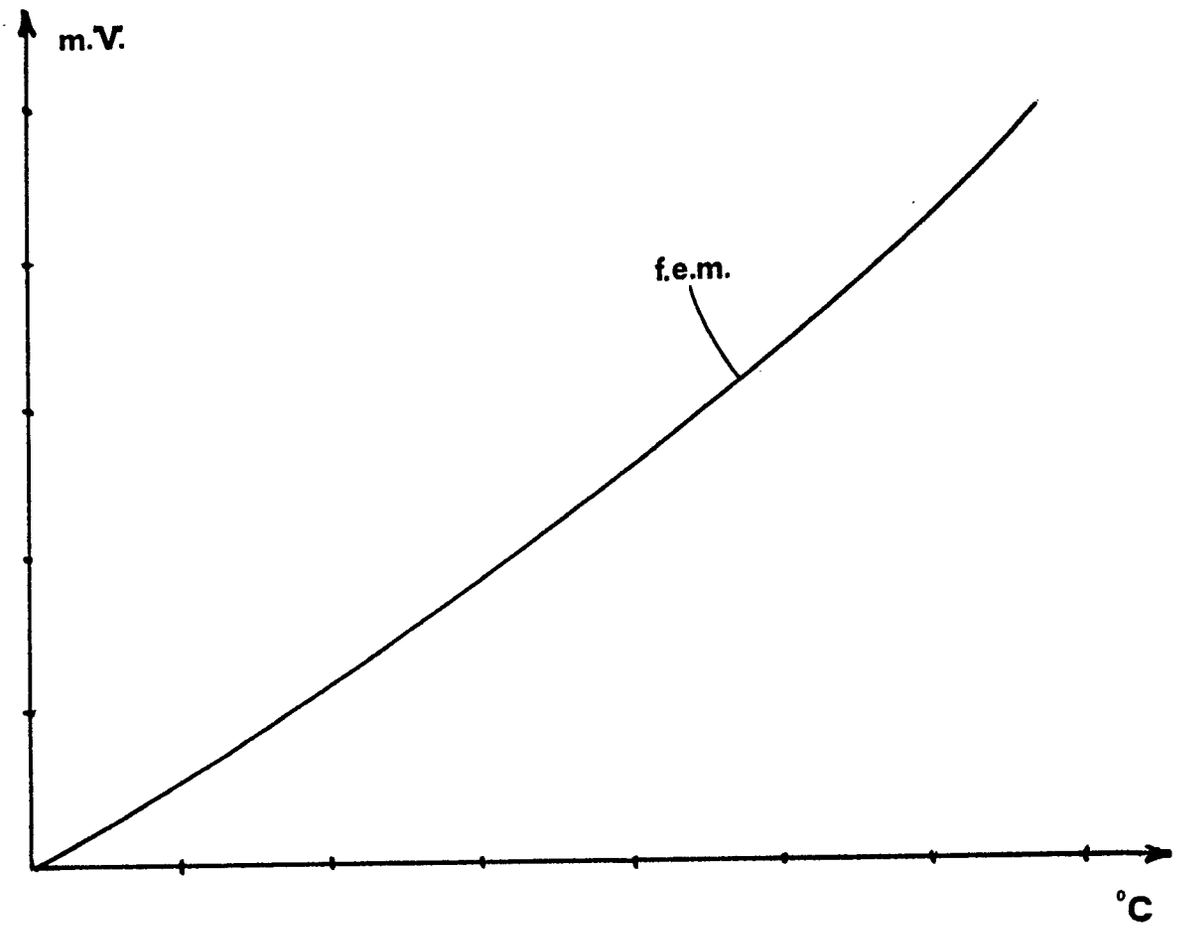

FIG.4

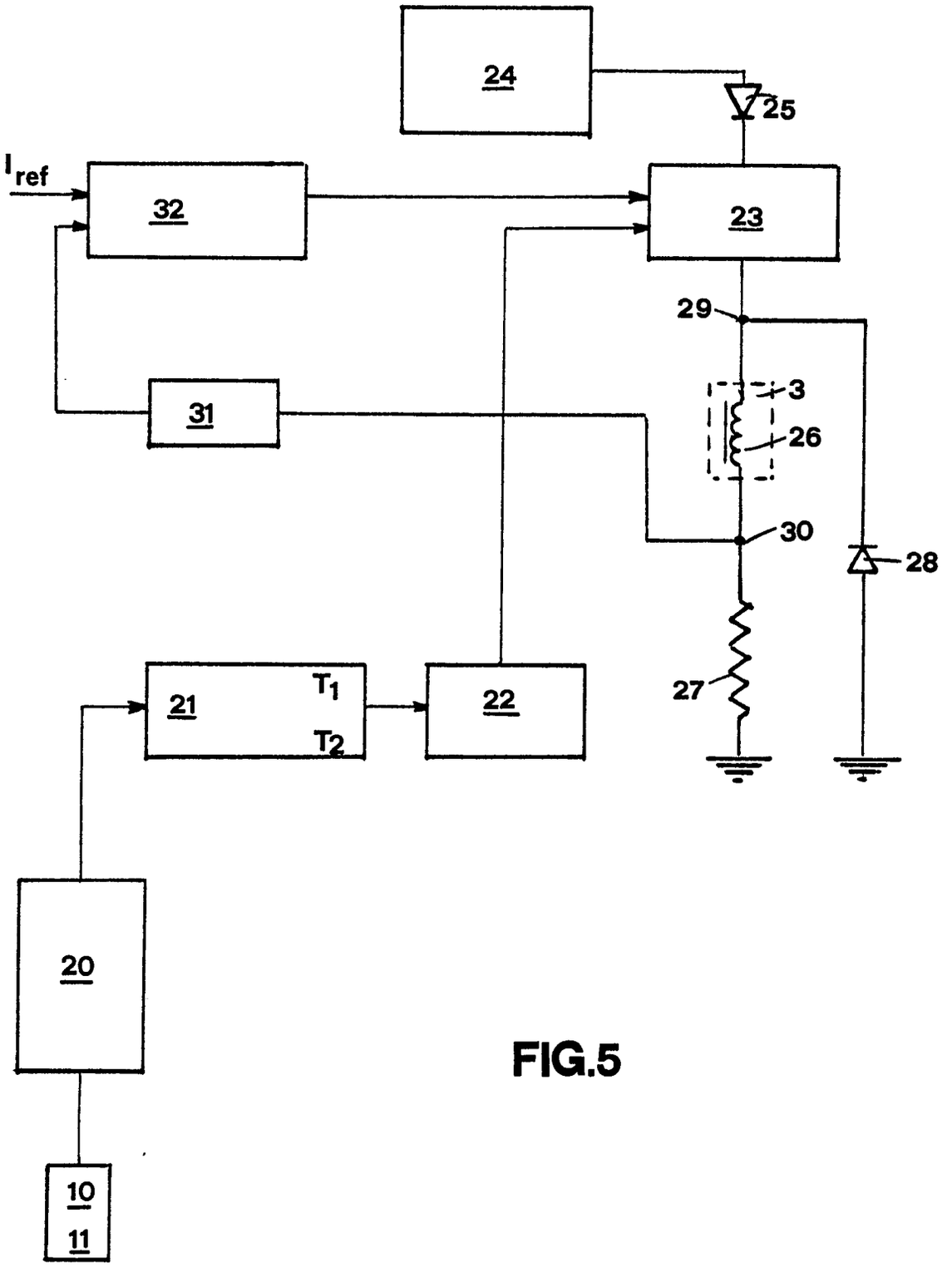

FIG.5

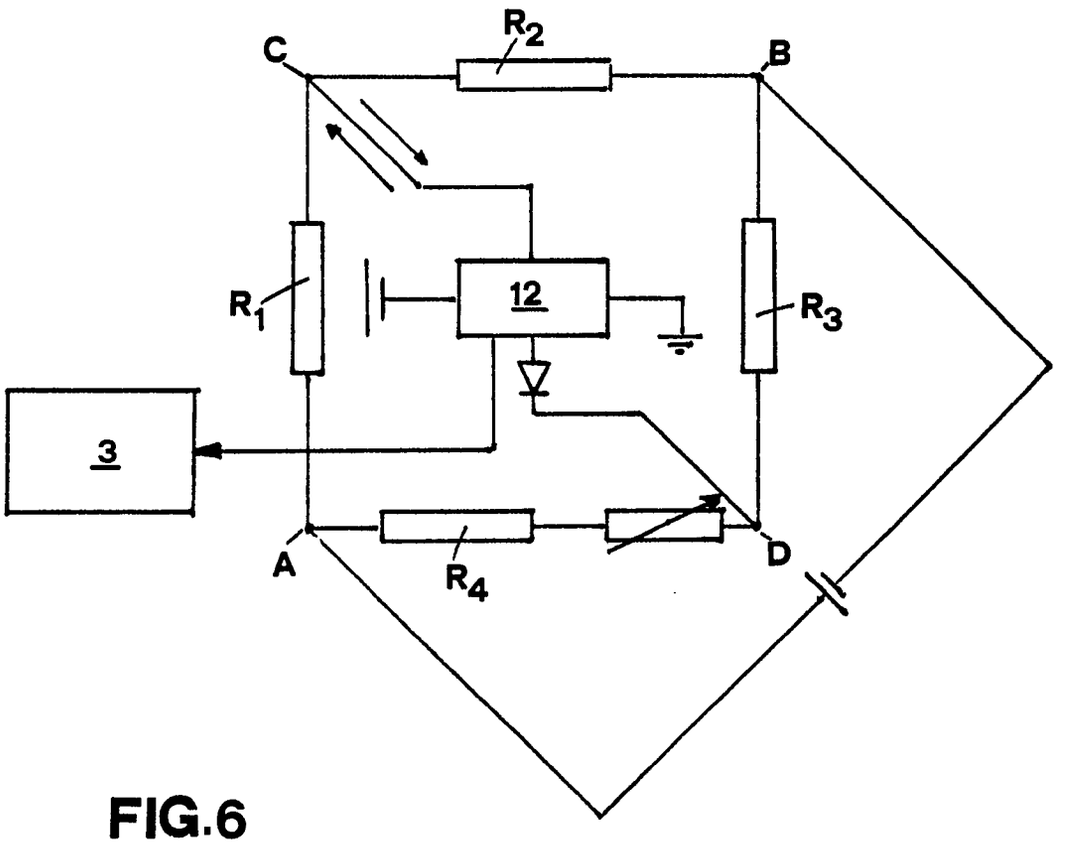

FIG.6

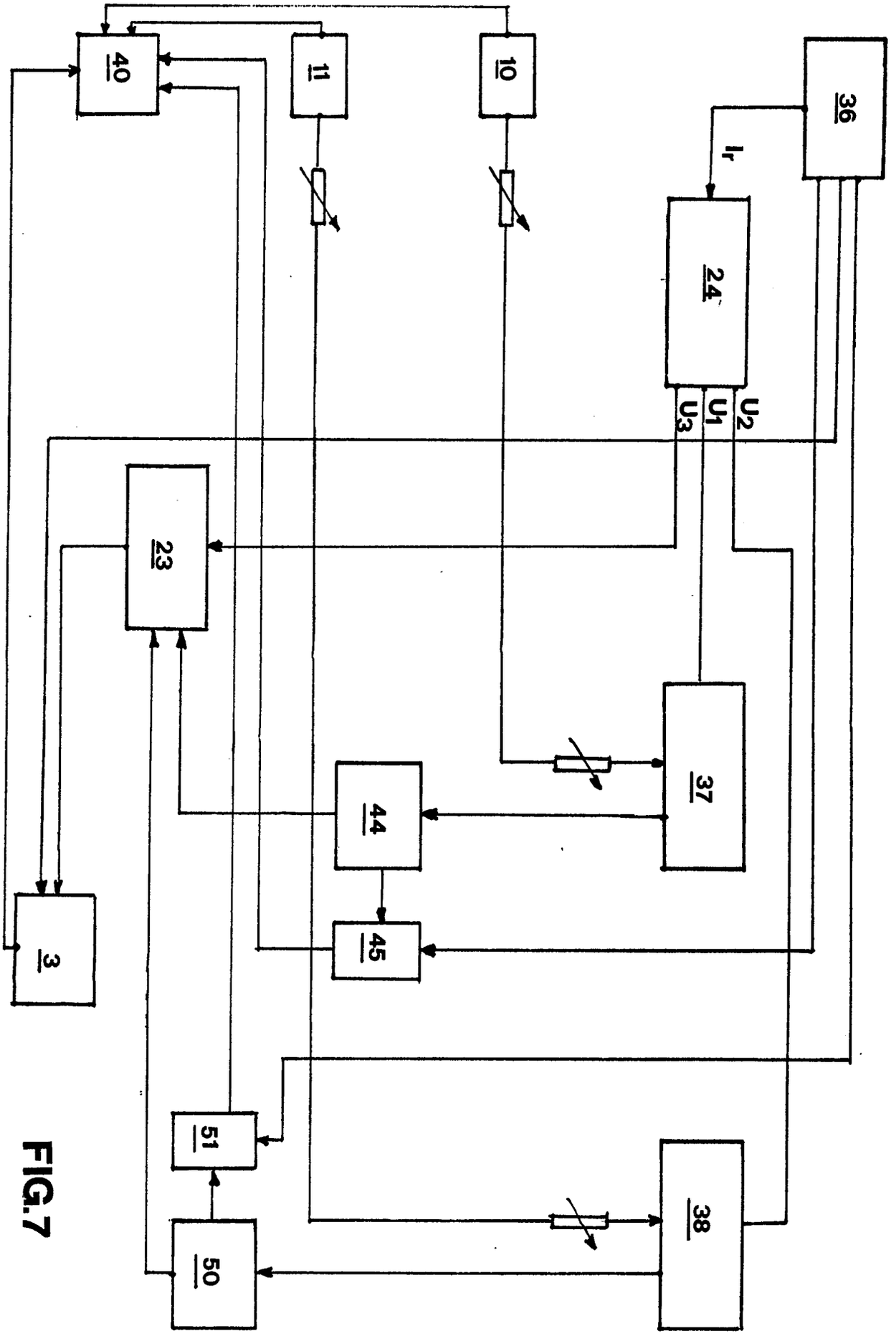

FIG.7

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 89 20 1691

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 4)
X	US-A-3 537 803 (IGNAZIO) * The whole document * --	1,2	F 24 H 9/20
X	GB-A-2 020 794 (SOCIETE E.L.M. LEBLANC) * Abstract * --	1	
X	DE-A-3 020 228 (JOH. VAILLANT GmbH U. CO.) * Claim 1 * ----	1	

TECHNICAL FIELDS SEARCHED (Int Cl 4)

F 24 H
F 23 M
F 23 N

[redacted]

Place of search	Date of completion of the search	Examiner
THE HAGUE	20-03-1990	VAN GESTEL

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

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European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid.

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely:

1. Claims 1-3: Safety device for boilers comprising two identical sensors.
2. Claims 1,4,5 : Safety device for boilers, the temperature sensors beiing thermocouples.
3. Claims 1,6,7: Safety device for boilers, the temperature sensors being thermistors.

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid.

namely claims:

☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims.

namely claims: 1-3