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(54) Safety device for the control of carbon oxide produced in burners

(57) The invention relates to a safety device (1; 10) for the control of carbon oxide produced in a burner (2) composed by a fan (21) which sends comburent air to a combustion head (23, 230). It consists of a differential pressure switch (11; 110) which presents a first pipe (12) connected downstream from said fan (21) and a second pipe (13; 130) connected with said combustion head (23; 130).

According to a preferred embodiment, a pneumatic shock-absorber (14) formed by a subsiding body having a variable volume, is connected in series with said second pipe (130).

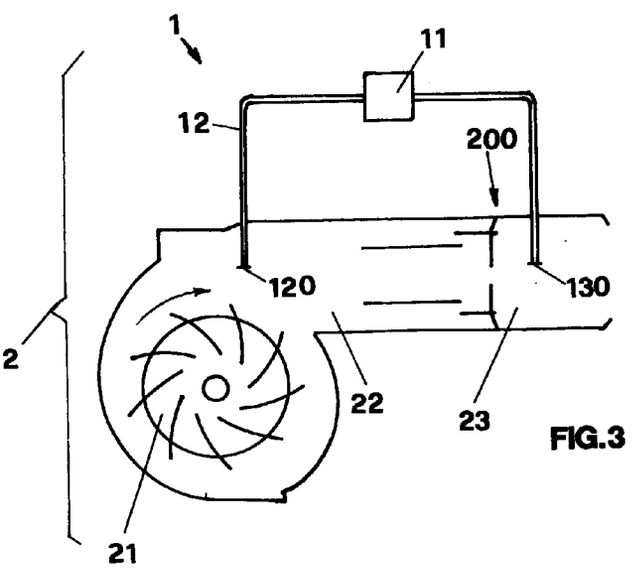

FIG.3

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Description

The invention concerns a safety device for the control of carbon oxide produced in a burner.

It is known that if a fuel burns on air lack, it produces carbon oxide (CO), a very dangerous toxic gas.

In order to avoid the carbon oxide formation, it is necessary that the combustion is always fed by the right quantity of air for a complete combustion, which avoids or limits within acceptable values the production of carbon oxide.

On this subject, a new European law on burners requires a stricter control of the carbon oxide compared to the preceding national laws. It is forbidden to overcome the fixed limits not only in normal working conditions, that is to say with normal flow of comburent air, but even when this flow can be reduced for any reason.

The control is usually made in an indirect manner by a pressure switch, connected to a pressure tube introduced in the burner, which picks up the absolute pressure value which changes according to the flow rate of the air and to the air resistance due to the flowing inside the burner.

Such resistance considerably changes, either if the flame is absent that is to say in a pre-ventilation phase of the burner, or if it is present, as it happens during the working.

In the first case the pressure is lower than the second one and the pressure switch, during the pre-ventilation phase, monitors a lower pressure than the one monitored when the flame is lighted, in this case the higher pressure is due to the counter-pressure coming from the combustion chamber of the boiler.

That is to say, when the burner begins to work, for a certain period, only the ventilation works, sending the air to the boiler and washing all the system, so to assure that at the lighting time there are not smokes and residual gas. In such conditions the pressure switch P inserted in a downstream position from the fan, as it can be observed in Fig. 1, shows a pressure which changes according to the air flow rate Q following the curve A of the diagram: flow rate Q - pressure P, represented in Fig. 2.

When the burner is lighted, the machine works normally and the pressure switch that, because of the counter-pressure that is created downstream from the fan as it has already been said, monitors a greater pressure which, at the flow rate changes, moves along the curve B represented in the same diagram of Fig.2.

In order that the pressure switch works as a safety device and stops the burner working when the quantity of the produced carbon oxide overcomes the admitted limit, it is necessary first of all to calibrate the system. This is effected reducing the air flow rate introduced in the burner till to establish the flow rate value to which the carbon oxide is produced in a greater quantity than the established limits. The pressure value corresponding to such flow rate is retained as a calibration reference value of the pressure switch, the reaching of which the pressure switch must stop the burner.

For safety reasons, the pressure switch is then calibrated at slightly greater operating pressure, so to be sure that the burner stopping happens before reaching the limit value of carbon oxide generation.

With reference to the diagram of Fig. 2, the pressure to which the pressure switch intervenes and that it indicated as control pressure of the pressure switch Pr, must be lower than both the pressure value of working Pf when the flame is present, and the value Pp of working in pre-ventilation.

The system works without inconveniences, if the pressure from which the carbon oxide is produced in a greater quantity than the one admitted and indicated with Pco, results lower than the Pr value.

The problems come up, and this is the application limit of the pressure switch having only one pipe belonging to the known technique, when the Pco pressure from which the carbon oxide is generated in a greater measure than the maximum allowed, overcomes, as it can be observed in Fig. 2, the Pp pressure value of the pre-ventilation working. In such a case being the control pressure value Pr greater than the pressure value Pco, the pressure switch would never allow the pre-ventilation working.

Since obviously, the pre-ventilation working is necessary, in the known technique as it can be observed in Fig. 2, the pressure switch is always calibrated with Pr values just a little under the pre-ventilation pressure value Pp and so an accidental reduction of the flow air during the working can cause the production of carbon oxide without that the pressure switch can intervene to stop the burner being its calibration value too low. Substantially the pressure switch intervenes just in case of a drastic reduction of the air flow rate with a consequent great pressure drop.

It can be understood that the known technique which considers the use of the pressure switch with only one pipe as safety device to stop the burner before it produces carbon oxide in greater quantity than the maximum allowed, presents unacceptable limits according to the new law.

The present invention propose to overcome such limits.

In particular it is one of the purpose of the invention to realize a safety device for the control of carbon oxide produced in a burner, where the stop of the burner is obtained using a pressure signal which results always proportional to the flow rate of comburent air.

It is another purpose of the invention to stop the burner before the carbon oxide overcomes the law limits without interfere with the pre-ventilation conditions.

Said purpose is achieved with the realization of a safety device for the control of the carbon oxide produced in a burner consisting of a fan which, by a conduction pipe sends comburent air in a combustion head, and it is characterised in that said safety device com-

prises a differential pressure switch, which presents a first pipe connected downstream from said fan and a second pipe connected downstream from the area where said conduction pipe is connected with said combustion head, said differential pressure switch being mechanically connected to electromechanical devices suited to stop said burner when the value of the differential pressure monitored by said differential pressure switch is lower than a prefixed value.

Preferably, said second pipe is connected with said combustion head but in other cases it can be connected even with other points downstream from the area where said conduction pipe is connected with said combustion head.

According to a preferred embodiment, a pneumatic shock absorber is placed in series with said second pipe and consists of a subsiding body having a variable volume which has the function of putting off the lighting counter-pressure which try to get involved the pressure switch and so to stop the burner.

Said purposes and advantages will be stressed during the description of a preferred embodiment of the invention given as an example but not as a restriction and which represented in the enclosed drawings wherein:

- Fig. 1 shows a burner provided with a safety device belonging to known technique consisting of a pressure switch with only one pipe, inserted in the air conduction pipe coming to the combustion head;
- Fig. 2 shows the curves of the burner of Fig. 1, in pre-ventilation working conditions in a diagram: flow rate - pressure.
- Fig. 3 shows a burner with the safety device object of the invention;
- Fig. 4 shows the working curve of the burner of fig. 3 in a diagram: flow rate - pressure;
- Fig. 5 shows a different embodiment of the safety device of the invention where it can be observed the inserting of a pneumatic shock-absorber;
- Fig. 6 shows the detail of the pneumatic shock absorber belonging to a different embodiment of the safety device of the invention represented in Fig. 5.

As it can be observed in Fig. 3 the safety device of the invention, indicated as a whole with 1, is applied to a burner indicated as a whole with 2, consisting of a fan 21 which through a conduction pipe 22 sends a comburent air flow towards the inner of the combustion head 23.

Said safety device 1 comprises:

- a pressure switch 11;
- a first pipe 12 which connects said pressure switch 11 to the conduction pipe 22 of the comburent air coming to the combustion head 23;
- a second pipe 13 which connects said pressure switch 11 to the combustion head 23, in a point downstream from the area 200 where said combustion head 23 is connected to the air conduction pipe 22.

Therefore, the pressure switch 11 is a differential pressure switch which receives a pressure signal taken from the points 120 and 130 having a different pressure equal to the pressure gradient that the air flow undergoes between the two pressure points.

Therefore, such a signal is proportional to the flow itself, independent from the upstream or downstream absolute pressure that is to say, from the absolute pressure presents in the pipe 22 and in the combustion chamber 23. In a different embodiment, not represented, the second pipe 13 can be connected even downstream from said combustion chamber 23, for example even with the boiler.

In order to control the carbon oxide ,the pressure switch 11 is calibrated with the lowest value of the working differential pressure of the burner.

If during the working for a whichever cause, such differential pressure decreases, the pressure switch changes over the electrical contact with which is supplied, not represented in the drawing, stopping the burner.

The lowering of the differential pressure is proportional to the reduction of the air flow rate and so, the safety device of the invention achieves the first purpose that is to give a signal proportional to the variation of the flow rate of the comburent air, unlike the safety devices of the known technique where the signal supplied from the pressure switch is function of the pressure variation only.

The working curve of the burner is the curve indicated with 30 represented in the diagram: flow rate Q - differential pressure ΔP, represented in Fig. 4. The curve is the same, either the burner works with a lighted flame or it works in pre-ventilation, and this because the measure given by the pressure switch 11 is a differential pressure, proportional to the air flow rate.

So, with reference to the Fig. 4, the value of the differential pressure to which the pressure switch 11 is calibrated and to which the burner is stopped, is pointed with Pr and it is lower than the differential pressure Pf which is measured during the working of the burner both in pre-ventilation and with the flame, but it results greater than the differential pressure Pco in which there is a carbon oxide production in a greater quantity than the law limits.

The safety device of the invention intervenes even in the case in which the chimney should be blocked because of accidental causes. In fact, in such a case, there is an air reduction flow which allows a reduction of the differential pressure which causes the burner stop, which should be not possible using a safety device with a pressure switch with only one pipe, because in case of obstruction of the chimney it would cause, due to a

reduction of the air flow, an increase of the pressure value which would not cause the involvement of the pressure switch 11.

A different embodiment of the safety device of the invention is represented in Fig. 5 where it can be observed that the safety device, indicated as a whole with 10, comprises even a pneumatic shock-absorber, indicated as a whole with 14, represented in the detail of fig. 6, which results connected in series to the second pipe 130 which connects the pressure switch 110 to the combustion head 230.

Substantially, said shock-absorber 14 comprises a bellows made of subsiding material, for example, plastic material, which presents a side surface 140 formed by a plurality of concave surfaces 240 joined among them and suited to guarantee to the shock-absorber, as a whole, the possibility to be subsiding and so to get short and lie down along the axial direction 141 when its internal volume 340 is interested by a pressure changing.

The use of said shock-absorber 14 is essential when the temporary counter-pressure which is developed inner the burner at the lighting time, tends to cancel for an instant the differential pressure existing at the two ends of the pressure switch 110 because the counter-pressure at the lighting tends to reverse the polarity of the pre-existing pressure differential. If this happens, it creates the stop of the burner at the same moment of the lighting, because of the intervention of the pressure switch.

In order to avoid such a phenomenon, the pneumatic shock-absorber 14 is inserted with the function of absorbing, by deformation, the peak of energy due to the lighting counter-pressure.

Further, in the inlet and outlet of the shock-absorber 14, the lengths 132 and 131 of the second pipe 130 which connect it respectively to the combustion head 230 and to the pressure switch 110, are capillary pipes which having a hole of small diameter, oppose resistance to the flow, reducing the energy. The joining action of the pneumatic shock-absorber 14 and of the capillary lengths 131 and 132 which form the second pipe 130, damps with efficiency the counter-pressure at the lighting phase allowing the free working of the system.

According to what has been described it is understood that the safety device of the invention, in both the described embodiments achieves all the prefixed purposes. First of all, it is achieved the purpose to stop the burner only in case of lack of flow rate that can cause, if the burner does not stop, the production of carbon oxide in a greater quantity than the one allowed by the law.

Further it has been seen that the safety device of the invention as it monitors a differential pressure and not an absolute pressure, makes the control action independently from the burner operation either if it works in presence of flame, or in pre-ventilation system.

Further it has been seen too, that the insert of a suitable pneumatic shock-absorber allows the absorbing of the lighting counter-pressure which attempt to stop the burner when this is lighting.

It is clear that the safety device of the invention can be applied to each kind of burner, even preferably, its use is expected for gas burner.

Regarding in particular, the differential pressure switch and the pneumatic shock-absorber, these could be of whichever type.

Further, as it has been already said, the pressure switch can be connected with the conduction pipe of the comburent air or can be in the combustion chamber.

During manufacturing, further modifications can be made suited to improve the working device of the invention or to make its construction more economical, meaning that all said modifications are to be considered protected by the present invention.

Claims

1. Safety device (1; 10) for the control of carbon oxide produced in a burner (2) composed by a fan (21) which, by a conduction pipe (22), sends comburent air in a combustion head (23; 230), **characterized in that** said safety device (1; 10) comprises a differential pressure switch (11; 110) which presents a first pipe (12) connected downstream from the area (200) where said conduction pipe (22) is connected to said combustion head (23; 230), said pressure differential switch (11; 110) being mechanically connected to an electromechanical device suited to stop said burner when the differential pressure monitored by said pressure switch (11; 110) is lower than a preestablished value (Pr).

2. Safety device (10) according to the claim 1) **characterized in that** a pneumatic shock-absorber (14) formed by a subsiding body having a variable volume is placed in series to said second pipe (130).

3. Safety device (10) according to the claim 2) **characterized in that** said subsiding body which forms said pneumatic shock-absorber (14) is an elastic bellows having a substantially cylindrical shape presenting the lateral surface (140) formed by a plurality of concavities (240) joined among them, suited to make subsiding said bellows according the axial direction (141) when its internal volume (340) is interested of a pressure change.

4. Safety device (10) according to the claim 2) **characterized in that** said second pipe (130) presents at least one length (131) upstream from said shock-absorber (14) and at least one length (132) downstream from the same shock-absorber (14) formed by a capillary tube.

5. Safety device (1; 10) according to the claim 1) **characterized in that** said second pipe (13; 130) is connected with said combustion head (23; 230).

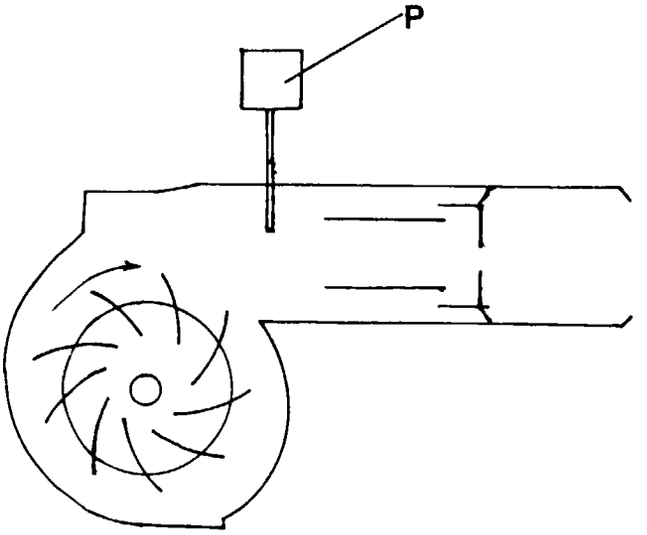

FIG.1

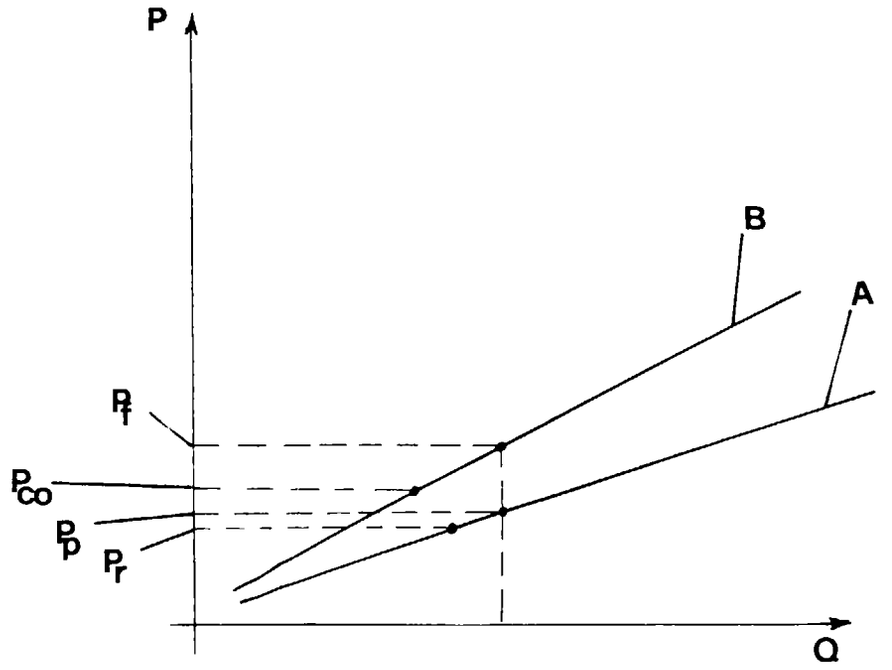

FIG.2

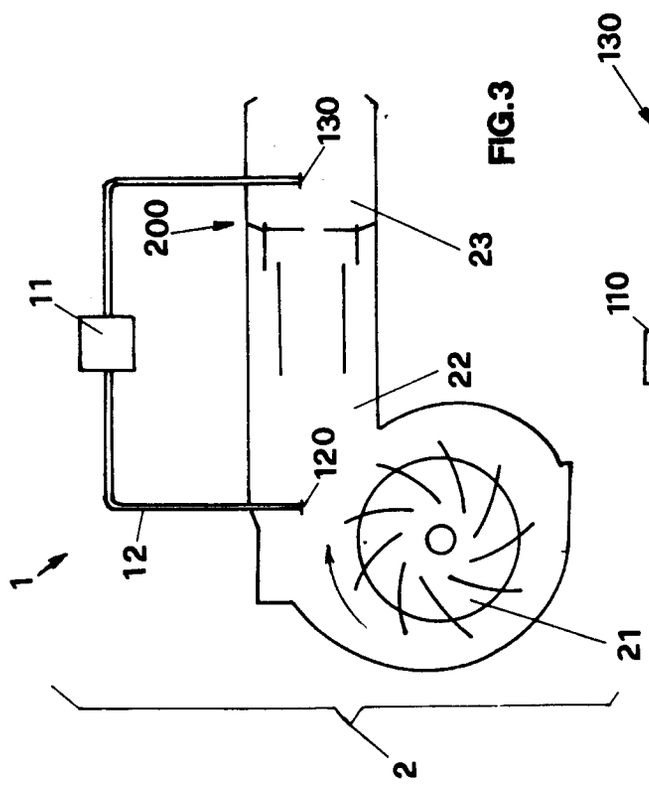

FIG.3

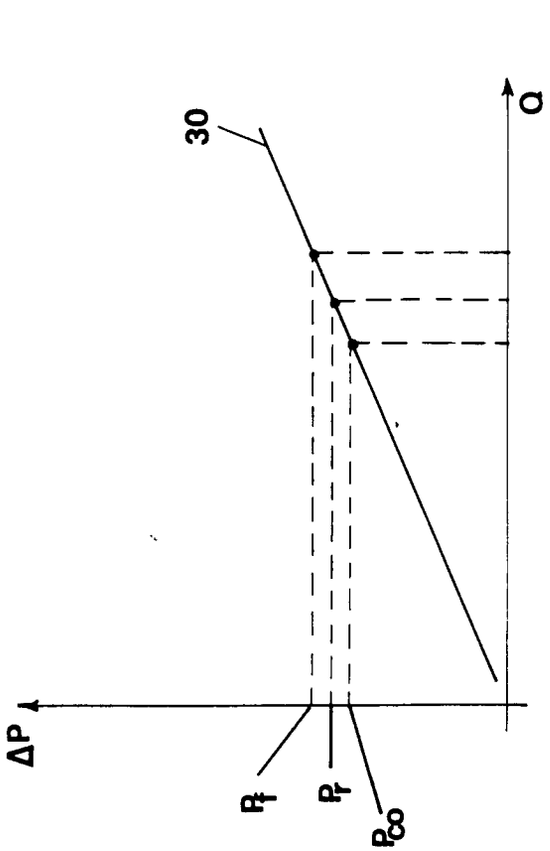

FIG.4

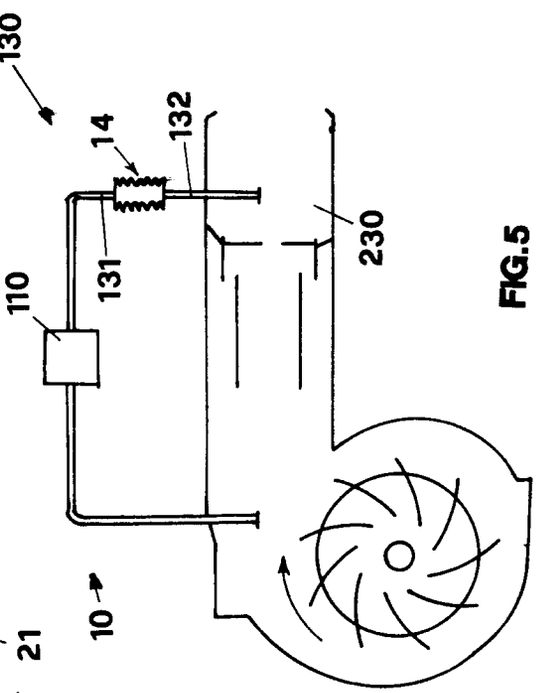

FIG.5

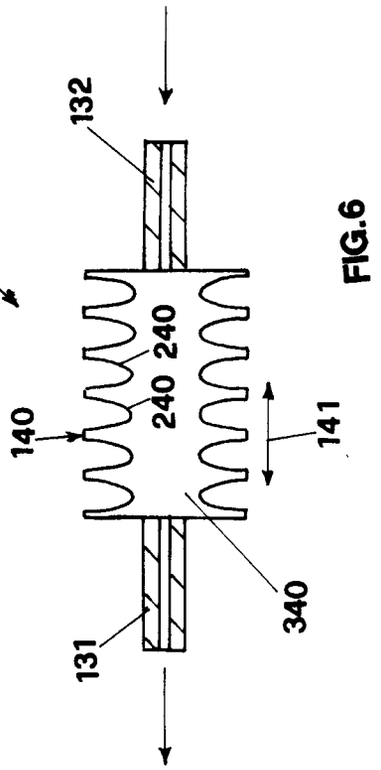

FIG.6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 11 1442

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	PATENT ABSTRACTS OF JAPAN vol. 017, no. 562 (M-1494), 12 October 1993 & JP 05 157231 A (PALOMA IND LTD), 22 June 1993, * abstract; figures *	1	F23N5/18
X	EP 0 025 622 A (RHEEM NEDERLAND) * the whole document *	1	
X	PATENT ABSTRACTS OF JAPAN vol. 017, no. 558 (M-1493), 7 October 1993 & JP 05 157230 A (PALOMA IND LTD), 22 June 1993, * abstract; figure *	1	
A	EP 0 080 257 A (POTTERTON INTERNATIONAL) * page 3, line 30 - line 34; figures *	1,2,4	
A	DE 38 18 049 A (VAILLANT) * the whole document *	2	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	PATENT ABSTRACTS OF JAPAN vol. 006, no. 187 (M-158), 25 September 1982 & JP 57 095525 A (MATSUSHITA ELECTRIC IND CO LTD), 14 June 1982, * abstract; figure *	1,5	F23N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 September 1997	Kooijman, F

CATEGORY OF CITED DOCUMENTS

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