(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 061 915**
A1

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **82301614.2**

(22) Date of filing: **26.03.82**

(51) Int. Cl.^{3}: **F 23 L 3/00**
F 23 N 5/18, F 23 N 3/02

(30) Priority: **27.03.81 FR 8106198**

(43) Date of publication of application:
06.10.82 Bulletin 82/40

(84) Designated Contracting States:
CH DE FR GB IT LI NL SE

(71) Applicant: **Esso Société Anonyme Française**
6 Avenue André Prothin
F-92400 Courbevoie(FR)

(72) Inventor: **Bouvin, Jacques**
Le Mesnil Gremichon St. Martin du Vivier
F-76160 Darnetal(FR)

(72) Inventor: **Paysant, Paul Rene Pierre**
4 Impasse Pegase
F-76800 St. Etienne du Rouvray(FR)

(74) Representative: **Field, Roger Norton et al,**
ESSO Engineering (Europe) Ltd. Patents & Licences
Apex Tower High Street
New Malden Surrey KT3 4DJ(GB)

(54) **Burner with an air regulator.**

(57) Air regulator (1) upstream of the burner comprising a detector having a diaphragm (3) suspended in a chamber (4) which is subjected on one side (12) to the pressure of the air supply to the burner and which is subjected on the other side (11) to the pressure of the air or gas flow downstream of the burner. A change in pressure in the combustion chamber of the burner causes a change in the equilibrium position of the diaphragm (3). There is a stepping motor connected to the regulator (1) whereby movement of said motor causes a change in the amount of air flowing through the regulator and means (7, 8) for actuating the stepping motor in response to a change in the equilibrium position of the diaphragm (3) or a change in the equilibrium position of the diaphragm above a predetermined level so that the pressure difference, which may be zero, between the air supply to the burner and the air or gas flow downstream of the burner remains substantially constant.

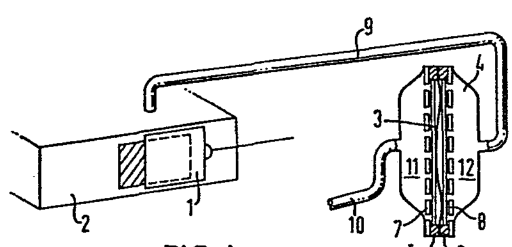

FIG. 1.

EP 0 061 915 A1

Croydon Printing Company Ltd.

0061915

BURNER WITH AN AIR REGULATOR

This invention relates to a burner having a regulator for the air supply.

In any burner the air for combustion is regulated by a damper, butterfly valve, one or more gates etc, and this causes a loss of head in the air circuit. Also the air is set in motion either by the natural draught, by a fan or more usually by a combination of the two. Apart from certain highly automated industrial installations, the adjustment is fixed and is set at intervals which may range from for example one week to one year. The adjustment is made for average conditions and therefore is rarely satisfactory if the natural draught of the chimney represents a substantial part of the total motive head.

A burner having an air regulator which automatically controls the air pressure at the inlet of the burner at a fixed value which may be that of the combustion chamber or at a value differing from that of the combustion chamber by a fixed amount is disclosed and claimed in our French patent application 8022360. This invention concerns a modification of that invention and comprises a burner having an air regulator through which air must flow before entering the air inlet to the burner wherein said regulator comprises a detector having a sensitive element which is subjected to the pressure of the air supply to the burner and which is subjected to the pressure of the air or gas flow downstream of the burner. A change in pressure in the combustion chamber of the burner causes a change in the equilibrium position of the sensitive element. There is a stepping motor connected to the regulator whereby movement of said motor causes a change in the amount of air flowing through the regulator. There are means for actuating the stepping motor in response to a change in the equilibrium position of the sensitive element or a change in the equilibrium position of the sensitive element above a predetermined level. By this means whilst the burner is operating the pressure difference (which may be zero) between the air supply to the burner and the air or gas flow downstream of the burner remains substantially constant.

The air regulator is eminently suitable for use with the burner described in French patent specification 75-15854 (equivalent to UK patent application 20532/76). However the air regulator can be attached to any burner, for example burners used for heating premises connected to natural draught chimneys. Furthermore the air regulator can act as a scavenging limiter when the burner is not being used, for as the pressure drops in the combustion zone and chimney of the burner so will the supply of air to the regulator from the atmosphere substantially cease.

It has been found that there is good control on burners fitted with this regulator with a diminution in the variation in the amount of CO_2 produced compared with the same burner not using this regulator.

The sensitive element of the detector is preferably a diaphragm, but it could for example, be a bellows. For a simple diaphragm it is only necessary to ascertain whether it is deformed in one direction or another; it is not necessary to measure the deformation. Consequently the mechanical characteristics of the diaphragm are unimportant and its assembly does not necessitate great rigidity or precision machining.

The diaphragm can for example be made of mylar (polyester film) and be clamped between two spacing frames. These frames are placed between two printed circuit plates (which constitute part of the actuating means).

and which are perforated to let the pressure pass through. Depending on the direction of the pressure the diaphragm presses against one or other of the printed circuits and activates the stepping motor as explained later.

Other forms of diaphragm are discs of flexible metal, e.g. brass. The diaphragm should be supported in a container so that one face of the diaphragm can be subjected to the pressure of the air supply to the burner and the other face can be subjected to the pressure of the air or gas flow downstream of the burner.

The separate communications between the detector and the air or gas flow downstream of the burner and between the detector and the air supply to the burner are usually by way of pipe, conduit or tubing. The communication with the air or gas flow downstream of the burner is preferably made with the chimney stack of the boiler, but it can if desired be made at the combustion chamber itself.

Most burners are provided with a fan or other device which takes in air at atmospheric pressure and delivers it at a higher pressure e.g. a compressor. In such cases the relevant part of the sensitive element, e.g. one face of the diaphragm, must be subjected to the pressure of the air supply upstream of the fan or said other device. Most burners also have an adjustment means whereby for a given operation the amount of air entering the burner is fixed at a certain level. Again the respective face of the diaphragm or relevant part of the sensitive element must communicate with the pressure of the air supply upstream of the adjustment means and the fan.

The means for actuating the stepping motor can take various forms. Thus, as previously mentioned when the sensitive element is a diaphragm the actuating means can be a pair of printed circuits, one located near one face of the diaphragm and the other located near the other face of the diaphragm so that when the diaphragm deforms it contacts either one printed circuit or the other printed circuit depending on which face of the diaphragm is pressurised. Alternatively, there may be optoelectronic means, for instance a photodiode, so that a light signal e.g. from a light emitting diode, is only received when the diagraphm which is preferably a reflective metallised membrane, is deformed in one direction. As another alternative if the diaphragm is made of conductive material or is coated with a conductive film, deformation of the diaphragm in one direction causes electrical contact.

There is preferably a single, bi-directional, stepping motor, movement of which changes the amount of air entering the regulator from the atmosphere. The stepping motor is usually controlled by a simple electronic control card comprising a simple ring-wired shift register. The control clock signal can be obtained by for example half wave rectification of a 50 Hz main, the square signal being obtained by clipping.

When the direction of the shift of the register is reversed e.g. by the diaphragm contacting the opposite printed circuit, then the stepping motor rotates in the opposite direction and this causes a change in the amount of air entering the regulator from the atmosphere. If air has been entering the regulator freely then a reversal of the stepping motor causes the supply of air to cease, but on the contrary if air has been unable to enter the regulator then the reversal of direction of the stepping motor causes air to enter the regulator.

Although the above described system operates satisfactorily, sometimes it can be unstable around the point of zero pressure. Thus, the motor advances a few steps, the regulator closes slightly, the pressure differential upon the detector is reversed, the latter deflects, the motor recedes a few steps, the regulator opens slightly, the detector reverses again, etc. In this system there can be no resonance, the motor always advances or recedes at the speed imposed by the clock signal and always receives control impulses of constant intensity.

This system however can be stabilised by creating a neutral zone. To achieve this two detectors of slightly different sensitivities are used and their control signals received in an appropriate manner. When both detectors are deflected in the same direction the stepping motor advances (or recedes), but when only one pick-up, the more sensitive, is deflected the shift of the register is stopped and this stops the motor.

The advantage of having two detectors of different sensitivity is that there is no change in the air supply when the pressure of the air or gas flow downstream of the burner changes over a relatively narrow pressure band, e.g. 1 Pa. Change in the air supply only occurs when the pressure of the air or gas flow downstream of the burner changes outside this relatively narrow pressure band.

For the system to function appropriately it is necessary for the detectors to have a definite position, e.g. left or right, at least the less sensitive of the two. This is achieved automatically when the sensitive element, e.g. diaphragm activates a microswitch because the latter has only two positions. Alternatively the diaphragm can be locked "on the right" or "on the left" for example, by placing two small magnets on the armatures, on each side of the diaphragm, the latter carrying a soft iron washer in its centre. As another alternative when a metallised mylar diaphragm is used it is attracted to one or other armature by electrostatic attraction. In all cases the diaphragm will be very flexible and it is the force of the spring of the microswitch or the force of magnetic or electrostatic attraction which defines the sensitivity of the system. The latter case is advantageous in that the sensitivity of the diaphragm can be regulated electrically. The system using magnets can be regulated by varying the distance of the magnets from the diaphragm. With a microswitch the sensitivity of the system is fixed.

The connection between the detector and the regulating means can be adjusted so that negative pressure in the combustion chamber will tend to move the detector in a direction closing the regulating means. If the burner is operating this closure will subject the air supply to a subatmospheric pressure and with no return force the regulating means will continue to close until the air supply pressure is equal to the pressure in the combustion chamber.

If the burner is not working the flow of air is very slight so that the pressure drop through the regulator is negligible and the regulator will close completely, thus limiting the scavenging of the combustion chamber when the burner is not working. This may often be advantageous in that heat losses can be reduced during shut-down periods.

The advantage of the system of this invention lies in the fact that there is ease of integration due to the small volume of the motor and its large torque enabling registers of widely different designs to be actuated. There is also greater tolerance to dirt due to the strong torque of the motor.

The invention is now described with reference to the drawings in which:

Figure 1 shows a perspective view of one form of regulator suitable for use with the burner in accordance with the invention;

Figure 2 shows a cross-section of the diaphragm of the regulator shown in Fig 1 contacting a printed circuit plate;

Figures 3 to 5 show elevations of portions of alternative forms of regulators to that shown in Figure 1 and

Fig 6 shows a stepping motor controlling the air supply to the burner and being itself controlled by signals from a pair of diaphragms.

Referring to Figure 1 of the drawings where it is assumed that the combustion chamber is under negative pressure a damper 1 closes an air box 2 in communication with the air supply. This damper 1 is constructed so as to slide freely so that the difference in pressure between the two faces of the damper does not lead to any forces tending to open or close the damper.

A diaphragm 3 is suspended in a chamber 4 between two spacing frames 5 and 6 and is free to contact alternately (according to the pressure exerted on it) perforated printed circuit plates 7 and 8. The zones 12 and 11 on each side of the diaphragm 3 are connected respectively via conduits 9 and 10 to the box 2 and the combustion chamber (not shown). Fig 2 shows more clearly the diaphragm 3 pressed against one of the printed circuit plates 7. Movement of the damper 1 is controlled by movement of the stepping motor (not shown). The motor is itself controlled by its control system which is an electronic control card comprising a simple ring-wired shift register. The direction of the shift of the register is reversed every time the diaphragm 3 contacts the opposite printed circuit 7 or 8.

Fig 3 shows an alternative detection system to that shown in Fig 2. Supported from the printed circuit plate 71 are a light emitting diode 20 and a photodiode 21. The membrane which in this case is a reflective metallised membrane is shown in two positions at 31a and 31, and it can be seen from the light rays that the photodiode 21 only receives rays from the diode when the membrane is in the position shown at 31a.

Fig 4 shows an alternative system where the diaphragm 32 is stabilised by being locked by the presence of a magnet 22. The diaphragm 32 has a soft iron washer 23 at its centre. The printed circuit 72 has contacts 40 and 41.

Fig 5 shows another alternative diaphragm stabilised system wherein a double-faced metallised mylar diaphragm 33 is used. This is attracted to two double-faced printed circuits 73 and 74, each at a potential of +300V, the potential of the diaphragm 33 being maintained at -100V. In fact the potentials are adjustable according to the dimensions, contacts, dielectric properties, etc.

Fig 6 shows one form of regulating means by which the damper 1 in Fig 1 for example is controlled. In Fig 6 there is an air fan 50 controlled by a stepping motor 51 which in turn is controlled by a ring-wired shift register 52. This register 52 receives its signal as the result of the deflections of the two diaphragms 80 and 81, one of which is more sensitive than the other. It is only when both diaphragms 80 and 81 are deflected in the same direction that the stepping motor 51 advances (or recedes). Conduit 82 enables the diaphragms 80 and 81 to be subjected to the pressure of the air or gas flow downstream of the burner (not shown) and conduit 83 enables the diaphragms 80 and 81 to be subjected to the pressure of the air supply to the burner.

CLAIMS

1. A burner having an air regulator upstream of the burner so that air must flow therethrough before entering the air inlet to the burner, wherein said regulator comprises a detector having a sensitive element which is subjected to the pressure of the air supply to the burner and which is subjected to the pressure of the air or gas flow downstream of the burner, wherein a change in pressure in the combustion chamber of the burner causes a change in the equilibrium position of the sensitive element, a stepping motor connected to the regulator whereby movement of said motor causes a change in the amount of air flowing through the regulator and means for actuating the stepping motor in response to a change in the equilibrium position of the sensitive element or a change in the equilibrium position of the sensitive element above a predetermined level so that the pressure difference, which may be zero, between the air supply to the burner and the air or gas flow downstream of the burner remains substantially constant.

2. A burner according to claim 1 wherein the sensitive element is a diaphragm.

3. A burner according to claim 2 wherein the actuating means includes a pair of printed circuits, one located near one face of the diaphragm and the other located near the other face of the diaphragm.

4. A burner according to claim 2 wherein the actuating means includes a photodiode whereby a light signal is only received when the diaphragm is deformed in one direction.

5. A burner according to any one of the preceding claims wherein two detectors of different sensitivities are used whereby only when both detectors move in the same direction is the stepping motor caused to move.

6. A burner according to any one of the preceding claims wherein the pressure difference between the air supply to the burner and the air or gas flow downstream of the burner is substantially zero.

7. A burner according to any one of the preceding claims wherein communication is made between one face of the sensitive element and the air supply to the burner and between the other face of the sensitive element and the chimney stack of the boiler.

8. A burner according to any one of the preceding claims which is provided with a fan, upstream of which is the air supply to the burner.

9. A burner according to any preceding claim wherein a single bi-directional stepper motor is operatively connected to the regulator for both increasing and decreasing selectively the amount of air flowing through the regulator.

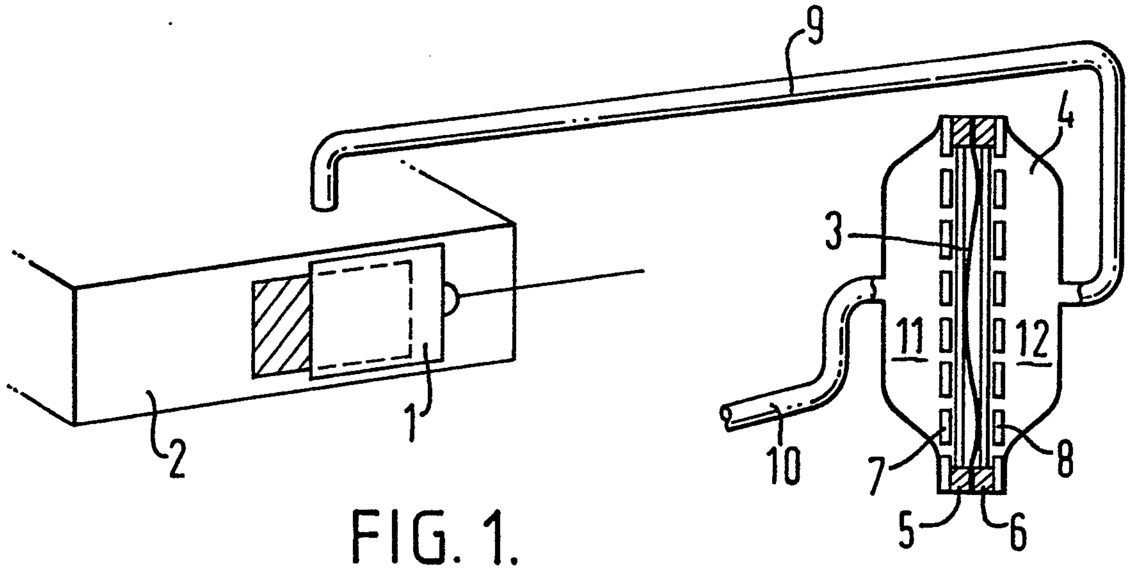

FIG. 1.

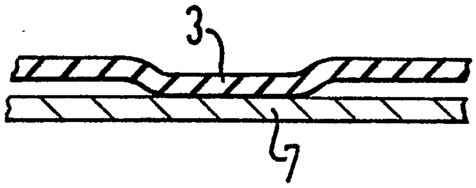

FIG. 2.

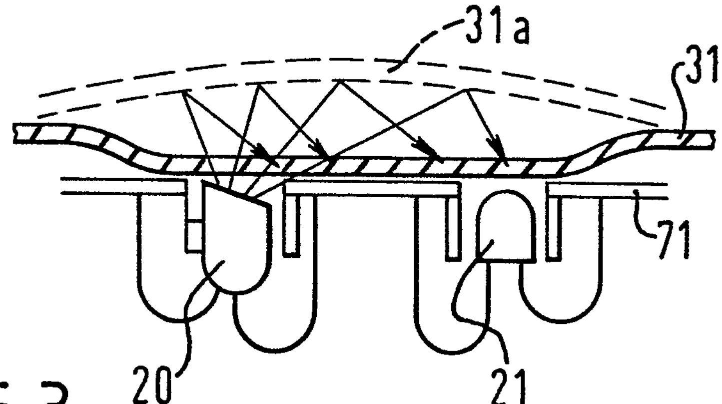

FIG. 3.

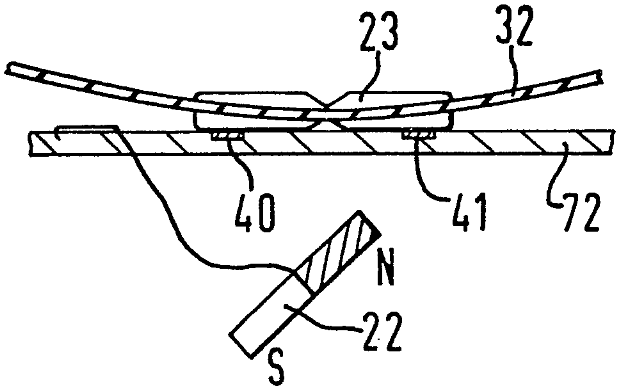

FIG. 4.

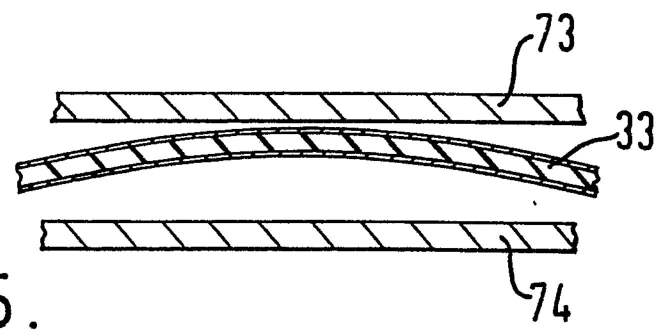

FIG. 5.

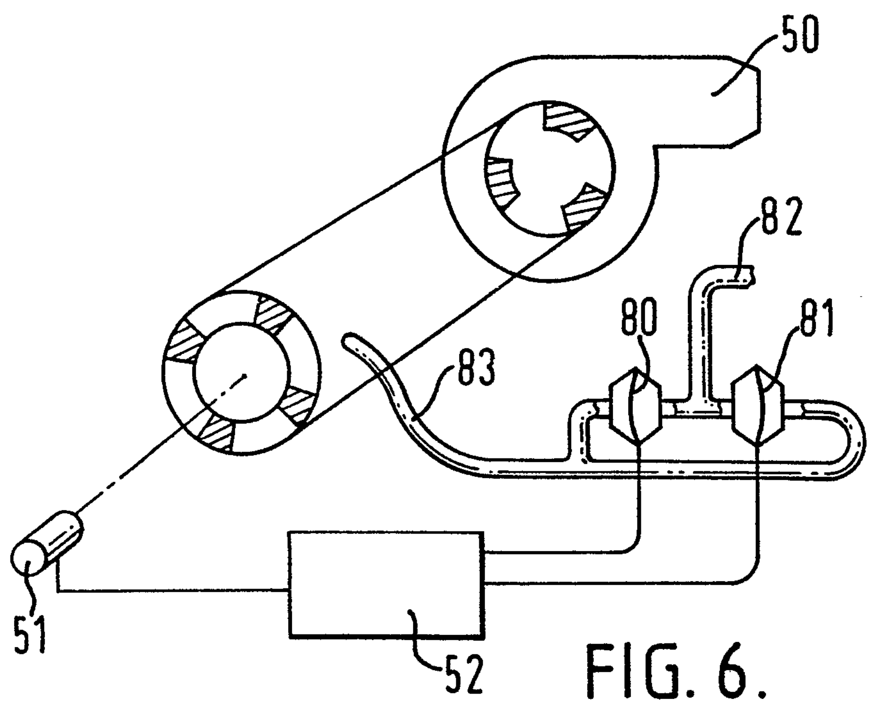

FIG. 6.

European Patent Office

EUROPEAN SEARCH REPORT

0061915

Application number

EP 82 30 1614

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)
A	US-A-3 294 146 (VOORHEIS) *Column 2, lines 48-61; column 3, lines 17-75; column 4, lines 1-41; figures 1-3* ---	1,2,8	F 23 L 3/00 F 23 N 5/18 F 23 N 3/02
A	US-A-3 391 866 (ROHRER) *Column 2, lines 36-42; column 3, lines 7-41; figure 1* ---	1,2,8	
A	FR-A-2 127 967 (PHILIPS) ---		
A	FR-A-2 182 354 (LA TELEMECANIQUE ELECTRIQUE) ---		
A	US-A-2 283 745 (LINES) -----		TECHNICAL FIELDS SEARCHED (Int. Cl. 3) F 23 L F 23 N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05-07-1982	PHOA Y.E.

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