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(71) Applicant: **ZONNE-ENERGIE NEDERLAND B.V.**
5504 DG Veldhoven (NL)

(72) Inventor: **In t' Groen, Richard Petrus Cornelis**
5046 DR Tilburg (NL)

(74) Representative: **Bartelds, Erik et al**
Arnold & Siedsma,
Advocaten en Octrooigemachtigden,
Sweelinckplein 1
2517 GK Den Haag (NL)

(54) Heat exchanger and filling part therewith

(57) The invention relates to a heat exchanger provided with a collecting tank for a heating liquid with an inlet opening and an outlet opening, means for bringing the heating liquid into heat-exchanging contact with a medium for heating, and an overflow opening arranged in the tank for discharging an excess of heating liquid. The overflow opening can herein form the mouth of an overflow tube protruding through a wall of the tank. The outlet opening can debouch into a liquid pipe in which a filling opening is arranged, wherein the overflow tube then debouches in the vicinity of the filling opening, and the filling opening and the mouth of the overflow tube are covered by a single cover member. The heat exchanger can be further provided with a pump with a suction side and a delivery side which is connected to the liquid pipe, the delivery side of which is directed upward.

The invention also relates to a filling part for such a heat exchanger, in addition to a heating system in which such a heat exchanger is applied.

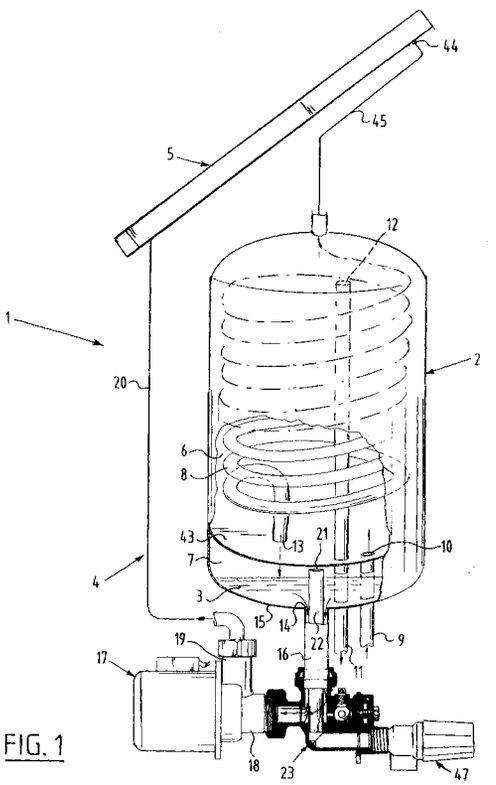

FIG. 1

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Description

[0001] The invention relates to a heat exchanger, provided with a collecting tank for a heating liquid, with at least one inlet opening and at least one outlet opening, means for bringing the heating liquid into heat-exchanging contact with a medium for heating, and at least one overflow opening for discharging an excess of heating liquid. Such a heat exchanger is known and is applied for instance in a system for heating tap water or a central heating system on the basis of solar energy.

[0002] In such a system a heating liquid, generally water, flows through a closed circuit comprising one or more solar collectors and one or more heat exchangers. In the solar collector(s) the water is heated by radiation from the sun, whereafter the heat from this water is relinquished to the medium for heating, generally tap water or water of a central heating system. The system further comprises a storage tank, in which a store of water is retained to ensure that water will be present in the closed circuit under all circumstances. Further incorporated somewhere in the system is an overflow opening through which excess water, for instance during filling of the system, or air inevitably present in the case of excessive expansion of the system can flow away. In addition, the circuit generally has a venting opening or pressure relief valve, whereby an excess pressure of the air in the system can be blown off.

[0003] The overflow opening and venting opening are generally arranged in a part of the circuit outside the storage tank and the heat exchanger, which will usually be embodied as an integral unit. The part of the circuit or the conduit in which the overflow opening and venting opening or pressure relief valve are arranged is widened relative to the rest of the circuit so as to be able to accommodate the necessary connections. This part of the circuit forms a relatively expensive part of the whole installation. Also generally arranged in this wider part of the pipe is a filling opening, onto which a pipe for filling the system can be connected.

[0004] Filling the known system must be done in careful manner. The system must herein be filled to a point such that the water just reaches the overflow opening. Filling must further take place without pressure in order to avoid damaging the system. The known system herein has the drawback that the degree of filling of the widened part of the pipe in which the filling opening and the overflow opening are situated is not a particularly accurate measure for the degree of filling of the system as a whole. In addition, the known system has the drawback that there is a possibility of the system being filled too far or under pressure if the overflow opening is closed, whether or not intentionally, during filling.

[0005] The invention therefore has for its object to provide a heat exchanger of the above described type, wherein these drawbacks do not occur. This is achieved according to the invention in that the overflow opening is arranged in the tank. Thus is ensured that the water flows out of the overflow opening only when a sufficient liquid level has been reached in the storage tank.

[0006] The overflow opening preferably forms the mouth of an overflow tube protruding through a wall of the tank. The location of the overflow opening in the tank can hereby be varied in simple manner by adjusting the extent to which the tube is inserted in the tank.

[0007] In order to minimize the number of individual connections on the tank, the overflow tube advantageously protrudes through the outlet opening. The number of costly operations on the tank is thus reduced as much as possible.

[0008] When the overflow tube is placed concentrically in the outlet opening, an annular outlet opening is herein obtained, thereby reducing the risk of swirl formation in the storage tank, and therewith the risk of air being drawn in from the storage tank.

[0009] When the outlet opening debouches into a liquid pipe in which at least one filling opening is arranged, the overflow tube preferably debouches in the vicinity of the filling opening. Advantageously the heat exchanger herein has a member covering the filling opening and the mouth of the overflow tube. Such a cover member ensures that when the filling opening is left clear the overflow opening is also left clear, whereby overfilling or filling of the system under pressure is avoided.

[0010] An overpressure safety device is preferably arranged in the cover member. Integration of this safety device in the overflow system ensures that only air is blown off. This in contrast to earlier overpressure safety devices, which were often placed lower than the overflow opening and therefore also blew off water.

[0011] When the heat exchanger is further provided with at least one pump with a suction side and a delivery side which is connected to the liquid pipes, at least the delivery side of the pump is preferably directed substantially upward. A self-venting arrangement of the pump is hereby obtained, which is possible because a widened part of the pipe no longer has to connect onto the delivery side of the pump, this in contrast to the situation in older heat exchangers.

[0012] The invention also relates to a filling part for a heat exchanger of the above described type. According to the invention such a filling part comprises a body for connecting to the liquid pipe, in which body are arranged at least one filling opening and at least one discharge opening formed in the vicinity thereof.

[0013] The filling part preferably has a member covering the filling opening and the discharge opening. An overpressure safety device is advantageously arranged in the cover member.

[0014] The filling part is preferably further provided with a closing valve which is arranged in the filling opening and with which this latter can be closed in liquid-tight manner until the moment a filling hose is connected thereto. This closing valve can be a ball valve, a spring-loaded valve or a rotatable closing disc.

[0015] Finally, the invention also relates to a system

for heating a liquid, comprising a heating source and at least one heat exchanger as described above connected in a closed circuit to the heating source. The heating source herein preferably comprises at least one solar collector.

[0016] The invention will now be elucidated on the basis of a number of embodiments, wherein reference is made to the annexed drawing, in which:

Figure 1 shows a partly cross-sectional and partly cut-away, partly perspective side view of a system for heating liquid according to the invention;
Figure 2 shows a detailed view on enlarged scale of the filling part of the system shown in figure 1;
Figure 3 shows a cross-sectional view of the filling part during filling of the storage tank of the system of figure 1; and
Figures 4 and 5 show cross-sections of alternative embodiments of the filling part.

[0017] A system 1 for heating a medium, for instance water for a central heating installation or tap water, comprises a heat exchanger 2, in which the medium for heating is brought into heat-transferring contact with a heating liquid 3 (fig. 1). This heat exchanger 2 is connected in a closed circuit 4 to a heating source, in the shown embodiment a solar collector 5. This system 1 further comprises two pipes 9,11 connected to the heat exchanger for feeding and draining the medium for heating.

[0018] The heat exchanger 2 takes the form of a tank which is divided by a bottom partition 43 into an exchanger space 6 and a storage space 7. Arranged in exchanger space 6 is a spiral-shaped conduit 8, which forms part of closed circuit 4 and through which the heating liquid flows, which liquid is thus in heat-exchanging contact with the liquid for heating in the exchanger space 6 for a relatively long time. The spiral-shaped conduit 8 debouches via an opening 13 in bottom partition 43 in the storage space 7. The liquid for heating is carried into the tank by a feed pipe 9 with a feed opening 10, and leaves the tank via an outlet opening 12 on the upper side of discharge pipe 11.

[0019] In the collecting space 7 a supply of heating liquid 3 is retained such that there is a guarantee that liquid always circulates through the system. From collecting space 7 the heating liquid 3 is drawn through an outlet opening 14 in the bottom 15 and through a liquid pipe 16 which communicates with the suction side 18 of pump 17. The delivery side 19 of this pump 17, which is directed upward so as to ensure a good venting, is in turn connected to a pressure conduit 20, whereby the heating liquid is carried to solar collector(s) 5. Pump 17 herein produces a power such that the heating liquid is carried upward in solar collector 5 as far as an outlet opening 44 thereof, whereafter this liquid flows back through a conduit 45 to heat exchanger 2.

[0020] The heating system must be prevented from being filled further than a desired level. The ratio between the quantity of heating liquid 3 and the quantity of air in system 1 would thereby become too high. Because the air in system 1 has the function of absorbing, by means of compression, the expansion of the heating liquid 3 resulting from differences in temperature, which can amount to several percent, too small a quantity of air could result in too high a liquid level in the whole system 1. Heating liquid 3 could hereby come to a standstill in the conduits 20,45 going to and from collector 5, and in extreme cases even in the collector 5 itself, where the liquid would be exposed to the danger of freezing. An overflow opening 21 is therefore present through which an excess of heating liquid 3 can be drained from system 1.

[0021] This overflow opening 21 is arranged according to the invention in collecting space 7 of the heat exchanger 2 itself, instead of outside it as was usual in such systems. Overflow opening 21 thus forms an accurate measure for the quantity of liquid in system 1. In the shown embodiment the overflow opening 21 is the mouth of an overflow tube 22 which protrudes into the collecting space 7 of the tank. Overflow tube 22 is herein arranged in outlet opening 14, which must anyway always be present in the wall of the tank, so that no additional adaptations of the tank are required. In the shown embodiment the overflow tube 22 is even arranged concentrically in outlet opening 14, whereby outlet opening 14 in fact becomes annular, which has the added advantage of thereby preventing swirl formation in collecting space 7, and therewith the risk of air being drawn into pipes 16, 20.

[0022] Further arranged in liquid pipe 16 is a filling opening 28 through which the system 1 can be replenished. (fig.2). In the shown embodiment the overflow tube 22 debouches in the vicinity of this filling opening 28. This enables covering of filling opening 28 and mouth 27 of overflow tube 22 with a single cover member 30, which is fixed in the shown embodiment by means of a screw 31 and which must be removed before the system 1 can be replenished. When this cover member 30 is removed, not only is filling opening 28 left clear but also the mouth 27 of overflow tube 22, thereby avoiding the risk of system 1 being filled while overflow opening 21 is still closed.

[0023] The mouth 27 of overflow tube 22 and the filling opening 28 form part of a separate filling part 23, which is mounted on the underside of liquid pipe 16 (fig. 3). This filling part 23 comprises a housing 24 in the form of a kneebend, with connecting pieces 25 and 26 for the connection to respectively pump 17 and discharge pipe 16. Pump 17 is herein fixed to connecting piece 25 by means of a threaded ring 33 with interposing of a gasket 34, while to fix the filling part 23 to discharge pipe 16 use is made of a squeeze coupling, consisting of a threaded part 35 and a deformable clamping ring 36. Cover member 30 is fixed onto filling part 23 via a gasket 38.

[0024] Arranged in filling opening 28 is a closing valve 29, in the shown embodiment a ball valve. This ball-valve is provided on the top with an operating part 39 which co-acts with an operating recess 37 in cover member 30. When released from filling part 23, the cover member 30 can thus be used to rotate ball valve 29 such that a passage opening 40 arranged therein comes wholly or partially into register with filling opening 28. Ball valve 29 is of course only opened after a coupling piece 42 of a filling hose 46 has been connected, for instance by screws, to a connecting piece 41 in filling opening 28.

[0025] During filling of the system 1 heating liquid 3, usually water, is thus injected through the filling hose 46 in filling opening 28 into filling part 23, and will flow upward therein around the overflow tube 22 and flow through pipe 16 via outlet opening 14 into collecting space 7 of heat exchanger 2. When this collecting space is filled to an extent such that the water reaches the overflow opening 21, it begins to flow away through overflow tube 22, which debouches in the bottom of filling part 23, so that the water runs away through outlet opening 27. At that moment filling can be stopped and ball valve 29 can be closed again, whereafter cover member 30 can be put in place again.

[0026] Cover member 30 is further provided with a connection 32 for an overpressure safety device 47, whereby in the case of excess pressure air can be blown off through overflow tube 22 and outlet opening 27 via the overpressure safety device 47. Because this overpressure safety device 47 is connected to overflow tube 22, the mouth of which will normally be located above the liquid level in collecting space 7, it is indeed only air which is blown off in the overpressure safety device, and it will not be accompanied by water, as was the case in conventional systems.

[0027] Instead of the shown ball valve 29, a spring-loaded valve 129 can also be used as closing valve (fig. 4). This valve 129 can comprise a pin-like part 152 which is received in a guide member 153 in filling opening 128. The pin-like part 152 is herein connected to a dish-like or otherwise shaped pressure part 150, which is in contact with a compression spring 151 in filling opening 128. This closing valve 129 is therefore opened by pressing thereagainst a suitably formed filling nozzle of a filling hose (not shown here), whereby the closing valve 129 is pressed inward counter to the force of spring 151 and thus leaves clear a passage opening 140. This variant is therefore simpler to operate than the first embodiment, since opening of closing valve 129 takes place automatically when the filling hose is coupled.

[0028] In yet another variant the closing valve 229 is embodied as a rotatable disc, which can rotate around a central pin 251 (fig. 5). For the sake of clarity in figure 5 the surface 252 of the disc is herein rotated through 90° in the plane of the drawing in order to show clearly the peripheral form thereof. Arranged in the disc is a first opening 240, the cross-section of which corresponds with the filling opening 228, as well as a second slot-like opening 250 which runs in peripheral direction. Gaskets 253 are arranged between the disc-like closing valve 229 and the housing 224 of filling part 223. In the shown position the installation can be filled by connecting a filling hose onto filling opening 240. Once the system is filled, the opening 240 can be taken out of register with opening 228 by rotating the disc-like closing valve 229, whereby opening 228 is covered by the disc-like body 229. However, the opening 250 will herein still remain in register with outlet opening 227, whereby an excess of water or air under pressure can still escape from the system.

[0029] Although the invention has been elucidated above with reference to a number of embodiments, it will be apparent that it is not limited thereto. The overflow tube could for instance protrude at a different position into collecting tank 7, while in addition other forms of overflow tube or overflow opening can also be envisaged. The annular outlet opening could also be realized in a different manner, without using the overflow tube for this purpose and, while retaining the advantages associated therewith, it could also be used in other heat exchangers. The pump with vertically directed outlet opening on the delivery side, whereby an automatic venting is obtained, could, with the same advantages, also be applied in combination with another heat exchanger. In addition, instead of using a separate filling part, the filling opening and the mouth of the overflow tube could also be arranged in an existing pipe.

[0030] The scope of the invention is therefore defined solely by the appended claims.

Claims

1. Heat exchanger (2), provided with a collecting tank for a heating liquid (3), with at least one inlet opening and at least one outlet opening, means for bringing the heating liquid into heat-exchanging contact with a medium for heating, and at least one overflow opening for discharging an excess of heating liquid, **characterized in that** the overflow opening is arranged in the tank.

2. Heat exchanger as claimed in claim 1, **characterized in that** the overflow opening forms the mouth of an overflow tube protruding through a wall of the tank.

3. Heat exchanger as claimed in claim 2, **characterized in that** the overflow tube protrudes through the outlet opening.

4. Heat exchanger as claimed in claim 3, **characterized in that** the overflow tube is placed concentrically in the outlet opening.

5. Heat exchanger as claimed in any of the foregoing claims, wherein the outlet opening debouches into a liquid pipe in which at least one filling opening is arranged, **characterized in that** the overflow tube debouches in the vicinity of the filling opening.

6. Heat exchanger as claimed in claim 5, **characterized by** a member covering the filling opening and the mouth of the overflow tube.

7. Heat exchanger as claimed in claim 6, **characterized in that** an overpressure safety device is arranged in the cover member.

8. Heat exchanger as claimed in any of the claims 5 to 7, provided with at least one pump with a suction side and a delivery side which is connected to the liquid pipe, **characterized in that** at least the delivery side of the pump is directed substantially upward.

9. Filling part for a heat exchanger as claimed in any of the claims 5 to 8, comprising a body for connecting to the liquid pipe, in which body are arranged at least one filling opening and at least one discharge opening formed in the vicinity thereof.

10. Filling part as claimed in claim 9, **characterized by** a member covering the filling opening and the discharge opening.

11. Filling part as claimed in claim 9 or 10, **characterized in that** an overpressure safety device is arranged in the cover member.

12. Filling part as claimed in any of the claims 9-11, **characterized by** a closing valve arranged in the filling opening.

13. Filling part as claimed in claim 12, **characterized in that** the closing valve is a ball valve.

14. Filling part as claimed in claim 12, **characterized in that** the closing valve is a spring-loaded valve.

15. Filling part as claimed in claim 12, **characterized in that** the closing valve is a rotatable closing disc.

16. System (1) for heating a medium, comprising a heating source (5), at least one heat exchanger (2) as claimed in any of the foregoing claims connected in a closed circuit (4) to the heating source (5) and at least one pipe (9,11) for the medium for heating connected to the heat exchanger (2).

17. Heating system (1) as claimed in claim 16, **characterized in that** the heating source (5) comprises at least one solar collector.

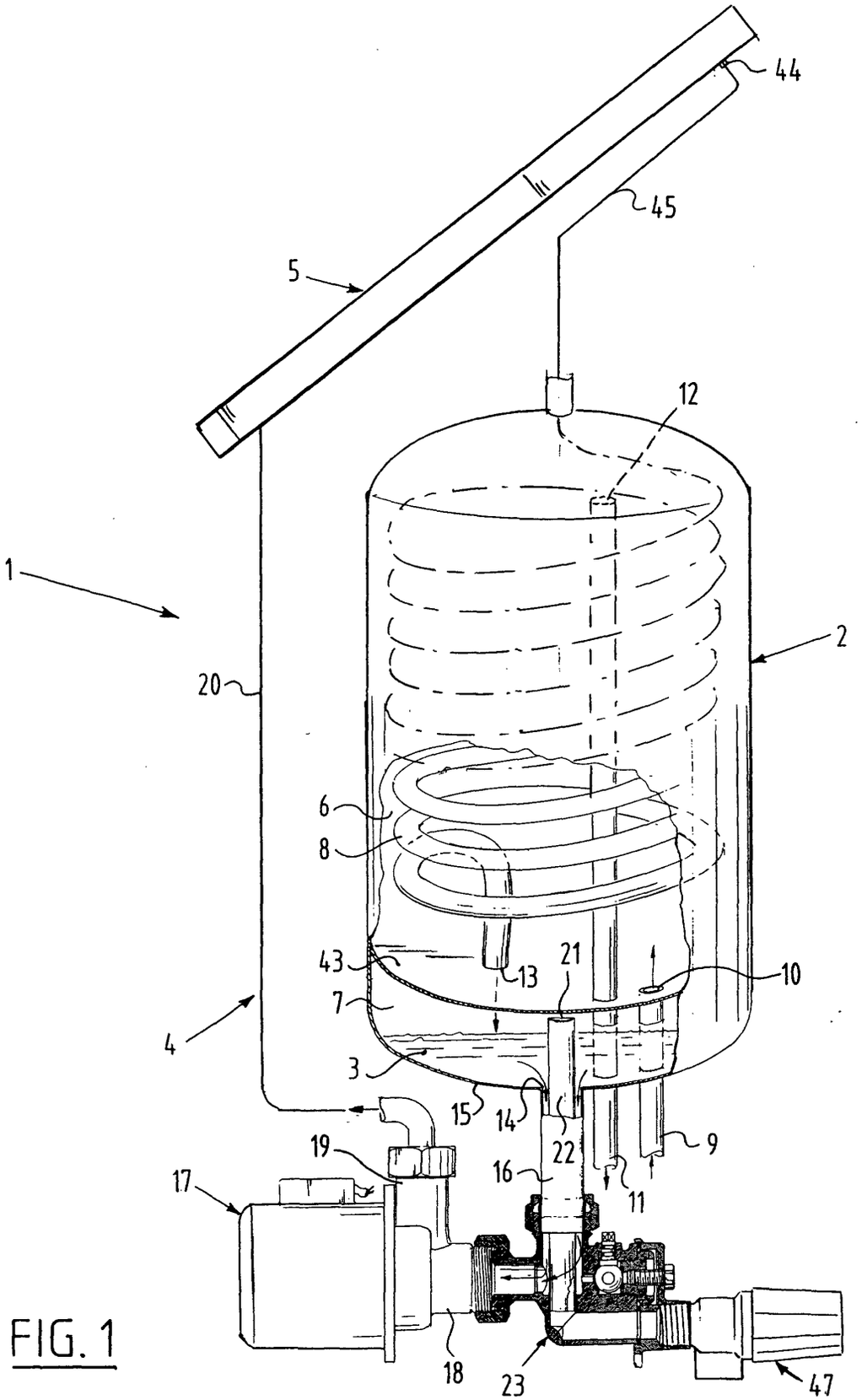
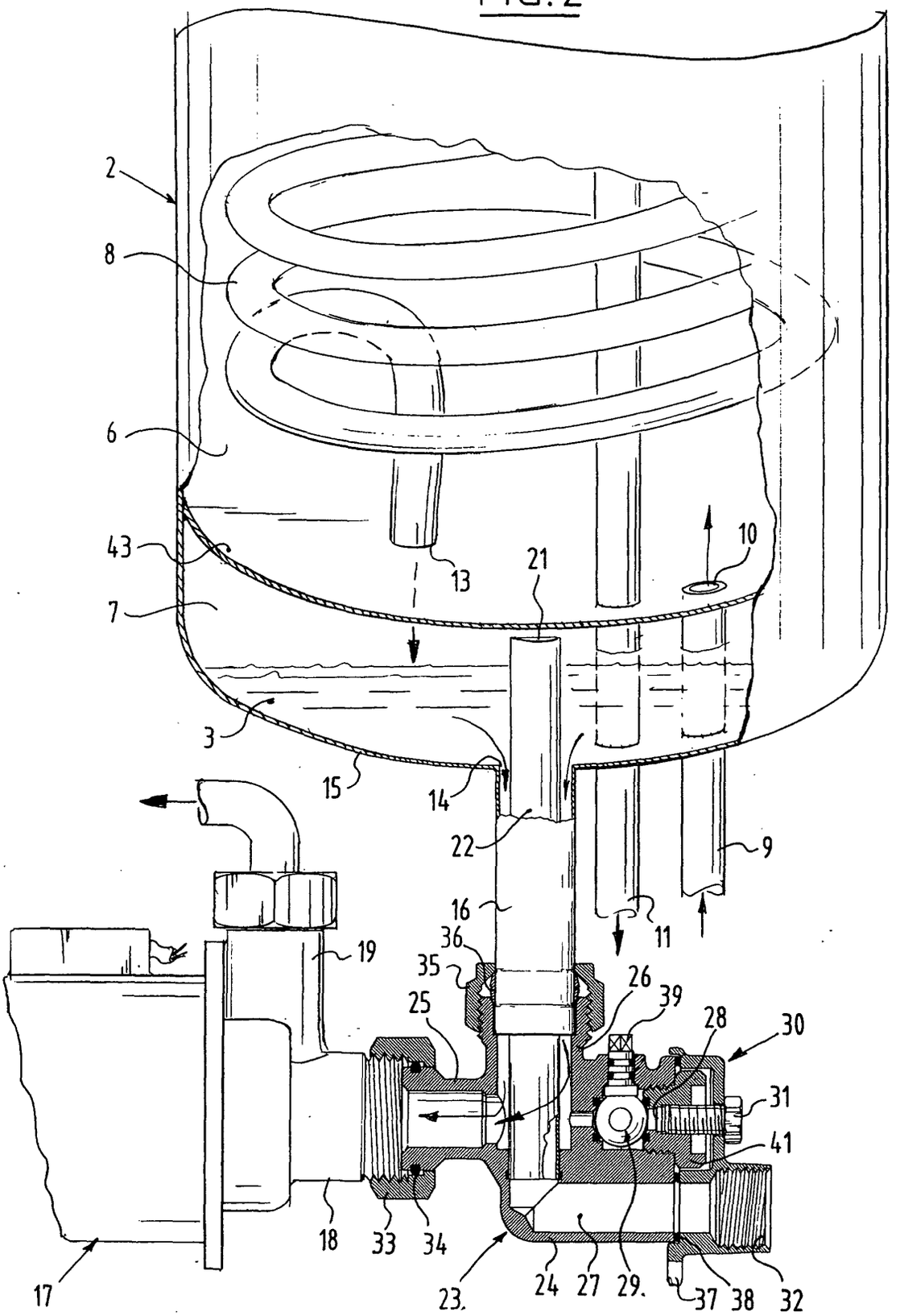


FIG. 1

FIG. 2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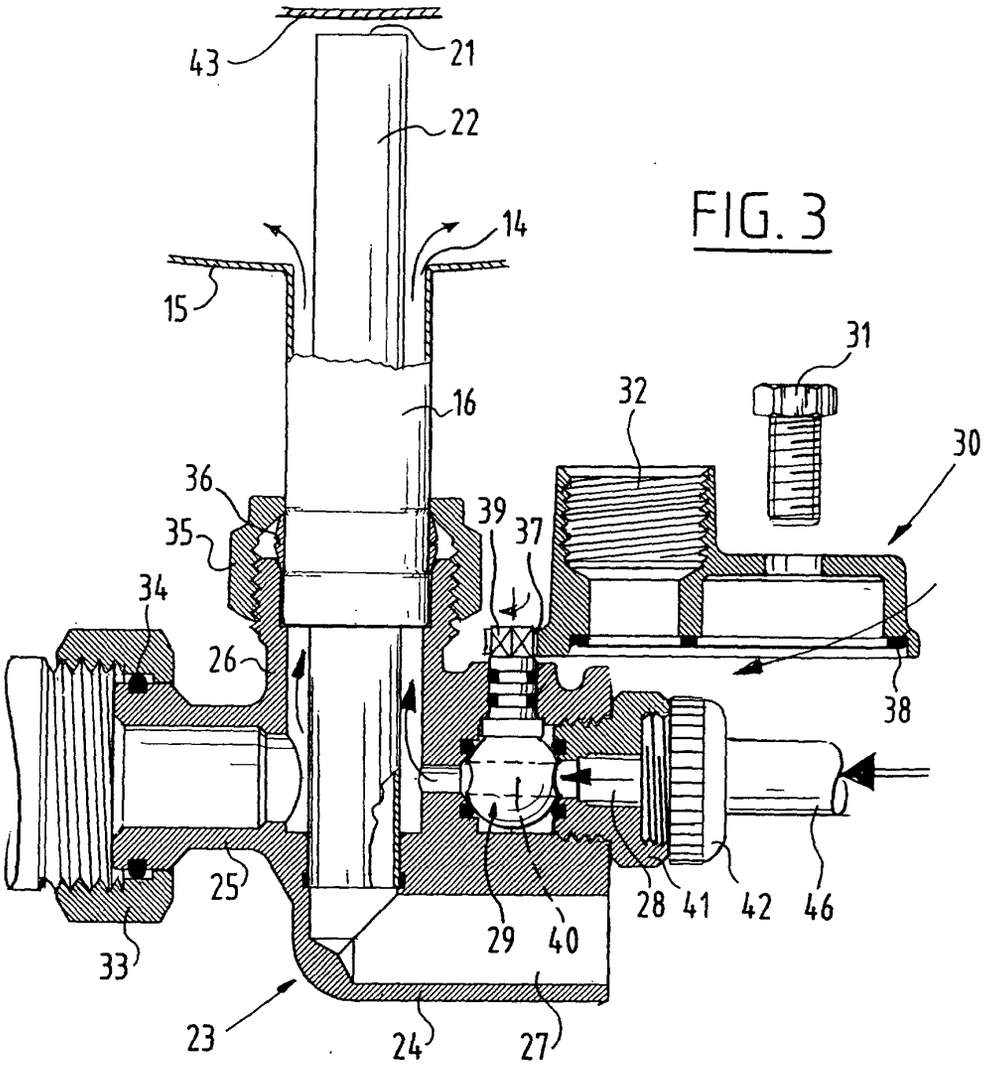


FIG. 3

FIG. 4

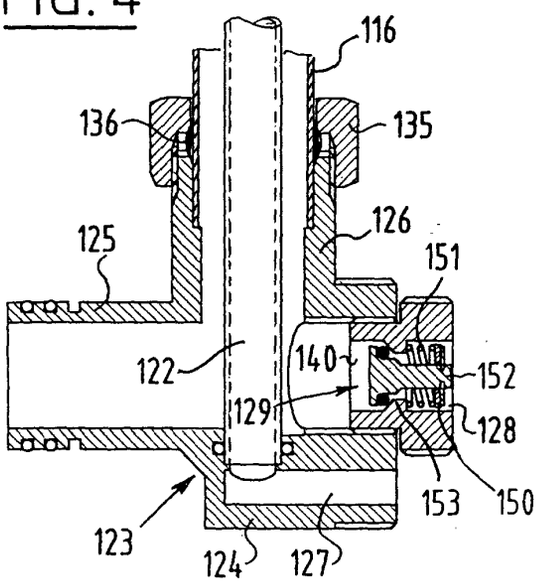
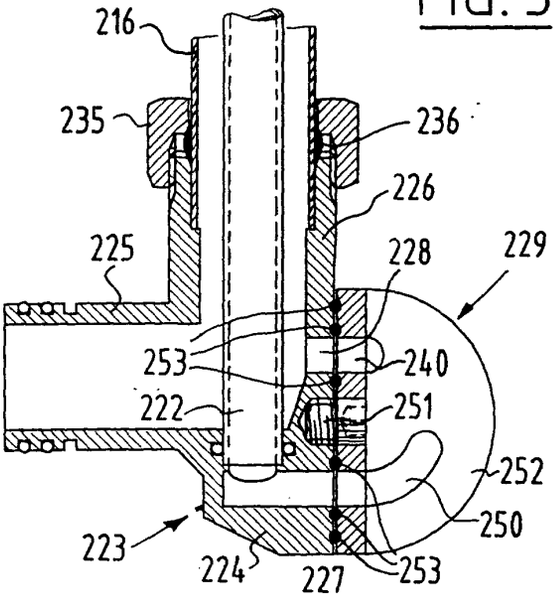


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 01 20 0126

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 July 2001	Van Gestel, H

CATEGORY OF CITED DOCUMENTS

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