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(54) **Process and apparatus for controlling the comburent/combustible ratio, particularly in boilers.**

(57) The described process consists in picking up a modulation signal from a combustion-air sucking fan (12) proportional to the rotational speed of the fan, and converting the modulation signal to an electric signal operating a fuel delivery adjusting unit (15). The apparatus putting the process into practice comprises an assembly (16) for generating the modulation signal which is controlled by an electric motor (13) operating the combustion-air sucking fan (12), and means (17) for transmitting and converting the modulation signal so as to change it into a drive signal for the fuel delivery adjusting unit (15).

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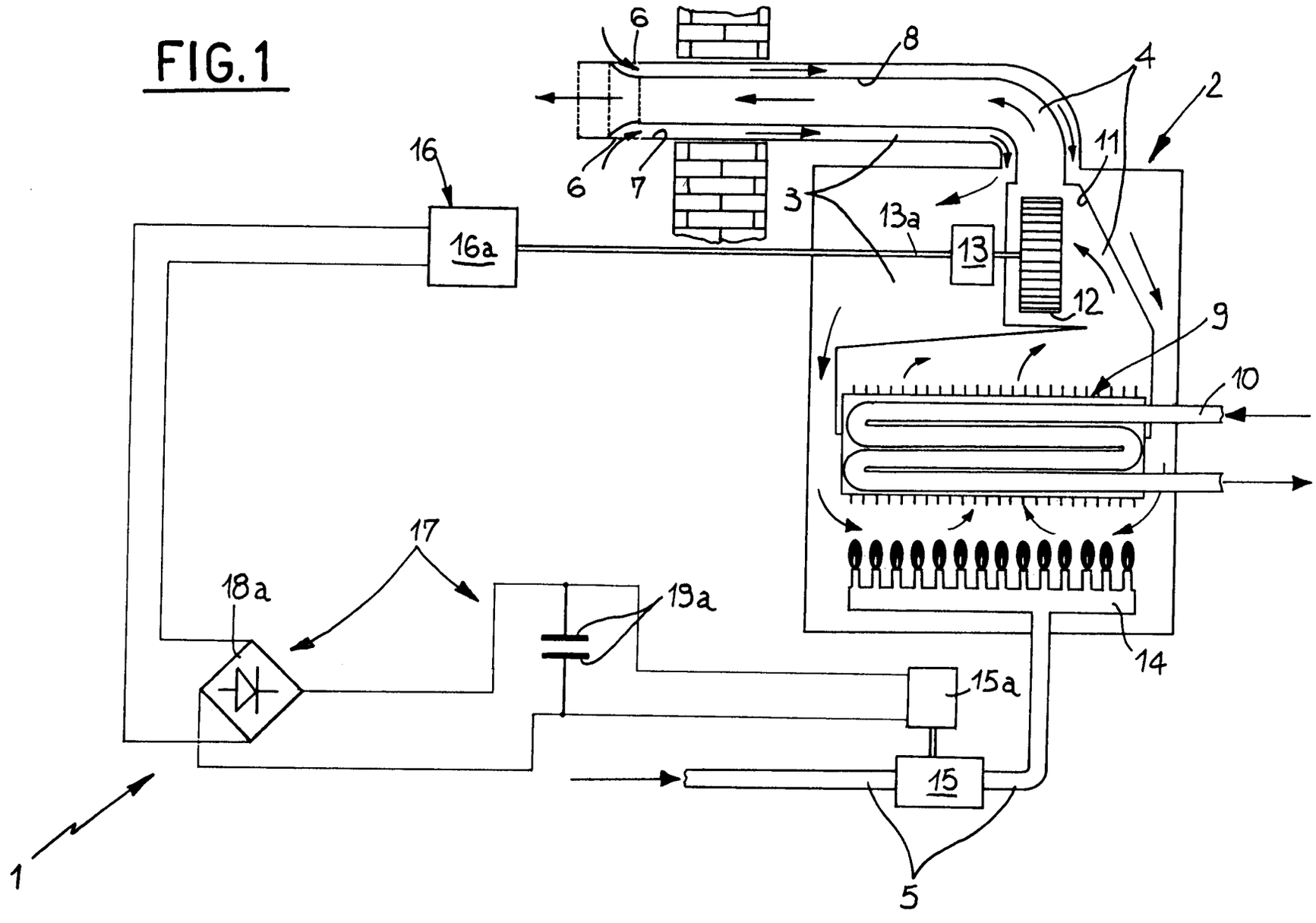
FIG.1



The present invention relates to a process and apparatus for controlling the comburent/combustible ratio, particularly in boilers.

It is known that presently in heat producing apparatus of reduced thermal capacity such as wall-supported boilers, boilers standing on ground and small premixed and blown-air burners the adjustment of the produced heat depending on the actual user's requirements is generally carried out by acting on the fuel (gas for example) pressure to the burner and consequently on the delivery thereof.

In order to keep a high combustion efficiency and reduce the production of harmful gas it is consequently necessary to act on the comburent delivery as well, that is the combustion air, so that the comburent/combustible ratio be as much as possible corresponding to the value considered as the optimal one.

For example in wall-supported boilers provision is made for a fuel circuit normally provided with a unit for the fuel delivery adjustment, a comburent circuit comprising an air-intake opening, and a smoke circuit following the comburent circuit and comprising a combustion chamber, a heat exchanger for transferring heat from the smoke to the water to be heated, a conveyor, and exhaust pipes near which a fan operated by an electric motor is generally disposed which performs the function of both sucking the combustion air and ejecting the smoke resulting from the exhaust gas.

The variation in the air delivery is carried out, in relation to the heat amount to be produced, by acting by known means for example of the electronic type on the rotational fan speed, whereas the consequent fuel delivery variation in the fuel circuit is carried out by the use of control apparatus of the pneumatic-mechanical type.

These known apparatus generally comprise a Venturi tube or similar means, usually located in the suction duct, adapted to generate the vacuum theoretically in proportion to the delivery of air drawn by the fan and actuating a diaphragm which in turn acts on the fuel delivery adjusting unit defined by a pressure regulator, normally of the spring type.

The above described known apparatus have important drawbacks.

First of all the setting of said apparatus is very difficult and the adjustments they make do not always offer satisfactory results. The difficulty encountered in the apparatus setting is also due to the fact that the air density and therefore the vacuum produced by air in the Venture tube is subjected to variations as a result of temperature variations occuring as the combustion goes on.

Attempts have been made to solve the above drawbacks by the use of electronic devices of great complexity comprising sensors and means for comparing the combustion air and combustible gas deliveries. However these apparatus have very high costs and therefore they cannot be conveniently used in boilers of reduced heat capacity.

Under this situation the technical task underlying the present invention is to devise a process and an apparatus for the control of the comburent/combustible ratio, capable of substantially overcoming the above drawbacks.

Within the scope of this technical task it is an important object of the invention to provide a process and an apparatus for the control of the comburent/combustible ratio offering high precision, reliability, construction simplicity and reduced production costs.

Another object of the invention is to provide at least a specific embodiment of the invention which is advantageous in itself and depicts a technical progress in the specific field.

The technical task mentioned and the objects specified are substantially achieved by a process for controlling the comburent/combustible ratio particularly in boilers, of the type comprising a comburent circuit and a smoke circuit disposed in consecutive relationship with respect to each other and exhibiting at least a fan driven by an electric motor, and a fuel circuit comprising a unit for adjusting the fuel delivery, characterized in that it comprises the steps of:

- picking up a modulation signal from said fan which is proportional to the rotational speed thereof, and
- converting said modulation signal to an electric signal controlling said adjusting unit.

The process is advantageously put into practice by an apparatus for controlling the comburent/combustible ratio, particularly in boilers, of the type comprising a comburent circuit and a smoke circuit disposed in consecutive relationship with respect to each other and exhibiting at least a fan driven by an electric motor, and a fuel circuit comprising a unit for adjusting the fuel delivery, characterized in that it comprises:

- a generator assembly for generating a modulation signal which is controlled by said electric motor, said modulation signal being of the electric type, and
- means for transmitting and processing said modulation signal disposed between said generator assembly and adjusting unit and adapted to convert said modulation signal to an electric signal for the control of said adjusting unit.

The description of some preferred embodiments of an apparatus in accordance with the invention is given hereinafter by way of non-limiting example with reference to the accompanying drawings, in which:

- Fig. 1 is a diagrammatic view of one embodiment of the apparatus of the invention, associated with a wall-supported boiler; and
- Fig. 2 shows a second embodiment of the concerned apparatus, associated with said boiler.

Referring to the drawings, the process of the invention consists in picking up a modulation signal from a fan designed to take in the combustion air and eject the exhaust gas, and converting said modulation signal to an electric signal controlling the adjusting unit for the combustible gas delivery.

The process of the invention is advantageously put into practice by an apparatus which also is the object of the present invention.

Referring to the drawings, the apparatus for controlling the comburent/combustible ratio, particularly in boilers, is generally identified by reference numeral 1. It is located for example in a wall-supported boiler of the sealed type 2 comprising a comburent circuit 3, a smoke circuit 4 and a fuel circuit 5.

The comburent circuit 3 in turn comprises an air intake opening 6 and a suction pipe 7 coaxial with an exhaust pipe 8 provided in the smoke circuit 4. The latter also comprises a heat exchanger 9 for transferring heat from the smoke to the water flowing through the heat exchange pipes 10 and a hood or conveyor 11 communicating with the exhaust pipe 8. Disposed close to the exhaust pipe 8 is a fan 12 operated by an electric motor 13.

The fuel circuit 5 comprises a burner 14 and a delivery-adjusting unit 15 consisting for example of a conventional spring pressure regulator controlled by an electric modulation coil 15a.

The apparatus of the invention is operatively disposed between the electric motor 13 and the delivery adjusting unit 15 and comprises a generator assembly 16 mechanically connected to the electric motor 13, adapted to generate a modulation signal of the electric type, and means 17 for transmitting and processing said modulation signal and adapted to convert it to an appropriate electric signal for actuation of the modulation coil 15a.

In one embodiment shown in Fig. 1, the generator assembly 16 is defined by an alternator 16a operatively connected to a shaft 13a of the electric motor 13 and the transmitting and processing means 17 for example comprises a bridge rectifier 18a and a filter 19 designed to correctly feed the coil 15a with current produced by the alternator 16a.

In a second embodiment shown in Fig. 2, the generator assembly 16 is defined by an encoder 16b operatively connected to the shaft 13a of the electric motor 13 and adapted to emit a low-power signal, depending upon the number of revolutions of the motor. The frequency value of the signal from the encoder 16b is not of great importance to the ends of the present invention. However it is expedient that said value be different from the frequency of the alternating current issuing from the normal mains supply. The transmitting and processing means 17 for example comprises a transistor 20, a transformer 21, a bridge rectifier 18b and a filter 19b.

Operation of the apparatus according to the invention described above mainly as regards structure, is as follows.

In the first embodiment alternator 16a supplies the coil 15a with a current of variable intensity depending upon the number of revolutions of fan 12. If, for example, fan 12 rotates to its maximum speed because the maximum heat delivery is required, the maximum value of available current circulates through the coil 15a and consequently the maximum thrust is exerted against the spring of the fuel delivery regulator which therefore reaches its maximum delivery.

A reduction in the rotational speed of fan 12 and therefore in the sucked-air delivery brings about a reduction in the value of the current circulating through the coil 15a and therefore a consistent reduction in the combustible-gas pressure and delivery.

In the second embodiment to be advantageously utilized when one wishes to use an electric motor 13 of reduced power which enables the power installed in the boiler to be economized, the encoder 16b produces a pulsating signal the frequency of which is proportional to the rotational speed of fan 12. The transformer 21, provided with a self-governing D.C. working voltage of its own is travelled by a current which is made oscillating by transistor 20 to the frequency of the pulsating signal issuing from encoder 16a. As a result coil 15a reaches a current which is proportional to the rotational speed of fan 12.

The invention attains the intended purposes and reaches important advantages.

In fact it enables the fan sucking speed and therefore the sucked-air delivery to be precisely correlated with the fuel delivery, through the use of simple, reliable and inexpensive components.

It will be appreciated that the control apparatus of the invention also enables the maximum operational safety to be achieved even in the presence of possible failures in the apparatus itself. It is in fact known that a boiler can be considered safe when the condition in which there is a maximum gas delivery and a minimum air delivery can never take place, which condition is unacceptable as it is very dangerous. In the apparatus of the invention if the electric motor 13 does not run or idles the current generated in the coil 15a is not sufficient to operate the spring-closed pressure regulator (in the first case) or to bring the fuel output pressure to its maximum extent (in the second case).

In addition, any short-circuit in one of the electric components forming the apparatus prevents current from flowing to the coil 15a so that the maximum fuel pressure cannot be reached.

It is also important to note that the particular embodiments shown are also advantageous in their most specific aspects. The invention is susceptible of many modifications and variations, all of them falling within the scope of the inventive idea. In addition, all of the details can be replaced by technically equival-

ent elements. In actual fact, the materials used as well as the shapes and sizes can be of any nature and magnitude depending upon requirements.

Claims

1. A process for controlling the comburent/combustible ratio particularly in boilers, of the type comprising a comburent circuit and a smoke circuit disposed in consecutive relationship with respect to each other and exhibiting at least a fan driven by an electric motor, and a fuel circuit comprising a unit for adjusting the fuel delivery, characterized in that it comprises the steps of:
   - picking up a modulation signal from said fan which is proportional to the rotational speed thereof, and
   - converting said modulation signal to an electric signal operating said adjusting unit.

2. An apparatus for controlling the comburent/combustible ratio particularly in boilers, of the type comprising a comburent circuit (3) and a smoke circuit (4) disposed in consecutive relationship with respect to each other and exhibiting at least a fan (12) driven by an electric motor (13), and a fuel circuit (5) comprising a unit (15) for adjusting the fuel delivery characterized in that it comprises:
   - a generator assembly (16) for generating a modulation signal which is controlled by said electric motor (13), said modulation signal being of the electric type, and
   - means (17) for transmitting and processing said modulation signal disposed between said generator assembly (16) and adjusting unit (15) and adapted to convert said modulation signal to an electric signal for operating said adjusting unit.

3. An apparatus according to claim 2, characterized in that said generator assembly (16) consists of an alternator (16a).

4. An apparatus according to claim 3, characterized in that said adjusting unit (15) comprises a modulation coil (15a) acting on a spring pressure regulator and in that said transmitting and processing means (17) comprises a rectifier (18a) for said modulation signal issuing from said alternator (16a).

5. An apparatus according to claim 2, characterized in that said generator assembly consists of an encoder (16b).

6. An apparatus according to claim 5, characterized in that said adjusting unit comprises a modulation coil (15a) acting on the spring pressure regulator and in that said transmitting and processing means (17) comprises a transformer (21) and a rectifier (18b) for said signal issuing from said encoder (16b).

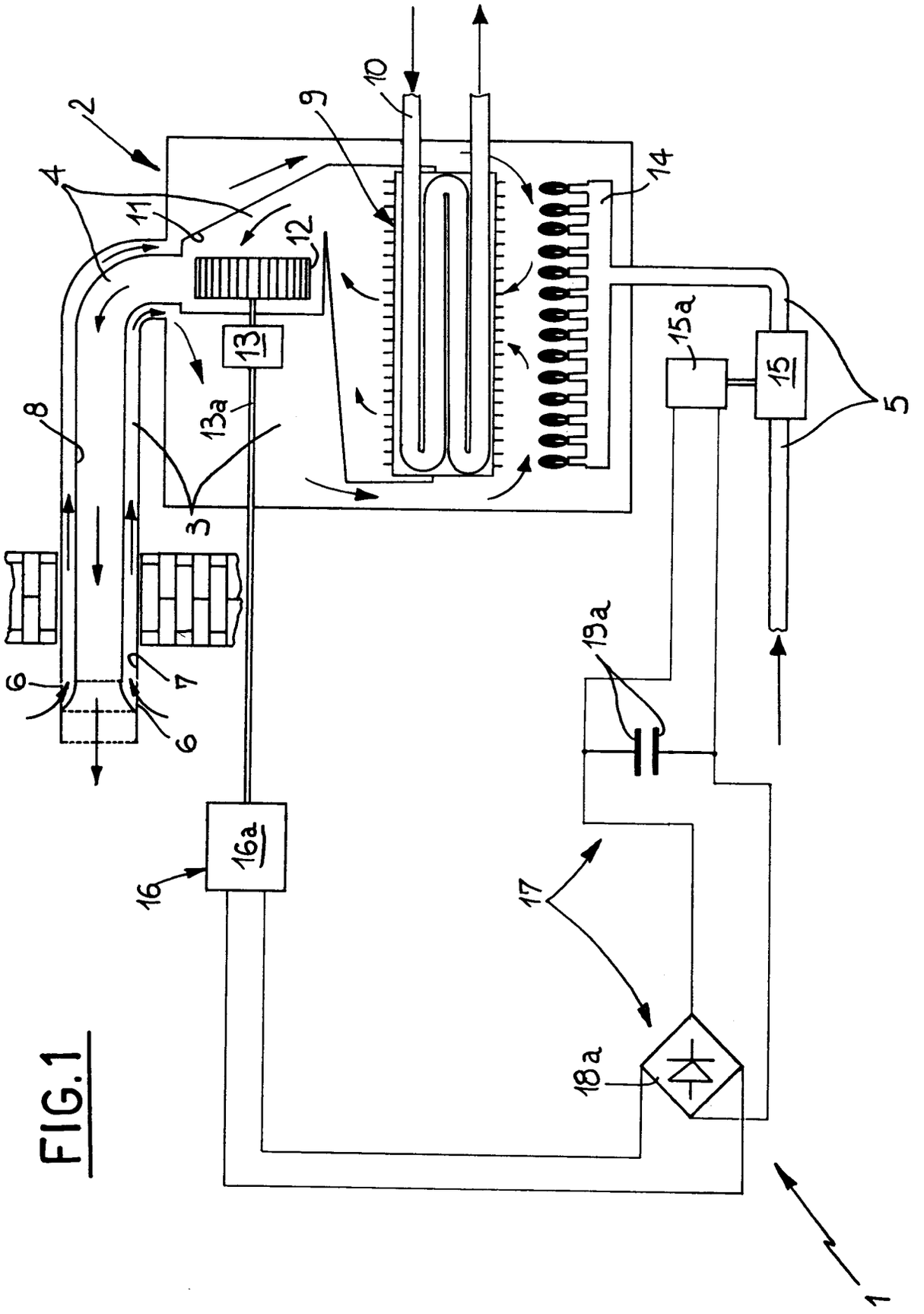


FIG.1

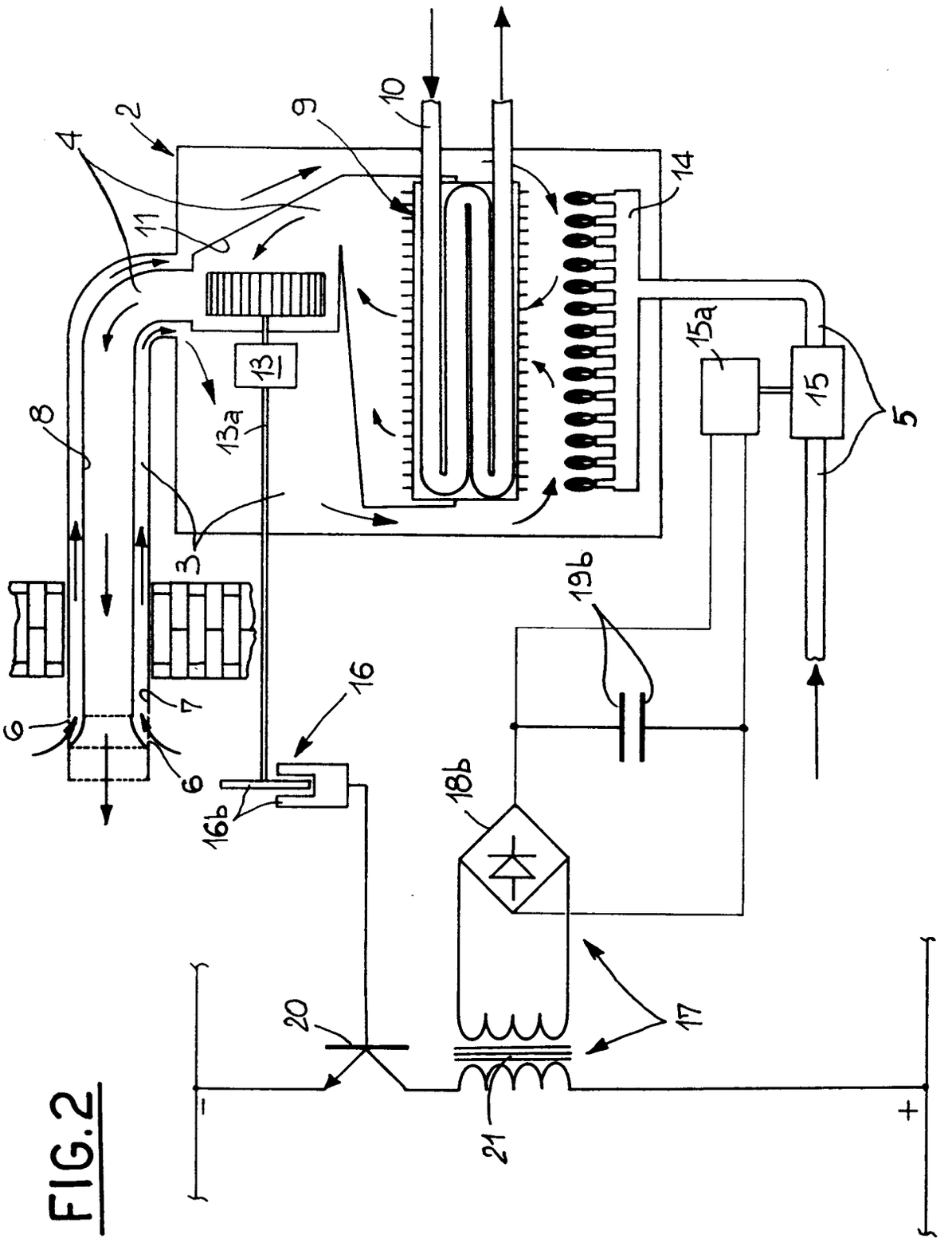


FIG.2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 83 0323

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	FR-A-2 296 146 (SAUNIER - DUVAL)	1-4	F23N1/06
Y	* the whole document *	6	
X	EP-A-0 073 717 (SAUNIER DUVAL EAU CHAUDE CHAUFFAGE)	1-3,5	
Y	* the whole document *	6	

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	18 DECEMBER 1991	KOOIJMAN F.G.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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