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# (54) Boiler

(57) A boiler with a reservoir (1) and a heating element (3) provided with a guard (12) in the reservoir (1) which screens the heating element (3) at a slight distance therefrom and defines an interspace (13) between the guard (12) and the wall (5) of the heating element (3). The interspace (13) communicates directly with the rest of the interior (2) of the reservoir (1) via passages (14) distributed over the guard (12). The guard constitutes a guide which guides water along the wall, resulting in an intensive, cooling flow along the heating element. As a result, boiling phenomena and lime deposition against the heating element are prevented. The interspace communicates directly with the rest of the interior space of the reservoir, without necessitating an extensive duct system.

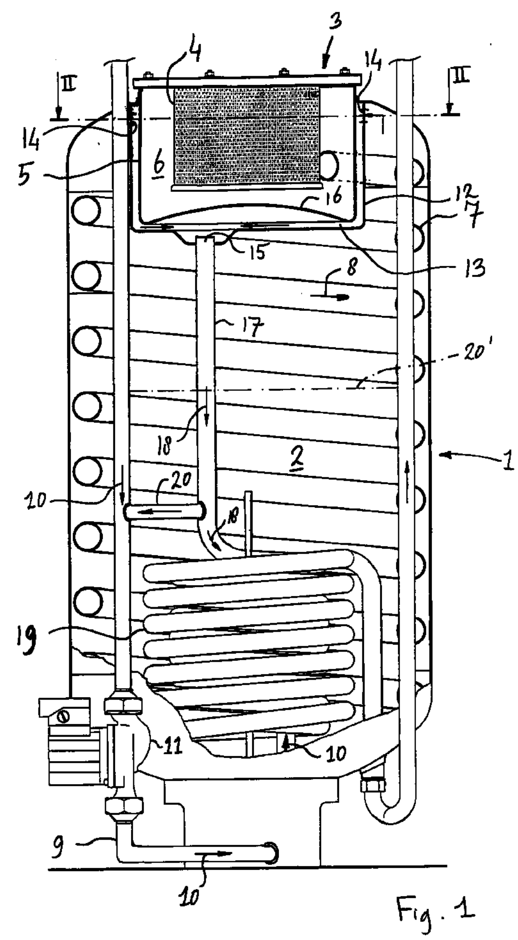


Fig. 1

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## Description

This invention relates to a boiler according to the introductory portion of claim 1.

In such boilers known from practice, water in the reservoir is heated through heat transfer from the heating unit. This involves the problem that on the side of the interior of the reservoir lime precipitates on the heating element, which impedes the heat transfer and has an adverse effect on the efficiency and the effective heating capacity of the boiler. Further, the problem occurs that the temperature of the wall of the heating element, partly owing to the insulating effect of the lime deposits, exceeds the boiling point of water (at the pressure prevailing in the reservoir). Water contiguous to the heating element is thereby brought to a boil, so that lime scale locally chips off the heating element. This is accompanied by objectionable ticking or banging sounds. Further, lime fragments which have come off and float through the interior of the boiler increase the risk of malfunctions of the boiler or downstream facilities.

Such problems occur especially in boilers with direct heating, whereby energy conversion takes place in the heating element, such as direct-fired boilers, where the heating element is designed as a furnace, and electric boilers.

The object of the invention is to provide a boiler in which lime precipitation on the heating element and chip-off of lime fragments off the heating element do not occur or at any rate occur to a substantially lesser extent.

This object is achieved according to the present invention by designing an apparatus of the above-indicated type in accordance with the characterizing portion of claim 1.

The guard provided with passages constitutes a guide which guides water along the heating element and thus causes an intensive, cooling flow along the external surface of the heating element, so that the above-described boiling phenomena and lime deposits on the heating element are prevented.

Owing to the interspace between the guard and the heating element communicating directly with the rest of the interior of the reservoir via the distributed passages, water can be passed into or out of the interspace via points distributed over the guard, without necessitating an extensive duct system. Owing to the water being admitted in a manner distributed over the surface of the guard, a flow through the interspace which is uniformly distributed over the external surface of the heating element and a correspondingly uniformly distributed cooling effect are achieved.

Special embodiments of the invention are described in claims 2-8 and are hereinafter further described and elucidated with reference to the drawings, wherein:

Fig. 1 is a cutaway side elevation of a boiler according to a first exemplary embodiment of the invention;

Fig. 2 is a diagrammatic partial view in cross-section taken on the line II-II of Fig. 1; and

Fig. 3 is a diagrammatic side elevation of a boiler according to a second exemplary embodiment of the invention.

Corresponding parts of the two exemplary embodiments shown in the drawings are designated by mutually identical reference numerals.

The boiler according to the example shown in Figs. 1 and 2 has a reservoir 1 with an interior space 2 for storing water. For the purpose of direct heating of water, the boiler comprises a furnace 3 with a burner 4 and a furnace wall 5 which constitutes a boundary between a burner chamber 6, containing the burner 4, and the interior 2 of the reservoir 1.

Connected to the burner chamber 6 is a flue duct 7 for discharging flue gases in a direction indicated with an arrow 8. The flue duct 7 follows a helical line through the reservoir, in order to operatively promote heat transfer from the flue gases to the water in the reservoir 1. Also connected to the burner are ducts for supplying fuel and ambient air, but these are not shown in the drawings for the sake of simplicity.

Connected to the reservoir 1 is a supply duct 9 for supplying water to be heated in a direction indicated with an arrow 10, which supply duct 9 includes a pump 11.

Further arranged in the reservoir 1 is a guard 12, which screens the furnace 3 at a slight distance therefrom and defines a space 13 between the guard 12 and the furnace wall 5. The guard 12 is provided with passages 14, 15 for letting water into and out of the interspace 13. A number of the passages 14 are distributed over the guard. Via these distributed passages 14 the interspace 13 communicates directly with the rest of the interior 2 of the reservoir 1.

In operation, water is admitted to the interspace 13 between the guard 12 and the furnace wall 5 via the distributed passages 14 in the guard 12 at points distributed over the interspace 13. The water is thereafter guided by the guard 12 along the furnace wall 5, resulting in an intensive, cooling flow along the external surface of the furnace 3. As a result, the temperature of the furnace wall 5 remains relatively low during the burning of the burner 4, so that boiling phenomena and lime deposits on the furnace wall 5 are prevented.

Owing to the interspace 13 between the guard 12 and furnace wall 5 communicating directly with the rest of the interior 2 of the reservoir 1 via the distributed passages 14, in operation water is admitted via positions in the interspace 13 which are distributed over the guard 12, without necessitating an extensive duct system. The water admitted in a manner distributed over the surface of the guard forms a flow through the interspace 13 which is uniformly distributed over the external surface of the furnace wall 5 and which cools the furnace wall 5 correspondingly uniformly.

In the boiler according to Figs. 1 and 2, the cooling effect of the water flowing through the interspace 13 is distributed particularly uniformly in that the distributed passages 14 constitute inlets for admitting water to the interspace 13 and another, central passage 15 constitutes a discharge for discharging water from the interspace 13. The highly uniformly distributed cooling action is here obtained in that, while the burner 4 burns, the temperature difference between the water in the interspace 13 and the furnace wall 5 is smallest in the area adjacent the central discharge passage 15, where the flow in the interspace 13 is concentrated most strongly.

The shell-like interspace 13 has a greater layer thickness in the area of the central passage 15 than in its more peripherally located areas. As a result, the rate of flow of the water is limited in the more centrally located area adjacent the central passage, which is advantageous for obtaining a uniformly distributed cooling action of the water flow in the interspace 13.

With the boiler according to Figs. 1 and 2, the increased layer thickness of the interspace in the area of the central passage is obtained in that the furnace wall 5 has a concave outer side 16, opposite which the central discharge passage 15 is located. The central discharge passage 15 is moreover located opposite the concave outer side 16 in spaced relation from the edges of the concave outer side 16. By virtue of the concave outer side 16, the furnace wall 5, at a given material choice and wall thickness, is better resistant to excess pressure in the interior space 2 of the reservoir 1. Moreover, by virtue of the arcuate configuration of the concave outer side 16, the furnace wall 5 can better accommodate to local differences in thermal expansion and shrinkage. It is noted that a furnace wall with one or more concave sides for the purpose of obtaining an improved pressure resistance and a reduction of thermal stresses can also be used with advantage in boilers which are not provided with a guard for guiding water to be heated along the furnace wall.

Connected to the central discharge passages 15 is a tapping duct 17 for tapping water from the reservoir 1 in a direction indicated with arrows 18. As a result, in use, the water displacements generated during the tapping of water are also utilized for causing water to be heated to flow through the interspace 13.

Owing to the tapping duct 17 moreover including a heat exchanger 19 disposed in the reservoir 1, part of the heat which has been transferred to water in the interspace 13 is subsequently transferred in turn to the water in the interior 2 of the reservoir 1. As a consequence, during the tapping of water, a large heating capacity can be employed for heating the water to be tapped, without this leading to unduly high tapping temperatures. Further, what is achieved by preheating the water in the reservoir is that lime precipitation which occurs in many regions during the heating of mains water in a particular temperature range, occurs at least for the greater part before the water supplied is guided along the furnace wall 5. Thus lime deposits on the furnace wall are further prevented, as is, by implication, the chipping off of lime deposits resulting from boiling phenomena along the furnace wall 5.

The helical path of the flue duct 7 also contributes to the heat transfer for heating up water in the reservoir 1 before it is passed along the furnace wall 5.

Lime precipitation against the furnace wall is effectively prevented in particular in that the furnace 3 is located above at least the most important parts of the heat exchanger 19 and the flue duct 7 in the reservoir 1. Owing to its relatively high specific gravity, freshly supplied, cold water, which is still relatively rich in lime, collects especially in the lower portions of the reservoir 1. Only after the water has been heated through heat transfer from the heat exchanger 19 and the flue duct 7, and the lime content has decreased correspondingly, and after, moreover, colder water has been supplied to the reservoir, does it rise in the reservoir 1 and does it get an opportunity to reach the interspace between the guard 12 and the furnace wall 5 via the supply passages 14.

Owing to the pump 11 being included in a duct 10 between the central passage 15 and the interior 2 of the reservoir 1, it is possible with this pump 11, also when no water is being tapped from the reservoir, to maintain a flow in the interspace 13. The furnace 3 can therefore be fired also when no water is being tapped. The heated water then flows back directly into the interior 2 of the reservoir 1.

Connected to the tapping duct 17 is a short-circuit duct 20. The short-circuit duct 20 communicates at its end remote from the tapping duct 17, via a part of the supply duct 9, with the interior 2 of the reservoir 1. Via this short-circuit duct 20, when no water is being tapped, water that has passed through the interspace 13 can be recirculated to the interior 2 of the reservoir 1.

Owing to the pump 11 being included in the supply duct 9 downstream of the point where the short-circuit duct 20 terminates in the supply duct, the pump 11 can be used both for tapping and supplying water and for recirculating water. When the pump 11 is running, water is passed back to the reservoir, in so far as the flow rate through the pump is greater than the tapping flow rate downstream of the short-circuit duct 20.

In the boiler according to Figs. 1 and 2, during recirculation, the heated water coming from the interspace 13 is led to the pump 11 without this water having passed through the heat exchanger 19. If it is desired that the heated water first give off heat in the interior 2 of the reservoir 1 before it is recirculated via the pump 11 to that interior 2 of the reservoir 1, it is alternatively possible to use a short-circuit duct which is branched off from the tapping duct at a point downstream of the heat exchanger 19. Such a short-circuit duct is diagrammatically indicated with a chain-dotted line 20'.

With the above description and the drawings, many variants within the scope of the present invention have been brought within reach of those skilled in the art. Thus, as is shown in Fig. 3, the furnace 3 can be arranged in a bottom portion of the reservoir 1 and the pump 21 can be designed for pumping water from the interior 2 of the reservoir 1, via the central passage 15 into the interspace 13 between the guard 12 and the furnace wall 5. The supplied water then leaves the interspace 13 again via distributed passages 14, so that a flow is obtained which is uniformly distributed over the interspace 13.

## Claims

**1.** A boiler for heating water and keeping in store a volume of heated water, comprising:

a reservoir (1) with an interior (2) for storing water, and
a heating element (3) with a wall (5) which forms a boundary relative to the interior (2) of the reservoir (1), **characterized by**
a guard (12) in the reservoir (1), which screens the heating element (3) at a slight distance therefrom, defines an interspace (13) between the guard (12) and the wall (5), and is provided with passages (14, 15) for letting water into and out of said interspace (13), said interspace (13) communicating directly with the rest of the interior (2) of the reservoir (1) via a number of distributed ones of said passages (14).

**2.** A boiler according to claim 1, wherein said distributed ones of said passages (14) constitute inlets for admitting water to said interspace (13) and another, central one of said passages (15) constitutes a discharge for discharging water from said interspace (13).

**3.** A boiler according to claim 2, wherein there is connected to said central one of said passages (15) a tapping duct (17) for tapping water from the reservoir (1).

**4.** A boiler according to claim 3, wherein said tapping duct (17) includes a heat exchanger (19) disposed in the reservoir (1).

**5.** A boiler according to any one of the preceding claims, further comprising a pump (11, 21) included in a duct (9) between a central one of said passages (15) and the interior (2) of the reservoir (1).

**6.** A boiler according to claim 3 or 4 and according to claim 5, wherein there is connected to said tapping duct (17) a short-circuit duct (20) which, remote from the tapping duct (17), communicates with the interior (2) of the reservoir (1).

**7.** A boiler according to claim 6, further comprising a supply duct (9) for supplying water to be heated, the short-circuit duct (20) terminating in the supply duct (9) and the pump (11) being included downstream of the point where the short-circuit duct (20) terminates in the supply duct (9).

**8.** A boiler according to any one of the preceding claims, wherein the heating element (3) is located above a heat exchanger (19) in the reservoir (1).

**9.** A boiler according to any one of the preceding claims, wherein the wall (5) has a concave outer side (16), and a central discharge or supply passage (15) in the guard (12) is located in spaced relation from the edges of said concave outer side (16), opposite said concave outer side (16).

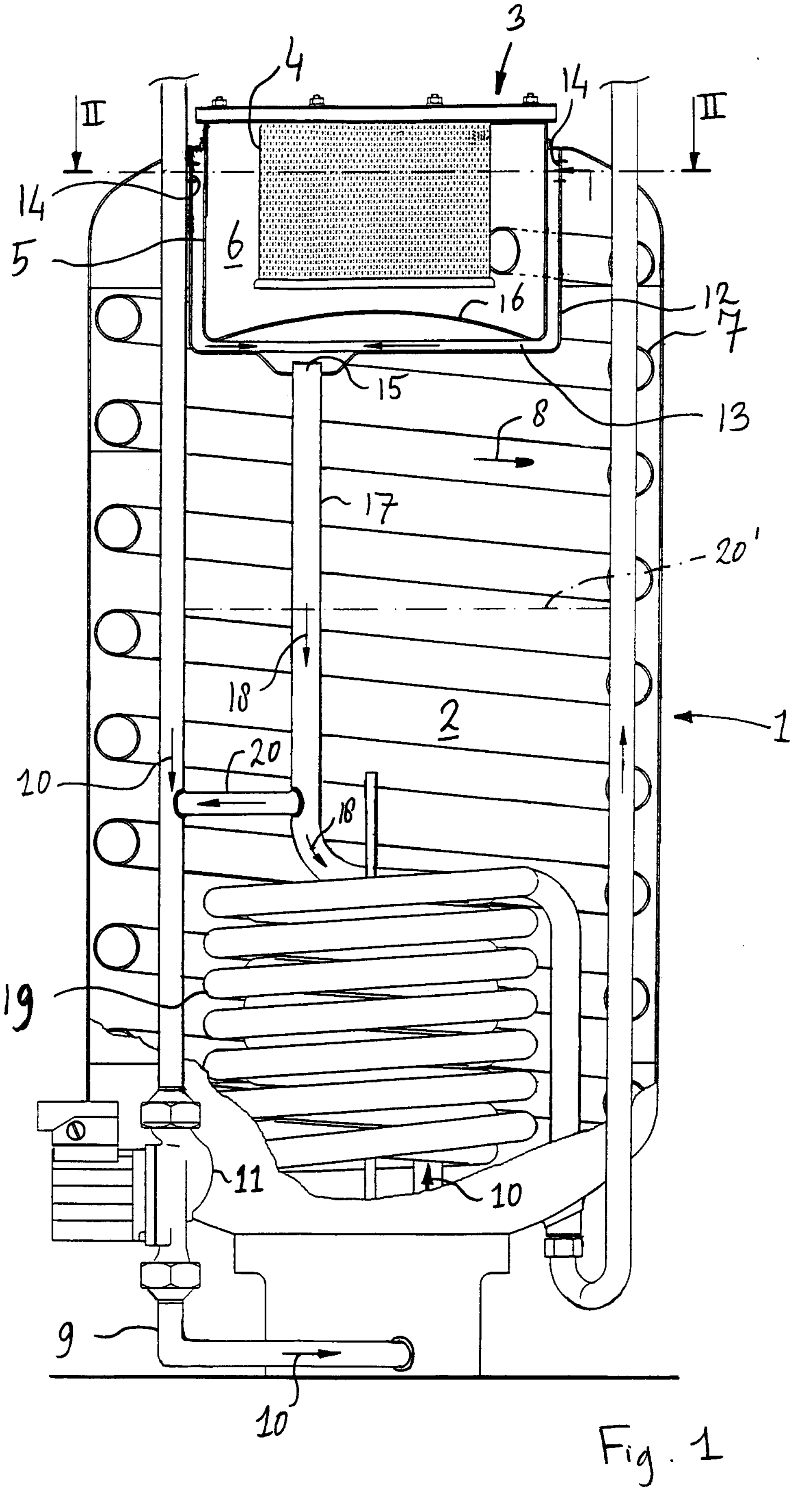


Fig. 1

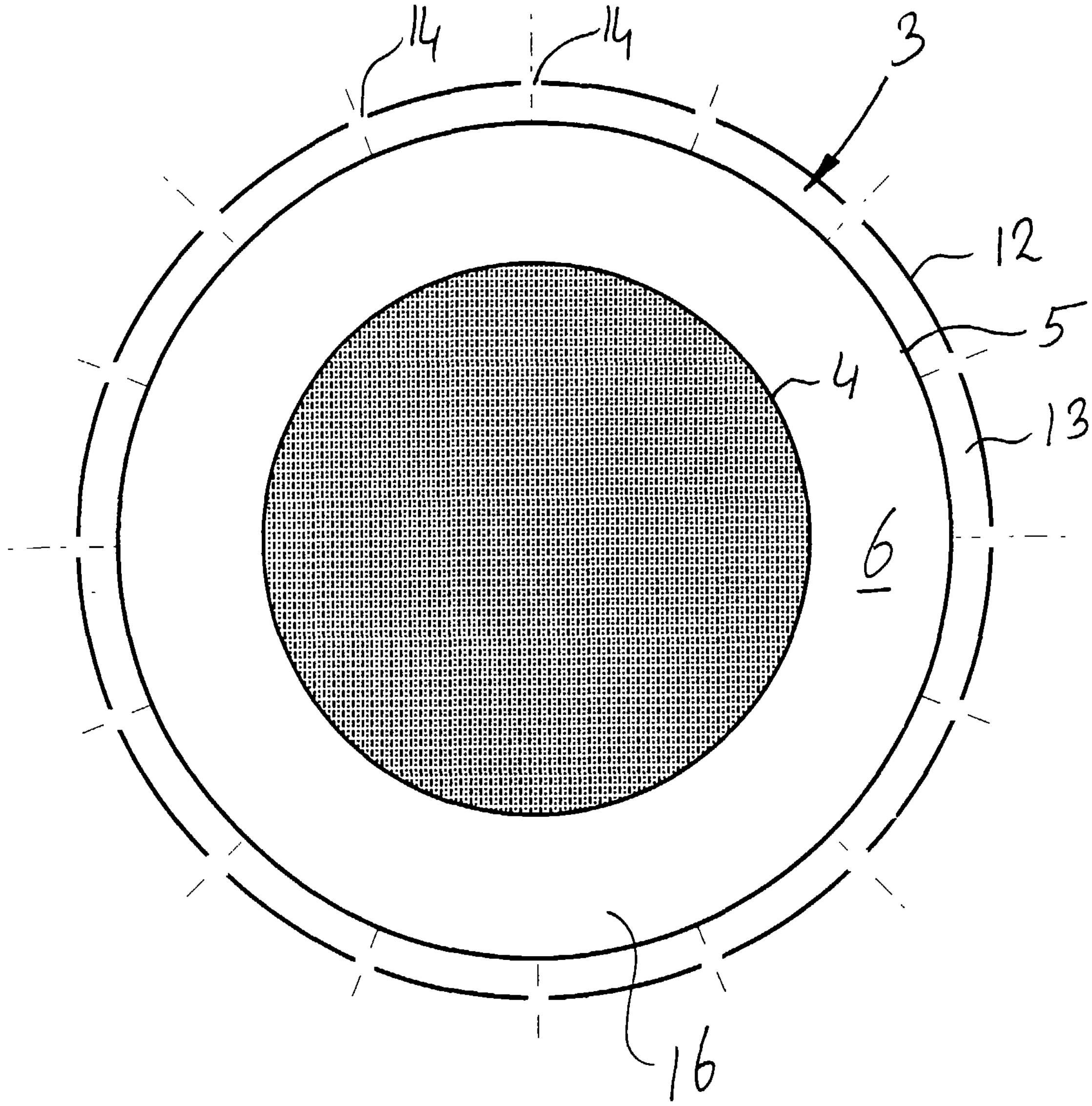


Fig. 2

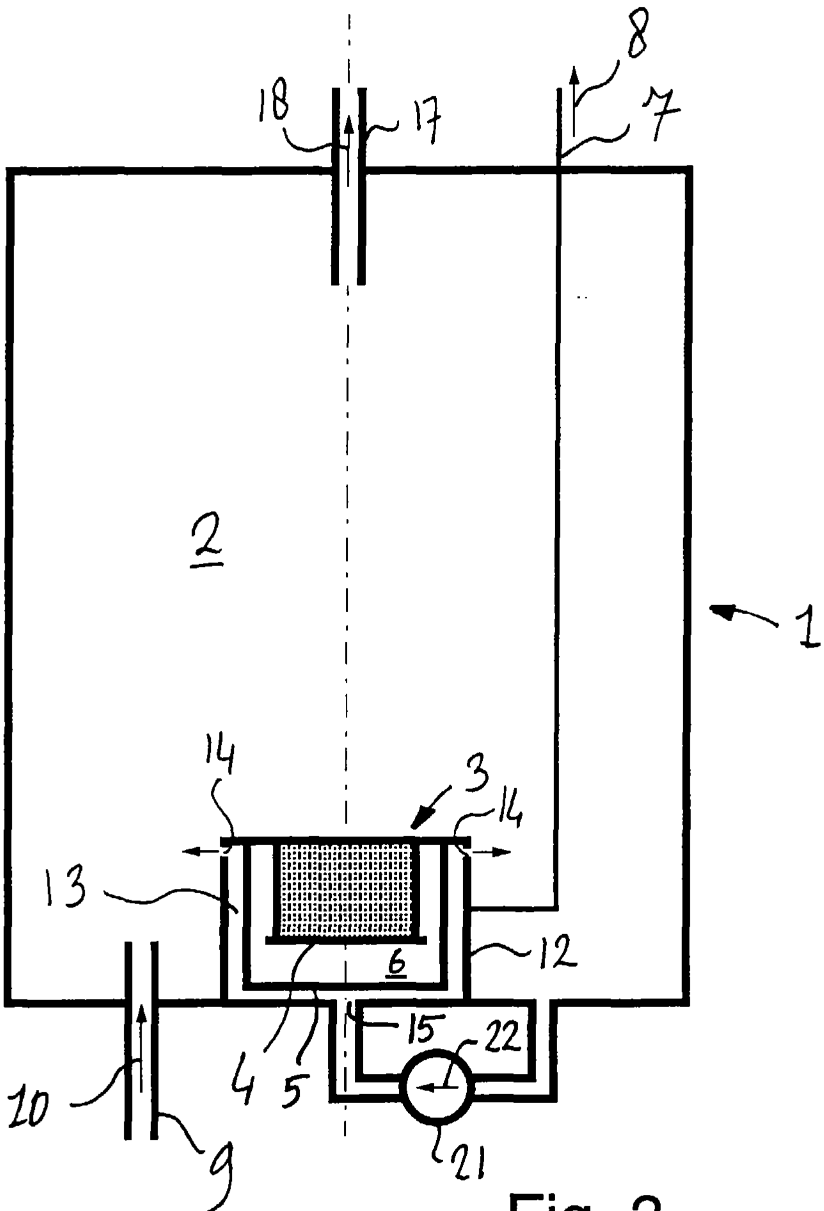


Fig. 3