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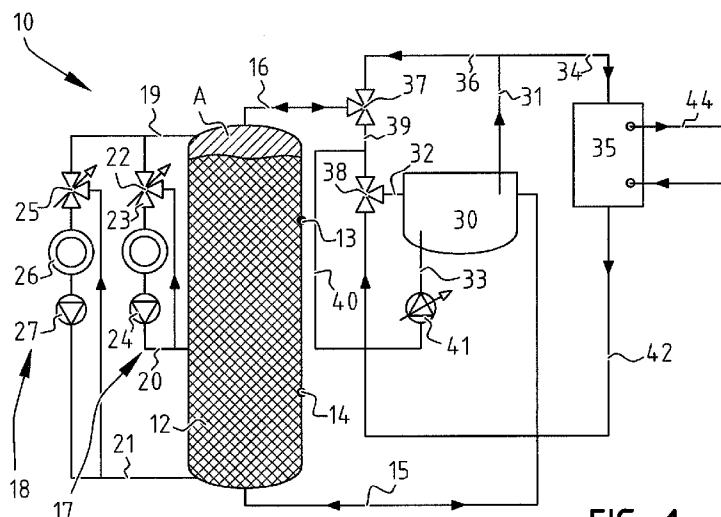
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(54) Title: DEVICE AND METHOD FOR HEATING A FLUID SUCH AS WATER, HEATING AND TAP WATER

**FIG. 1**

(57) Abstract: The present invention provides a method for obtaining hot tap water and heating, comprising: a storage reservoir for storing hot fluid, this storage reservoir having a certain height so that considerably hotter fluid is located on the upper side of the storage reservoir than on the underside thereof; a heating appliance with a primary heating conduit for heating of fluid and a secondary heating conduit for recovering residual heat from the flue gases; and a heat exchanger for obtaining clean and hot tap water from the fluid, wherein hot fluid is guided from the upper part of the storage reservoir to the heat exchanger as soon as a hot tap water is demanded and wherein the heating appliance is switched on in order to continue meeting this demand.

**DEVICE AND METHOD FOR HEATING A FLUID SUCH AS WATER, HEATING
AND TAP WATER**

In the light of the limited availability of fuels,
5 which will inevitably only become scarcer in the future, and
the associated increasing price level, energy saving and
efficient heating are extremely important in the near and
more distant future.

All manufacturers seek to find efficient combinations
10 of heating and tap water using so-called HE (high-
efficiency) combi-boilers.

The present invention has for its object to take a
significant step forward in this efficiency process and
makes efficiency improvements possible of 10 to 30 percent.

15 The present invention provides a system for obtaining
hot tap water and heating, comprising a storage reservoir
for storing hot fluid, this storage reservoir having a
certain height so that considerably hotter fluid is located
on the upper side of the storage reservoir than on the
20 underside thereof; a heating appliance with a primary
heating conduit for heating of fluid and a secondary heating
conduit for recovering residual heat from the flue gases;
and a heat exchanger for obtaining clean and hot tap water
from the fluid, wherein hot fluid is guided from the upper
25 part of the storage reservoir to the heat exchanger as soon
as hot tap water is demanded and wherein the heating
appliance is switched on in order to continue meeting this
demand.

In the present invention a determined quantity of CH₄
30 water of the heating fluid is stored in a storage reservoir,
which storage reservoir is provided on the upper side with
sufficient hot fluid for direct heating of tap water while
switching of the three-way valve in the system is also

highly suitable for space heating. Although the system is highly suitable for space heating, it is optionally also possible to envisage other heating applications.

Since the heat demand in the heat exchanger will depend on the demanded quantity of tap water, it is recommended for the purpose of further efficiency to make a pump on the primary inlet side of the heating appliance controllable so that in the case of a lower heat demand a smaller quantity of heat fluid is also guided through the heating appliance and the heat exchanger.

Although it is possible to make use of a four-way valve combining the desired switching functions, use is made in a preferred embodiment of two three-way valves since these are available on the market for central heating equipment at relatively low prices. The outlet of the heat exchanger is preferably coupled to the secondary conduit of the heating appliance, whereby the flue gases are likewise cooled to below the dew point when hot tap water is demanded and there is also a high efficiency when tap water is drawn off.

In a further preferred embodiment the wall of the storage reservoir is provided at a determined height, for instance between 20 and 80% of the full height, with a temperature sensor which can be set to a determined temperature in order to determine the temperature at which the heating appliance has to be switched on and off; this temperature and location of the temperature sensor can depend on the requirements in a particular season or in a particular household, i.e. more or less frequent use of tap water and/or space heating.

Owing to the storage reservoir and the control according to the present invention, heat from a solar boiler or wood-burning stove is particularly suitable for adding to the fluid of the storage reservoir. The heating appliance is

hereby set into operation less often in order to hold the storage reservoir at temperature.

In a further preferred embodiment the system according to the invention is provided with means for allowing to greater or lesser extent tap water to be drawn for a shorter or longer period of time. Suitable means for allowing to greater or lesser extent tap water to be drawn for a shorter or longer period of time are for instance a time switch, an automatic burner control, a legionella prevention system and/or an electronic, automatic or manually switched on/off switch.

In a further aspect the invention relates to a heating appliance, preferably a heating appliance in the present system. Said heating appliance is suitable for providing a temperature increase between supply fluid and discharge fluid of at least 40°C, such as at least 50, 60, 70, 80 or even 90°C. This is advantageous for enabling maximum use to be made of the condensation effect of the flue gases, since fluid can be supplied from the storage reservoir which is colder than the at least 40°C of the discharge fluid as present in the storage reservoir. Known heating appliances are unable to cope with such a wide heating range because the great temperature differences occur in a short time and existing appliances cannot withstand the expansion and contraction resulting from the great temperature differences.

In a further preferred embodiment the present primary heating conduit is a pipe heat exchanger which is straight or extends in a straight line and which is partially enclosed by a burner chamber for heating fluid and by the present secondary heating conduit for recovering residual heat from the flue gases. A straight pipe heat exchanger has the advantage that it can contract and expand freely and a

wide temperature range can hereby be obtained between supply and discharge fluid. This expansion and contraction is problematic in curved heat exchangers which cannot withstand rapid temperature differences over a wide temperature range.

5 In the present system the fluid can for instance have a temperature of around 10°C at the inlet side of the pipe heat exchanger, while the temperature of the fluid at the outlet side of the heat exchanger may have increased to boiling point. Because the fluid has a temperature at the
10 inlet side lying preferably more than 40°C below the temperature at the outlet side, maximum use is made of the condensing capacity of the heating appliance.

Said pipe heat exchanger preferably has a length in the range of 0.5 to 1.5, 2.0, 2.5 or even 3 metres. The diameter
15 of the primary heating conduit is preferably greater than 1.0, 2.0 or even 3.0 cm. The pipe heat exchanger is preferably provided with ribs so as to increase the contact surface area between the primary heating conduit and heat from combustion and/or flue gas.

20 About 20 to 80% of the length of the primary heating conduit is preferably enclosed by the burner chamber. More preferably about 40 to 70% of the length of the primary heating conduit is enclosed by the burner chamber. The remaining length of the primary heating conduit is
25 preferably enclosed by the secondary heating conduit for the purpose of recovering residual heat from the flue gases.

In a further preferred embodiment the secondary heating conduit guides the flue gases at least 1, 2 or 3 times along the primary heating conduit for the purpose of recovering
30 residual heat from the flue gases. The flue gases are preferably guided for the purpose of combustion through the secondary heating conduit by means of a flue gas impeller and the overpressure of freshly supplied gas and air.

Said secondary heating conduit can consist of a conduit for flue gases, of a conduit for fluid, but also of mutually separated conduits, one of which is embodied and connected for guiding fluid and the other is embodied and connected for guiding flue gases. A connection diagram is in this way obtained wherein maximum use is made of the condensing capacity of the system since fluid is guided in a primary direction, for instance in the direction of a plate exchanger in order to provide hot tap water, as well as in a secondary direction, for instance return fluid from a plate exchanger which is fed back to the storage reservoir.

In a further preferred embodiment the present heating appliance is provided with a flue gas discharge which is in direct contact with a supply conduit for the combustion mixture of gas and air for the purpose of heating the combustion mixture with residual heat from the flue gases. The combustion mixture is in this way preheated so that the combustion proceeds more efficiently, which further increases the efficiency of the system. The flue gas discharge is preferably placed downstream in the flow direction of the flue gases relative to the secondary heating conduit so that the heat of the flue gases is relinquished first to the fluid in the primary heating conduit and any remaining heat is relinquished to the combustion mixture.

First measurements with the embodiment of a straight pipe heat exchanger show an efficiency improvement of about 10% compared to a standard Coopra N37K HE Combi-boiler, measured relative to the number of litres of gas used to provide 9 litres of water at 60°C. Noticeable during the analysis was that the heating appliance according to the invention condensed continuously and thereby used residual heat from the flue gases.

The present invention also provides a method for quick and efficient heating of tap water, wherein use is more preferably made of the above stated system.

Further features, advantages and details of the present invention will be elucidated on the basis of the following description which describes a preferred embodiment and wherein reference is made to the drawing, in which:

Fig. 1 shows the preferred embodiment of the system according to the present invention;

Fig. 2 shows the preferred embodiment of fig. 1 in a first situation for heating the CH water in the tank;

Fig. 3 shows the preferred embodiment of fig. 1 in a second situation for providing hot tap water;

Fig. 4 shows a cross-section of a preferred embodiment of a heating appliance suitable for the present system;

Fig. 5 shows a preferred embodiment of the system according to the present invention;

Fig. 6 shows another cross-section of the preferred embodiment of a heating appliance according to figure 4.

The preferred embodiment of the CH system 10 (fig. 1) according to the present invention comprises a supply tank 12, for instance substantially cylindrical and with a volume of about 100-1000 litres, which is provided with one or more temperature sensors 13, 14, at least one connection on the underside for a conduit 15, a connection for the conduit on the upper side 16 and a first schematically represented space heating CH system 17 and a second schematically represented CH system 18, but in any case connected to conduits 19, 20, 21 of the supply tank. The first CH system comprises a controllable three-way valve 22 and radiators 23 and a pump 24, while the second CH system comprises a controllable three-way valve 25 and floor heating system 26 and a pump 27.

Connected to conduit 15 is a heating appliance 30 with a power of for instance 15-40 kW, to which conduits 31, 32, 33 are also connected. Conduit 31 is connected on the one hand to a conduit 34 leading to a plate exchanger 35 and on the other to conduit 36 leading to a three-way valve 37, to which conduit 16 is also connected. Conduit 32 leads to three-way valve 38 which is connected via conduit 39 to three-way valve 37. Also connected to conduit 39 is a conduit leading via a controllable pump 41 to a conduit 33. A conduit 42 is connected between plate exchanger 35 and three-way valve 38.

As is assumed known, the liquid in the supply tank has a certain temperature gradient. The liquid in the upper part A of the tank, shown with diagonal hatching, has for instance a temperature of about 65°C, while the liquid a certain distance thereunder has for instance a temperature of about 40°C. At the bottom of the tank the water will have a temperature of about 20-25°C. Selecting the desired setting for both the position and the temperature to be measured of at least one of the two sensors 13, 14 can ensure that the water in part A has a determined high temperature without the rest of the content of the supply tank having to be heated unnecessarily.

Figure 2 shows the heating of the CH water in the tank. When the temperature sensor (13) indicates that the temperature of the CH water in the tank is decreasing, CH water is guided from the underside of the supply tank via conduit 15 through the condensing part of heating appliance 30 via conduit 32 and three-way valve 38 via conduit 40 to the primary combustion circuit (controllable pump 41, conduit 33 and conduit 31 and via conduit 36 and three-way valve 37 and conduit 16 to the upper part A). By using the relatively cold CH water in the condensing part, optimal use

is made of the high efficiency of heating appliance 30, while admitting the heated CH water into the supply tank on the upper side prevents the cold water from being heated too much; the heating cycle stops as soon as the temperature sensor indicates that the desired temperature has been obtained at a certain height in the tank.

Figure 3 shows the situation where hot tap water is demanded in conduit 44, as determined by a sensor (not shown). This hot CH water is then guided via upper side A of the supply tank via conduit 16, three-way valve 37, conduit 39, conduit 40 into the heating appliance and via conduit 31, conduit 34 to plate exchanger 35 for heating the tap water supplied by conduit 43. The cooling CH water is guided via conduit 42, three-way valve 38 and conduit 32 to the condensing part of heat appliance 30, and eventually via conduit 15 to the bottom part of the supply tank.

Owing to the use of the hot CH water from the supply tank for tap water, the hot water is immediately available to heat tap water, whereby conduit and standstill losses are avoided, while the heating appliance is utilized optimally by making use of CH water cooled in the plate exchanger on the condensing side of the heating appliance.

When the supply tank has a sufficient temperature a schematically designated floor heating 23 and schematically designated radiators 26 of the space heating system can be heated therewith. The controllable flow rate for the floor heating system is more efficient and easy to realize with the controllable three-way valve 22, wherein the temperature in return conduit 21 of this system can be assumed to be the temperature in the underside of the supply tank of about 20-25°C. Since return conduit 20 of the radiator system is arranged at a higher level in the tank, the return

temperature in this return conduit 20 is higher, for instance about 35-40°C.

A close-in-boiler can be connected in a manner not shown to the part A of the supply tank, this being considerably more efficient than the current electrically heated close-in-boilers as are applied on a large scale. It is also possible to connect other heat sources to the supply tank, such as a solar boiler or a wood-burning stove, since the temperature sensor determines whether sufficient heat is present in the supply tank and whether, on the basis thereof, the heating appliance does or does not have to be switched on.

First calculations and tests have shown that the present connection diagram brings within reach a saving of 10 to 30% of the energy required for a domestic system. Owing to the more efficient use of the upper part of the supply tank tap water is quickly available, while the residual heat thereof flows back into the supply tank. Standstill losses are extremely limited, while the cost of two three-way valves (or one four-way valve) is of little significance.

Figure 4 shows a heating appliance which can be used in the present system. Figure 4 shows walls 112, the fluid circuit with controllable pump 41, conduit 33 and primary heating conduit 101 with ribs 102, which together form a straight pipe heat exchanger with a length of 140 cm. Figure 4 also shows the combustion mixture and flue gas circuit with gas block 103, fan 104, combustion mixture conduit 105, burner chamber 106 with ceramic plates 107 and ionization pin 110, burner chamber walls 111, flue gas impeller 108, secondary heating conduit 109 with guides 113 and flue gas discharge 114.

When the system is in operation, fluid is supplied by pump 41 via conduit 33 to the primary heating conduit 101 and, when heated, leaves the pipe heat exchanger on the upper side. Via gas block 103 and fan 104 the combustion mixture 121 is also supplied via conduit 105 to burner chamber 106, where flames 115 result due to ignition via ionization pin 110 so that the flames radiate heat to both the ceramic plates 107 and the primary heat conduit 101 so that the fluid is heated. The flue gases 123 which occur during the combustion in combustion chamber 106 are carried by flue gas impeller 108 with openings (not shown) therein to the secondary heating conduit 109a, as shown by arrows 123a. The overpressure created by fan 104 then guides the flue gases via guides 113 along the primary heating conduit 101 into space 109b. Arrows 123b indicate how the flue gases flow along ribs 102 and primary heating conduit 101 for a first time. Arrows 123c indicate how the flue gases flow along ribs 102 and primary heating conduit 101 for a second time. Arrows 123d indicate how the flue gases flow along ribs 102 and primary heating conduit 101 for a third time. The residual heat of the flue gases is hereby relinquished to the primary heating conduit 101 and ribs 102, which increases the contact surface area with flue gases 124. The flue gases then flow from 109b to 109c as indicated by arrows 123d, where the flue gases 125 flow along the conduit with the combustion mixture 121 therein so that this combustion mixture 121 can extract residual heat from flue gases 125. Arrows 123e show how the flue gases flow further to flue gas discharge 114, where the flue gases are discharged outside. The condensed water created in secondary heating conduit 109 is discharged in a manner not shown, preferably to the sewer.

Figure 6 is an enlarged view of primary heating conduit 101 with ribs 102. Figure 6 further shows combustion mixture conduit 105, burner chamber 106 with flames 115 and burner chamber walls 111, flue gas impeller 108 and secondary heating conduit 109a, and walls 112.

Figure 6 shows how during operation heat exchange occurs at arrow 126 between the flue gases in secondary heating conduit 109c. The combustion mixture combusts in burner chamber 106, whereby heat exchange with the fluid in primary heating conduit 101 occurs at arrow 127. The flue gases created in burner chamber 106 are delivered via flue gas impeller 108 with openings (not shown) to secondary heating conduit 109a, as indicated by arrows 123a.

Figure 5 shows an embodiment of a system according to the present invention, wherein hot tap water is demanded in conduit 44, as determined by a sensor (not shown). This CH water is then guided via upper side A of the supply tank via conduit 16, three-way valve 37, conduit 39, conduit 40, controllable pump 41 into the heating appliance and via conduit 31, conduit 34 to plate exchanger 35 for the purpose of heating the tap water supplied by conduit 43. The cooling CH water is introduced via conduit 42 into the bottom of the storage reservoir.

The present invention is not limited to the above described preferred embodiment; the rights sought are defined by the following claims, within the scope of which many modifications can be envisaged.

CLAIMS

1. System for obtaining hot tap water and heating, comprising:

5 a storage reservoir for storing hot fluid, this storage reservoir having a certain height so that considerably hotter fluid is located on the upper side of the storage reservoir than on the underside thereof;

10 a heating appliance with a primary heating conduit for heating of fluid and a secondary heating conduit for recovering residual heat from the flue gases; and

15 a heat exchanger for obtaining clean and hot tap water from the fluid, wherein hot fluid is guided from the upper part of the storage reservoir to the heat exchanger as soon as hot tap water is demanded and wherein the heating appliance is switched on in order to continue meeting this demand.

20 2. System as claimed in claim 1, wherein two three-way valves are arranged between the upper part of the storage reservoir and the conduit system between the heat exchanger and the heating appliance so that the fluid can flow in both directions.

25 3. System as claimed in claim 2, wherein the outlet side of the heat exchanger is coupled to the secondary conduit of the heating appliance.

30 4. System as claimed in one or more of the claims 2 or 3, wherein a temperature sensor is arranged at a determined location, for instance halfway along the height of the storage reservoir, for switching on the heating appliance as soon as the temperature falls below a predetermined value,

and wherein the heating process continues in the heating appliance wherein hot fluid from the upper part is heated in the primary conduit and the cooler fluid is guided into the secondary conduit until the temperature has risen to
5 sufficient extent.

5. System as claimed in one or more of the claims 1-4, wherein an external heat source is coupled to the storage reservoir in order to generate heat to the fluid therein.

10 6. System as claimed in one or more of the claims 1-5, provided with means for allowing to greater or lesser extent tap water to be drawn for a shorter or longer period of time.

15 7. System as claimed in one or more of the claims 1-6, wherein the heating appliance is suitable for providing a temperature increase between supply fluid and discharge fluid of at least 40°C.

20 8. System as claimed in one or more of the claims 1-7, wherein the primary heating conduit is a straight pipe heat exchanger which is enclosed partially by a burner chamber for heating fluid and partially by the secondary heating conduit for recovering residual heat from the flue gases.

25 9. System as claimed in claim 8, wherein about 20 to 80% of the length of the primary heating conduit is enclosed by the burner chamber.

30 10. System as claimed in one or more of the claims 1-9, wherein the secondary heating conduit guides the flue gases at least 1, 2 or 3 times along the primary heating conduit

for the purpose of recovering residual heat from the flue gases.

11. System as claimed in one or more of the claims 1-10, wherein the heating appliance is provided with a flue gas discharge which is in direct contact with a supply conduit for a combustion mixture for the purpose of heating the combustion mixture with residual heat from the flue gases.

12. System as claimed in claim 11, wherein the flue gas discharge is placed downstream relative to the secondary heating conduit.

13. Heating appliance with the characteristics in one or more of the claims 7-12.

14. Method for obtaining hot tap water, wherein hot fluid from an upper part of a storage reservoir is guided through a heating appliance to a heat exchanger in order to provide hot tap water in quick and efficient manner.

15. Method as claimed in claim 14, wherein the system according to one or more of the claims 1-13 is applied.

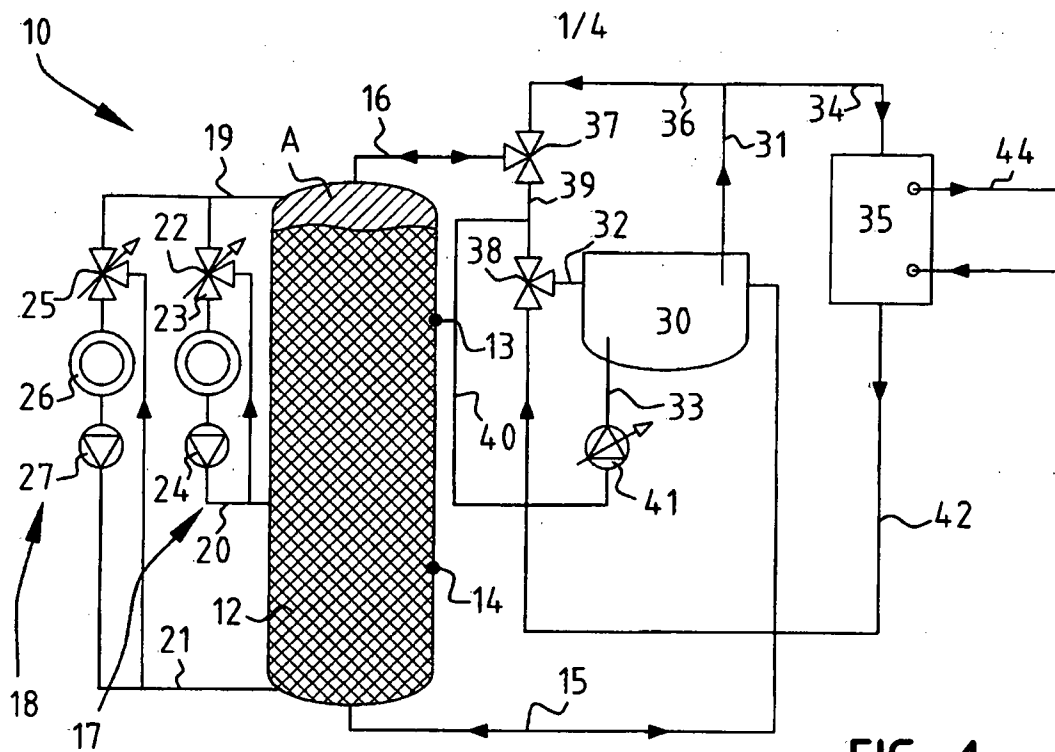


FIG. 1

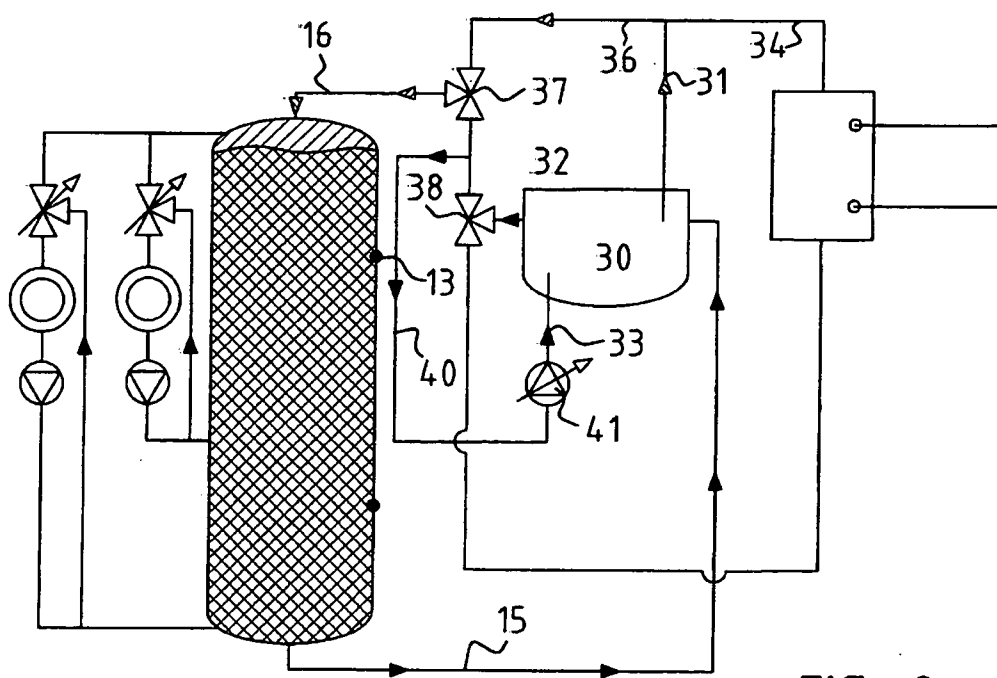
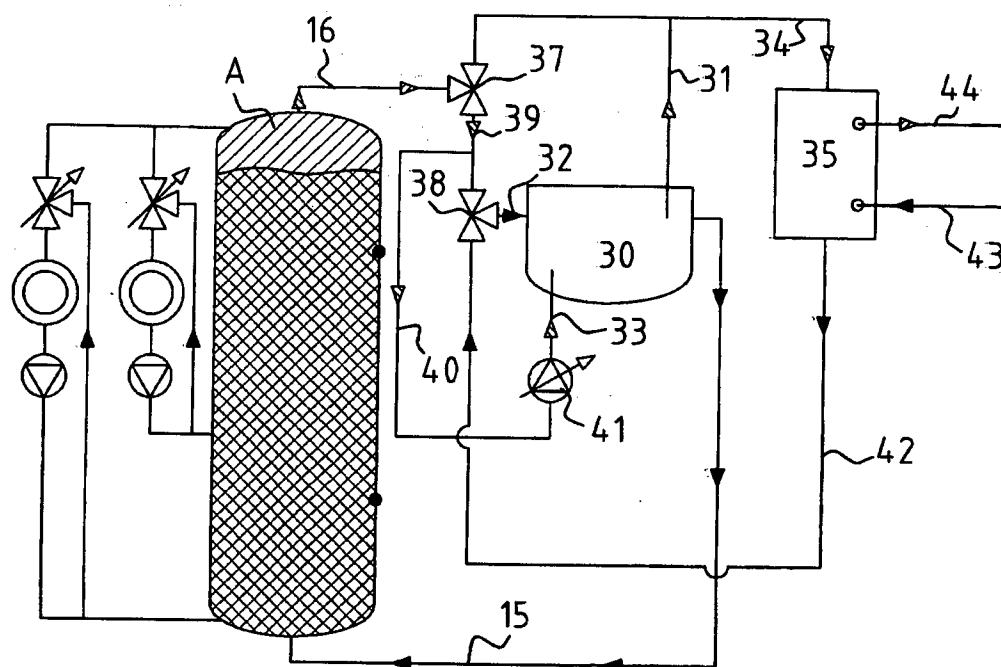
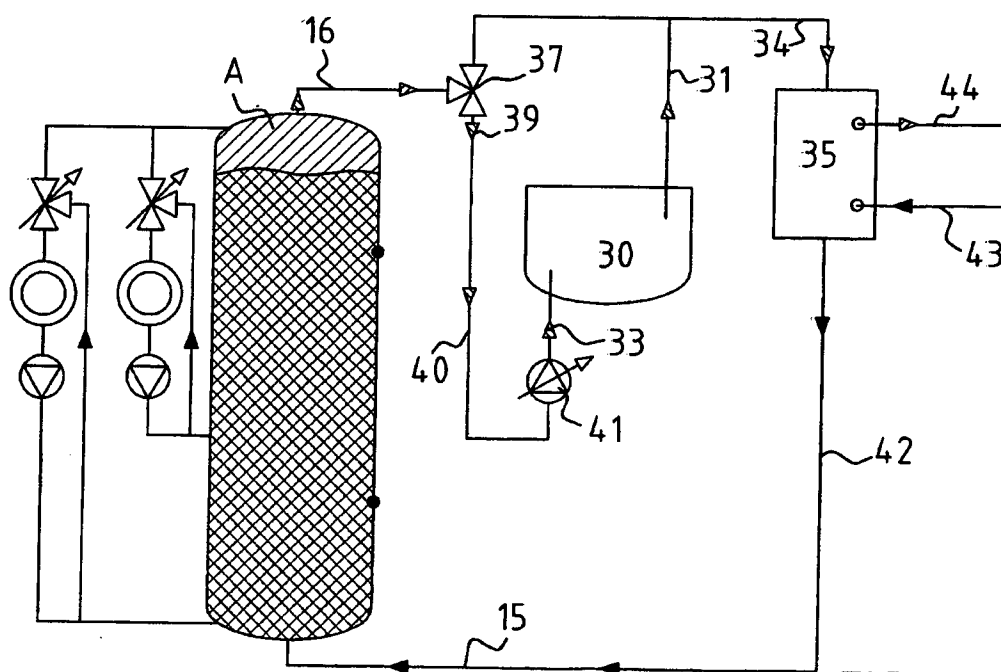
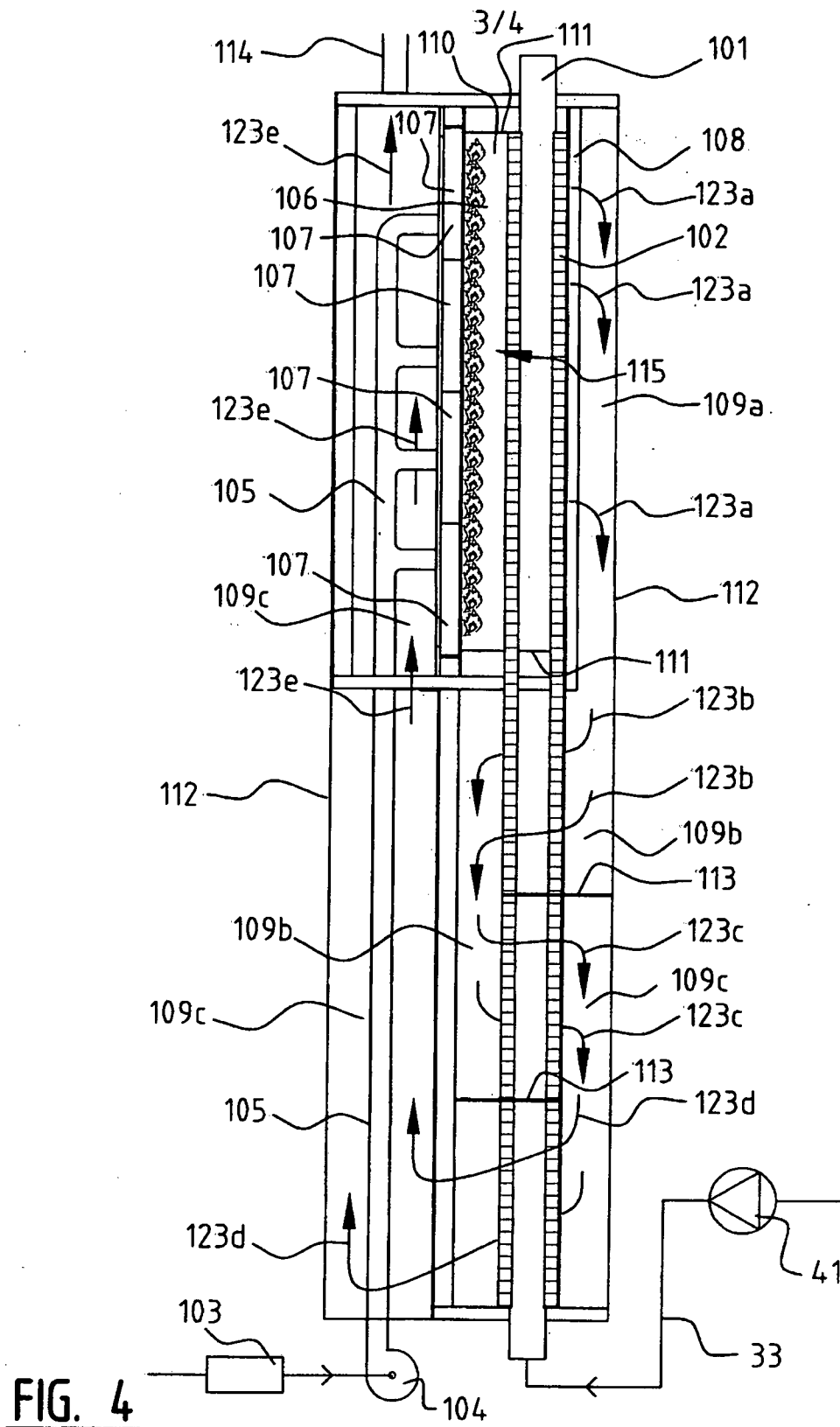


FIG. 2

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FIG. 3FIG. 5



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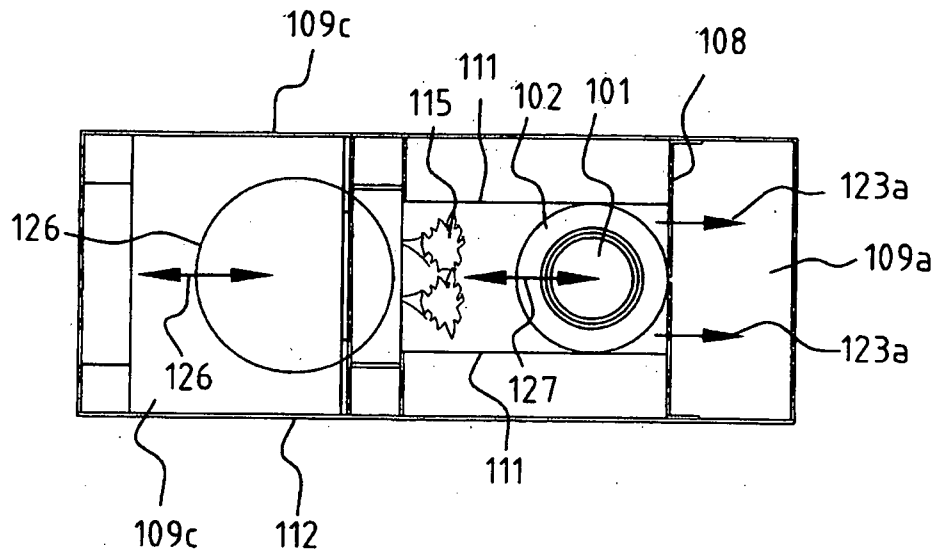


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2013/050425

A. CLASSIFICATION OF SUBJECT MATTER

INV. F24D3/08 F24D11/00 F24D12/02 F24H8/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24D F24H F28D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2013/050425

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