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(54) Heating boiler comprising more than one chamber

(57) A heating boiler comprising a burner in a burner chamber, an internal heat exchange element connected thereto, a flue duct and at least two chambers, wherein the first chamber (1) is connected with a further chamber via at least two spaced apart orifices, the first chamber (1) comprising connecting means for a supply pipe for a first heating circuit and wherein connecting means for a return pipe of the first heating circuit connect to the further chamber.

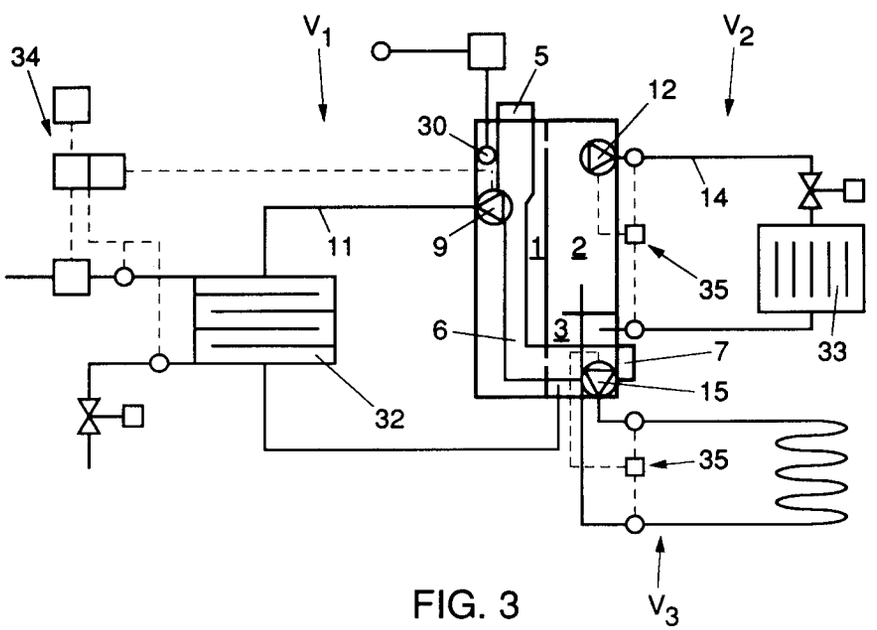

FIG. 3

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This invention relates to a heating boiler according to the preamble of claim 1.

Such an apparatus is disclosed in AT-B-377 357. This publication describes a heating boiler comprising two chambers both abutting around or against a combustion space. In addition, through one of the two chambers extend a number of flue ducts. Water can be supplied from a central supply either via the first chamber alone or via the first and the second chamber to a three-way valve. Thence the heated water is then fed to one heating circuit. The return water coming from the heating circuit is fed to the boiler again via a single connection. A drawback of this known boiler is that the relatively cold return water is fed near the combustion space and not near the flue gases of the burner which have meanwhile cooled off partially. As a consequence, it will not be possible to make the known heating boiler of condensing design, as the water temperature in the second chamber, i.e. there where the flue ducts extend, will be relatively high. Owing to the fact that a non-condensing boiler is involved here, it can never achieve a high efficiency. Moreover, the known boiler is suitable only to be connected to a single heating circuit.

In practice, for the purpose of heating for instance sanitary water or living spaces, typically water is heated in a heating boiler, whereafter the heated water is passed either through a sanitary water heating circuit or through a space heating circuit for heat exchange with the environment. Thus, in order to be able to meet the heat demand, it should be possible for sufficient water to be heated in a relatively short time.

To that effect, the heating boilers known from practice are equipped with a burner which is arranged in a burner chamber and which connects to a heat exchange element. The burner chamber and the heat exchange element are arranged in a chamber in which a volume of water can be heated. This chamber comprises connecting means for a supply pipe and a return pipe to which a space heating circuit and a sanitary water heating circuit can be connected simultaneously. In accordance with the demand, using a multiway valve, heated water is passed to one or to the other heating circuit.

In these known heating boilers, water being returned from a heating circuit into the heating boiler is added directly to the heated water in the water chamber. As the water will have lost a relatively large part of its heat in the heating circuit as a result of heat exchange with the environment, such return water has a relatively low temperature. This has an advantage in that heat exchange between this relatively cold water and already cooled flue gases is possible, so that the efficiency of such boilers can be high, but another consequence is that water heated in the heating boiler is cooled by the return water. The associated disadvantage is that in particular in the case where the heat demand is large, and the return water has cooled off to a large extent, the heat demand can no longer be met directly, the consequence being that the comfort or convenience of the heating apparatus in which the heating boiler is included is adversely affected, in particular where the apparatus is used, for instance, for sanitary water heating. A further disadvantage of the known heating boiler is that it should be possible for a relatively large water volume to be heated directly, which renders a relatively large burner capacity is necessary.

Accordingly, the object of the invention is to provide a heating boiler of the type described in the preamble, which does not have the disadvantages thereof but retains the advantages thereof. To that effect, a heating boiler according to the invention is characterized by the features of claim 1.

By virtue of the features according to the invention, which enable circulation of water via the chambers, the water volume of the heating boiler is in fact divided into at least two subvolumes. Because during use of the heating boiler, water which has passed from the first chamber through a heating circuit connected thereto is not directly returned into the first chamber but is first passed through at least one other chamber, the (subvolume of) water in the first chamber can be brought to the desired temperature particularly fast. The first chamber then functions as a heat buffer for the heating circuit connected thereto. As a result, a change in the heat demand in the relevant heating circuit can be rapidly met, even if the water in the heating boiler has priorly cooled off to a relatively high degree.

In further elaboration, a heating boiler according to the invention is characterized by the features of claim 2.

The connecting means for a supply pipe of a second heating circuit make it possible in a simple manner to connect a second heating circuit to the heating boiler, independent of the first heating circuit. Because the second heating circuit connects to the second chamber, at least by its supply pipe, during use the water passing through the second heating circuit will generally have a lower temperature than the water being passed through the first heating circuit.

This embodiment is particularly advantageous if, for instance, the first heating circuit is used for heating sanitary water by means of, for instance, a storage boiler, a tap boiler, or a plate heat exchanger, and the second heating circuit for heating spaces, since heating requires that water be supplied directly upon a heat demand being estab-

lished. The temperature of the water necessary for the sanitary water supply should then be higher than the desired tap water temperature and consequently is also higher than is necessary for space heating. Water coming from the first heating circuit, where it has cooled to some extent, is mixed in the second chamber with water already present there and possibly with heated water coming directly from the first chamber and thus has sufficient heat capacity to be able to meet the heat demand in the second heating circuit. This embodiment of the heating boiler moreover has the advantage that the heat demand of the first as well as the heat demand of the second heating circuit can be met simultaneously.Thus this heating boiler enables, for instance, the simultaneous heating of sanitary water and spaces.

A particularly advantageous embodiment of a heating boiler according to the invention is characterized by the features of claim 3 and/or 4.

During use the water will have a lower temperature in the third chamber than in the other chambers, so that this third chamber is eminently suitable for connection to a low-temperature heating circuit, for instance for use as a floor heating circuit or for swimming pool heating. The temperature of the water being fed to the third heating circuit is then for instance 70 °C, rather than 90 °C in the known apparatus, and the temperature of the return water is for instance 50 °C instead of 70 °C. Due to the third chamber forming a connection between the first and the second chamber, circulation of at least a part of the water volume in the heating boiler through all chambers is forced in a simple manner, as the water temperature in a heating boiler will always rise from the bottom to the top.

According to claim 5, the flue duct preferably extends through the third chamber, the third chamber being arranged under the second chamber, with the first chamber extending along the second and third chambers, while according to claim 6 the burner chamber and the internal heat exchange element are arranged in the first chamber. Because the flue duct extends through the third chamber, in which chamber the water has the lowest temperature, heat exchange between the flue gases and the water is being provided for in optimum manner. As a result, the efficiency of the heating boiler is positively influenced.

As a result of the specific arrangement of the different chambers, the average temperature of the water in the third chamber is always lower than the average temperature of the water in the other chambers, even if little flow arises in the heating boiler, as the water temperature in a heating boiler will always rise from the bottom to the top. As a consequence, during use of the heating boiler, water of the desired temperature is always present in each chamber, so that water of the desired temperature is always directly available for each heating circuit.

According to claim 7, the different chambers are preferably each equipped with at least one pump by means of which water can be fed from the relevant chamber into the heating circuit connected thereto. In accordance with claim 8, it is then preferred that the capacity of the pumps is controllable. Thus always an optimum amount of water of a suitable temperature can be fed into the different heating circuits, for instance depending on the heat demand in the different heating circuits.

A further elaboration of the invention is described in claim 9. Such a casting provides the advantage that the heating boiler can be assembled particularly fast and simply, can be serviced easily, provides a good heat capacity and moreover can simply satisfy the nominal dimensions which are known in the wall boiler market.

According to claim 10, it is preferred that in the heating boiler according to the invention the first chamber has a water volume that is relatively small with respect to the total water volume of the heating boiler, the second chamber having a water volume that is relatively large with respect to the total volume of the heating boiler.

Because the first chamber has a relatively small water volume, this water volume can be heated very rapidly, so that the convenience or comfort time of the first heating circuit connected thereto can be kept particularly low. The volume of the first chamber is for instance between 5 and 15% of the total volume of the heating boiler. Because the volume of the second chamber is relatively large, a large heat capacity is available for the second heating circuit, which is important for a good comfort, particularly in space heating. The volume of the second chamber is for instance more than 50% of the total volume of the heating boiler.

To clarify the invention, an exemplary embodiment of the heating boiler, included in a heating apparatus, will be described with reference to the drawings.

Fig. 1 shows a sectional front view of a heating boiler according to the invention;

Fig. 2 shows a side elevation of the heating boiler according to Fig. 1;

Fig. 3 diagrammatically shows a heating device according to the invention; and

Fig. 4 diagrammatically shows a second exemplary embodiment of a heating apparatus according to the invention.

Fig. 1 shows a heating boiler 4 in sectional front view. The heating boiler 4 comprises a first chamber 1, a second chamber 2 and a third cham-

ber 3. The first chamber 1 extends throughout the height of the heating boiler along one side thereof. The second chamber 2 and the third chamber 3 are arranged next to the first chamber, the third chamber 3 being arranged under the second chamber 2. The second chamber 2 is approximately 1.5 times as high as the first chamber 2. It is noted that these proportions and positions can also be chosen differently and more or fewer chambers can be included, as desired.

Formed in the first chamber, from the top, is a burner chamber 5, which includes a burner, not shown in the drawings. Preferably, this burner can be actuated in different positions, but can also be a burner which can only be switched on and off or a burner designed for stepless control. To the underside of the burner chamber 5 connects a heat exchange element 6, also arranged in the first chamber 1, which is dimensioned so as to enable optimum heat transfer between the hot combustion gases of the burner and the water in the first chamber 1, regardless of whether flow can be generated in the heating boiler. On a side remote from the burner chamber 5 a flue duct 7 extending substantially horizontally through the third chamber 3 connects to the heat exchange element 6. The flue duct 7 extends outside the heating boiler 4.

The first chamber 1 comprises, near the top at the back 8 of the heating boiler 4, a first pump 9 which comprises connecting means 10 for a supply pipe 11 of a first heating circuit V_1, which is shown in Fig. 3 and will be discussed further with reference to that figure. In comparable manner, the second chamber 2 comprises a second pump 12 which is equipped with connecting means 13 for a supply pipe 14 of a second heating circuit V_2 (Fig. 3) and the third chamber comprises a third pump 15 which is equipped with connecting means 16 for a supply pipe 17 for a third heating circuit V_3 (Fig. 3).

The third chamber 3 comprises near the underside connecting means 18 for a return pipe 19 of the first heating circuit V_1 and connecting means 20 for a return pipe 21 of the second heating circuit V_2. The second chamber 2 comprises adjacent the underside thereof connecting means 22 for a return pipe 23 of the third heating circuit V_3.

Provided in the partition 24 between the first chamber 1 and the second chamber 2, adjacent the top thereof, is a first orifice 25 which interconnects the two chambers. Provided in the partition 26 between the first chamber 1 and the third chamber 3, adjacent the bottom thereof, is a second orifice 27 which interconnects the two chambers. Provided in the partition 28 between the second chamber 2 and the third chamber 3 is a third orifice 29. The first 25, second 27 and third orifice 29 provide a circulation path for the water in the heating boiler 4 through all three chambers.

In the first chamber 1 adjacent the top a maximum thermostat 30 is arranged and the heating boiler comprises around its entire circumference an air duct 31 which connects to the burner chamber 5 and through which the heating boiler can be circumfused with air during use.

Fig. 3 shows a heating apparatus according to the invention in which a boiler according to Figs. 1 and 2 is included. Shown on the left in Fig. 3 is the first heating circuit V_1, which is designed as a sanitary water heating circuit, comprising a boiler 32 of the through-flow type. Shown on the right, top, in Fig. 3 is the second heating circuit V_2, which is designed as a space heating circuit. This space heating circuit V_2 comprises, for instance, radiators 33. Shown on the right, bottom, in Fig. 3 is the third heating circuit V_3 which is designed as a floor heating circuit. By means of connecting means which are known per se, the heating circuits V_1, V_2, V_3 are connected to the connecting means 10, 13, 16; 18, 20, 22 of the heating boiler 4.

The first heating circuit V_1 comprises a control unit 34 which controls the first pump 9 on the basis of at least the inflow of mains water into the boiler 32 and the temperature of the tap water from the boiler 32. The second heating circuit V_2 is designed with a control unit 35 which controls the second pump 12 on the basis of the difference in temperature between the supply pipe 14 and the return pipe 21 of the second heating circuit V_2. The third heating circuit V_3 is designed with a comparable control unit 36 which controls the third pump 15 on the basis of the difference in temperature between the supply pipe 17 and the return pipe 23 of the third heating circuit V_3. The three pumps 9, 12 ,15 are then designed so that the capacity thereof is controllable, and the control units 34, 35, 36 are coupled to each other.

The heating apparatus according to the invention can be used as follows.

By means of the burner in the burner chamber 5 the water in the heating boiler 4 is heated in the first chamber 1, until the burner is switched off by the maximum thermostat 30 when a pre-set maximum water temperature has been reached, for instance 60 °C. As a consequence of convection in particular, the water temperature in the second chamber 2 will then rise approximately to, for instance, 50 °C, and the water temperature in the third chamber 3 to, for instance, 40 °C.

When in the first heating circuit V_1 a heat demand is established by the control unit 34, the first pump 9 is actuated, so that hot water is pumped from the first chamber 1 via the first heating circuit V_1 into the third chamber 3. This gives rise to a flow through the different chambers 1, 2, 3, with the result that cooled water is heated

again in the heat exchange element 6 due to the burner switching on, and can be passed through the first heating circuit V_1 again.

Because the first chamber 1 has but a relatively small volume with respect to the total water volume of the heating boiler, the water in the first chamber 1 can be rapidly brought to the desired temperature and be simply maintained at that temperature, so that always sufficient heat capacity is present for the sanitary water heating circuit. The control unit 34 continuously controls the capacity of the first pump 9, so that always exactly the proper amount of water of the proper temperature is directed through the first heating circuit V_1.

When at the same time a second control unit 35 establishes a heat demand in the second heating circuit V_2 and/or the third heating circuit V_3, the respective second pump 12 and third pump 13, included in the corresponding heating circuits V_2, V_3, are actuated, with the result that water is pumped round which has a lower temperature than the water in the first chamber 1 but is sufficiently hot to be adequate in the relevant heating circuit. Moreover, the different control units 34, 35 control the capacity of the actuated pumps in such a manner that in each heating circuit V_1, V_2, V_3 the optimum heat capacity is supplied.

The water returned from the first and second heating circuits is fed into the third, relatively coldest chamber 3 and mixed there with the water already present there, and is heated by flue gases flowing through the flue duct 7, whereafter through circulation in the heating boiler it is at least partly passed through the first chamber 1, along the heat exchange element 6, and in the first chamber it is further heated to the desired temperature.

If the first heating circuit does not demand any heat but one of the other heating circuits does, water is sucked from the first chamber through the orifices 25 and/or 27, so that also relatively cool water is fed into it. The temperature in the first chamber will fall and the burner will be set in operation.

A heating apparatus according to the invention makes it possible to respond promptly to changes in the heat demand of a number of heating circuits connected to a heating boiler, and different heat demands can be met simultaneously. In addition, the heating boiler can be made of relatively small design, while yet having a large heat capacity. The heating boiler 4 comprises a casting 36 in which the different connecting means for the supply pipes and return pipes and for the pumps are integrally cast. In addition, the casting 36 comprises integrally cast partitions 24, 26, 28 including the orifices 25, 27, 29, and the burner chamber 5, the heat exchange element 6 and the flue duct 7. This casting 36 enables very simple mounting and assembly of the heating boiler 4 and moreover the heating boiler has an agreeably taut appearance. The pumps 9, 12, 15 are mounted on the casting 36 from the outside, so that mounting them is very simple too.

The casting 36 for the heating boiler 4 can be designed with small dimensions, for instance 600 mm high, 400 mm wide and 220 mm deep. Thus a heating boiler is obtained having, for instance, a water volume of 25 liters and a weight of about 25 kg.

Fig. 4 is a diagrammatic representation of a second exemplary embodiment of a heating apparatus according to the invention, comprising three heating circuits, viz. a sanitary water heating circuit V_1 which comprises a boiler 134, a heating circuit V_2 which comprises radiators 135 and a heating circuit V_3 which comprises a floor heating tube system. In this exemplary embodiment too, the floor heating circuit V_3 is connected directly to the boiler. To make this possible, the boiler should include a zone having a very low water temperature in comparison with the existing central-heating boilers. As a result, relatively much water can condense from the combustion gases, so that a high boiler efficiency is attainable. The exemplary embodiment of Fig. 4 is distinguished from the example shown in Fig. 3 in that the boiler 4 has a different division into chambers. The boiler comprises four chambers 101, 102, 103, 104. The first chamber 101 extends throughout the height of the heating boiler 4 along one side. The second, third and fourth chambers 102, 103, 104 are arranged next to the first chamber 101, the second chamber 102 is situated at the top of the boiler 4, the third chamber 103 is situated at the bottom of the boiler 4 and the fourth chamber 104 is situated between the second 102 and the third chamber 103. The first and the second chambers 101, 102 are separated by a partition 124 with an orifice 125 provided therein. The second and the fourth chambers 102, 104 are separated by a partition 128 which contains an orifice 129 which connects the second and the fourth chamber 102, 103 with each other. The fourth and the third chamber 104, 103 are separated by a partition 130 which contains an orifice 131 which connects the fourth and the third chamber 104, and 103, respectively, with each other, and the first and the third chamber 101, 103 are separated by a partition 132 comprising an orifice 133 through which extends the flue duct 107 of the heat exchange element 106. The heat exchange element 106 is connected to a burner chamber 105 which is situated at the top of the first chamber 101.

The course of the water for the first and the second heating circuit V_1, V_2 is as follows:

The return water enters into the coldest part of

the third chamber 103. The water flows from the third chamber 103 through the orifice 133 to the first chamber 101 and upwards in the first chamber 101. Then the heated water passes through orifice 125, ending up at the top of the second chamber 102. In the second chamber 102 the water continues its course to a supply pipe 111. For the third heating circuit V_3, serving, for instance, for floor heating and for which only a low temperature is required, the return water enters into the coldest part of the third chamber 103. The supply water for the floor heating circuit V_3 is taken from the fourth chamber 104 and the desired temperature is achieved by mixing the relatively cold water from the third chamber 103 with the supply of heated water from the second chamber 102 according to a fixed mixing ratio which is determined by the magnitude of the orifices 129 and 131. For the rest, the operation of the exemplary embodiment shown in Fig. 4 corresponds with the exemplary embodiment shown in Fig. 3. Accordingly, for details relating to the control of the pumps 109, 112 and 115, reference is made to the description given with reference to Fig. 3. The presence of the fourth chamber 104 makes it possible to arrange for the temperature of the supply water for the third heating circuit V_3 to lie between the water temperature for the first and the second circuits V_1, V_2 and the return water temperature of these circuits. This is effected in that in the fourth chamber 104 water coming from the second chamber 102 and the third chamber 103 is mixed in a fixed mixing ratio which is determined by the ratio of the magnitude of the passage areas of the orifices 129 and 131 respectively connecting the second and fourth chambers 102, 104, and the third and fourth chambers 103, 104.

The invention is not in any way limited to the exemplary embodiments shown, which are only given as examples. Many adjustments are possible within the framework of the invention.

The partition 28 between the second chamber 2 and the third chamber 3 can for instance be provided with a break plate or bypass means which make it possible to adapt the casting in simple manner to a heating apparatus with only two heating circuits. Moreover, the heating boiler may comprise a larger or smaller number of chambers if more or fewer than three separate heating circuits are included in the heating apparatus. In addition, a single chamber may have more heating circuits connected to it, to which effect the chamber in question may comprise a series of pumps. Further, pumps of a different type can be used and the control of the pumps can be provided for in different ways, for instance by means of room thermostats and/or a weather-dependent control. The sanitary water heating circuit, if present, can moreover by designed differently, for instance as a storage boiler.

Claims

1. A heating boiler comprising a burner in a burner chamber, an internal heat exchange element connected thereto, and a flue duct, the heating boiler (4) comprising at least two chambers (1, 2, 3; 101, 102, 103, 104), characterized in that the first chamber (1; 102) is connected with a further chamber (2, 3; 104, 103; 101) via at least two spaced apart orifices (25, 27, 29; 129, 131, 133, 125), the first chamber (1; 102) comprising connecting means (10) for a supply pipe (11; 111) for a first heating circuit (V_1), while connecting means (18) for a return pipe (19) of the first heating circuit (V_1) connect to the further chamber (2, 3; 103), the arrangement being such that during use of the heating boiler (4) water in the first chamber (1; 102) can be heated by means of at least the burner, the burner chamber (5; 105) and the heat exchange element (6), can be introduced from the first chamber (1; 102) into a heating circuit (V_1) connected thereto and thence can be returned only via at least one further chamber (2, 3; 103) to the first chamber (1; 102).

2. A heating boiler according to claim 1, characterized in that a second chamber (2; 104) comprises connecting means (13) for a supply pipe (14) of a second heating circuit (V_2; V_3).

3. A heating boiler according to claim 2, characterized in that the heating boiler (4) comprises a third chamber (3; 103), at least one connection between the first (1; 102) and the second chamber (2; 104) being formed by the third chamber (3; 103).

4. A heating boiler according to claim 3, characterized in that the third chamber (3) comprises the connecting means (18) for the return pipe (19) of the first heating circuit (V_1), connecting means (20) for a return pipe (21) of the second heating circuit (V_2) and connecting means (16) for a supply pipe (17) of a third heating circuit (V_3).

5. A heating boiler according to claim 3 or 4, characterized in that the flue duct (7) extends through the third chamber (3), the third chamber (3) is arranged under the second chamber (2), and the first chamber (1) extends along the second (2) and the third chamber (3).

6. A heating boiler according to any one of the preceding claims, characterized in that the burner chamber (5) and the internal heat exchange element (6) are arranged in the first chamber (1).

7. A heating boiler according to any one of the preceding claims, characterized in that at least the first chamber (1), and preferably each chamber (1, 2,3), comprises at least one pump (9, 12, 15).

8. A heating boiler according to claim 7, characterized in that the capacity of at least the pump (9) in the first chamber (1), and preferably of each pump (9, 12, 15), is controllable.

9. A heating boiler according to any one of the preceding claims, characterized in that the heating boiler (4) comprises a casting (35) which comprises at least the burner chamber (5), the internal heat exchange element (6), the flue duct (7), the chambers (1, 2, 3), connecting means for the pumps (9, 12, 15) and the connecting means (10, 11; 13, 14; 16, 17; 18, 19; 20, 21; 22, 23) for the supply pipes and return pipes for the different heating circuits (V_1, V_2, V_3).

10. A heating boiler according to any one of the preceding claims, characterized in that the first chamber (1) has a water volume which is relatively small with respect to the total water volume of the heating boiler (4), while the second chamber (2) has a water volume which is relatively large with respect to the total volume of the heating boiler (4).

11. A heating boiler according to any one of the preceding claims, characterized in that the heating boiler (4) is so dimensioned that during use the temperature of the water in the first chamber (1) is higher than that of the water in the second chamber (2) and the temperature of the water in the second chamber (2) is higher than that of the water in each further chamber (3), if any.

12. A heating boiler according any one of the preceding claims, characterized in that the first chamber (1) comprises a maximum thermostat (30), which is preferably arranged near the top of the first chamber (1).

13. A heating apparatus comprising a heating boiler according to any one of the preceding claims, characterized in that a first heating circuit (V_1) is arranged for sanitary water heating, a second heating circuit (V_2) is arranged for space heating via, for instance, radiators (33) and/or convectors, and a third heating circuit (V_3), if any, is designed as a low-temperature heating circuit, for instance for floor heating or swimming pool heating.

14. A heating apparatus according to claim 13, characterized in that in at least one of the heating circuits (V_1, V_2, V_3) temperature-recording means and switching means (34, 35) are included for actuating the pump (9, 12, 15) included in the associated heating circuit during use on the basis of the recorded temperature or temperatures.

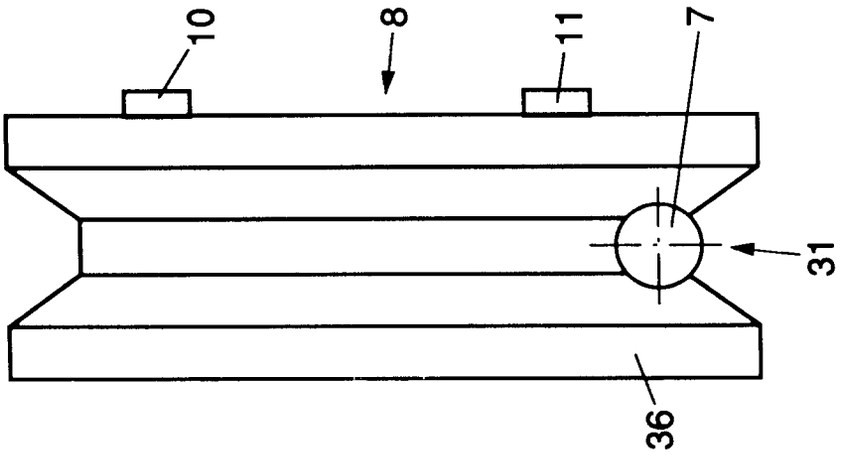
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FIG. 2

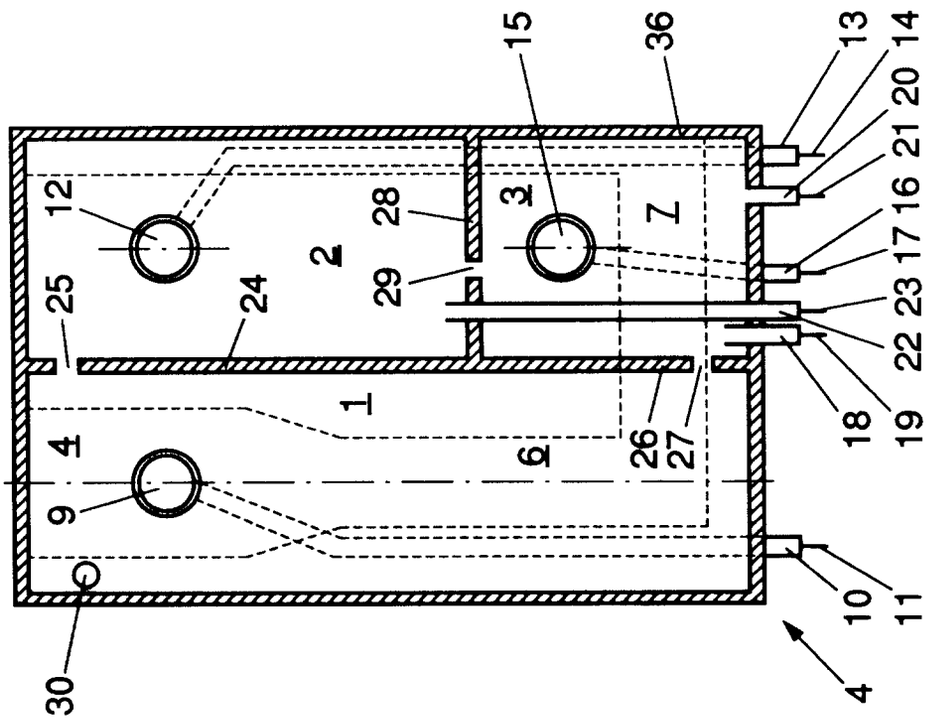
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FIG. 1

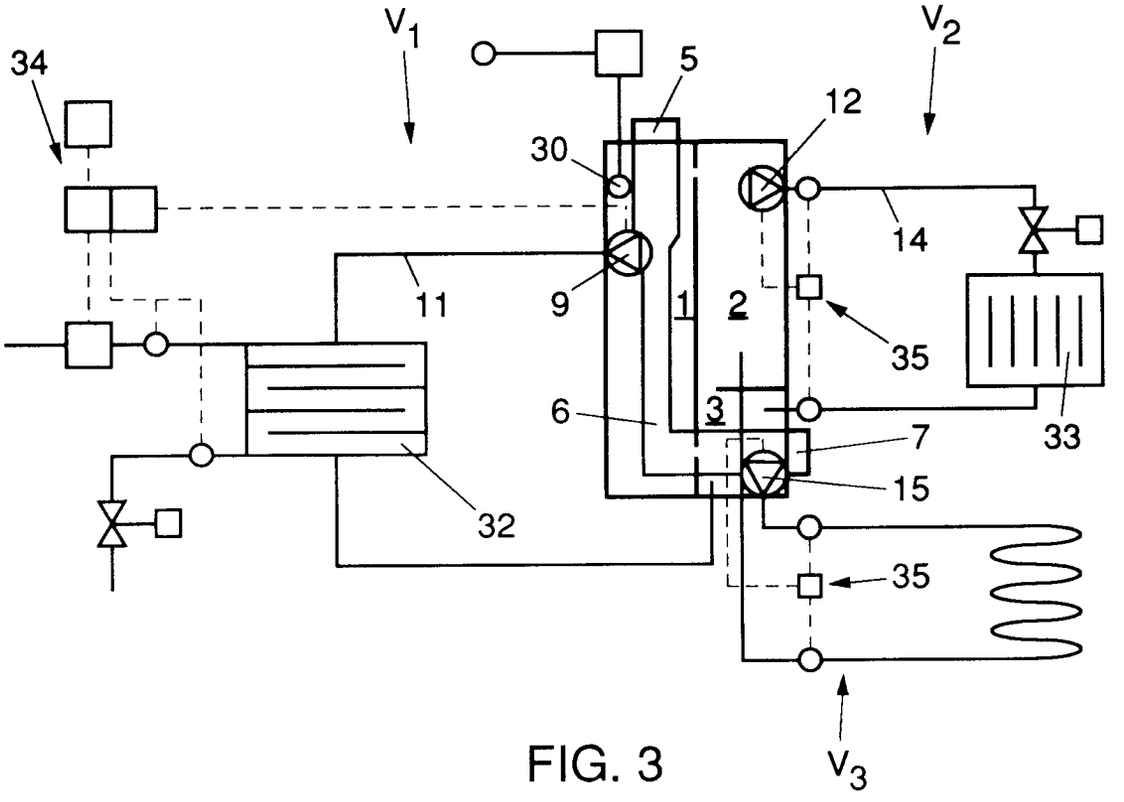
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FIG. 3

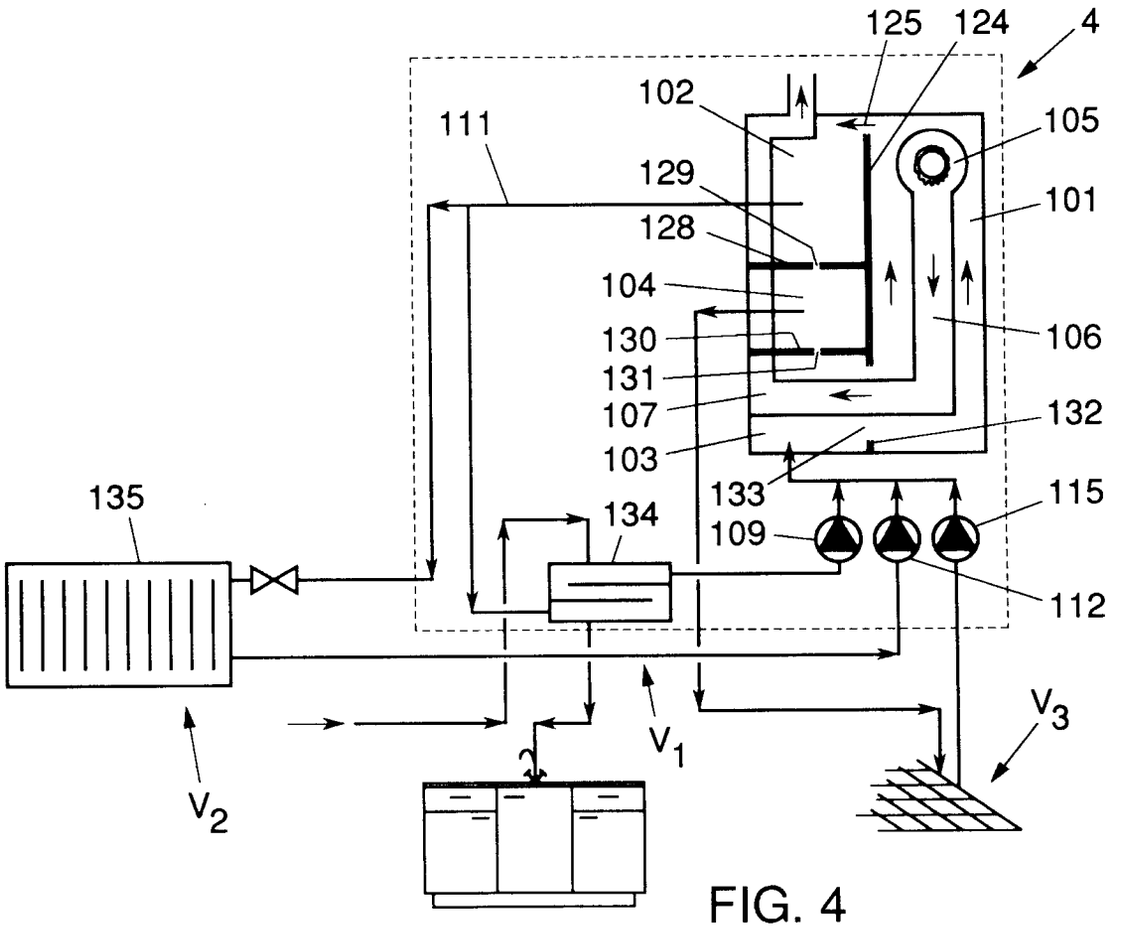
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FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 20 1612

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.6)
A,D	AT-A-377 357 (KOHLER) 11 March 1985 * the whole document * ---	1	F24H9/00 F24H1/28 F24D3/08
A	WO-A-82 04115 (FAGERSTA AB) 25 November 1982 * abstract * ---	1	
P,X	EP-A-0 616 173 (FRÖLING GMBH & CO KESSEL-APPARATEBAU) 21 September 1994 * the whole document * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F24H
F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 September 1995	Van Gestel, H

CATEGORY OF CITED DOCUMENTS

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