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(54) Heating apparatus having a cast, integrated heat exchanger

(57) A heating apparatus, comprising at least a first heat exchanger, pump means, burner means, connecting means for an inlet and an outlet of a space heating circuit, connecting means for the supply pipe of a further heating circuit, in particular a tapping water heating circuit and a multiple-way valve for connecting a water duct in the heat exchanger to either the connecting means for the inlet of the space heating circuit or the connecting means for the inlet of the further heating circuit, the heat exchanger being cast from light metal or an alloy with light metal, at least the connecting means for the multiple-way valve and/or the pump means being cast integrally therewith.

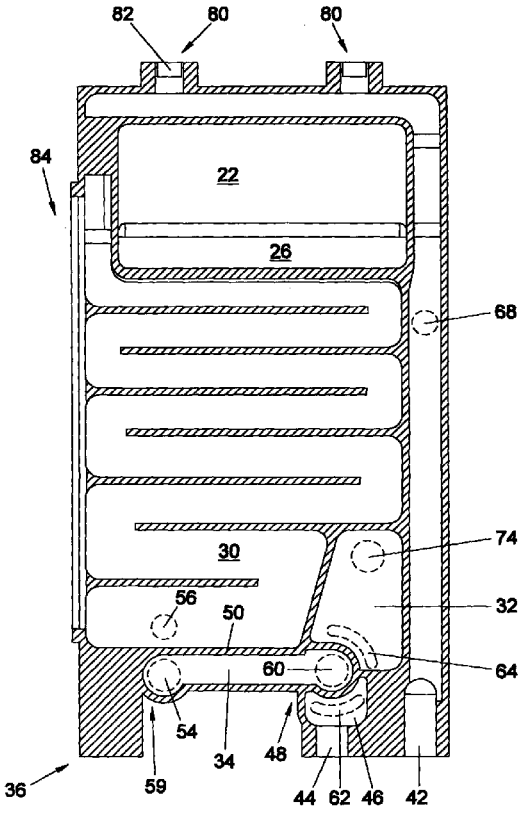

Fig. 5

EP 1 028 298 A1

Description

[0001] The invention The invention relates to a heating apparatus. The invention in particular relates to a heating apparatus suitable for use as a combined heating boiler for a space heating circuit and a tapping water heating circuit. Such heating apparatus is known from, for instance, NL 9402157.

[0002] This known heating apparatus, schematically shown in Fig. 1, comprises a heating boiler provided with a first heat exchanger and burner means connected thereto. Through the first heat exchanger, a water duct extends between connecting means for an inlet and an outlet of a space heating circuit. This first heat exchanger moreover comprises a flue duct for exchanging heat between flue gases coming from the burner means and water flowing through the water duct during use. From the connecting means for the inlet of a space heating circuit there extends a first pipe part connected, on a side remote from the boiler, to a first connecting stub of a three-way valve. To a second connecting stub of this three-way valve, a second pipe connects, leading to the space heating circuit, while to the third stub of the three-way valve, a third pipe connects, connected to tapping water heating means, for instance a second heat exchanger, a storage water heater or a tapping water heater. From the connecting means for the outlet of the space heating circuit, a fourth pipe extends connected, on the side remote from the boiler, to a first connecting stub of pump means whose second connecting stub is connected to a first connecting stub of a T-piece, of which a second connecting stub connects to the tapping water heating apparatus and the third connecting stub is connected to a fifth pipe for returning water from the space heating circuit.

[0003] This known heating apparatus has as an advantage that thus, a heat demand in a space heating circuit as well as the heat demand in a tapping water heating circuit can be satisfied in a simple and economical manner. However, it is still a drawback of this known heating apparatus that connecting pipes and couplings are necessary for the various pipes, the pump means, the three-way valve and the tapping water heating means, as well as for the burner means. This renders the manufacture and assembly of this known heating apparatus complicated, as a consequence of which it requires much time and, moreover, easily leads to errors. In addition, the use of such pipes and couplings is relatively costly, as is the time required for assembly. Further, the pump means, the three-way valve and the tapping water heating means take up relatively much space and are moreover relatively vulnerable outside the heating boiler.

[0004] The object of the invention is to provide a heating apparatus of the above-mentioned type, in which said drawbacks of the known heating apparatus are avoided, while the advantages thereof are maintained. To that end, a heating apparatus according to the present invention is characterized by the features of claim 1.

[0005] The use of a first heat exchanger, cast from metal, with at least the connecting means for the three-way valve or the pump means being cast integrally therewith, offers the advantage that at least the three-way valve or the pump means respectively can be directly coupled to the first heat exchanger, at least the respective connecting means therefor, without the interposition of any further pipes or couplings. In this manner, the costs and time involved in the manufacture are limited and, moreover, the risk of errors in, for instance, the assembly is reduced considerably. Moreover, an even more compact heating apparatus is obtained. In this respect, it is preferred that the connecting means both for the three-way valve and for the pump means be cast integrally in the first heat exchanger.

[0006] It will be appreciated that a heating apparatus according to the invention is also applicable in a single heating circuit, for instance only for space heating, or for use with multiple heating circuits, for instance a central heating circuit and a floor heating circuit. In this context, multiple-way valve should be understood to comprise at least valves for switching between at least three pipes or the like.

[0007] In a first advantageous embodiment, a heating apparatus according to the present invention is further characterized by the features of claim 2.

[0008] By also casting fasteners and connecting means for a second heat exchanger integrally in the first heat exchanger, the advantage achieved is that the second heat exchanger can also be directly coupled to the first heat exchanger, at least to the various connecting pipes thereof, without the interposition of any further external pipes or couplings.

[0009] Preferably, fastening points and fastening surfaces required in a heating apparatus according to the present invention, and means for the packings required for the fastening and/or sealing, such as packing chambers, are cast integrally with the first heat exchanger, so that finishing of the casting is not necessary, or only to a very limited extent, while the assembly thereof is possible in an unequivocal manner and the risk of assembly errors is reduced even further.

[0010] Similarly, means for positioning and sealing the burner means relative to the first heat exchanger may be cast integrally therewith.

[0011] In a further advantageous embodiment, a heating apparatus according to the present invention is further characterized by the features of claim 7.

[0012] Positioning the pump means, the multiple-way valve, the burner means and the second heat exchanger in or against the first heat exchanger offers the advantage of realizing an even more compact construction, while, moreover, the assembled parts are protected more properly.

[0013] In further elaboration, a heating apparatus according to the present invention is further character-

ized by the features of claim 8.

[0014] By providing the connecting pipes between the various assembly parts in the first heat exchanger through casting, an even simpler heating apparatus is obtained, in particular a first heat exchanger for which the various assembly parts can be directly provided on the casting.

[0015] Preferably, for assembly of the different assembly parts, O-ring seals are used whereby, in a particularly simple manner, at least fluid seals can be obtained which are sufficiently flexible to take up any differences in expansion coefficients and sufficiently durable, while such seals are relatively inexpensive and particularly simple in use.

[0016] The invention further relates to a heat exchanger for use in a heating apparatus according to the present invention.

[0017] Further advantageous embodiments of a heating apparatus according to the present invention are given in the further claims.

[0018] To elucidate the invention, an exemplary embodiment of a heating apparatus according to the present invention will hereinafter be specified with reference to the accompanying drawings. In these drawings:

Fig. 1 is a schematic front view of a heating apparatus according to the prior art;
Fig. 2 is a front view of a cast heat exchanger for use in a heating apparatus according to the invention;
Fig. 3 is a sectional side elevation of a heat exchanger, taken on the line III-III in Fig. 2;
Fig. 4 is a rear view of a heat exchanger according to Fig. 2;
Fig. 5 is a sectional view of a heat exchanger, taken on the line V-V in Fig. 3;
Fig. 6 is a sectional view of a heat exchanger, taken on the line VI-VI in Fig. 3; and
Fig. 7 schematically shows a connection of a pump to the first heat exchanger in a heating apparatus according to the invention.

[0019] Fig. 1 is a schematic front view of a heating apparatus according to the prior art, comprising a boiler 1 containing a heat exchanger, not shown, which comprises a water duct and a flue duct, as well as burner means for forcing heated flue gases through the boiler via the flue duct. By a first pipe 2, the water duct connects to a first connecting stub 4' of a three-way valve 4. A second connecting stub 4'' of the three-way valve 4 is connected to a second pipe 6 leading to a space heating circuit. A third connecting stub 4''' of the three-way valve 4 is connected to a third pipe 8 connecting, on a first side thereof, to a first side 10' of a heat exchanger 10. Connecting to the opposite side 10'' of the water duct of the boiler 1 is a fourth pipe 12, connected to a first connecting stub 14' of a pump 14. A T-shaped coupling piece 16 is connected by a first connecting stub 16' to a second connecting stub 14'' of the pump 14, by a second connecting stub 16'' to the second side 10'' of the second heat exchanger 10 and by a third connecting stub 16''' to a fifth pipe 18 for returning water from the space heating circuit.

[0020] In this heating apparatus, five pipes 2, 6, 8, 12, 18, one T-shaped coupling piece 16 and eight couplings 2a, 6a, 8a, 8b, 12a, 16a, 16b, 16c are necessary for coupling the three-way valve 4, the second heat exchanger 10 and the pump 14. Each coupling consists of at least three parts, is relatively costly, susceptible to failure and requires relatively much time for assembly, while the chance of assembly errors is relatively great. Moreover, the height H of such known heating apparatus is relatively great.

[0021] Figs. 2-6 represent a number of views of a first heat exchanger 20 for use in a heating apparatus according to the present invention, comprising a burner space 22 and a flue passageway 24, communicating with the burner chamber 22 via a flue passage 26. On the side remote from the flue passage 26, the flue passageway 24 connects to chimney connecting means 28. Moreover, in the first heat exchanger 20, a first water duct 30 and an intermediate water duct 32 are cast integrally therewith, as well as a connecting water duct 34. Adjacent the front side 38, the first water duct 30 meanders from a position adjacent the bottom side 36 of the first heat exchanger 20 to a position adjacent the burner space, then passes the flue passage 26 to meander, as shown in Fig. 6, along the rear side 40 via the burner space 22 and, subsequently, back in the direction of the bottom side 36. Adjacent the bottom side 36, the first water duct 30 comprises first connecting means 42 for connection of, for instance, a space heating circuit provided with radiators. Moreover, adjacent the bottom end of the first heat exchanger 20, second connecting means 44 are provided for connecting a return pipe of said space heating circuit. The connecting means 44 for the return pipe open into a valve cavity 46 adjacent a first end 48 of the connecting water duct 34. The intermediate water duct 32 is arranged on the side of said first end 48 opposite the valve cavity 46. The connecting water duct 34 extends approximately parallel to the bottom side of the first heat exchanger 20, along the lower part of the first water duct 30, separated therefrom by a relatively narrow wall part 50. This wall part 50 further extends around the first end 48 of the connecting water duct 34, to separate it from the intermediate water duct 32 and the valve cavity 46. This will be further discussed hereinbelow.

[0022] As shown in Fig. 2, adjacent the bottom end of the first heat exchanger 20 there is provided a first positioning surface 52 for positioning pump means (not shown), which may be of a conventional type. Provided centrally in the first positioning surface 52 is a pump inlet opening 54 for the suction side of the pump means, while above it there is provided a pump outlet opening 56 for the delivery side of the pump means. In Fig. 5, the

pump inlet opening 54 and pump outlet opening 56 are depicted in dotted lines, which shows that the pump inlet opening 54 opens into the second end 59 of the connecting water duct 34, on a first side of the wall part 50, while the pump outlet opening 56 opens into the first water duct 30 on the opposite side of the relevant wall part 50. Hence, by pump means arranged on the first positioning surface 52, water can be pumped from the connecting water duct 34 into the first water duct 30. With the interposition of a suitable packing, the pump means can be fixed against the first positioning surface 52 with bolts or like means engaging the blind holes 57.

[0023] Provided next to the first positioning surface 52 is a second positioning surface 58 for positioning a three-way valve, not shown. This is preferably a conventional three-way valve. Provided centrally in the second positioning surface 58 is a three-way valve outlet opening 60, while below it there is provided a slightly reniform first three-way valve inlet opening 62 and above the three-way valve outlet opening 60 there is provided a second three-way valve inlet opening 64 which is likewise slightly reniform. In Fig. 5, the three-way valve outlet and three-way valve inlet openings 60, 62 and 64 respectively are depicted in broken lines. This shows that the three-way valve outlet opening opens into the first end 48 of the connecting water duct 34, the first three-way valve inlet opening 62 opens into the valve cavity 46 and the second three-way valve inlet 64 opens into the intermediate water duct 32. Thus, by means of the three-way valve, not shown, either the valve cavity 46 can be connected to the connecting water duct 34, or the intermediate water duct 32 can be connected to said connecting water duct 34.

[0024] The first heat exchanger 20 further comprises a third positioning surface 66, extending circularly around an inlet opening 68 for a second heat exchanger 70 whose contours are schematically shown in Fig. 2 in broken lines. There is provided a fourth positioning surface 72, extending circularly around an outlet opening 74 for the second heat exchanger 70. The second heat exchanger is preferably a plate heat exchanger of the conventional type, yet any suitable heat exchanger can be used here. Preferably, the second heat exchanger 70 is designed for heating tapping water through heat exchange. In Fig. 5, the inlet opening 68 and the outlet opening 74 for the second heat exchanger 70 are shown in broken lines. The inlet opening 68 opens into the first water duct 30 at some distance from the connecting means 42 for the supply pipe of the space heating circuit, while the outlet opening 74 opens into the intermediate water duct 74. Accordingly, during use, water can be passed from the first water duct 30, via the second heat exchanger 70, into the intermediate water duct 32 and can from there be passed, at a suitable setting of the three-way valve, into the connecting water duct 34 via the second three-way valve inlet opening 64 and the three-way valve outlet opening 60. By the pump means, water can hence be pumped round via the water duct 30, the second heat exchanger 70, the intermediate water duct 32 and the connecting water duct 34. However, if the three-way valve is switched over to connect the valve cavity 46 to the connecting water duct 34, water can be pumped round by the pump means via the first water duct 30 and the space heating circuit. The water can be heated in the water duct by means of flue gases coming from a burner (not shown) disposed in the burner space 22. For that purpose, on the rear side 40 of the first heat exchanger 20, below the flue passage 26 in the flue passageway 24, there are provided a large number of projections 76 increasing the heat exchanging surface area, in rows and columns staggered relative to one another. The projections 76 are cast integrally with and therefore in direct connection with the wall of the water duct 30, the intermediate water duct 32 and at least a part of the connecting water duct 34. In the first part of the flue passageway 24, viewed from the flue passage 26, the length of the projections 76 increases, while in this part, the projections are spaced apart slightly further than in the adjoining lower part of the flue passageway 24. Thus, the flow resistance in said first part of the flue passageway 24 is slightly lower than in the further flue passageway 24, to realize an even better heat exchange. During use, the chimney connecting means 28 are connected to a chimney suitable therefor for discharging the substantially cooled-down flue gases.

[0025] Adjacent the top end, the first heat exchanger 20 is provided with two core holes 80 provided with plugs 82, for closure thereof. On the left-hand side in Fig. 5, a core opening 30 is provided over substantially the full height of the water duct 30, so that the different parts of the meandering water duct 30 can be reached in a simple manner. During use, this opening is closed off by a cover 84.

[0026] The different positioning surfaces 52, 58, 66 and 72 offer the advantage that suitable packings can simply and unequivocally be positioned for obtaining fluidtight sealings of the pump means, three-way valve and the second heat exchanger respectively. Moreover, suitable fastening means, such as blind holes 57, 61, 63, having, for instance, screw thread, enable mounting the various parts in a fast and simple manner. Thus, a heating apparatus according to the present invention can be assembled in a particularly fast manner and with few loose parts, which reduces the chance of errors considerably and is moreover particularly economical. In addition, a heating apparatus according to the present invention is particularly compact in that the pump, the three-way valve and the second heat exchanger are mounted directly against the first heat exchanger, as is the burner, which may moreover be advantageous in terms of heat engineering.

[0027] Because in a first heat exchanger 20 according to the present invention, the burner space 22 is open towards the front side 38, while the flue passageway 24 is located on the rear side, accessible via the flue pas-

sage 26, the burner, the pump, the three-way valve and the second heat exchanger can all be mounted on the front side 38 of the first heat exchanger 20 so as to be properly accessible. The rear side 40 can simply be closed off with a substantially flat cover (not shown), which cover may abut against the free ends of the projections 76 and a circumferential wall 82. The first heat exchanger 20 is preferably cast in one piece from a light metal or an alloy thereof, such as aluminum. A burner for use in a heating apparatus according to the present invention is preferably of the premix type, while the fan required therefor can likewise be arranged on the front side 38 of the first heat exchanger 20. The first heat exchanger 20 can readily be dimensioned in such a manner that the heating apparatus is of the condensing type, to realize an even higher efficiency. Suitable discharge means for the condensate, such as a siphon, can readily be arranged in a manner known per se.

[0028] The invention is in no way limited to the embodiment represented in the description and the drawings. Many variations thereof are possible.

[0029] The water duct 30, the connecting water duct 34 and the intermediate water duct 32 may be designed differently and positioned relative to each other in a different manner, while the connecting water duct 34 may, for instance, extend in such a manner that the pump means are located further upstream in the first water duct 30, at least closer to the burner space 22. Also, the inlet opening 68 and outlet opening 74 for the second heat exchanger may open in other positions, to allow water of a different temperature to flow through the second heat exchanger 70. The projections increasing the heat-exchanging surface area may be designed differently or arranged in other patterns, for instance as ribs or the like, while, for instance, such elements may also be provided in the burner space 22 or be omitted. Moreover, the burner space 22 may, for instance, be open towards the top side of the first heat exchanger 20. Also, connecting means such as a gas and/or air supply pipe for the burner may be cast integrally in the first heat exchanger 20, comparable with the intermediate water duct 32 and the connecting water duct 34. Comparable advantages may be realized by omitting the inlet opening 68 and outlet opening 72 for the second heat exchanger, for instance when the heating apparatus is to be used only for space heating or when a different type of tapping water heating apparatus is preferred, for instance a storage water heater. Also, the second heat exchanger may be arranged outside the first heat exchanger 20 and several pumps may be applied, for instance depending on the number of circuits to be connected. Of course, the dimensions and the shape of at least the first heat exchanger may be adjusted as the occasion requires. Such variations are directly clear to a skilled person. These and many similar variations are understood to fall within the framework of the invention as defined in the appended claims.

[0030] Fig. 7 shows a pump 14 disposed on a first heat exchanger 20. A connecting stub 14a of the pump 14 projects into the pump inlet opening 54. A packing, in particular an O-ring 15, is provided in a circumferential groove in the stub 14a, such that in the assembled condition shown, it is sealingly clamped between the stub 14a and the wall of the opening 54. Between the pump 14 and the positioning face 52, a further packing 15a may be provided, for further sealing and/or for an even better positioning. Comparable fastening and sealing manners are preferably also used for the further connections, in particular for the second heat exchanger 70, the pump 14 and the multiple-way valve 4. If necessary, there may also be provided a groove in the wall of the opening 54, such that the pump 14 can at least partially be fixed with the O-ring 15. Of course, other packings may be applied as well, such as, for instance, a metal clamping ring.

Claims

1. A heating apparatus, comprising at least a first heat exchanger, pump means, burner means, connecting means for an inlet and an outlet of a space heating circuit, connecting means for the supply pipe of a further heating circuit, in particular a tapping water heating circuit and a multiple-way valve for connecting a water duct in the heat exchanger to either the connecting means for the inlet of the space heating circuit or the connecting means for the inlet of the further heating circuit, the heat exchanger being cast from light metal or an alloy with light metal, at least the connecting means for the multiple-way valve and/or the pump means being cast integrally therewith.

2. A heating apparatus according to claim 1, wherein a second heat exchanger is further provided which can be incorporated into a tapping water heating circuit, said second heat exchanger being fitted in or against the first heat exchanger, at least a part of the fasteners and connecting means for the second heat exchanger being cast integrally with the first heat exchanger.

3. A heating apparatus according to claim 2, wherein the second heat exchanger is a plate heat exchanger.

4. A heating apparatus according to any one of the preceding claims, wherein for at least the pump means and the multiple-way valve, at least a part of the required fastening points and fastening surfaces, as well as means for accommodating packing means required therefor, are cast integrally with the first heat exchanger.

5. A heating apparatus according to any one of the preceding claims, wherein connecting means and

accommodating means for packing means for the burner means are cast integrally with the first heat exchanger.

6. A heating apparatus according to any one of the preceding claims, wherein the multiple-way valve, the pump means and the burner means are mounted in, at least against the first heat exchanger.

7. A heating apparatus according to claims 2 and 6, wherein the second heat exchanger is also mounted in, at least against the first heat exchanger.

8. A heating apparatus according to any one of claims 2-7, wherein at least the connecting pipes between the pump means and the water duct in the first heat exchanger and/or between the multiple-way valve and the second heat exchanger on the one hand, and the multiple-way valve and the connecting means for the inlet of the space heating circuit on the other, are cast integrally in the first heat exchanger.

9. A heating apparatus according to any one of the preceding claims, wherein at least the pump means and the multiple-way valve are at least fluidtightly connected to the first heat exchanger by means of O-ring seals.

10. A heat exchanger for use in a heating apparatus according to any one of the preceding claims, cast from metal, provided with at least integrated, integrally cast pipes for connection and mutual connection of a water duct in the heat exchanger and pump means, a second heat exchanger and a multiple-way valve and connecting means for an inlet of a space heating circuit and the same multiple-way valve.

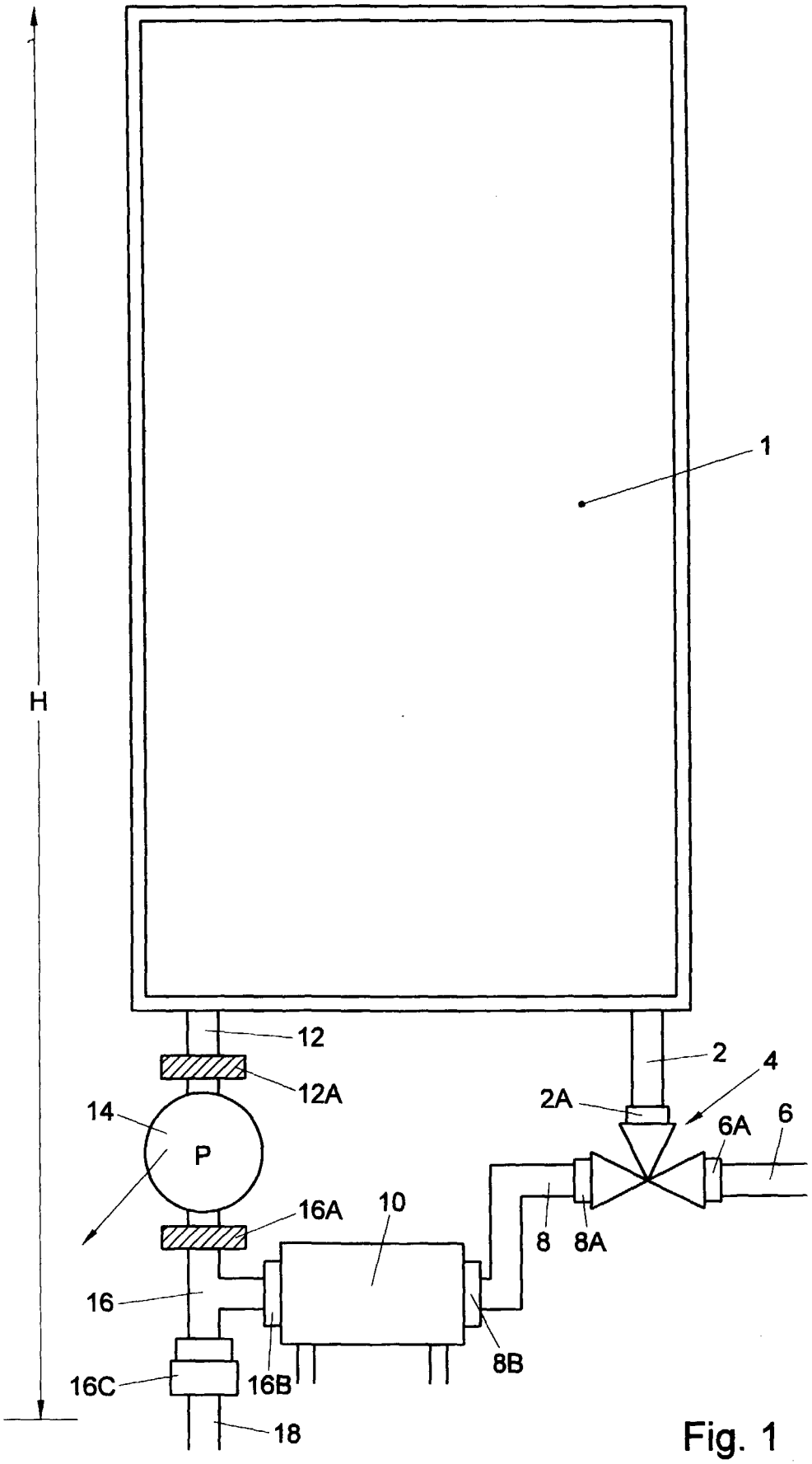

Fig. 1

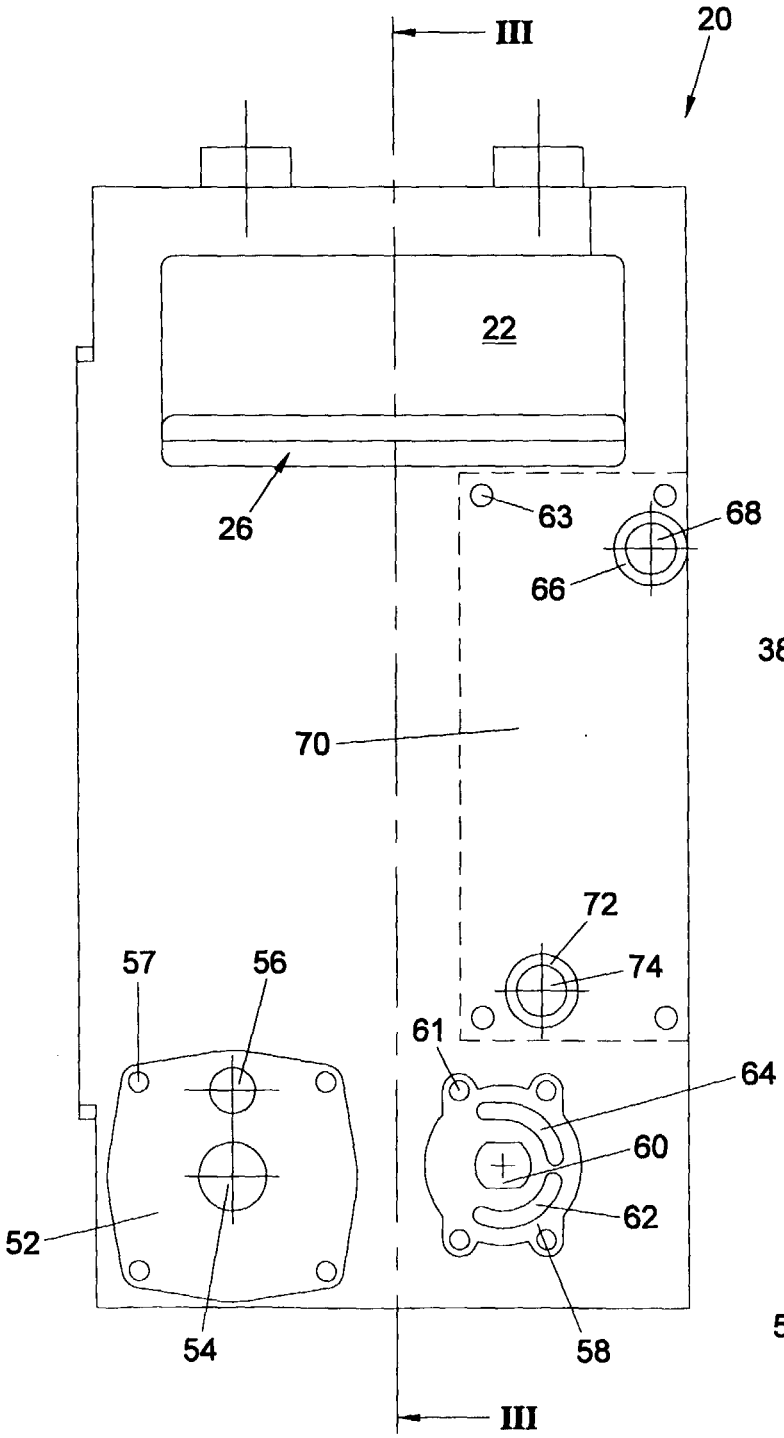
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Fig. 2

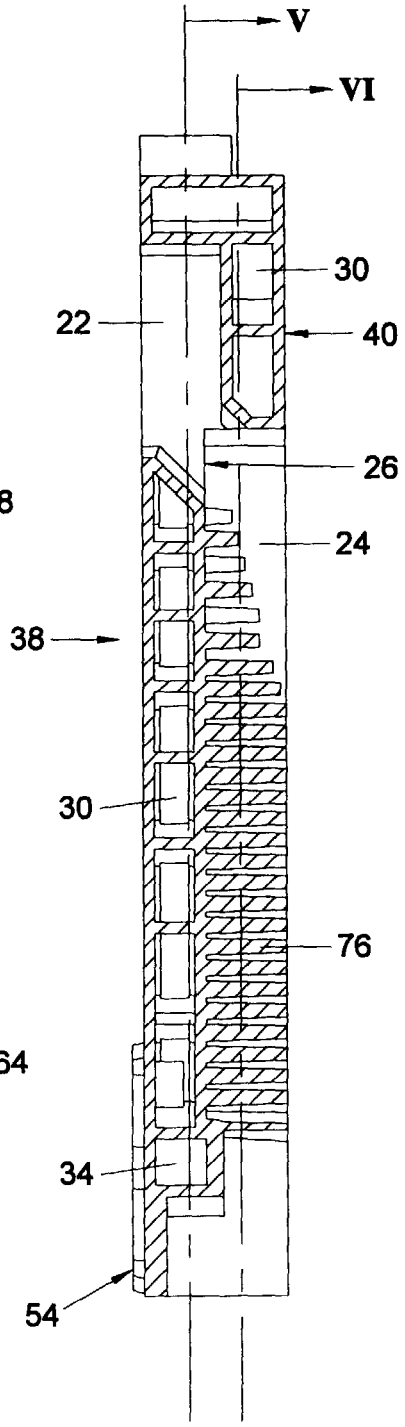
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Fig. 3

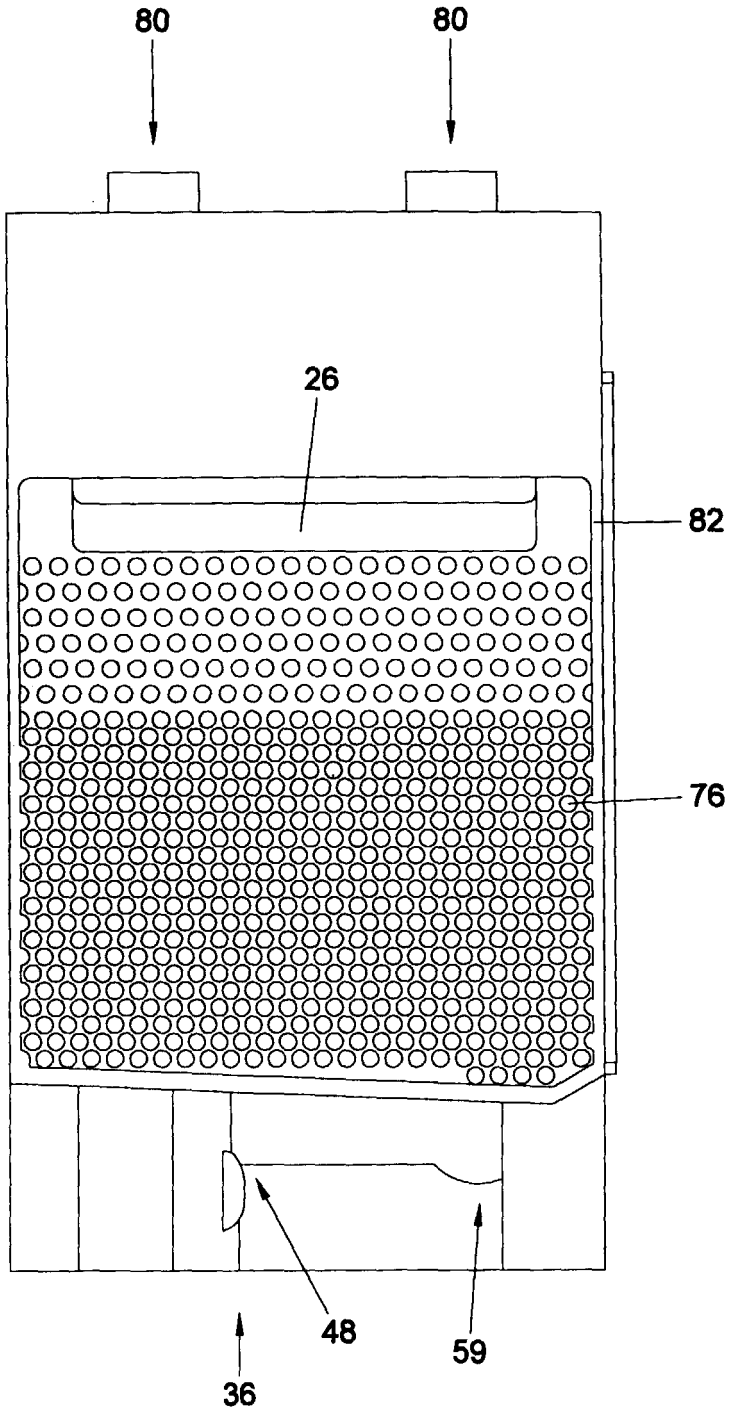

Fig. 4

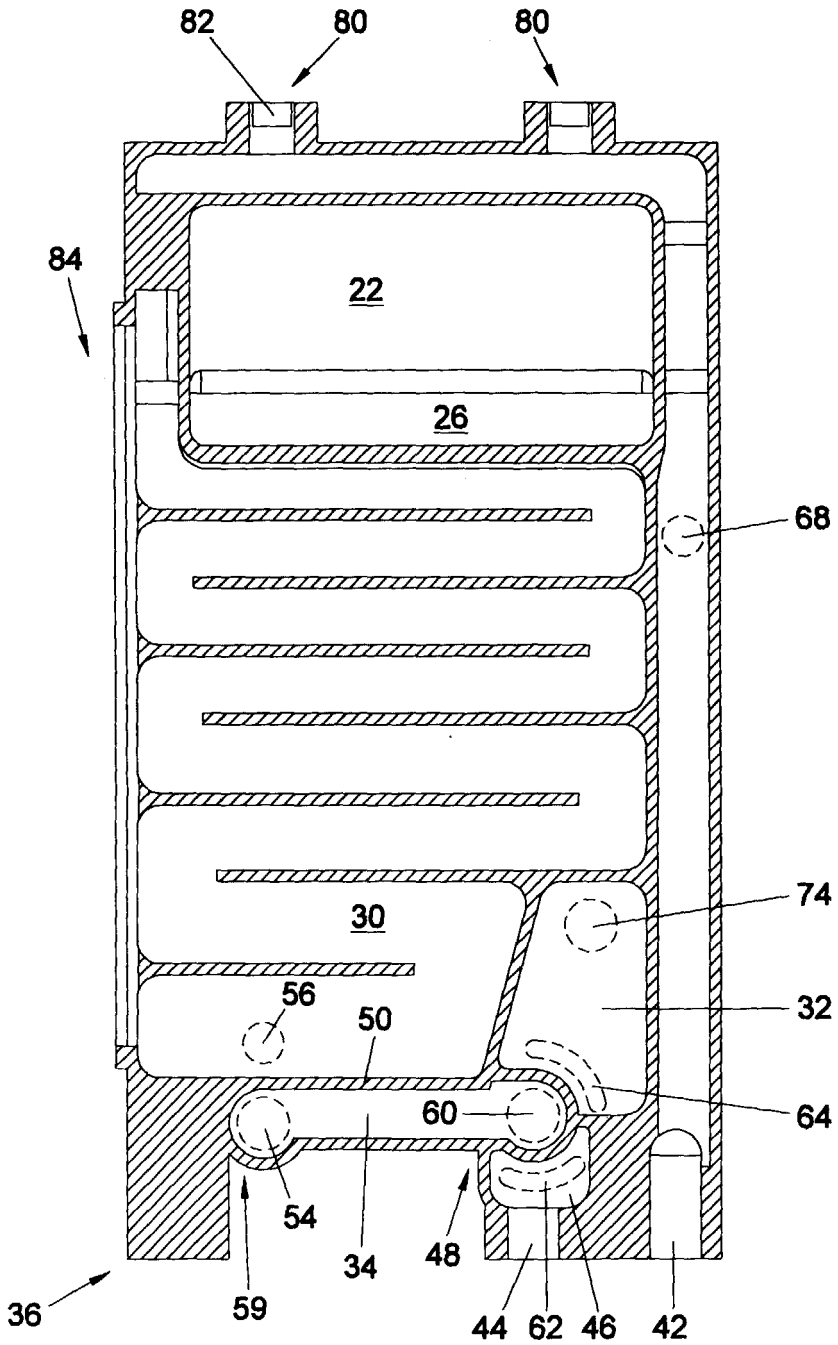

Fig. 5

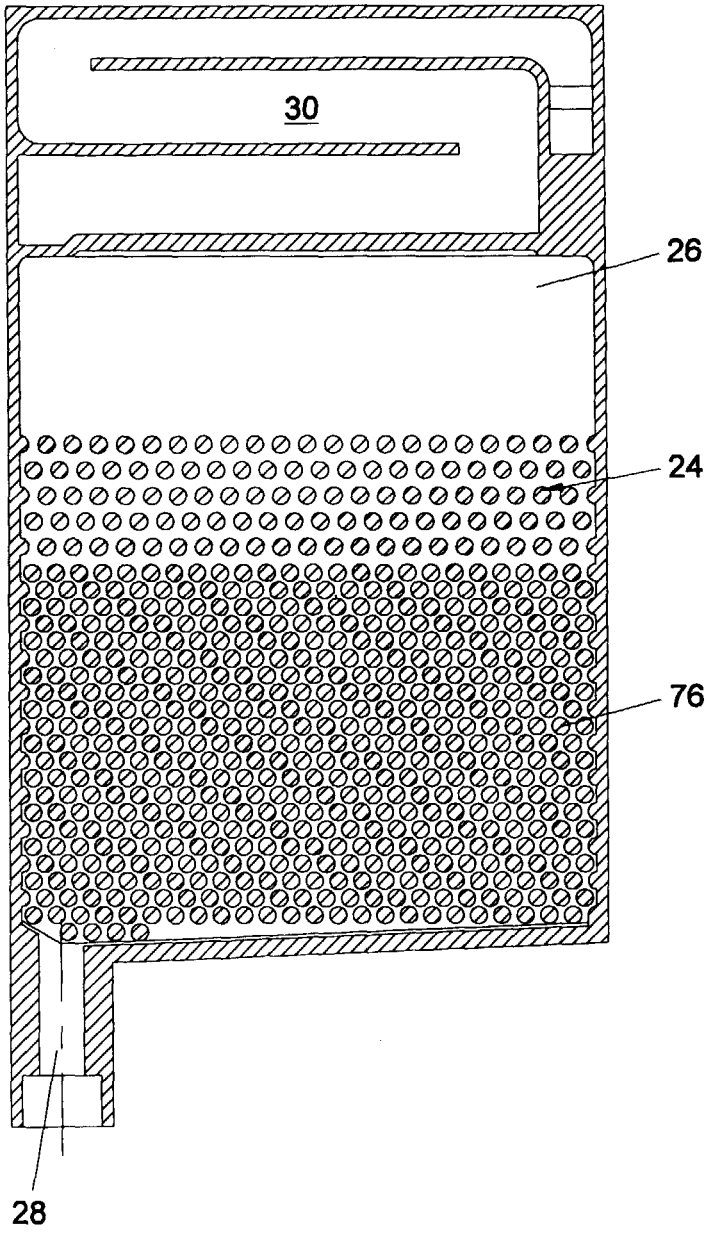

Fig. 6

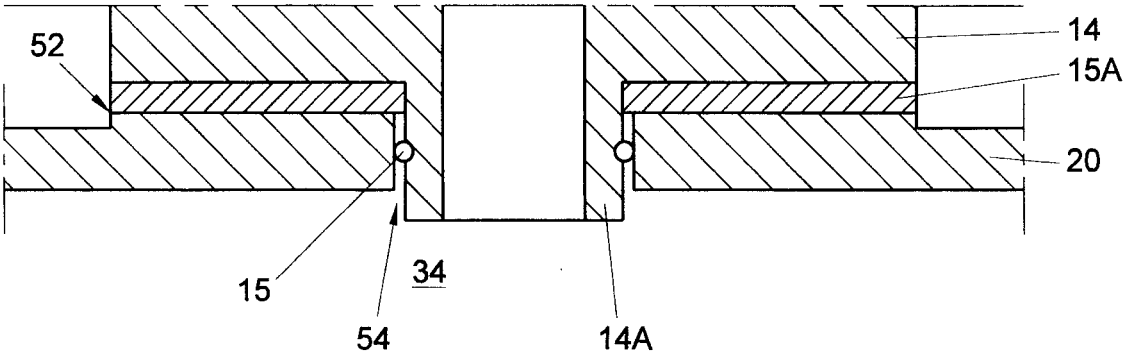

Fig. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 0459

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 May 2000	Van Gestel, H

CATEGORY OF CITED DOCUMENTS

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