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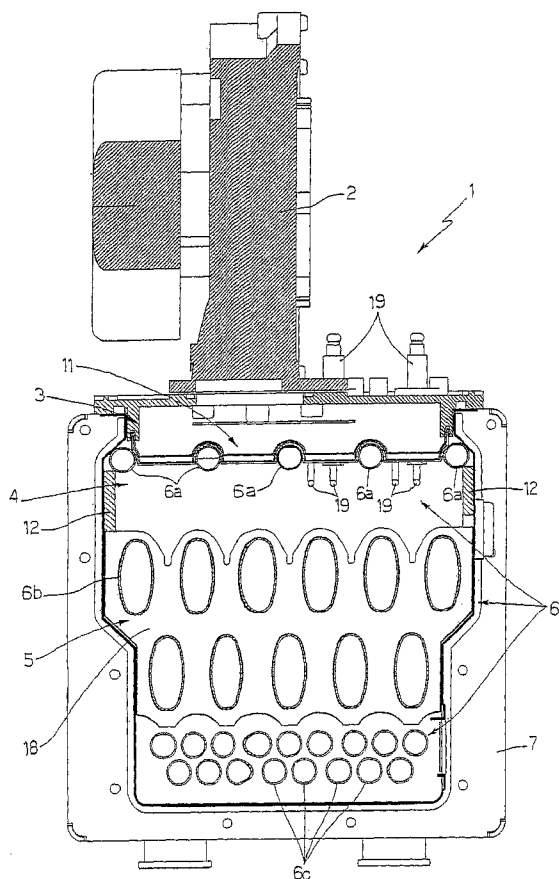
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(54) Title: BOILER WITH A COMBUSTION HEAD COOLING SYSTEM



(57) Abstract: A boiler (1;20) comprising a fan (2), an air-gas premixing burner (3), a combustion chamber (4) faced by a combustion head (11) of the burner (3) and a heat exchanger (5; 21) comprising a plurality of tubes (6; 22) in which the water of a heating system runs. The heat exchanger (5; 21) comprises cooling tubes (6a; 22a) arranged in contact either directly or with the interposition of an element (17) formed by high heat conducting material, with a diffuser (15) of the burner (3).

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BOILER WITH A COMBUSTION HEAD COOLING SYSTEM

TECHNICAL FIELD

The present invention relates to a boiler with
5 cooling system of the combustion head of the burner.
Specifically, the present invention relates to a heater
with air-gas premixing burner, to which explicit
reference will be made in the following description
without loosing in generality.

10 BACKGROUND ART

It is known that boilers with total air-gas
premixing burner are designed to work with burners using
only combustion air mixed with combustible gas upstream
of the combustion head of the burner and, thus, without
15 any contribution of secondary air downstream of the
combustion head of the burner.

The known boilers with air-gas premixing burners
comprise a mixer in which the total air-gas premixing is
performed, a fan, a burner, a combustion chamber
20 downstream of the burner and a heat exchanger which
comprises, in turn, a plurality of tubes defining the
path of the water in a heating system.

The mixer may be located upstream or downstream of
the fan according to the choice made by the
25 manufacturer.

The boilers of the above-described type present the
severe problem related to the excessive heating of the
combustion head of the burner, and specifically the

overheating of the diffuser element which represents the part of the combustion head in contact with the flame of the burner.

It is indeed known that when total air-gas
5 premixing burners run at the minimum of the heat supply thereof, the flame front progressively approaches the surface of the diffuser heating it to very high temperatures such as to require solutions adapted to withstand such high temperatures.

10 In order to overcome such a problem of the diffuser overheating there have been used diffusers formed by materials presenting a high resistance to high temperatures, which however imply other disadvantages. Specifically, the diffusers formed by high alloy steel
15 or high-temperature-resistant metallic mesh present the disadvantage of being too expensive, while the diffusers formed by ceramic material, such as the diffusers of porous matrix or ceramic matrix, in addition to being costly, present the disadvantage of being particularly
20 fragile.

DISCLOSURE OF INVENTION

It is the object of the present invention to make a cooling system for the combustion head of a total air-gas premixing burner, the technical features of which
25 are such to overcome the drawbacks of the known art.

The object of the present invention is therefore a boiler with a total air-gas premixing burner as claimed in Claim 1.

Furthermore, according to a preferred embodiment of the present invention, the external element of the combustion head of the burner is a diffuser.

According to a further preferred embodiment, a plurality of seats adapted to accommodate part of the tubes are obtained in the diffuser element.

BRIEF DESCRIPTION OF THE DRAWINGS

The following examples are provided by way of non-limiting illustration for a better understanding of the invention with the aid of the figures in the accompanying drawing, in which:

- figure 1 is a section of a condensing boiler with total air-gas premixing burner according to the present invention with parts removed for the sake of simplicity;
 - figure 2 is an enlarged detail of figure 1;
 - figure 3 is an exploded view of part of figure 1;
- and
- figure 4 is a section of a non-condensing boiler with total air-gas premixing burner according to the present invention with parts removed for the sake of simplicity.

BEST MODE FOR CARRYING OUT THE INVENTION

In figure 1, numeral 1 indicates a condensing boiler as a whole.

The boiler 1 comprises a fan 2 adapted to blow the air-gas mixtures into a burner 3 arranged underneath the fan 2 it is connected to, a combustion chamber 4 faced by the burner 3, and a heat exchanger 5 comprising a

plurality of tubes 6 in which the water of a heating system (not shown) runs. Specifically, the burner 3, the combustion chamber 4 and the heat exchanger 5 are accommodated inside a containing structure 7, the side walls of which at the combustion chamber 4 are protected by ceramic fibre panels 12.

As shown in figures 2 and 3, the burner 3 comprises a covering plate 8 adapted to superiorly close the containing structure 7 and presenting a hole 9 for the input of the air-gas mixture from the fan 2, a baffle arranged at the hole 9 and fixed to the covering plate 8, and a combustion head 11, which faces the combustion chamber 4 and comprises a distributor element 14 and a diffuser element 15.

Specifically, the covering plate 8 is fixed to the structure 7 in reversible manner to open and close the structure 7 itself, while the combustion head 11 is fixed to the covering plate 8 by means of fastening devices 24 and rests on a part of the tubes 6 as described below. In this manner, after having lifted the burner 3, the combustion chamber 4 may be easily inspected.

The distributor element 14 and the diffuser element 15 are constituted by two corresponding appropriately perforated plates, in which the sum of the holes obtained in the distributor element 14 has a total passage surface of generally smaller size than that of the holes obtained in the diffuser element 13.

In the distributor 14 and in the diffuser 15 there are obtained a plurality of longitudinal grooves 16, having an essentially semi-circular profile and defining corresponding semicircular profile protrusions 16a on the opposite surface.

Specifically, as shown in figure 2, the distributor 14 and the diffuser 15 are reciprocally coupled with the protrusions 16a of the diffuser 15 which engage the grooves 16 of the distributor 14.

10 The heat exchanger 5, in the specific embodiment shown in figure 1, comprises a first plurality of circular section tubes 6a arranged in the upper part of the combustion chamber 4, and accommodated inside the longitudinal grooves 16 obtained in the diffuser 15.

15 Specifically, the boiler 1 comprises a plurality of interposition elements 17 formed by heat-conducting material, such as for example metallic meshes, each of which is positioned between each tube 6a and the corresponding groove 16 in which it is accommodated.

20 The heat exchanger 5 further comprises a second plurality of elliptical section tubes 6b arranged in two reciprocally offset rows, and a third plurality of circular section tubes 6c arranged underneath the tubes 6b and also arranged on two reciprocally offset rows.

25 Specifically, the second plurality of tubes 6b is designed to exploit the heat coming directly from the flame and from the fumes and the latent condensation heat of the combustion fumes, and the third plurality of

tubes 6c is designed to further exploit the latent condensation heat of the combustion fumes.

As known, a plurality of fins 18, only one of which is shown in figures 1 and 2, is coupled to the tubes 6b
5 to assist the heat exchange between the fumes and the water. Furthermore, the boiler 1 comprises ignition means of the flame 19 (known and not described in detail).

Finally, in a lower part of the containing
10 structure 7 there are obtained (known and not shown for the sake of simplicity) a drain tap, through which the fume condensate is evacuated, and an inlet mouth of an evacuation stack of the fumes themselves.

In figure 4, numeral 20 shows a non-condensing
15 boiler as a whole, with total premixing according to the present invention.

The parts of the boiler 20 equal to those of the boiler 1 will be indicated with the same numerals and will not be described again.

20 The boiler 20 differs from the boiler 1 both for the total exchanging surface of the exchanger which, having a smaller number of tubes and a smaller exchange fin surface, does not allow the fumes to cool down to the extent of condensing the vapour contained therein,
25 both for the arrangement of the burner and of the heat exchanger, which, the condensate production ceasing, may possibly be arranged with the heat exchanger located over the burner.

Given the different spatial arrangement with respect to the boiler 1, in the boiler 20 the combustion chamber 4 may be easily inspectable after extracting the burner 3 downwards, since the burner is also in this case easily removable from the containing structure 7.

Unlike the boiler 1, the boiler 20 comprises a heat exchanger 21 comprising, in turn, a plurality of tubes 22 in which the water of a heating system (not shown) runs. The plurality of tubes 22 comprise a first type of circular section tubes 22a accommodated inside the longitudinal grooves 16 obtained in the diffuser 15 with the interposition of interposition elements 17 formed by heat conducting material, and a second type of elliptical section tubes 22b designed to exploit the heat coming directly from the flame and from the fumes. As known, a plurality of fins 23, only one of which is shown in figure 4, is coupled to the tubes 22b to assist the heat exchange between the fumes and the water. Finally, the boiler 20 comprises a pipe 24 for discharging the fumes which in this case will not undergo a condensation process.

It is apparent to a person skilled in the art that the present invention, ensuring a constant cooling of the diffuser, offers the advantage of using diffusers formed by low-cost steel, without because of this increasing the complexity of the burner components. Indeed, the hydraulic circuit responsible for the cooling of the diffuser belongs to the heat exchanger as

a whole without, therefore, adding a new hydraulic circuit and the corresponding components.

The boiler of the present invention, comprising part of the tubes of the heat exchanger in contact with the combustion head of the burner, contemplates a heat exchange directly from the burner estimatable in a fraction ranging from 5% to 15% according to the heat supply developed by the burner itself, with a consequent increase of the total exchange capacity of the exchanger-burner system.

Other advantages of the present invention relate to the reduction of polluting emissions, specifically NO_x , due to the presence in the burner of only rather cold surfaces, and the possibility by the operators to inspect the combustion chamber and the heat exchanger without need to disconnect any part of the hydraulic circuit. Indeed, it is sufficient to lift the covering plate 8 and extract from the containing structure 7 the combustion head 11 of the burner 3, generally integral with the containing structure 7, to gain direct access to the combustion chamber 4 and to the heat exchanger 5.

The tubes 6a and 22a responsible for the cooling of the diffuser 15 may have a different shape from that described above and, above all, may be in direct contact with the diffuser 15, which may either present different seats from those shown in the description or be entirely free thereof.

The tubes 6a and 22a responsible for the cooling of

the diffuser 15 may be in different number from those described above and at a reciprocally different distance, providing that the number and distance are such to sufficiently cool the diffuser 15.

5 The reciprocal distance between distributor 14 and diffuser 15 may be different from that shown in the figures according to the known art.

10 The dimensions of the chamber formed by the covering plate 8 and the distributor 14 may be different from that shown in the figures according to the known art.

15 The surfaces of the diffuser 15 and of the distributor 14 may be, taken individually, either flat or curved with curving radius facing either inwards or outwards with respect to the burner chamber, in order to allow the displacements deriving from the thermal expansions in a known and predetermined direction.

20 The distributor 14 may be made in one piece or in several pieces coupled to the diffuser 15 so as to prevent the escape of air-gas mixture directly from the chamber inside the burner 3 to the diffuser.

25 The number of holes or slots and the shape of the holes and the slots of the distributor 14 and the diffuser 15 may be variable at will according to the known art.

 The distributor 14 and the diffuser 15 may be either rigidly fixed to the covering plate 8, e.g. by means of the fastening devices 24, or be coupled to the

covering plate 8 by means of the same fastening devices which are used to fasten the covering plate 8 onto the structure 7 according to the known art.

Finally, the circulation of water in the tubes 6a and 22a may be in series and/or in parallel according to the specific needs of the water circuit of the heating system.

C L A I M S

1. A boiler (1; 20) comprising a burner (3), a combustion chamber (4) faced by a combustion head (11) of said burner (3) and a heat exchanger (5; 21) comprising a plurality of tubes (6; 22) in which the water of a heating system runs; said boiler (1; 20) being characterized in that said heat exchanger (5; 21) comprises a plurality of cooling tubes (6a; 22a) arranged in contact either directly, or with the interposition of an element (17) formed by heat-conducting material, with an element (15) of said combustion head (11) of the burner (3).

2. A boiler (1; 20) according to claim 1, characterized in that said element of the combustion head (11) with which the cooling tubes (6a; 22a) are in contact is a diffuser (15).

3. A boiler (1; 20) according to claim 2, characterized in that said diffuser (15) presents a plurality of seats (16) adapted to accommodate corresponding cooling tubes (6a; 22a).

4. A boiler (1; 20) according to claim 3, characterized in that the diffuser element (15) comprises a perforated plate, in which there are obtained a plurality of longitudinal grooves (16), having an essentially semicircular profile; said grooves (16) being the seats adapted to accommodate said plurality of cooling tubes (6a; 22a).

5. A boiler (1; 20) according to claim 4,

characterized in that it comprises a distributor element (14) comprising a perforated plate the holes of which have a total passage section smaller than that of the holes of the diffuser (15); said plate also presenting
5 longitudinal grooves (16) and being coupled to the said diffuser (15) at said grooves (16).

6. A boiler (1; 20) according to any of the preceding claims, characterized in that the burner (3), the combustion chamber (4) and the heat exchanger (5;
10 21) are accommodated inside a containing structure (7); said burner (3) being reversibly coupled to said containing structure (7) so as to be easily extracted.

7. A boiler (1; 20) according to any of the preceding claims, characterized in that said heat
15 exchanger (5; 21) comprises in addition to said plurality of cooling tubes (6a, 22a), a second plurality of tubes (6b; 22b) having equal or reciprocally different dimensions and adapted to exploit the heat coming directly from the flame and from the fumes and
20 the latent condensation heat of the fumes.

8. A boiler (1; 20) according to claim 7, characterized in that said second plurality of tubes (6b; 22b) is coupled to a plurality of fins (18).

9. A boiler (1) according to claim 7 or 8,
25 characterized in that it comprises a third plurality of tubes (6c) arranged downstream of said second plurality of cooling tubes (6b); said third plurality of tubes (6c) being designed to further exploit the latent

condensation heat of the combustion fumes.

10. A boiler (1; 20) according to any preceding claim, characterized in that said burner (3) is a total air-gas premixing burner.

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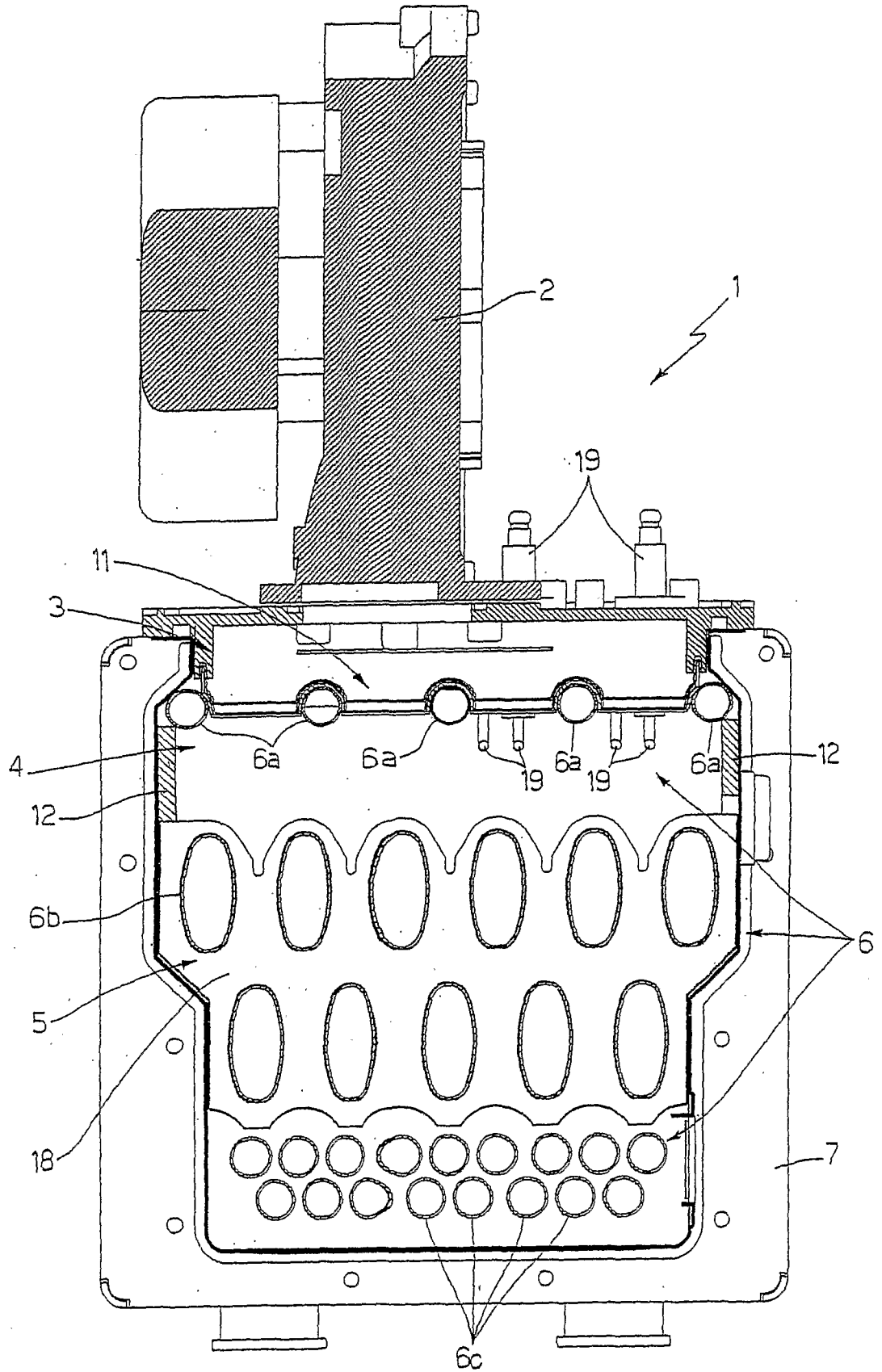


Fig.1

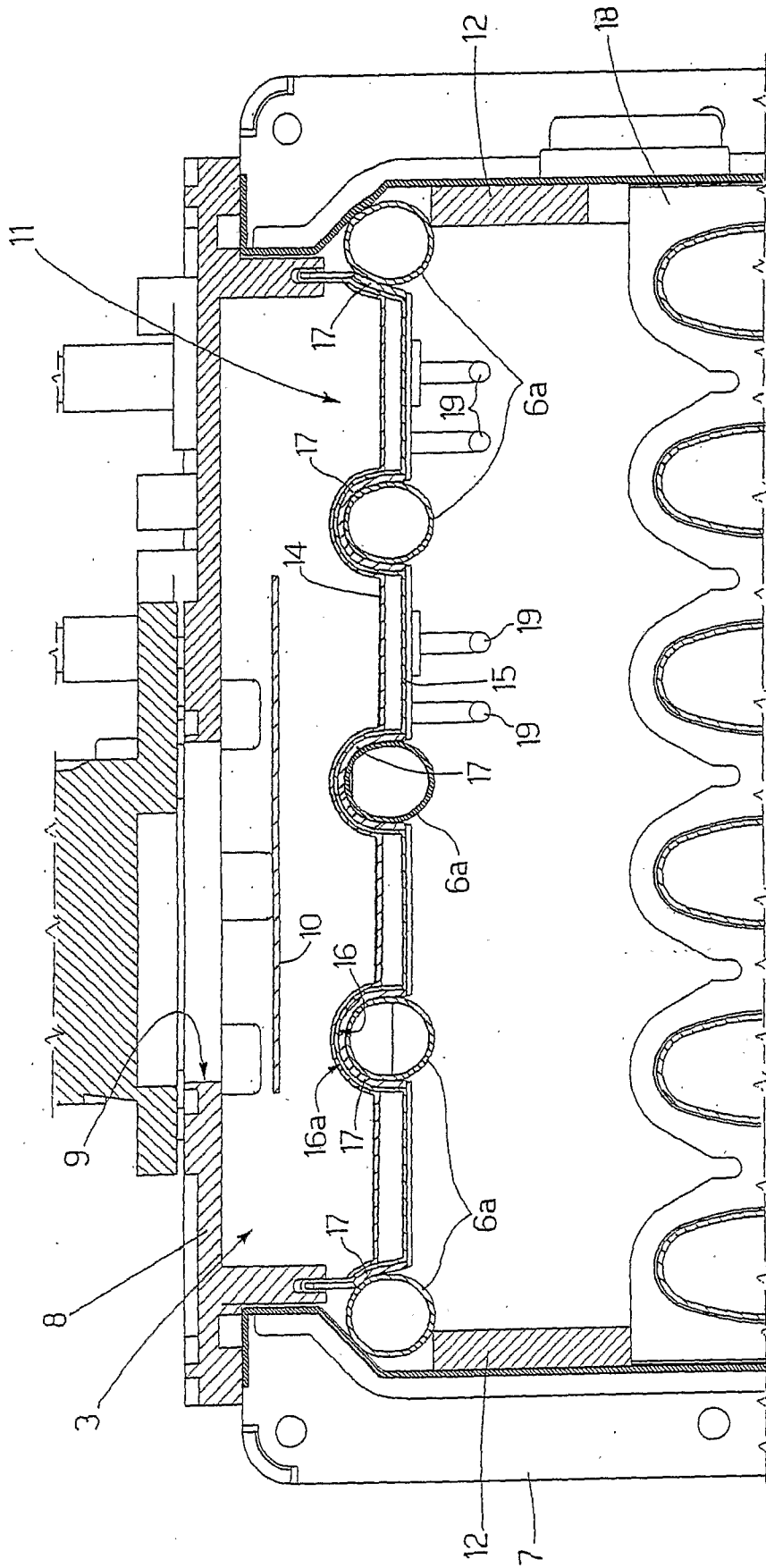


Fig.2

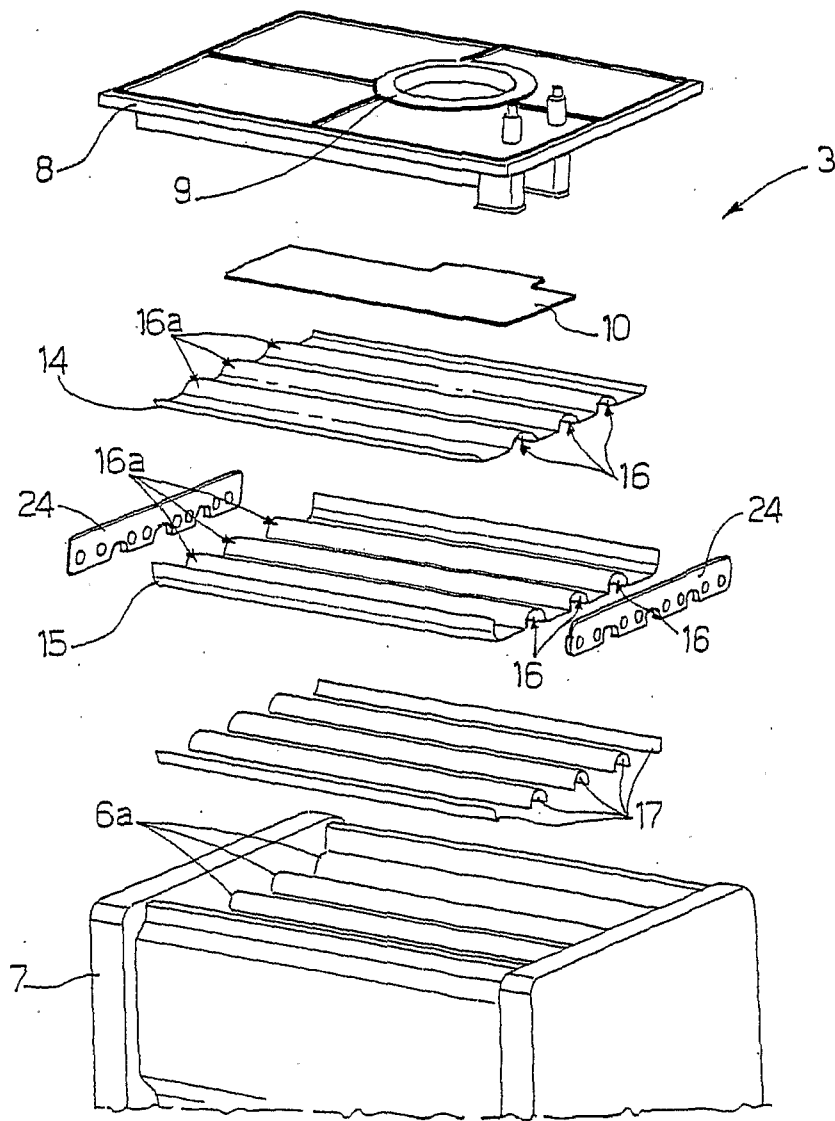


Fig.3

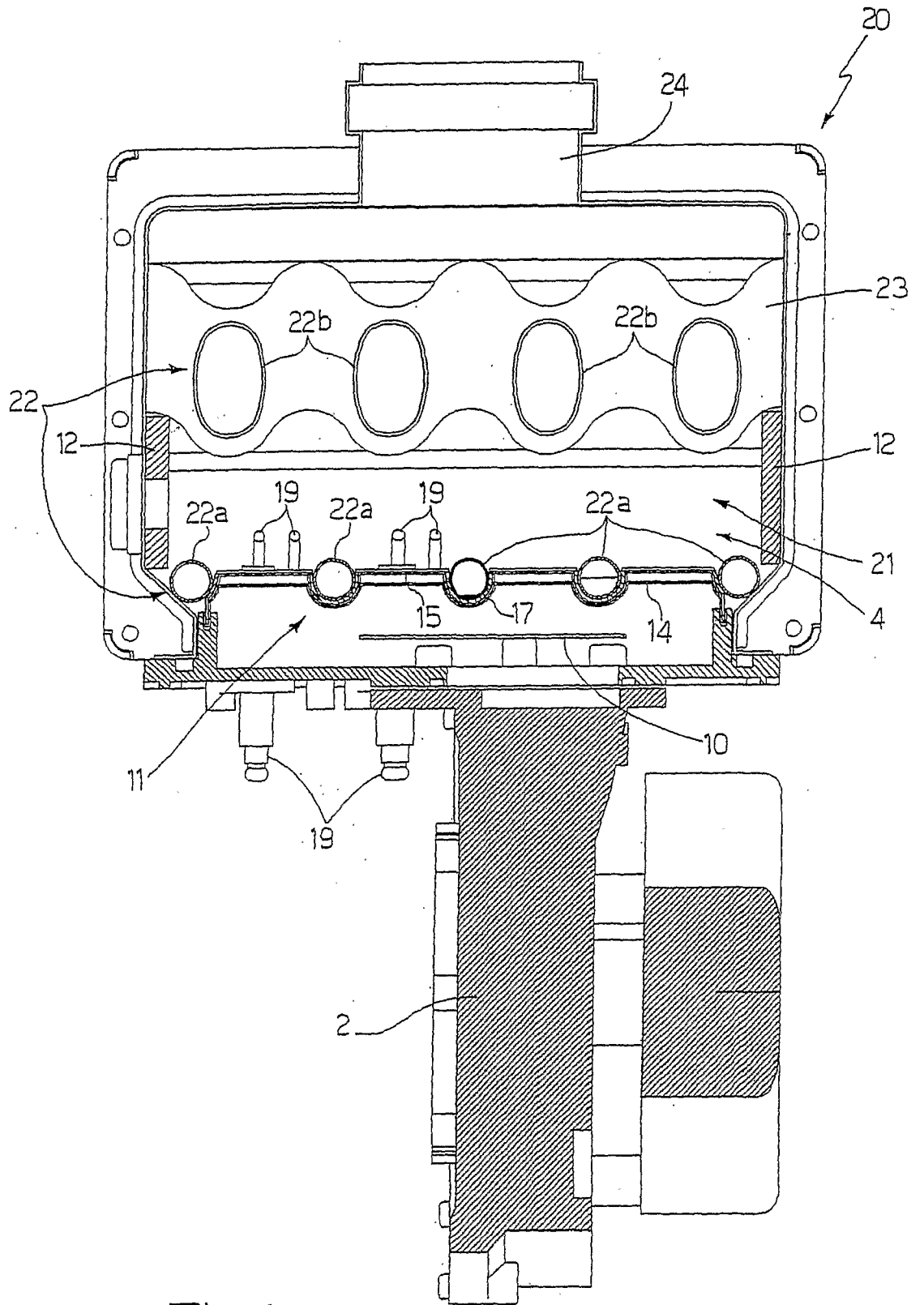


Fig.4