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(54) **Wall-mounted gas boiler with premixing burner, particularly for domestic use.**

(57) This invention relates to a wall-mounted gas boiler, particularly useful for domestic employment, of the type comprising a pre-mix burner (13), a heat exchanger (12), a circuit (8) for allowing the combustion air to circulate, means (5) for causing said air to circulate, a chamber (18) for mixing air with the gas, in which chamber an opening (19) is provided, upstream of said mixing chamber (18) in the circuit (8) for the circulation of air, said opening being closed by valve means (20) and allowing the dilution air to flow towards the openings (21) without becoming mixed with the gas at the point corresponding to the mixing chamber (18), means (22, 23 and 24) being provided for changing the amount of gas introduced in proportion to the flowrate of the air flowing through the same.

The boiler according to this invention can also be provided with a single-piece container (2) having a pressurized inner chamber (9), inside which both the burner (13) and the heat exchanger (12) are arranged, and an outer depressurized chamber (8) through which the air sucked in by the fan (5) flows, the outflow of smokes from the inner chamber (9) and the inflow of air into the outer chamber (8) occurring through an upper coaxial pipe (14); a closure member (3) of the container, said member being provided with a double seal for closing both the inner chamber (9) and the outer chamber (8) tightly; and a lower Archimedean screw (4) inside which the fan (5) is housed.

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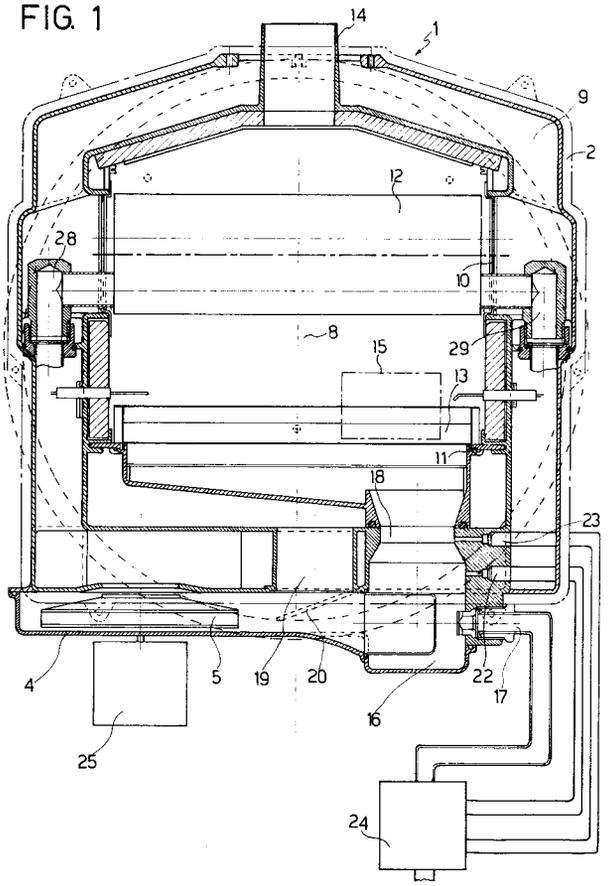
FIG. 1



This invention relates to a wall-mounted gas boiler with premixing burner, particularly useful for domestic use.

More particularly, this invention relates to a boiler of the type mentioned above, whose features are such as to make the technologies of premixing burners advantageously applicable to wall-mounted boilers of domestic type.

As is known, atmospheric burners are mainly employed in technology of wall-mounted gas boilers, i.e. burners in which the flame is fed with gas, with the addition of primary air, such components being mixed before they enter the burner, as well as by secondary air which is present around the flame.

The essential feature of such type of boiler consists in that, as air is present in abundant amount, optimal combustion conditions occur in the most different situations.

However, such boilers are characterized by combustion residues of polluting type, as well as by a low power density.

Indeed, it is well known that carbon dioxide, water, oxygen, nitrogen and NO_x are formed in combustion.

The NO_x oxides are made up of $NO + NO_2$, and such compounds, on becoming dispersed in the atmosphere, react with water forming nitric acid, so giving rise to the well known acid rains.

The formation of NO_x occurs in the very core of the flame, at very high temperatures, so that the formation of NO_x is very high in burners of the atmospheric type, wherein a very large flame is formed so that high temperature are reached.

Another kind of boilers already known is that in which a premixing (or premix) burner is provided, this kind of boiler being particularly employed in case of high powers, because the technology connected to the same is a very sophisticated and advanced one.

Such kind of burner realizes the combustion just of gas with the addition of primary air, such components being mixed upstream of the burner itself.

It is obvious that it is necessary to have a gas/air ratio always of optimal value, as well as an always intimate mixing in connection.

It is just because of such requirements that in general this technology only is advisable for application to high power plants.

However, the technical feature of said pre-mix burners are such as to make them interesting for the application also to domestic plants.

Indeed, combustion occurs through the formation of a number of small flames, so that the temperature reached in each one of them is averaged and does not reach up to the values of the atmospheric-type burners.

This means a combustion wherein a very low production of NO_x occurs, in addition to a higher power density (value of about 1/10 with respect to the atmospheric boilers).

Accordingly, a much less polluting combustion is obtained with respect to the combustion occurring in plants equipped with atmospheric burners.

The structure of the pre-mix burner also has, in addition to the problem connected to the sophisticated technology involved, the problem arising from the noise produced by vibrations.

Such drawback also has certainly not contributed to the employment of said type of burners in the field of wall-mounted boilers for domestic use.

In the light of what has been discussed above, the Applicant has developed a wall-mounted boiler for domestic use, wherein a pre-mix burner is provided which is capable of operating also in a modulated way and has a very compact structure.

Moreover, the boiler according to this invention is so realized as not to produce noise.

Accordingly, it is a specific object of this invention a wall-mounted gas boiler, in particular for domestic use, of the type comprising a pre-mix burner, a heat exchanger, a circuit for the introduction of the combustion air, means for causing said air to circulate, a chamber for mixing air and gas, wherein an opening which can be closed by valve-means is also provided, upstream of said mixing chamber in the circuit for the circulation of air, said opening allowing the dilution air to flow downstream of the burner, said air being so prevented from mixing with the gas; said opening being of so sizes as to allow the burner to operate at the maximum power when the opening is completely closed, and to allow said burner to operate at the minimum power when said opening is completely open, said valve means becoming opened or closed on the basis of the temperature of water contained within the heat exchanger, means being provided at the point corresponding to said mixing chamber for changing the amount of gas introduced in proportion to the air flowrate passing through the same.

Moreover, it is a specific object of this invention a boiler of the type mentioned above, having the features mentioned above, said boiler comprising an integral container having a pressurized inner chamber, the burner and the heat exchanger being arranged within said pressurized chamber, and an outer depressurized chamber through which the air sucked by the fan flows, the outflow of the inner chamber smokes and the inflow of air into the outer chamber occuring through an upper coaxial pipe; a closure member of the container, said member being provided with a double seal in order to tightly seal the inner chamber as well as the outer chamber; and a lower Archimedean screw, which houses

the fan, said screw being connected with the outer chamber, and in which screw the chamber is provided for mixing gas with air, while said chamber is in turn provided with means for changing the amount of gas introduced in proportion to the flowrate of the air flowing through the same.

According to this invention, said burner is provided laterally with holes that allow air to flow through said opening directly above the burner itself.

Said valve means will preferably be made up of a butterfly valve which is controlled by a step motor.

The means employed for changing the amount of gas introduced into the mixing chamber can comprise, according to the present invention, two static-pressure tubes arranged respectively at the points corresponding to the outlet of the mixing chamber and to a reduction in the cross section downstream of said chamber and before the burner, said static-pressure tubes being connected to the valve for the introduction of gas.

Further according to this invention, the heat exchanger is realized with a pipe coil arranged along a double array, the pipes being staggered, said heat exchanger being preferably provided with holes for the introduction of air at the points corresponding to the upper pipes.

Preferably, according to this invention said container which is made up of an integral piece provides in the inner chamber some guides for inserting the burner and the exchanger in a slidable way.

The mixing in the mix chamber is preferably realized counter-currently.

This invention will be now disclosed in the following according to some preferred embodiments of the same, with particular reference to the Figures of the enclosed drawings, wherein:

Figure 1 is a front view whose closure member is removed, of the boiler according to this invention;

Figure 2 is a vertical transverse cross-sectional view of the boiler according to this invention; and

Figure 3 is a top view of the Archimedean screw according to this invention.

With reference now to all figures enclosed herein, the boiler according to this invention is realized by means of an outer container 1 which is made up of just three parts, i.e. a die-cast aluminum casing 2, a cover 3 and a lower Archimedean screw 4 for housing the fan 5.

The structure realized between the casing 2 and the cover 3 provides two different sealing closures 6 and 7 (see in particular Figure 2) so as to realize two zones, respectively an inner zone 8 which is under pressure, and an outer zone 9 which is depressurized.

The exchanger 12 and the pre-mix burner 13 are provided within the inner zone 8 on the guides 10 and 11 a slidable way.

The outflow of the smokes from the zone 8 and the inflow of air sucked in by the fan 5 occur through the coaxial pipe 14.

The container 1 so realized reduces the possibility of noise from vibration to a minimum.

Moreover, the presence of a double tight seal prevents any unburnt gas leakage from the inner zone 8 from becoming dispersed through the environment so that the unburnt gases are dispersed within the zone 9 and they come back into circulation in the depressurized part.

A small window 15 which is made up of a transparent material is provided at the point corresponding to the burner 13, in order to observe the flame.

The outer air enters from the outer pipe of the coaxial pipe 14 and flowing through the lateral passages of the zone 8 while it is sucked by the fan 5 arrives up to the Archimedean screw 4 which provides a mixing chamber 16 for mixing the air with the gas.

The gas is in turn introduced into said chamber 16 through the nozzle 17 counter-currently with respect to air in order to obtain an optimal mixing.

The gas-air mixture goes from the mixing chamber 16 towards the burner 13 flowing through a throttled portion 18.

A hole 19 supplied with a butterfly valve 20 is provided on the path of air, upstream of the mixing chamber 16, so that air can be directly conveyed into the zone 8. Said air will flow directly above the burner 13 through the lateral holes 21 as will be disclosed in the following, without taking part in combustion.

Two static-pressure tubes 22, 23 connected to the gas valve 24 are provided at the outlet of the mixing chamber 16, at the point corresponding to the throttled zone, said gas valve 24 being in turn connected to the nozzle 17. The fan 5 is provided with a motor 25.

The exchanger 12 is made up of two arrays of alternate pipes 26 and 27, connected to the inlet 28 and to the outlet 29 of water circulating through the plant.

The fins in the smoke passage are shaped laterally in such a way as to convey the outer smokes towards the pipes 27, and are provided below said pipes 27 with holes 30 for discharging heat in order to prevent them from receiving an excess amount of heat.

The design selected in the realization and the arrangement of the burner 13 and the exchanger 12 allows a very compact boiler to be realized both in the horizontal and the vertical direction, so that

such boiler can be embedded into a usual hanging housing.

Turning now to the description of the operation of the boiler according to this invention, it is to be remarked that the kind of embodiment shown in the figure provides a system for modulating power.

With the hypothesis of a boiler whose sizes are suitable for operating between a minimum power of 7,000 kcal/hr and a maximum power of 20,000 kcal/hr, the boiler, when is switched on by the user and is regulated for a water feed at 70 °C, begins operating with the valve 20 in the position that closes the hole 19 fully.

Gas and the air sucked in by the fan 5 are mixed within the chamber 16 and then they go towards the burner 13.

The boiler in such conditions and till the value of the temperature designed is almost reached, operates at the maximum power.

As already mentioned above, the pre-mix burners ask for a constant optimal regulation of mixing: indicatively, a gas-air mixture with a 30 % excess air amount with respect to the stoichiometric proportion.

To that aim, the two static-pressure tubes 22 and 23 will operate.

Indeed, tha value of Δp which is detected by them on the basis of the change in cross-section, is proportional to the value of the fluid (gas-air) flowrate that flows, even though the value of p keeps always positive.

Said value of Δp which is read by the valve 24 determines the amount of gas which is introduced into the mixing chamber 16.

When the value of the water temperature comes close to the value set forth by the user, there is the need for regulating the power of the boiler.

This could also be realized by reducing the speed of the fan, so as to decrease the amount of air. Such reduction is read by the static-pressure tubes 22 and 23 so that there is also a reduction in the amount of gas. As a consequence, the power of the burner is reduced.

Such modulation system is affected however by the drawback connected to the fact that, as the sizes of the exchanger 12 are designed for 20,000 kcal/hr, smokes would be cooled too much, so giving rise to condensation phenomena, with all accompanying problems.

Accordingly, the boiler of this invention has been so realized as to modulate its power without the occurrence of condensation.

This is possible thanks to the hole 19 as well as to the butterfly valve 20 which are provided in the flow of air, upstream of the mixing chamnber 16.

The hole 19 is of such sizes that when it is fully closed by tha valve 19 the maximum power of the burner is employed, whereas when such hole is completely open, the burner is at the minimum power.

As the requirement of reducing the boiler power occurs, which reduction is decided on the basis of the water temperature, an electronic device causes through a small step-motor the valve 20 to open.

A part of the air instead of being conveyed into the chamber 16 is conveyed directly into the zone 8, above the burner 13 through the small holes 21.

Thus the value of Δp is reduced, as the air flowrate through the throttled zone 18 is reduced, so that the gas conveyed is also reduced and the boiler power is thus reduced.

At the same time, air flowing through the hole 19, which air is called "dilution air", dilutes the smokes so preventing them from being condensed when in contact with the exchanger 12.

It is to be observed that the dilution air does not take part in combustion in any way, so that the burner 13 keeps its pre-mix features unaltered.

This invention has been disclosed with specific reference to some preferred embodiments of the same, but it is to be understood that modifications and/or changes can be introduced by those who are skilled in the art without departing from the spirit and scope of the invention for which a priority right is claimed.

Claims

1. A wall-mounted gas boiler, particularly useful for domestic employment, and of the type comprising a pre-mix burner, a heat exchanger, a circuit for conveying the combustion air, fan means for the circulation of said air and a chamber for mixing air with the gas, said boiler being characterized in that it is provided with an opening upstream of said mixing chamber, in the air circulation circuit, said opening being provided of valve means and allowing the dilution air to flow downstream the burner without being mixed with the gas present in the mixing chamber; said opening being of such sizes that when it is fully closed by the valve, the burner works at the maximum power, whereas when the opening is completely open, the burner operates at the minimum power, said valve means being opened or closed on the basis of the water temperature in the heat exchanger, means being provided at the point corresponding to the mixing chamber in order to change the amount of gas introduced in proportion to the flowrate of the air flowing through the same.

2. A wall-mounted gas boiler, which is particularly useful for domestic employment, of the type comprising a pre-mix burner, a heat exchanger, a circuit for mixing combustion air, fan means for the circulation of air, and a chamber for mixing air with gas, said boiler being characterized in that it is provided with a container which is built as an integral piece, comprising an inner pressurized chamber, inside which both the burner and the heat exchanger are arranged, and an outer depressurized chamber in which the air sucked in by the fan flows, said fan beig provided with an upper coaxial pipe for the outflow of the smokes from the pressurized chamber, and the inflow of air into the outer chamber; a closure member of the container, said member being provided with a double tight seal in order to close the inner and the outer chambers tightly; and a lower Archimedean screw in which the fan is housed, said screw being connected with the outer chamber, the chamber for mixing gas with air being provided within said screw, the mixing chamber being in turn provided with means for changing the amount of gas introduced, in proportion to the flowrate of air flowing through the same.

3. A wall-mounted gas boiler according to claim 2, characterized in that it is provided with the technical structural features according to claim 1.

4. A wall-mounted gas boiler according to one of the preceding claims 1 or 3, characterized in that said burner is provided laterally with holes that allow the passage of air that arrives from said opening directly above the burner itself.

5. A wall-mounted gas boiler according to any one of the preceding claims 1, 3 or 4, characterized in that said valve means are made up of a butterfly valve controlled by a step-motor.

6. A wall-mounted gas boiler according to one of the preceding claims, characterized in that said means for changing the amount of gas introduced into the mixing chamber comprise two static-pressure tubes arranged respectively at the point corresponding to the outlet of the mixing chamber and at the point corresponding to a reduction in the cross section which is realized downstream of said chamber, before the burner, said static-pressure tubes being connected to the gas introduction valve.

7. A wall-mounted gas boiler according to one of the preceding claim 2-6, characterized in that said heat exchanger is realized with a pipe coil which is arranged along a double array, the pipes being staggered.

8. A wall-mounted gas boiler according to claim 7, characterized in that aeration holes are provided in said heat exchanger at the points corresponding to the upper pipes.

9. A wall-mounted gas boiler according to one of the preceding claims 2-8, characterized in that single-piece container is provided in its inner chamber with guides for inserting both the burner and the exchanger in a slidable way.

10. A wall-mounted gas boiler according to one of the preceding claims, characterized in that the mixing within said mixing chamber occurs counter-currently.

11. A wall-mounted gas boiler with a pre-mix burner, said boiler being particularly useful for domestic employment, according to each one of the preceding claims, and substantially as illustrated and disclosed above.

FIG. 1

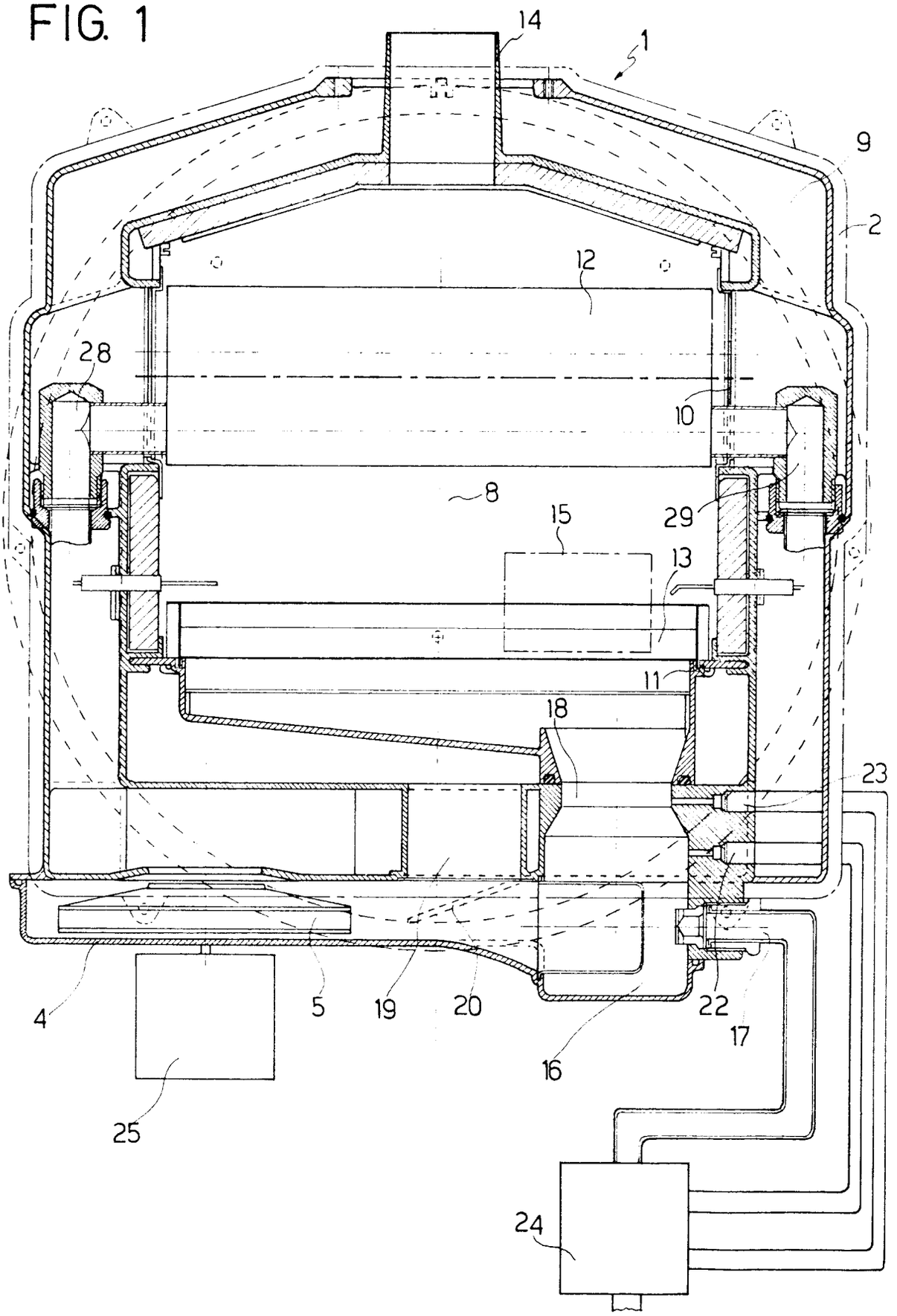


FIG. 2

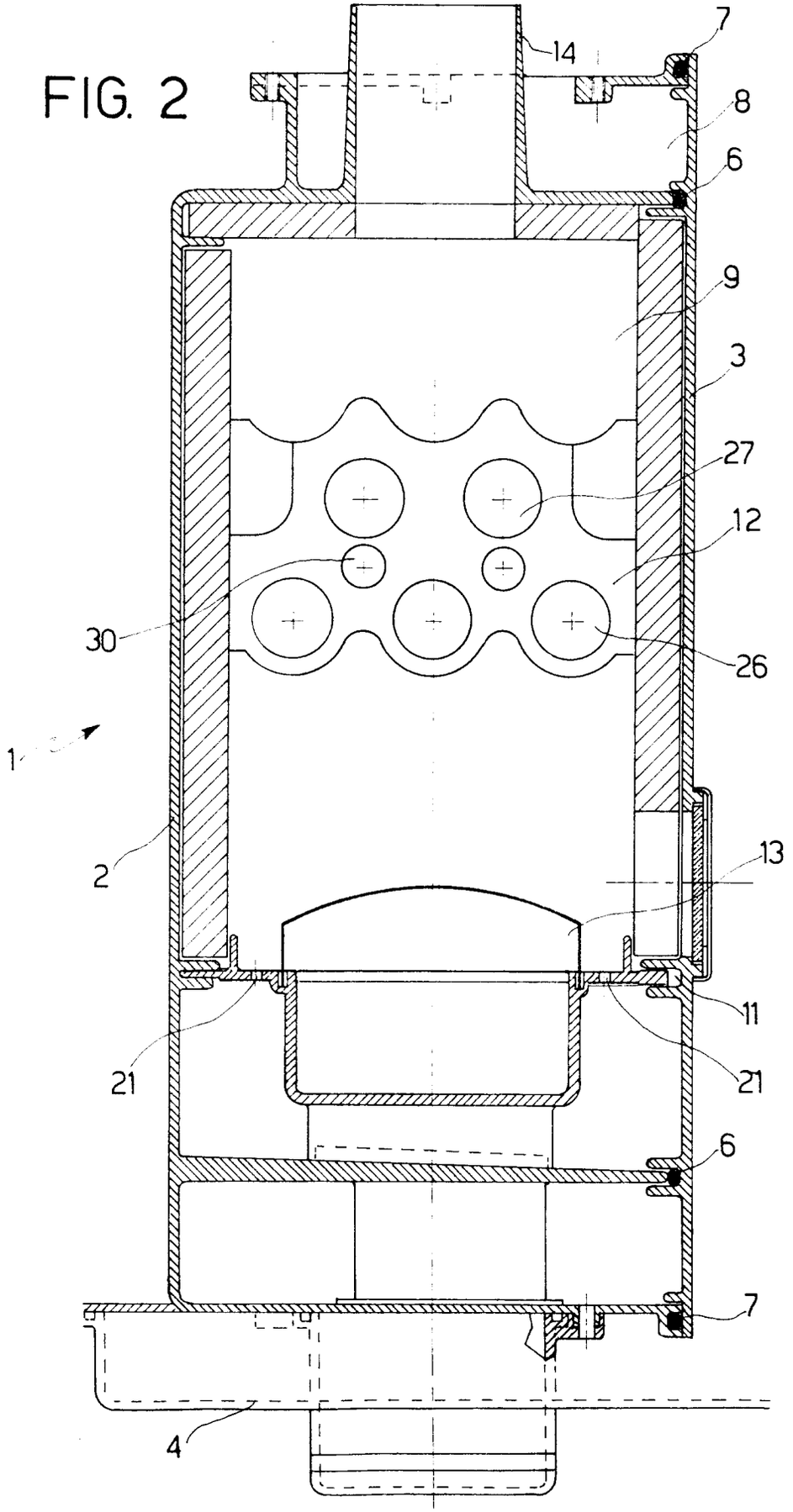


FIG. 3