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54 **Device for signaling the operation conditions and the failures in a burner.**

57 A device for showing the operation conditions of the failures in a burner comprising, in combination: an instrument for counting and visualizing the time (10) beginning from the moment in which the control and monitoring instrumentation gives the consent to start to the burner; a plurality of pilot lights (1-6), each of them indicating at least: the presence or the absence of the mains voltage (1); the operation or the failure of the burner motor (2); the operation or the failure of the burner (3); the operation or the failure of the first fuel valve of the burner (5); the operation or the failure of an eventual second fuel valve of the burner (4); the waiting condition or the failure of the control and monitoring instrumentation of the burner (6). According to a preferred embodiment the instrument for the time counting is a micro-processor (24) able to repeat the count at each consent to start given to the burner.

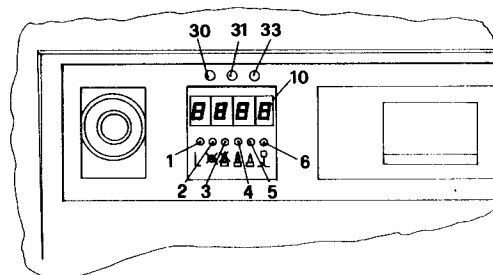


FIG.2

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The invention concerns a device for showing the operation conditions and the failures in a burner burning fuel of any kind.

It is a known fact that each burner is equipped with devices for controlling and monitoring its operation which, besides controlling the sequence of the various operation phases of the burner, interrupt the operation in the presence of anomalous conditions.

More in particular, the majority of the burners are equipped with monitoring boxes commonly called "control box" in which the control and monitoring circuits usually signal only the eventual failure of the burner with a proper luminous device.

Any type of burner in the market is equipped with monitors suitable for its functional requirements in the respect of the international safety rules.

At present the monitoring and safety devices foreseen by such rules are provided only with the luminous signal in case of a performance failure, but they present an important limit in that most of them do not make evident the instant or the cycle phase in which the failure has occurred. This fact is not of minor importance since the operation sequences, typical of each control and monitoring device of the burner, would permit to diagnose exactly the cause of the failure if it were possible to know the instant or the period in which said failure has occurred and, therefore, it would be possible to make some target interventions which would save time, as a consequence.

The purpose of the present invention is to overcome the limits now mentioned.

In particular, the main purpose is that of obtaining a device for showing the operation conditions and the failures in a burner, which combines the signaling of the failure with the signaling of the time when said failure has occurred.

Another purpose of the present invention is that of obtaining the device according to the invention insertable in any burner, so that said device works in addition to the already existing device and is compatible with the same.

Finally, another purpose is that of obtaining the device according to the invention at low costs and make it easy to connect with the control and monitoring devices already present in the burners, without the external circuits having to undergo any modifications.

The above mentioned purposes and others which will be better pointed out hereinafter, are achieved by the device for showing the operation conditions and the failures in a burner which, in accordance with the invention, is characterized in that it comprises, in combination:

- **an instrument for counting and visualizing the time**, with the count beginning from

the moment in which the instrumentation gives the consent for the burner to start;

- **a plurality of pilot lights** each of them indicating at least:

- the presence or the absence of the mains voltage,
- the operation or the failure in the burner motor,
- the operation or the failure of the burner,
- the operation or the failure of the fuel valve of the burner,
- the operation or the failure of an eventual second fuel valve of the burner,
- the stand by condition or the failure of the burner instrumentation,

said pilot lights being activated by electrical signals coming from the control and monitoring instrumentation belonging to the burner.

According to a preferred embodiment of the invention, the electrical signals are drawn from significant spots of the control and monitoring instrumentation belonging to the burner and are processed by an electronic circuit with the help of a microprocessor, so that said signals, previously made compatible with the microprocessor logic itself, after being elaborated by the same, cause the leds of a signal board to switch on, switch off or flash, while the microprocessor has also a clock function and activates a display for the time count.

According to the preferred embodiment previously mentioned, the microprocessor beside counting the time which elapses from the start until the occurrence of the failure, also counts the total number of hours during which of the valve belonging to the first and/or second stage of the burner remains open, so that the information for the failure diagnosis takes also into consideration the actual hours of operation of the burner.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific example, while indicating a preferred embodiment of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description and from the drawings, wherein:

- Fig. 1 shows in a perspective view a burner with the device according to the invention connected to it;
- Fig. 2 shows the detail of the display of the device according to the invention;
- Fig. 3 shows the chart indicating the occurrence of the event which can be read and explained through the display signals of Fig. 2.;

- Fig. 4 is a block diagram showing the principle governing the execution of the electronic circuit which realizes the signaling device according to the invention.

With reference to the mentioned drawings, it can be observed that the signaling device according to the invention essentially consists of an electronic circuit and a visualization board, as indicated in Fig. 2, which comprises a display 10 with four digits and six leds indicated with the letters from 1 to 6.

The first led indicated with 1, when lit, shows the presence of the mains voltage in the control device of the burner. The led indicated with 2 is activated by the electric signal coming from the circuit which shows an interruption in the burner operation, which has occurred because of a failure of the fan motor of the burner. The led indicated with 3, when lit, shows the failure of the burner. The led indicated with 4, when lit, shows the operation of the second stage, while the led will flash if the failure of the burner occurs during the passage to the second stage or during the operation in the second stage.

The led indicated with 5 remains lit during the operation of the first stage and it will flash instead, if the burner fails during the passage from the second to the first stage or during the operation in the first stage.

When the led 6 is lit, it shows the waiting condition of the burner because the load has been reached and when it flashes it indicates defects which will prevent the burner from starting.

Fig. 3 illustrates some situations with the purpose of pointing out how by associating the indication of the time when a certain event has occurred with the information of the event occurrence, one is led to different conclusions regarding the diagnostic of the failure.

More in particular, Fig. 3 represents the event, indicated with A, in which a failure of the burner occurs causing the light of the led 3 to switch on and the led 6 to flash. By reading the time indicated, which in this case is visualized with "0", it obviously means that the failure has occurred at the very start, before counting procedure has even started. Since the control and monitoring board of the burner has not given the consent to start the count, this means that a definite cause has prevented the electric circuit from beginning the starting phase, and this happens for instance, when the flame monitor of the burner has detected the flame presence in the combustion chamber before the starting.

The E event, with the switching on of the failure light 3 and of light 6, associated with a time count T being shorter than the total amount of time of the burner starting, indicates that the failure has

occurred during the preventilation phase.

With regard to the event indicated with B1 and the event indicated with B2, it can be observed that in both events the leds are identically on, and precisely, the following leds are on: led 3, showing the failure of the burner, and led 6, while led 5, showing the failure during the passage from the second to the first stage, is flashing.

Given the identity of the led signals, only the combined reading of this information together with the reading of the time within which the failure has occurred, can give the complete information for a precise diagnostic.

Precisely, if the B1 event occurs at the T time, before the starting phase is completed, it is possible to determine that the failure has occurred because the flame failing to light in the first stage.

In the B2 case instead, since the display shows the digits "1111", which conventionally denote that the starting phase of the burner has been reached, this means that a failure has occurred either during the operation in the second stage or during the passage from the second to the first stage, as required by the burner programming.

The same happens for the C1 and C2 events wherein it can be observed that the led lights are equally switched on.

In fact the switching on of led 3 shows the failure of the burner, the flashing of led 4 shows the failure because of the flame failing to light in the second stage. The led 6 is also switched on.

The indication in C1 of the T time, which is shorter than the starting time, as compared with the indication in C2 of the display showing with the digits "1111" the end of the starting time, shows that the occurrence of the event is different, since in the C1 case, the burner has failed during the starting phase in the passage to the second stage.

In the C2 event the starting time has been completed, as shown by the display with the digits 1111, and this means that the failure has occurred always during the passage from the first to the second stage, but while the burner is operating normally and not during the starting phase.

The series of cases is completed by the D1 and D2 events wherein it can be observed that the fan motor has failed due to its own specific causes, for instance, because the thermal protection has opened, with a consequent failure of the burner during the starting phase and during the normal operation respectively (in the case being analysed, the intermittent switching on of the led 4 shows that the failure of the motor has occurred during the operation in the second stage).

Fig. 4 shows a block diagram of the electronic circuit realizing the integration among the input signals 15, 25, 35, 45, 55 and 65 taken from the "control box" 11 or control and monitoring circuit of

the burner and which indicate the presence of the mains voltage for 15, the failure of the fan motor for 25, the failure of the burner for 35, the operation of the second stage for 45, the operation of the first stage for 55 and the reached load for 65. Such signals are processed in an input circuit 20 so that each kind of signal can be adjusted with the logic of the electronic circuit 23 and with the microprocessor 24 contained in it. The signals coming from the "control box", properly processed in the input circuit, are put into the logic circuit 23 together with other signals, such as the reset signal, and are processed by the microprocessor 24.

A feeding circuit 21 supplies the input circuits block 20, the logic block 24, the leds from 1 to 6, the decoding block 25 and the display 10.

The microprocessor 24 processes the input signals and supplies also the display 10 with a clock signal. In this way the clock signal exits from the logic block 23, is properly decoded by the block 25 and is visualized in the display 10. The microprocessor 24 not only provides the output clock signal activating the display 10, but it also counts separately the operation times of the burner during the first and second stage, so that, from this information, it is possible to draw further conclusions.

In order to visualize such information, it can be observed that in Fig. 2 above the display 10, there is the push button 30 for the visualization of the operation time of the burner during the first stage. Instead, the operation hours of the burner during the second stage are visualized by activating the push button 31. The push button 33 is the reset button that, when pushed simultaneously with the push buttons 30 and 31, resets to zero the counts of the operation hours previously mentioned.

It is well understood that with the present invention it is not only possible to visualize the burner operation phase during which the failure has occurred, but also to make a correct diagnostic, tracing back the reason of the failure occurrence. This is done with good approximation, since the information regarding the exact instant in which such a failure has occurred, is of great help in understanding where and why such a failure has occurred.

As shown in the examples indicated with B1, B2, C1, C2, D1, D2, in spite of the fact that the luminous information of the leds appears identical, the same signals lead back to different causes since they occurred at different periods of time.

It is pointed out that the device according to the invention can be easily associated with any control and monitoring panel of any burner, said device being able to work in parallel with the same without interfering in any way with the instrumentation already existing, said device having in fact the

specific task of taking from the control and monitoring instrumentation of the burner only electrical signals without causing any modification of the same and of subsequently properly processing them.

Claims

1. A device for showing the operation conditions and the failures in a burner, characterized in that it comprises, in combination:

- **an instrument for counting and visualizing the time** (10) beginning from the moment in which the control and monitoring instrumentation gives the consent to the burner to start;
- **a plurality of pilot lights** (1-6) each of them indicating at least:
 - the presence or the absence of the mains voltage (1),
 - the operation or the failure of the burner engine (2),
 - the operation or the failure of the burner (3),
 - the operation or the failure of the first fuel valve of the burner (5),
 - the operation or the failure of an eventual second fuel valve of the burner (4),
 - the waiting condition or the failure of the control and monitoring instrumentation of the burner (6),

said pilot lights being activated by electrical signals issuing from the control and monitoring instrumentation belonging to the burner.

2. A device according to claim 1, characterized in that the instrument for the time counting of the burner operation is a microprocessor (24) able to repeat the count at least at each consent to start given to the burner.

3. A device according to claim 2, characterized in that the microprocessor is provided with a counter suitable for storing the total operation time of the first stage of the burner flame and the total operation time of an eventual second stage of the burner flame.

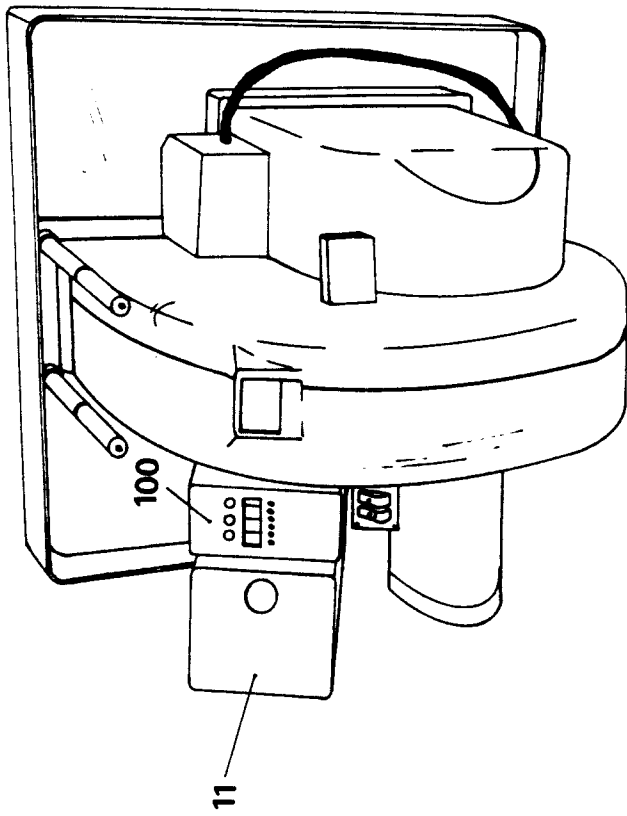


FIG. 1

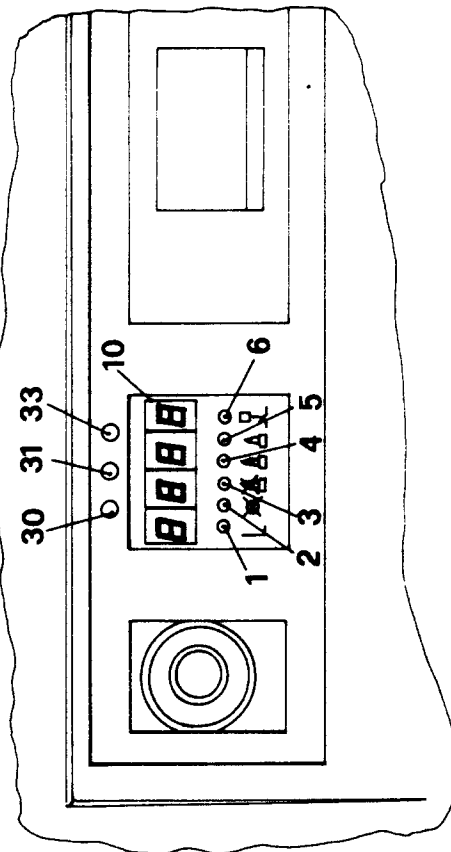


FIG. 2

	1	2	3	4	5	6	DISPLAY
A	○	○	○	○	○	○	○
E	○	○	○	○	○	○	○
B ₁	○	○	○	○	○	○	○
C ₁	○	○	○	○	○	○	○
C ₂	○	○	○	○	○	○	○
B ₂	○	○	○	○	○	○	○
D ₁	○	○	○	○	○	○	○
D ₂	○	○	○	○	○	○	○

FIG. 3

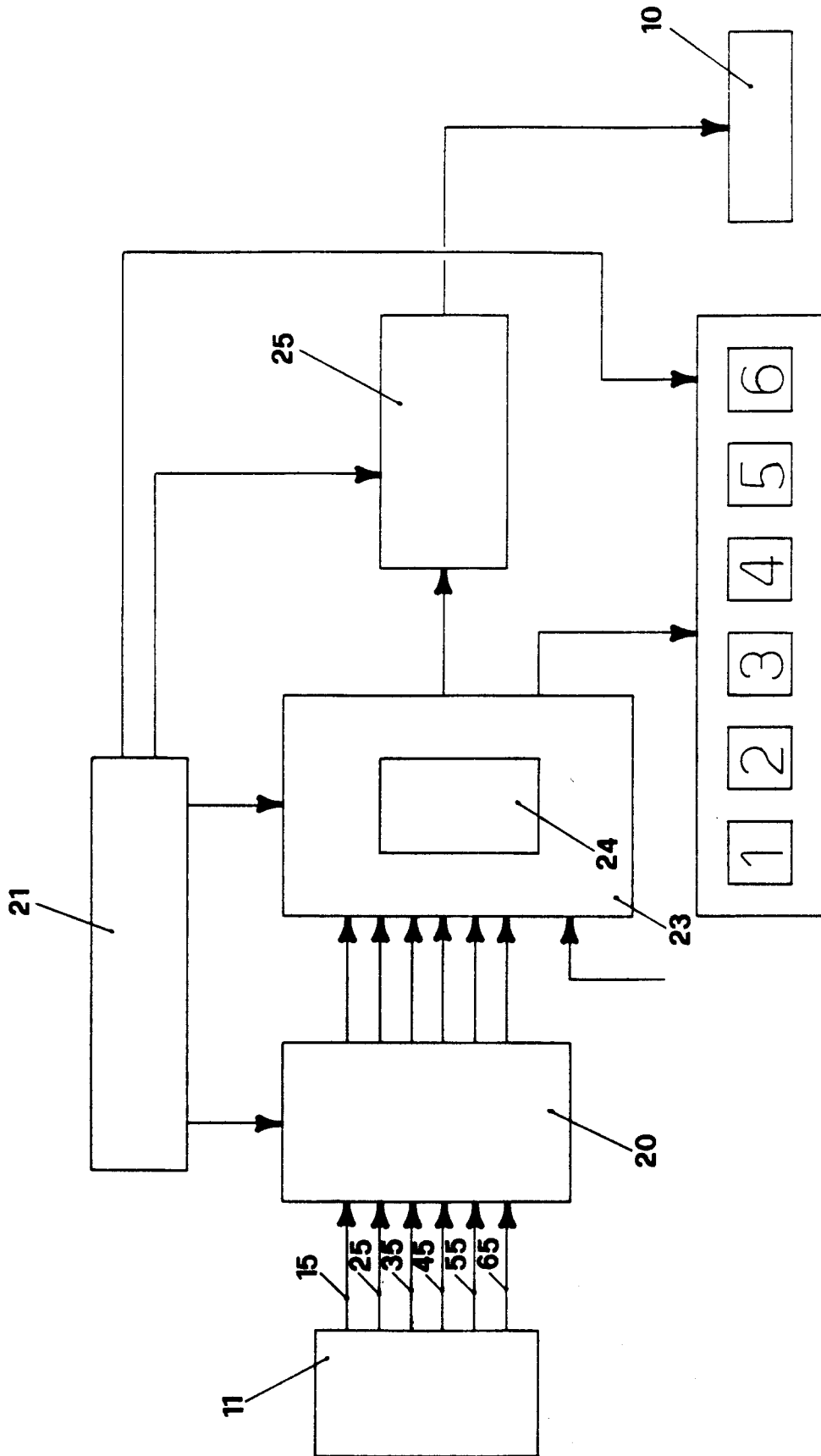


FIG.4



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.5)
X	PATENT ABSTRACTS OF JAPAN vol. 14, no. 135 (M-949)14 March 1990 & JP-A-02 004 128 (MATSUSHITA ELECTRIC) * abstract * * figure *	1,2	F23N5/24
X,P	DE-C-41 40 804 (WEBASTO) * the whole document *	1,2	
X,P	EP-A-0 566 177 (ENCON) * the whole document *	1,2	
A	GB-A-2 211 331 (A O SMITH) * abstract; figures *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 135 (M-949)14 March 1990 & JP-A-02 004 125 (MATSUSHITA ELECTRIC) 9 January 1990 * abstract * * figure *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			F23N
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		4 May 1994	Kooijman, F
CATEGORY OF CITED DOCUMENTS			
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