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71 Applicant: Natalini, Lino
Via Vanvitelli, 39
I-62100 Macerata (IT)

72 Inventor: Natalini, Lino
Via Vanvitelli, 39
I-62100 Macerata (IT)

74 Representative: Baldi, Claudio
Piazza Ghislieri, 3
I-60035 Jesi (Ancona) (IT)

54 Device for the automatic control of comburent air flow drawn into forced draught boilers by means of an electroventilator.

57 This invention relates to a device for the automatic control of the combustion air delivery drawn into modern boilers fitted with an air-tight or non air-tight combustion chamber, having forced draught with combustion air drawn either directly from outside or from the room in which the boiler is installed.

The device according to the invention can automatically control the combustion air delivery by varying the revs of the electric fan as necessary according to the gas delivery supplied by the modulating distribution valves so as to maintain the air-to-fuel ratio of the mixture from the burner, constant and equal to the optimum value.

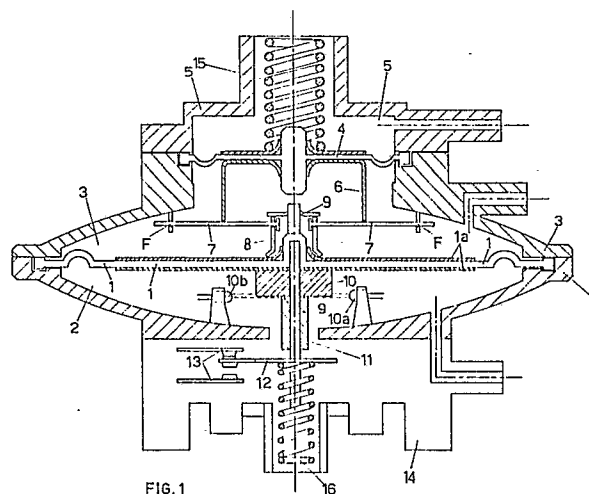


FIG. 1

Description

Device for the automatic control of the combustion air delivery drawn into forced draught boilers by means of an electric fan.

This application for an industrial patent relates to a device for the automatic control of the combustion air delivery in modern boilers, fitted with an air-tight or non air-tight combustion chamber, having a forced draught with combustion air drawn either directly from outside or from the room in which the boiler is installed.

As in the case of traditional boilers, modulating fuel-gas distribution valves are also used in boilers with air-tight or non air-tight chamber, capable of decreasing the gas supply gradually in the burner as the temperature of the back-flow water in the boiler increases to reach the temperature set on the thermostat.

The electric fan which is usually fitted after the combustion chamber, in drawing the fumes by forced draught, creates a depression in the boiler which helps the suction of the combustion air.

The electric fan currently used on boilers is not fitted with any automatic control device capable of varying the delivery of the drawn air according to the fuel-gas supplied to the burner by the modulating distribution valves with the resulting problem of a fuel mixture having an excess of combustion air which increases as the fuel-gas supplied decreases by means of the modulating action of the distribution valves.

It is clear that this problem directly affects the combustion yield which, as is commonly known, is closely related to the air-to-fuel ratio.

The object of this invention is therefore that of developing a device capable of automatically controlling the delivery of the combustion air by varying the revs of the electric fan according to the gas delivery supplied by the modulating distribution valves in order to maintain the air-to-fuel ratio of the mixture to the burner, constant and obviously equal to the optimum value.

The device according to the invention includes a diaphragm held between two circular half-shells, on the two sides of which the fluid pressure before and after the electric fan acts, in that another diaphragm, smaller than the other and held between the above half-shell and an external casing having a pressure which is always the same as the pressure of the fuel-gas measured before the supplying nozzles, is fitted parallel to the first in the half-shell communicating with the section, under depression, before the electric fan.

A sleeve is fitted on the internal side of the smaller diaphragm, whose edge opposes a series of radial levers supported at the ends which discharge the axial thrust from the sleeve by means of the above radial levers, on a collar fitted on the axial rod which crosses the larger diaphragm on which an optical barrier is fitted and whose axial position, obviously resulting from the pressure on the two above diaphragm, is read by an optical detector which regulates the rotation speed and consequently also the air delivery drawn by the electric fan.

Attention is drawn immediately to the reason for fitting a sleeve on the smaller diaphragm instead of fixing the two diaphragms axially on the centre rod, in order to transmit the axial thrust, by a lever system, on the latter diaphragm to the other larger diaphragm, on whose rod both the above optical barrier for regulating the electric fan and the opposing element, that is the part acting on the electric switch which starts or stops the system for supplying the fuel-gas, are fitted.

This technical feature makes it possible to rate the device in question according to the boiler in which it is to be installed, in that the differential pressure generated by the electric fan varies both with respect to the electric fan model and to the characteristics of the system in which the electric fan is to operate.

The thrust transmitted by the smaller diaphragm to the larger diaphragm, for the same force exerted by the above sleeve, can be regulated simply by changing the position of the lever pivots so as to vary the ratio between the axial thrust of the smaller diaphragm and that of the larger diaphragm, as necessary.

For major clarity the description of the invention continues with reference to enclosed drawings which are used descriptively rather than in a limiting sense in which:

- fig. 1 is a section having an axial plane of the device according to the invention.

With reference to fig. 1 the device according to the invention includes a circular diaphragm (1) fitted between two partially rigid plates (1a), held along the perimeter by two circular half-shells (2) and (3), the first (2) communicating with a section of the exhaust pipe fitted immediately after the electric fan, the other (3) with a section fitted before.

On the latter half-shell (3) where a depression is created when the electric fan is operating, a second smaller circular diaphragm (4) which is held along the perimeter between the semi-shell (3) and an external casing (5) communicating with the supply pipes of the fuel-gas, is fitted parallel and coaxially to the above diaphragm (1).

On the internal wall of the smaller diaphragm (4) a sleeve (6) is fitted whose edge opposes a coplanar series of radial levers (7) whose ends are supported respectively and peripherally on support and pivot points (F), at the centre, on a collar (8) fitted in and integrally with a rod (9), fixed axially on the larger diaphragm (1).

A barrier (10) is fitted along the rod (9) in the section in the half-shell (2), which according to the axial position assumed, totally or partially intercepts an optic flow emitted by a photo-emitter (10a) and detected by a photo-detector (10b) fitted on the internal surface of the half-shell (2).

An opposing element (11) is also fitted along the rod (9), which in its axial stroke integrally with the rod (9), intercepts the moving element (12) of an electric

switch resulting in an exchange of the electrical contacts (13) for starting and stopping the fuel-gas supply.

The contact-holder (13) casing fixed outside the half-shell (2) is indicated as number (14).

At rest there is atmospheric pressure in the three adjacent compartments separated by diaphragms (1) and (4) so that the safety spring (15) fitted in the casing (5) meets no resistance in pushing the rod (9) to the end of the stroke, to which a position of the moving element (12) corresponds so as to electrically disconnect the system for supplying the fuel-gas, the optical unit for detecting the position of the barrier (3) being inactive.

On closing an appropriate electrical contact of the boiler, as for example the thermostat, the electronic circuit which supplies current to the motor of the electric fan, is firstly supplied.

On starting the electric fan, a pressure difference is immediately created in the two half-shells (2 and 3) capable of moving in the diaphragm (1) axially, overcoming the opposing force of the safety spring (15).

The translation of the rod (9) integrally with the diaphragm (1) corresponds to an equivalent movement of the opposing element (11), in that it no longer interferes with the moving element (12) thereby allowing the latter to carry out, under the thrust of the release spring (16), the exchange of electrical contacts (13) so as to start the gas supply system electrically, whose pressure also acting on the external face of the small diaphragm (4) generates an axial thrust which balances the force on the diaphragm (1) thanks to the appropriate sizing of the areas of the two diaphragms and to the rating of the device (correct positioning of pivots F), as a result of the difference of pressure between the two half-shells (2) and (3).

The optical unit, activated after the electrical contact of the boiler (thermostat) is closed, regulates the electric circuit which controls the rotation speed of the electric fan, by means of the so-called "loop" and keeps the system balanced.

In particular, as the gas pressure increases, the optical barrier (10) is moved axially together with diaphragms (1 and 4) resulting in the interception of a greater part of the optical flow between the emitter (10a) and the photo-detector (10b) with a consequent increasing variation of the current transmitted to the electric fan motor.

The consequent increase in the rotation speed of the electric fan produced a greater difference in pressure between the section before and after the same and therefore also a pressure difference on the two sides of the diaphragm (1), thereby restoring equilibrium between the two opposing forces on the small diaphragm (4) and on the large diaphragm (1).

A similar but reverse effect occurs when the fuel-gas pressure decreases.

In view of the above it now becomes clear how the device according to the invention can control the combustion air delivery according to the delivery of the fuel-gas, maintaining the value of the air-to-fuel ratio, constant.

The device according to the invention can also act

as a safety device for stopping the supply of gas should the fume discharge pipe accidentally become plugged.

In this case in fact, the difference in pressure before and after the electric fan would reduce to zero and there would be no axial thrust on the diaphragm (1) to balance the thrust of the opposing safety spring (15), as well as the thrust on the small diaphragm (4) on the back of which there is fuel-gas pressure.

The unbalance of the system of forces results in the diaphragms (1 and 4) and the rod (9) moving to the end of the stroke with the opposing element (10) intercepting the moving element (12) and an exchange of electrical contacts (13) which disconnect the system for supplying fuel-gas.

It also acts as a safety device against blockages of the fuel-gas discharge; in fact as the speed of the air in the pipe decreases, the differential pressure also decreases, causing the large diaphragm to lower, a reduction of the optical flow and consequently more current to the electric fan motor so as to restore an overall balance.

The higher the fuel-gas pressure the greater this effect will be.

Claims

1) A device for the automatic control of the combustion air delivery drawn into forced draught boilers by means of an electric fan, having a larger diaphragm (1) held along the perimeter in two circular half-shells (2) and (3) where in the latter a second smaller diaphragm (4) is fitted parallel and coaxially to the large diaphragm (1) being held along the perimeter between the half-shell (3) and an external casing (5) where a pre-compressed safety spring (15) is fitted, and which exerts a constant axial thrust on the small diaphragm (4), in that the total axial force on the small diaphragm (4) is transmitted to the large diaphragm (1) by means of a sleeve (6) fitted on the internal side of the small diaphragm (4), the edge of which opposes a series of coplanar radial levers (7), whose ends are supported respectively and peripherally on the support and pivot points (F), at the centre on a collar (8) fitted in and integrally with the rod (9), fixed axially to the large diaphragm (1) along which an optical barrier (10) is fitted on the side of the half-shell (2), which depending on the axial position assumed, partially or totally intercepts the optical flow emitted by a photo-emitter (10a) and detected by a photo-detector (10b), installed on the internal side of the half-shell (2); an opposing element (11) is also fitted along the rod (9) which in its axial stroke, integrally with rod (9), intercepts at the end of the stroke the moving element (12) of an electrical switch, resulting in an exchange of the electrical contacts (13) placed in a casing (14) of the half-shell (2) which start or stop the system supplying the fuel-gas.

2) A device for the automatic control of the combustion air delivery drawn into forced draught boilers by means of an electric fan, according to claim 1), characterized in that the half-shells (2) and (3) communicate respectively with the section before and after the electric fan, which draws the fumes by forced draught, while there is a pressure which is always the same as the fuel-gas pressure measured before the supply nozzles, in the external casing (5) of the half-shell (3).

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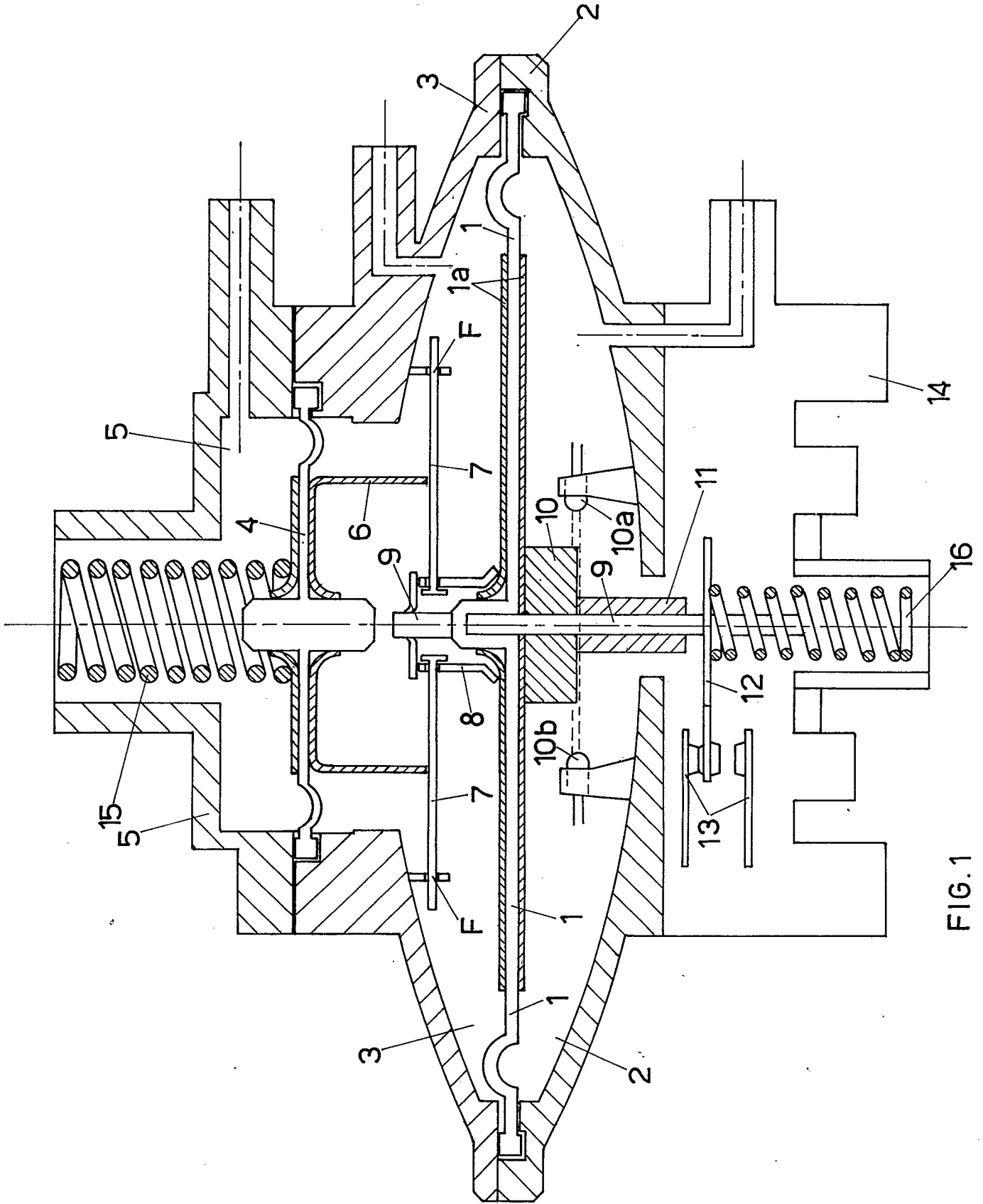
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3) A device for automatically controlling the combustion air delivery drawn into forced draught boilers by means of an electric fan according to claim 1) characterized in that the interception of a larger or smaller section of the optical beam by the optical barrier (10) results in an increase or decrease respectively of the rotation speed of the forced draught electric fan.





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)
A	FR-A-2 353 801 (SAUNIER DUVAL) * Figures 1,3 * ---	1	F 23 N 1/02
A	DE-A-2 011 717 (JOH. VAILLANT KG) * Figure * ---	1	
A	PATENT ABSTRACTS OF JAPAN, vol. 9, no. 70 (M-367)[1793], 30th March 1985; & JP-A-59 202 319 (MATSUSHITA DENKI SANGYO K.K.) 16-11-1984 * Whole abstract * ---	1	
A	FR-A-2 515 314 (CHAUDIERES SECCACIER) * Figures 1,3 * ---	1	
A	US-A-3 119 270 (WAYNE) * Figures 1-3 * ---	1	
A	US-A-3 590 259 (JOHNSTON) ---		
A	US-A-4 464 936 (McINTIRE) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 23 N G 01 L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 10-05-1989	Examiner THIBO F.
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