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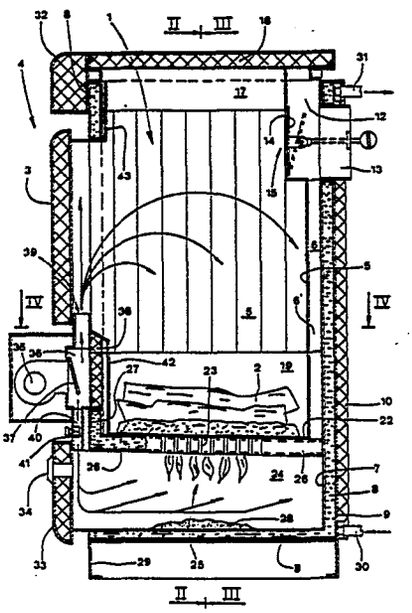
(54) A solid fuel fired inverted flame boiler for central heating systems and for hot water systems generally.

(57) The boiler disclosed consists principally in an enclosure (1) containing solid fuel (2), which is encompassed by a baffle structure composed of vertical L-section members (5, 6) creating passages (6') that rise toward a chamber (12) where the flue gases are gathered. The surrounding water jacket (8) receives heat from the gases as well as from the inner wall (5) of the baffle, in which transfer occurs by way of the radially-disposed members (6) of the L-sections. At the lower end (19) of the enclosure (1) one has a grate (22) incorporating fire bars (23) and making contact with sub-horizontal longitudinal hollow members (26) in which water circulates. Draughts are set up by a front-mounted blower unit (35) from which primary air is sent upward through a port (39) and secondary air is forced in the opposite direction, through a valve-controlled outlet (40, 41), into the combustion chamber (24).



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A solid fuel fired inverted flame boiler for central heating systems and for hot water systems generally.

The invention relates to a solid fuel fired boiler of the inverted flame type used in central heating and hot water systems, that is, a wood-fired unit for heating water used in central heating, domestic or otherwise, and for the production of hot water for domestic and industrial use in general, in which the flame is directed downwards.

The prior art embraces wood or coal fired boilers in which solid fuel is reduced to gas inside a chamber surrounded by a jacket containing the water to be heated. The fuel rests on a grate fashioned in steel and/or refractory material, which is fixed to the walls of the boiler and communicates with the inverted flame combustion chamber below; such a grate is not cooled. At the front of the boiler, beneath the stoking hatch, one has an intake through which three draughts of air are directed, namely, primary, secondary and tertiary; the primary, directed into the top of the fuel enclosure, and the secondary, directed at the base of the grate, or fire bars, in order to carburate the gas produced above, are both made to invest the front of the water jacket for pre-heating purposes.

Boilers of the type are beset by drawbacks originating from tar-laden condensation that forms on the internal jacket walls, which on the one side are in contact with water, still unheated, and on the other with gas, at high temperature immediately following distillation. Such condensation ultimately produces corrosion, with the result that the jacket metal is eaten through and the boiler put out of action.

A further drawback in boilers of the type is that the grate overheats, and one has early wear of the steel structure, and of the refractory if any.

Again, it is no simple matter to balance the three draughts, the third of which serves to produce a complete burn inside the combustion chamber, and one has the need for frequent attendance by personnel.

The state of the art thus leaves room for considerable improvement, such as will permit of overcoming the aforementioned drawbacks.

From the foregoing, one may discern the need for a solution to the problem posed by embodiment of a boiler which, first and foremost, will not produce tar-laden condesation on the walls of the fuel enclosure,in which overheating of the grate will not occur, and in which no difficulty is encountered in control of the draughts.

Such an object is achieved adopting a boiler design according to the invention, which consists predominantly in a solid fuel enclosure that is encompassed by baffles composed of a vertical L-sections arranged side by side and welded together in such a way that one member of the L profile forms an integral part of the internal wall of a substantially parallelepiped three-sided enclosure, and the radially disposed member connects with a surrounding sheet that constitutes the inner wall of the water jacket, the remaining outer wall of which takes the form of a further sheet separated from the outer panelling of the boiler by lagging. The L-section members and the sheet constituting the inner wall of the water jacket combine to create passages through which gas from the cobmustion chamber, located beneath the fuel enclosure, can be channelled upward, and then into the flue by way of manifolds if appropriate.

In a boiler according to the invention, the lower end of the fuel enclosure is flared, widening toward bottom in order to facilitate descent of the solid fuel, integral with the grate, and associated at its base with longitudinal and sub-horizontally disposed water passages that connect with the water jacket.

The boiler is provided further with a blower located at front, beneath the stoking hatch, which produces a primary draught directed upward and into the fuel enclosure so as to create a barrier of air immediately inside of the hatch, and a secondary draught directed downward through a valve-controlled outlet into the combustion chamber.

Advantages obtained with a boiler according to the invention

are: elimination of tar-laden condensation from surfaces of the boiler made cool by the as yet unheated water, hence longer service life; enhanced efficiency as regards transformation of solid fuel into gas; longer burn, considering volume as par; vigorous pre-heating of primary draught; metering of secondary draught commensurate with required boiler potential and type of fuel; quick start-up, and fast response to adjustment made during burn; pre-heating of fuel; markedly longer grate life.

An embodiment of the invention will now be described in detail, by way of example, with the aid of the four accompanying sheets of drawings, in which:

fig 1 shows the longitudinal and vertical section through a boiler according to the invention, seen in operation;

fig 2 shows the vertical section through a boiler as in fig 1, taken through II-II and viewing from the rear;

fig 3 shows the vertical section through a boiler as in fig 1, taken through III-III and viewing from the front;

fig 4 is a horizontal section through the boiler in fig 1, taken through IV-IV and viewing from above.

With reference to the drawings, 1 denotes an enclosure in which solid fuel 2 is deposited and converted into gas, access being afforded by way of a hatch 3 located in the upper half of the front section 4 of the outer panelling of the boiler, which exhibits parallelepiped shape in the example illustrated.

The intermediate part of the fuel enclosure 1 is encompassed by an internal baffle composed of vertically-disposed lengths of L-section (fig 4) arranged side by side and welded together in such a way as to create three internal walls (two side and one rear) exploiting the upright member 5 of the "L" profile; the horizontal member 6 of the "L" is welded to a further intermediate wall 7 embodied in sheet metal, which constitutes the inner wall of a water jacket 8 from which hot water flows to the heating system. The water jacket 8 surrounds the baffle on either side, at the lower rear, and at the topmost part of the front, and is encased by an outer sheet 9 which will be lagged

with insulating material 10 located between the jacket and the outer panelling 11; the rear of the boiler need not necessarily be panelled.

The baffle members 5 and 6 serve both to stiffen the structure, and to isolate tar-laden distillate from those walls 7 in contact with as yet unheated water, while transferring heat to the wall 7, hence to the water jacket 8. In addition, the assembled L-section members provide vertical passages 6' through which flue gas may ascend, and flow thus in the opposite direction to the descending solid fuel 2. It will be observed that the rear part of the baffle is stopped short of the top of the boiler to leave room for a chamber 12 in which flue gases are gathered and exhausted into the flue 13. A damper 14 controls the outlet 15 from the fuel enclosure 1 into the gathering chamber 12, and will be opened up whenever the boiler is lit.

16 denotes a pair of longitudinally disposed manifolds at the top of the side walls of the baffle (see figs 2 and 3), which connect with the gathering chamber 12, and 17 denotes the uppermost part of the enclosure 1, which is covered by the top panel 18. 19 denotes the bottom end of the enclosure 1, having sides 20 which are flared toward the base of the boiler and join with converging sections 21 that run into the grate 22, thereby favouring descent of the fuel 2 toward the fire bars 23, which are located at the centre of the grate, 24 denotes the combustion chamber with its downardly directed flame 25.

26 denotes a pair of sub-horizontally disposed hollow members interconnecting the rear of the water jacket with a further hollow member 27 at front; the further member 27 in its turn interconnects the two sides of the jacket 8. 28 denotes the ashes left following a burn, and 29 is the plinth on which the boiler stands. 30 and 31 denote the cold water supply inlet, and the hot water flow outlet, respectively; 32 denotes a fascia accommoadting instrumentation and controls; 33 denotes a bottom hatch affording access to the combustion chamber and the ash collector; 34 denotes an inspection glass.

According to the invention, a blower unit 35 is provided for the purpose of setting up primary and secondary draughts of air by way of a chamber 36 which is controlled by a check valve 37. The chamber 36 is lined with refractory material 38, admitting of preheating combustion-assisting air without causing the blower unit itself to overheat, and provided uppermost with a narrow port 39 by way of which a primary draught is channelled into the fuel enclosure 1; the flow of air issuing from the port 39 creates a barrier of air immediately inside the stoking hatch 3, so as the hatch can be opened during operation without any billowing of fumes from the enclosure.

40 denotes an outlet at bottom of the chamber 36, regulated by a throttle valve 41 and distanced from the hollow member 27 of the water jacket, which controls the secondary flow of air into the combustion chamber 24; air issuing from the bottom outlet 40 is similarly obliged to set up a laminar flow, thereby safeguarding the inspection glass 34.

42 denotes a guard protecting the refractory 38 in the air chamber 36 from heat in the bottom end 19 of the fuel enclosure; a similar guard 43 might also be provided to protect the top front part of the water jacket 8. The two flaps denoted 44 (fig 2) serve to vent the fuel enclosure to the gathering chamber 12, thereby preventing the risk of explosion.

Operation of a boiler according to the invention is as follows.

With a small quantity of solid fuel 2 positioned on the grate 22, the boiler is lit, and the damper 14 opened up to draw the flame; the enclosure 1 is then filled to capacity with fuel 2, the damper shut, and the blower 35 switched on. Gas given off by the fuel exits from the fire bars 23 and burns up in the combustion chamber, whereupon the products of such combustion, which are already dry and not thus liable to condense on the boiler walls, will rise from the chamber 24 through the vertical passages 6' created by the baffle member 5 and 6, transferring heat to the water jacket 8 in the process; the flow of gases is united

at the top of the boiler, and directed into the gathering chamber 12 via the manifolds 16. In rising through baffle, flue gases also transfer heat to the enclosure 1 through the inner walls 5 of the baffle so as to pre-heat the fuel 2, enhancing its conversion into gas, and ultimately improve the efficiency of the boiler.

When carrying the idea into effect, materials, dimensions and details of the design may be other than as described and illustrated. The flue gas passages 6' and hollow members 26 might be embodied in a different shape, the baffle could be extended uppermost to take in part of the gathering chamber 12, and extended at bottom to encompass the sides of the bottom end 19 of the fuel enclosure 1, and the passages themselves might exhibit any given cross section.

CLAIMS

1. A solid fuel fired inverted flame boiler for central heating systems and for hot water systems generally, comprising an enclosure in which solid fuel is converted into gas, and a combustion chamber located beneath the fuel enclosure and communicating directly therewith by way of a grate, wherein the flame is directed downwards and the products of combustion are gathered at the top of the boiler, characterized in that the bottom end (19) of the fuel enclosure (1) incorporates a grate (22) with fire bars (23) affording direct access to the combustion chamber (24); in that the fuel enclosure is encompassed at either side and at rear by a baffle consisting in an assembly of vertical passages (6'), extending either the entire height of the enclosure or part thereof and located between the enclosure and the water jacket (8) of the boiler; and, in that the water jacket (8) surrounds the baffle on either side and at rear, extends downward to surround the combustion chamber (24), connects across the uppermost part of the front (4) of the boiler, and is interconnected across the lower part of the front of the boiler by way of a hollow member (27).

2. A boiler as in claim 1, wherein the underside of the grate (22) of the fuel enclosure (1, 19) makes contact with at least two sub-horizontally disposed water-carrying hollow members (26) interconnecting the jacket (8) at rear with the hollow member (27) at front, and wherein the fire bars (23) affording direct access from the bottom end (19) of the fuel enclosure to the combustion chamber (24) below, are located between such hollow members (26).

3. A boiler as in claim 1, wherein the baffle formed by the assembly of passages (6') consists of vertically disposed L-sections arranged side by side and welded together such that one member (5) occupies a perimetral plane establishing the innermost wall of the fuel enclosure (1), whilst the remaining member (6) projects radially and is welded to a surrounding sheet (7) constituting the inner wall of the water jacket (8), the outer surrounding wall (9) of which

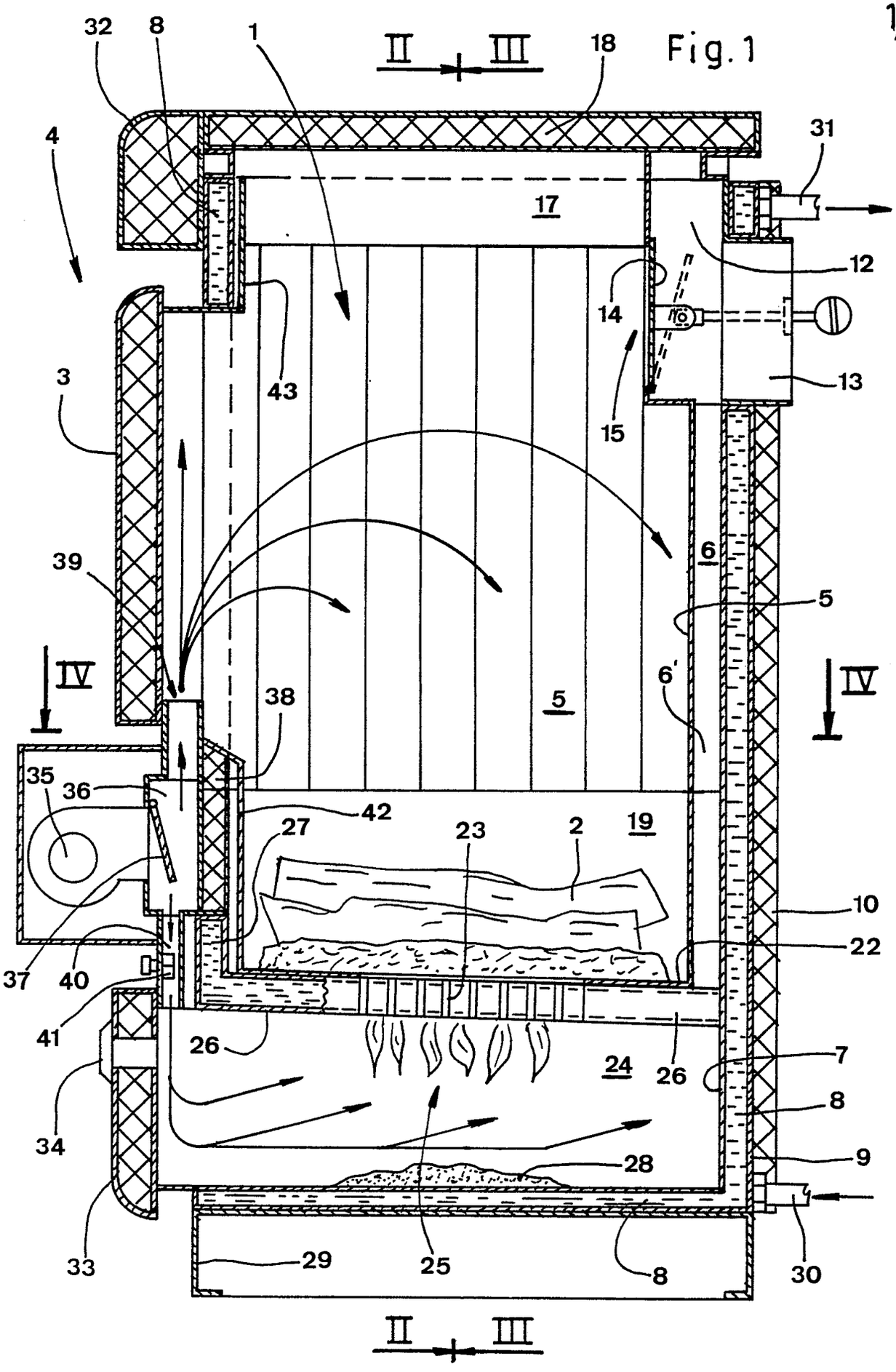
is lagged with insulating material (10) covered entirely or in part by the outer panelling (11) of the boiler.

4. A boiler as in claim 1, wherein a blower unit (35), mounted at front (4) below the stoking hatch (3), supplies air to a chamber (36) the side of which nearest the fuel enclosure (1) is lined with refractory material (38) protected by a guard (42) from heat generated in the bottom end (19) of the enclosure.

5. A boiler as in claim 4, wherein the chamber (36) connects uppermost with the fuel enclosure (1) by way of a narrow port (39), and supplies a primary draught to the enclosure in which the air flow is set up immediately inside of the hatch (3).

6. A boiler as in claim 4, wherein the chamber (36) connects at bottom with the combustion chamber (24), and supplies a secondary draught thereto, by way of an outlet (40) which is valve controlled (41) and distanced from the water jacket.

Fig.1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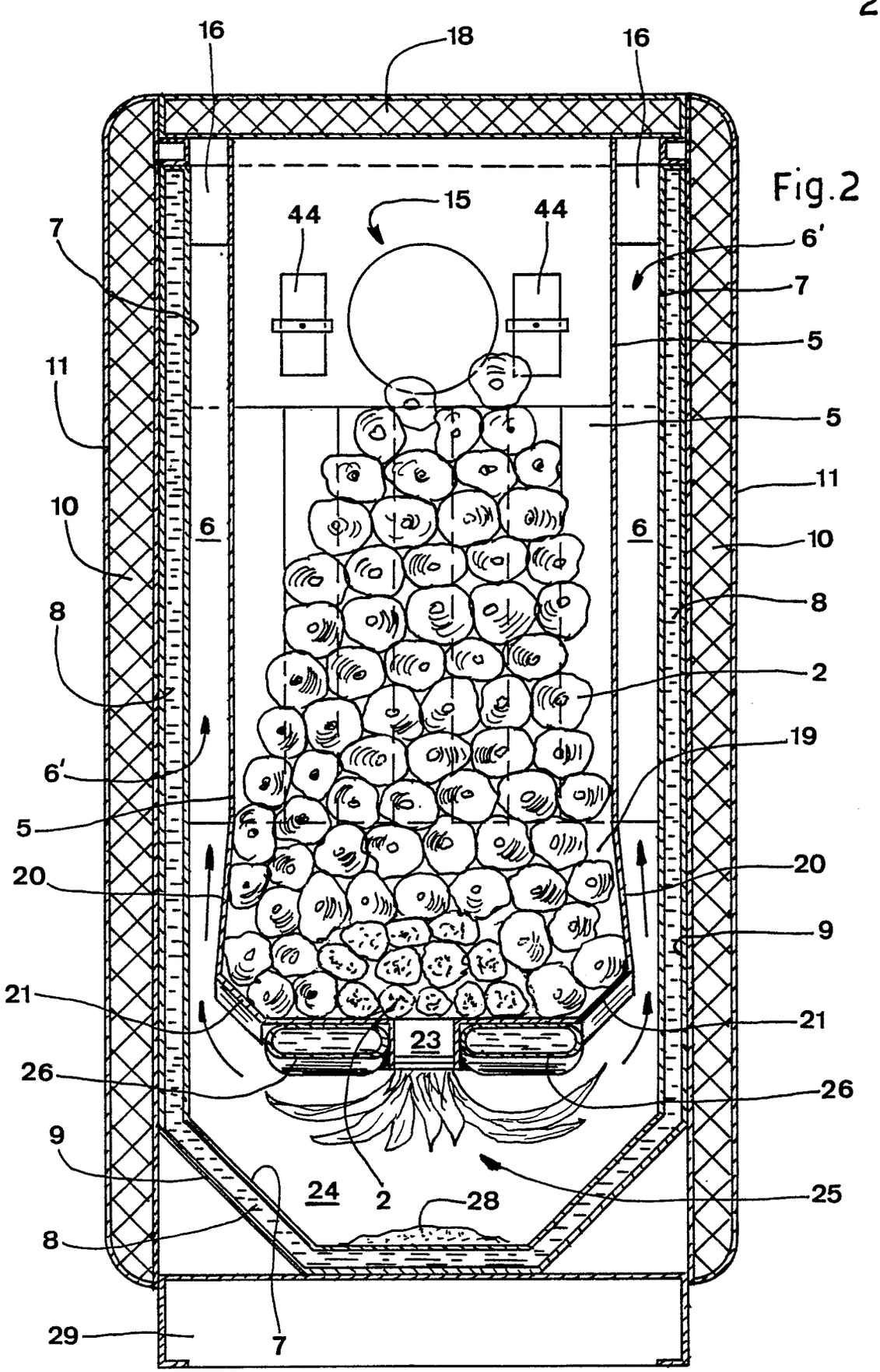
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Fig.2

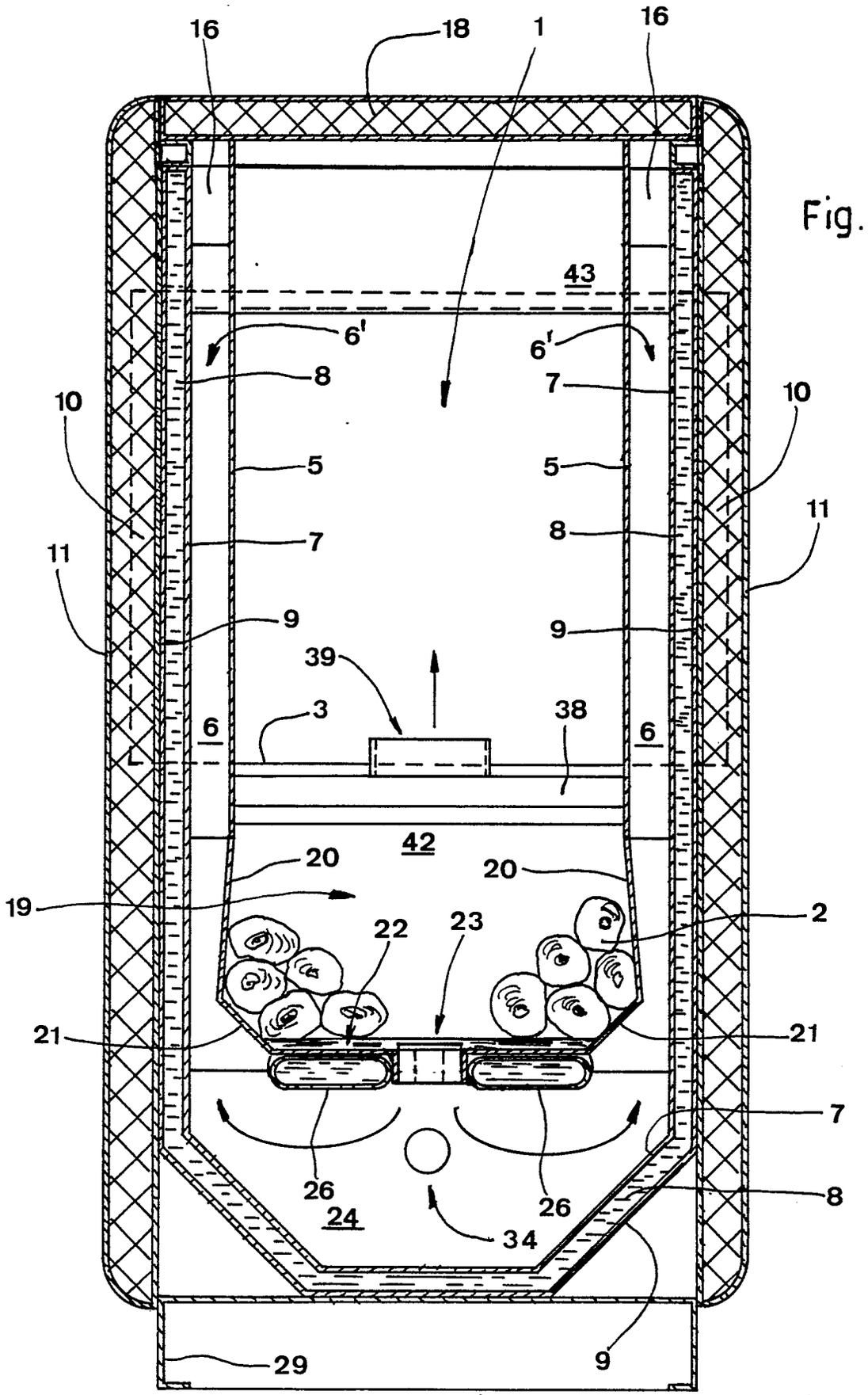
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Fig.3

Fig.4