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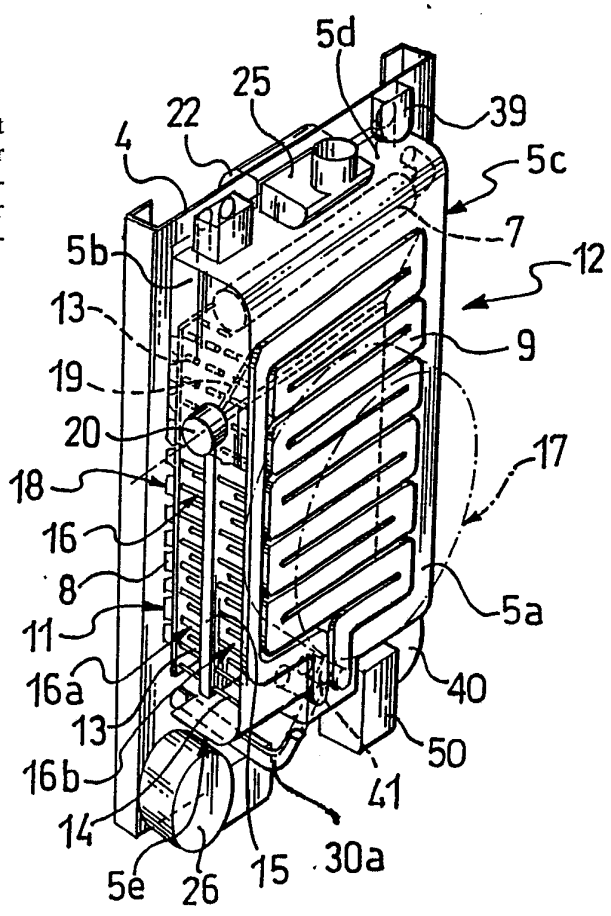
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(54) Title: A GAS-FIRED WATER HEATING APPLIANCE

(57) Abstract

A gas-fired water heating appliance of highly compact construction and high thermal efficiency comprises a burner (7), a flow path (16) for the flue gases wherein a pair of gas-water heat exchangers (11, 12) are supported, and means (18) for selectively directing the flue gases to one or both of the heat exchangers (11, 12).



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A gas-fired water heating appliance

DESCRIPTION

Technical Field

The present invention relates to a gas-fired water heating appliance of a type which comprises a burner, a flow path for the flue gases issuing from the burner, and a first gas-water heat exchanger placed in the gas flow path.

Throughout this specification and the appended claims, the term "gas-fired water heating appliance" is used to both denote a gas-fired boiler intended to supply heated water for sanitary and space heating purposes, and so-called "instant" or prompt delivery water heaters only intended for supplying sanitary heated water.

Background Art

As is known, a growing demand in the water heater industry is for increasingly more compact design, higher performance, and more reliable appliances having the lowest possible maintenance requirements.

To this aim, several solutions have been proposed in the pertinent art wherein, for example, the water system and the primary heat exchanger for supplying heated water for room heating are incorporated into the appliance main frame, as

disclosed in co-pending Italian Patent Application No. 21365-A/89 by this same Applicant.

A first unfavorable aspect of conventional water heaters when used in boiler applications is that liquid leakage paths may develop in the water-water heat exchanger arranged for transferring heat to the secondary fluid (sanitary heated water) from the primary one (heated water for room heating), which would result in some of the room heating water becoming admixed to the sanitary water and undesirably contaminating it.

A second unfavorable aspect of prior water heating appliances for instant water heater use is that it is difficult to fulfill efficiently varying sanitary hot water tapping demands.

Indeed, hot water tapping may vary, for example, between a required minimum to fill a kitchen sink to a maximum for filling a bath tub.

Where the appliance is sized for small demands, it will be uncapable of fulfilling high ones, and conversely, if sized for high demands, a substantial efficiency loss will have to be accepted along with an incapacity to maintain to a desired constant value the temperature of the heated water.

Disclosure of the Invention

The problem underlying this invention is, therefore, that of providing a water heating appliance of the foregoing type which, while retaining the same heating capacity and space requirements as the cited prior appliances, is able to overcome their drawbacks.

This problem is solved according to the invention by a water heating appliance which is characterized in that it includes, placed in said flue gas flow path, a second gas-water heat exchanger which is structurally and hydraulically independent from said first heat exchanger, means being also provided for selectively directing the flue gases to one or both of said heat exchangers.

The features and advantages of an appliance according to the invention can be understood from the following detailed description of some embodiments thereof, to be read by way of non-limitative examples with reference to the accompanying drawings.

Brief Description of Drawings

In the drawings,

Figure 1 is a perspective view of a water heating appliance according to the invention, in particular a wall mounted gas-fired boiler;

Figure 2 shows in perspective some details of the boiler in Figure 1;

Figure 3 is an exploded perspective view, drawn to an enlarged scale, of the wall mounted boiler shown in Figure 1;

Figure 4 is a front view of some additional details of the wall mounted boiler in Figure 1;

Figure 5 shows a cross-sectional view of the boiler in Figure 1, taken along the line V-V in Figure 4;

Figure 6 is a front elevation view schematically depicting a second embodiment of a water heating appliance according to the invention, in particular a wall mounted gas-fired water heater; and

Figure 7 is a cross-sectional view of the water heater in Figure 6, taken along the line VII-VII of Figure 6.

Modes for Carrying Out the Invention

With reference to Figures 1 to 5, generally shown at 1 is a water heating appliance, in particular a wall mounted gas-fired boiler of the instant type, intended to produce hot water for both room heating and sanitary purposes.

The boiler 1 has a front panel 2 and a pair of juxtaposed side walls 3a, 3b adapted to be anchored to a plate-like, load-carrying hanger frame 4 which extends parallel to the front panel 2.

The front panel 2, side walls 3a, 3b, and hanger frame 4 jointly form a casing substantially parallelepipedic in shape, on whose inside a plate-like member 5 is supported which has a box-type body, also substantially parallelepipedic in shape, and a bottom wall 5a and juxtaposed long 5b-5c and short 5d-5e sidewalls.

The plate-like member 5 is air-tight secured with its free ends onto the hanger frame 4 in a manner known per se, such as through the use of screw fasteners and sealing gaskets.

The hanger frame 4 and plate-like member 5 border a box-type, sealed boiler chamber having a path 16 defined therethrough for the flue gases outflowing from a gas burner 7 of the fully pre-mixed, high flame density type.

Preformed in the hanger frame 4 and the bottom wall 5a of the plate-like member 5 are respective pipe coils 8, 9 which comprise respective primary 11 and secondary 12 heat exchangers operative to produce, the former heated water for room heating, and the latter heated water for sanitary use.

Attached to the hanger frame 4 and the plate-like member 5, at the locations of respective pipe coils 8 and 9 in a manner known per se, such as by

spot or laser welding, are a plurality of pegs 13, 14 extending horizontally within the boiler chamber 6, transversely to the layout of the pipe coils 8 and 9.

The pegs 13, 14 are held apart by a partition 15 which extends parallel to the frame 4 and the wall 5a, wherebetween it is supported conventionally by the side walls 5b, 5c of the plate-like member 5.

The partition 15, being formed preferably from a thermally insulative material and having reflective surfaces, splits the gas flow path 16 into two parallel paths 16a, 16b, respectively defined in co-operation with the hanger frame 4 and the bottom wall 5a of the plate-like member 5.

Means 18, adapted to selectively direct the flue gases to either of said gas flow paths 16a, 16b, are provided at the top end of the partition 15.

Said means 18 comprise a baffle plate 19, having an actuator 20 which is driven conventionally as explained hereinafter by a control device 10 to suit the demand for sanitary heated water.

The baffle plate 19, being supported pivotally by the side walls 5b, 5c of member 5, is driven by the actuator 20 between two opposed positions where it will alternately block either of said gas flow paths 16a, 16b.

The boiler chamber 6 is in gas communication with a smoke exhaust duct 22 through a slit 21 formed across the frame 4 below the pipe coil 8. This duct is defined between the hanger frame 4 and a box-shaped metal sheet 23 conventionally sealed to the frame 4 as by welding.

Specifically, the smoke exhaust duct 22 (Figure 3) extends parallel to the pipe coil 8 and in gas communication at the top with a smoke exhaust header 25 on the boiler exterior, through an opening 24 formed in the frame 4.

The pipe coil 8 forming the primary heat exchanger 11 is in liquid communication (Figure 4) with a deaerator 28, in turn communicating, through a line 27, with the suction port 26a of a pump 26 for circulating hot water for room heating. The latter is delivered by the pump 26 to an external circuit -- not shown -- over a line 31, also formed in the frame 4, having opposed openings 32 and 33.

Furthermore, the pipe coil 8 is in fluid communication with the room heating circuit through a line 30 having an inlet opening 29 and communicating with an expansion tank 17 through a pipe 30a.

The openings 29 and 33, therefore, respectively constitute an inlet and an outlet for the

room heating hot water from the boiler.

Shown at 34 and 35 are conduits formed in parallel through the hanger frame 4 and adapted to connect a sanitary hot water delivery system to the pipe coil 9 constituting the secondary heat exchanger.

The conduits 34, 35 are connected to the pipe coil 9 through tubular fittings 36 and 37 and provided with openings 34a,b and 35a,b at their opposed ends. The openings 34a, 35a respectively constitute an inlet and an outlet for sanitary hot water from the boiler (see Figure 4).

Designated 41 is a flow sensor which is mounted coaxially in the tubular fitting 36 activated by the flow of the sanitary heated water.

Also formed in the frame 4 are a plurality of ducts for supplying the gas/air mixture to the burner 7. A first of said ducts, indicated at 38, connects an air intake 39 to a fan 40 which forces a predetermined air flow rate through an additional air delivery duct 44 being in gas communication with the burner 7 and provided with opposed openings 45, 46.

A gas supply duct 47 provided with juxtaposed gas inlet 48 and gas outlet 49 openings, enables the admission of a predetermined gaseous fuel flow rate into the duct 44. Provided in the duct 47, moreover,

are valve means 50 for controlling and regulating the gas flow rate.

With reference to Figure 4, it should be noted that the duct 44 is also connected, through a branch duct 51, to the smoke exhaust duct 22, whereby the smoke can be diluted.

The various operations of all the boiler components shown are controlled by the control device 10, known per se, which can be accessed to from outside through a slit 53 provided in the front panel 2.

In accordance with this invention, all of the aforementioned lines, with the exception of the gas supply duct 47, are conventionally pre-formed in the hanger frame 4 or the plate-like member 5, specifically in the bottom wall 5a. Thus, as an example, the hanger frame 4 and plate-like member 5 may be formed by first and second juxtaposed metal sheets, and the ducts and/or pipe coils defined preferably as by press forming on one of said metal sheets, or alternatively, on both metal sheets.

The ducts thus formed are then sealed by such conventional joining processes as laser or roller welding, or cementing.

All the ducts or lines formed in the hanger frame 4 are also provided with fittings, not shown,

fixed to the frame itself for connection to the remaining parts of the boiler or external circuits, in turn provided with connectors, not shown, adapted to fit sealingly thereon.

Advantageously, the foregoing fittings also provide mechanical support for the various elements being connected thereto.

The operation of the wall mounted boiler 1 according to the invention will be now described with reference to a starting condition, shown in Figure 5, wherein the baffle plate 19 is tilted toward the plate-like member 5 to only admit the flue gases issuing from the burner 7 to the gas flow path 16a.

Under this condition, the water in the space heating circuit is caused to flow by the pump 26 and becomes heated by means of the primary heat exchanger 11.

More particularly, the space heating water will be flown successively through the line 30, pipe coil 8, deaerator 28, line 27, pump 26, line 31, and finally discharged from the latter line through the opening 33.

When the temperature of the room heating water dropps below a set value, the fan 40 is operated in a conventional way, such as by means of a

thermostat. Thus, a selected air/gas mixture will be supplied to the burner 7 and burned thereat. Accordingly, the burner will heat the hanger frame 4 at the pipe coil 8, both directly and through the pegs 13, so as to heat, the water flowing through the pipe coil 8.

Advantageously, the partition 15, being lined with a reflecting material, will limit heat dissipation by reflecting it back onto the peg 13.

The combustion smoke from the burner 7, while being quite small in amount with burners of the aforesaid type, will flow down toward the slit 21 along the gas flow path 16a and sweep past the pegs 13 which swirl the smoke flow to enhance the rate of heat exchange.

The smoke, after flowing through the slit 21, is then passed into the duct 22, connected atop, via the header 25, to a conventional smoke stack, not shown.

It is to be noted that, in flowing up the duct 22, the smoke will sweep across the frame 4 at the location of the pipe coil 8, and be maintained thereby at a temperature generally above the dew point, thus limiting the risk of condensate forming within the smoke stack.

The last-mentioned risk is further attenuated by the fact that some of the air drawn in by the fan 40 is forced into duct 22 through duct 51 to dilute the flue gases and lower the dew point value.

Any condensate formed in the smoke exhaust duct 22 is in any case collected in a conventional drain duct or sump, not shown, arranged at the bottom end of the duct.

As can be appreciated from Figure 5, under this starting condition, whereby the boiler will heat the room heating water, the burner 7 only applies heat to the primary heat exchanger 11 formed within the hanger frame 4.

When heated water is tapped off for sanitary use through the outlet 35a, the flow sensor 41 arranged in the tubular fitting 36 sends a signal to the control device 10 to stop operation of the pump 26 and tilt the baffle plate 19 toward the hanger frame 4 by means of the actuator 20.

The baffle plate 19, whose position is illustrated by dash lines in Figure 5, will then shut off the gas flow path 16a and divert the flue gases from the burner toward the secondary heat exchanger 12.

The hot gases, now flowing along the gas path 16b, will therefore heat the water which flows through

the pipe coil 9, quite in the same way as discussed in relation to the primary heat exchanger 11 (pipe coil 8).

The boiler heating capacity is thus fully exploited to heat the sanitary water in a rapid and highly efficient manner.

By having the two heating water and sanitary water heat supply circuits separated, any chance of the two fluids mixing together is advantageously prevented.

On removal of the demand for hot sanitary water, the actuator is placed back under control by the thermostat controlling the temperature of the room heating water, and where required, returned to its original position whereat it opens the gas flow path 16a.

Partially and schematically shown in Figures 6 and 7 is a second embodiment of a water heating appliance according to the invention, comprising in particular a wall mounted, gas-fired water heater of the instant type, designated 101.

In the water heater 101, those component parts which are structurally or functionally equivalent to those of the boiler 1, are denoted by the same reference numerals and will not be further described.

In the water heater 101, the primary 11 and

secondary 12 heat exchangers are both intended for supplying heated water for sanitary use. Consequently, the water heater 101 is equipped with an additional flow sensor 42 located in the line 30 upstream of the pipe coil 8. In this case, the fluid flow through the heat exchangers 11 and 12 and their respective water circuits is advantageously promoted by the own pressure of the water supply, thereby the pump 26 is no longer required. In addition, the fan 40 is arranged to draw air directly from the environment, so that the air intake 39 and duct 38 are no longer necessary.

Advantageously, the burner 7 is of the dual flame type, and the baffle plate 19 can be set into three positions, respectively tilted against the frame 4, against the plate-like member 5, and an intermediate one (see Figure 7).

The operation of the water heater 101 just described is quite similar to the previously discussed one in relation to the boiler 1.

Where hot sanitary water is demanded in small amounts, such as for a kitchen sink, the heated water is tapped off through the opening 32 being fluid connected to the primary heat exchanger 11 (pipe coil 8) via the line 27.

The flow sensor 42 will then control the

positioning of the baffle plate 19 close against the plate-like member 5.

In quite a similar manner, the secondary heat exchanger 12 is operated when a larger amount of water is to be delivered through the opening 35a.

Where a demand for hot sanitary water exists at any one time from several outlets, the baffle plate 19 will move into the position illustrated in Figure 7 by full lines, to control heating of both pipe coils by the burner 7 and the flue gases issuing therefrom. Thus, heated water for sanitarty use is supplied from both heat exchangers 11 and 12.

On removal of the demand from one or both outlets, the baffle plate will locate so as to shut off either of gas flow paths, 16a or 16b, as required.

In this way, the water heater 101 is enabled to supply hot sanitary water in constant amounts at a constant temperature simultaneously to a number of outlets.

Advantageously by providing three different positions for the baffle plate 19, the temperature of the water being heated through the heat exchangers can be controlled in an independent way within a broad range of values.

The water heating appliance of this invention

is of simplified, extremely compact construction; in fact, its depth dimension can be at least halved with respect to that of conventional water heating appliances.

By providing two separate gas-water heat exchangers, flexibility of operation and a definitely higher degree of reliability can be ensured over conventional water heating appliance designs.

A further advantage afforded by the appliance of the invention, especially in boiler-type applications, is that it lends itself to the use within modular installations for room heating or producing hot sanitary water, which have a number of mutually spaced, parallel walls, whereby a high heating capacity and substantial operational flexibility can be built in, within limited volumes.

CLAIMS

1. A gas-fired water heating appliance of a type which comprises a burner (7), a flow path (16) for the flue gases issuing from the burner (7), and a first gas-water heat exchanger (11) placed in the gas flow path (16), characterized in that it includes, placed in said flue gas flow path (16), a second gas-water heat exchanger (12) which is structurally and hydraulically independent from said first heat exchanger (11), means (18) being also provided for selectively directing the flue gases to one or both of said heat exchangers (11,12).

2. A water heating appliance according to Claim 1, characterized in that said heat exchangers (11,12) comprise respective pipe coils (8,9) formed integrally within juxtaposed walls (4,5a) of a boiler chamber (6) having said flue gas flow path (16) defined therein.

3. A water heating appliance according to Claim 2, characterized in that at least one of said walls (4,5a) constitutes a load-bearing, hanger frame for the appliance.

4. A water heating appliance according to Claim 2, characterized in that it comprises at least one gas-air mixture supply duct (44) formed in at least

one of said walls (4,5a) and in fluid communication with said burner (7).

5. A water heating appliance according to Claim 2, characterized in that, a plurality of pegs (13,14), secured on opposed sides of said heat exchangers (11,12) , extend from at least one of said walls (4,5a) towards said flue gas flow path (16).

6. A water heating appliance according to Claim 1, characterized in that said means (18) comprise a baffle plate (19) and a partition (15) lying parallel between and extending along the full length of said heat exchangers (11,12).

7. A water heating appliance according to Claim 6, characterized in that a pair of parallel paths (16a,16b) extending between said partition (15) and each of said walls (4,5a) are defined in said flue gas flow path (16).

8. A water heating appliance according to Claim 1, characterized in that said boiler chamber (6) is in gas communication with a smoke exhaust duct (22) lying parallel to said primary heat exchanger (11).

9. A water heating appliance according to Claim 1, characterized in that, a plurality of conduits (27,30,34,35) for circulating fluid through the appliance are formed integrally with at least one of

said walls (4,5a).

10. A water heating appliance according to Claim 9, characterized in that said conduits (27,30,34,35) include a plurality of fittings made fast with at least one of said walls (4,5a) for connection to respective water piping components, said fittings providing mechanical support for said water piping components.

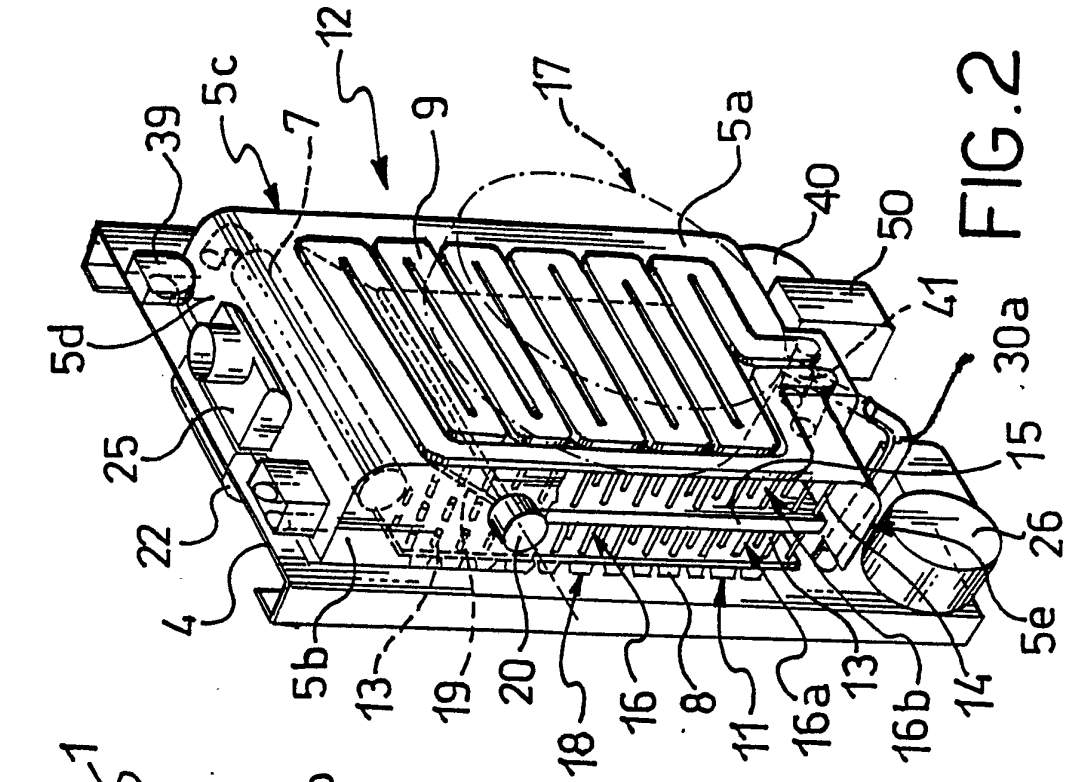

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FIG.2

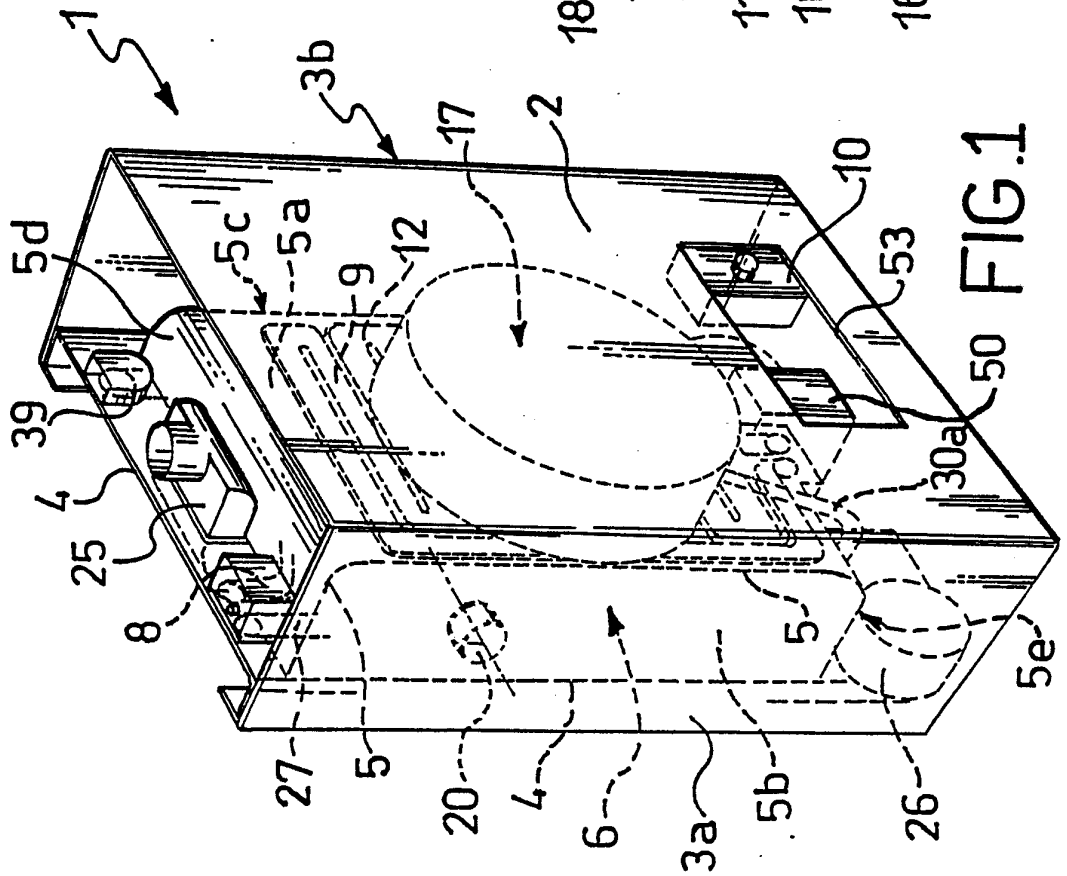

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FIG.1

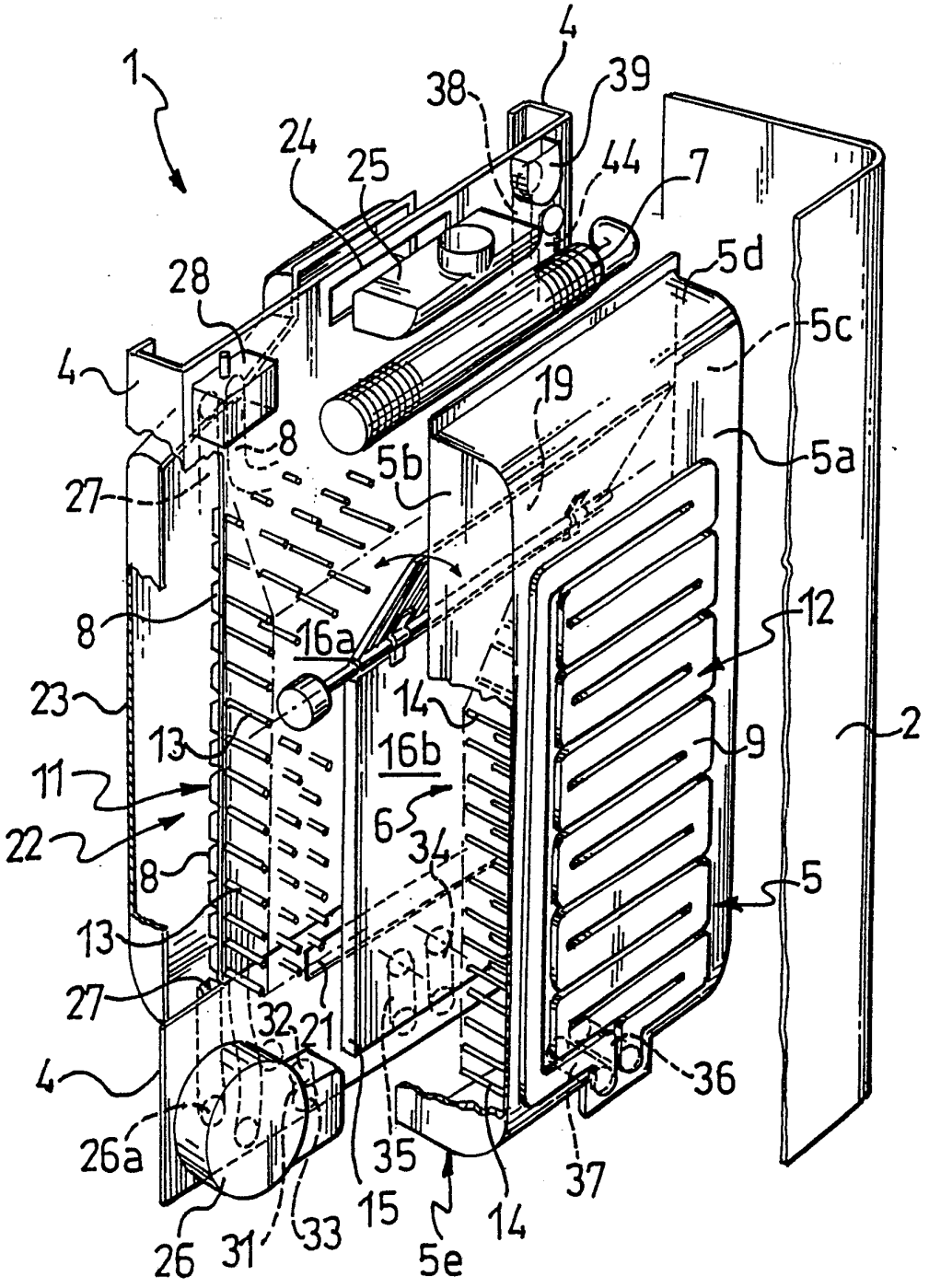

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FIG.3

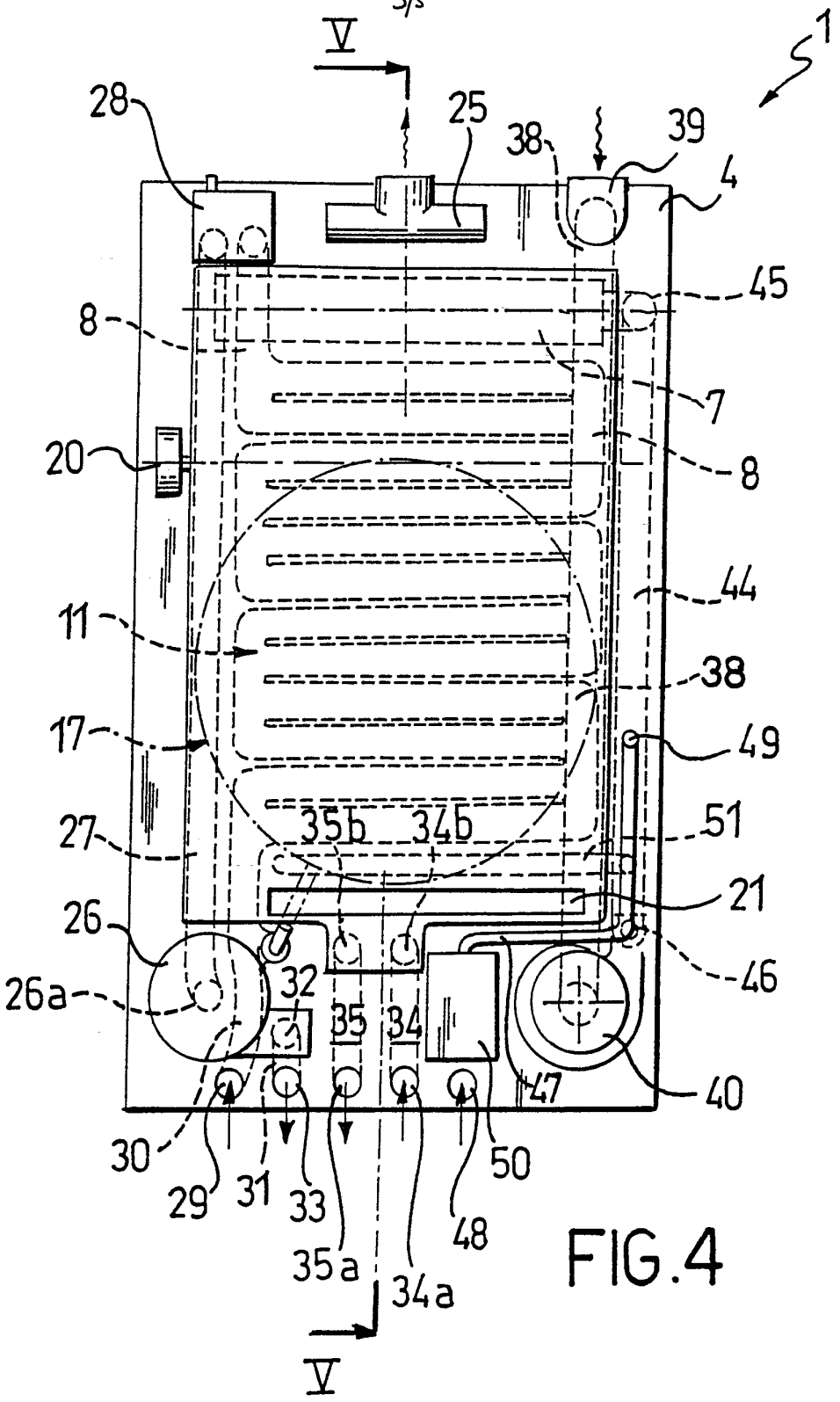

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FIG.4

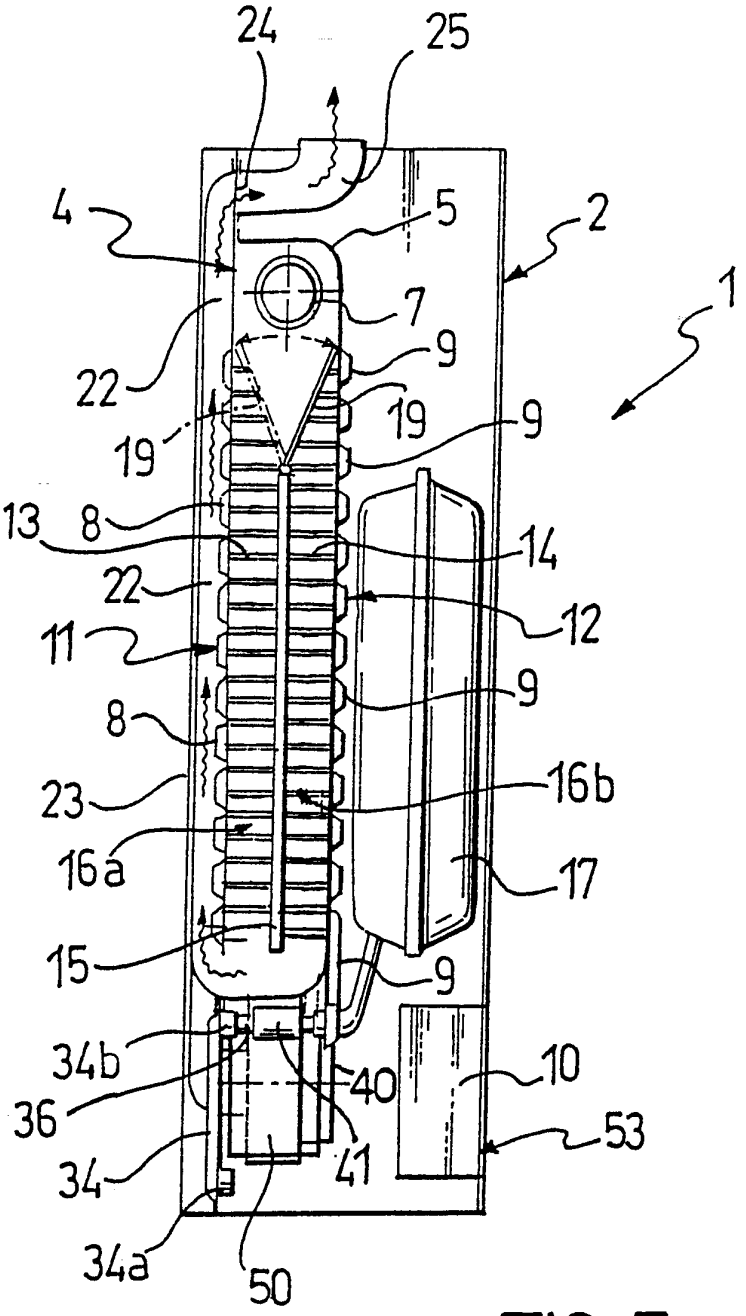

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FIG.5

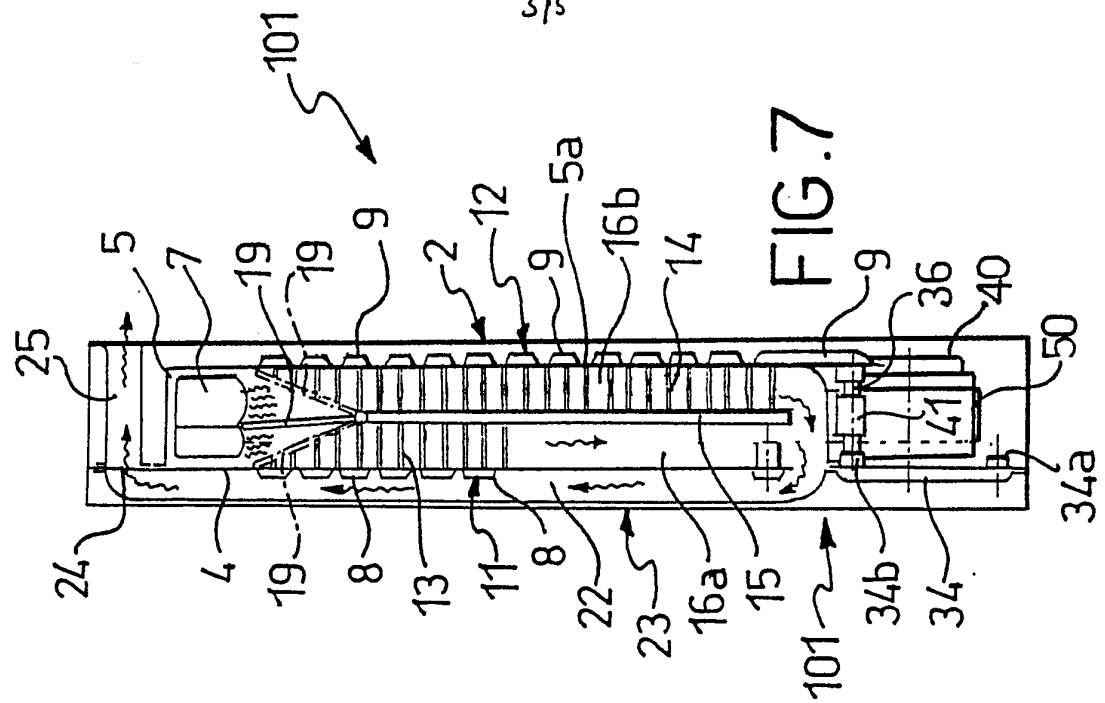

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FIG.7

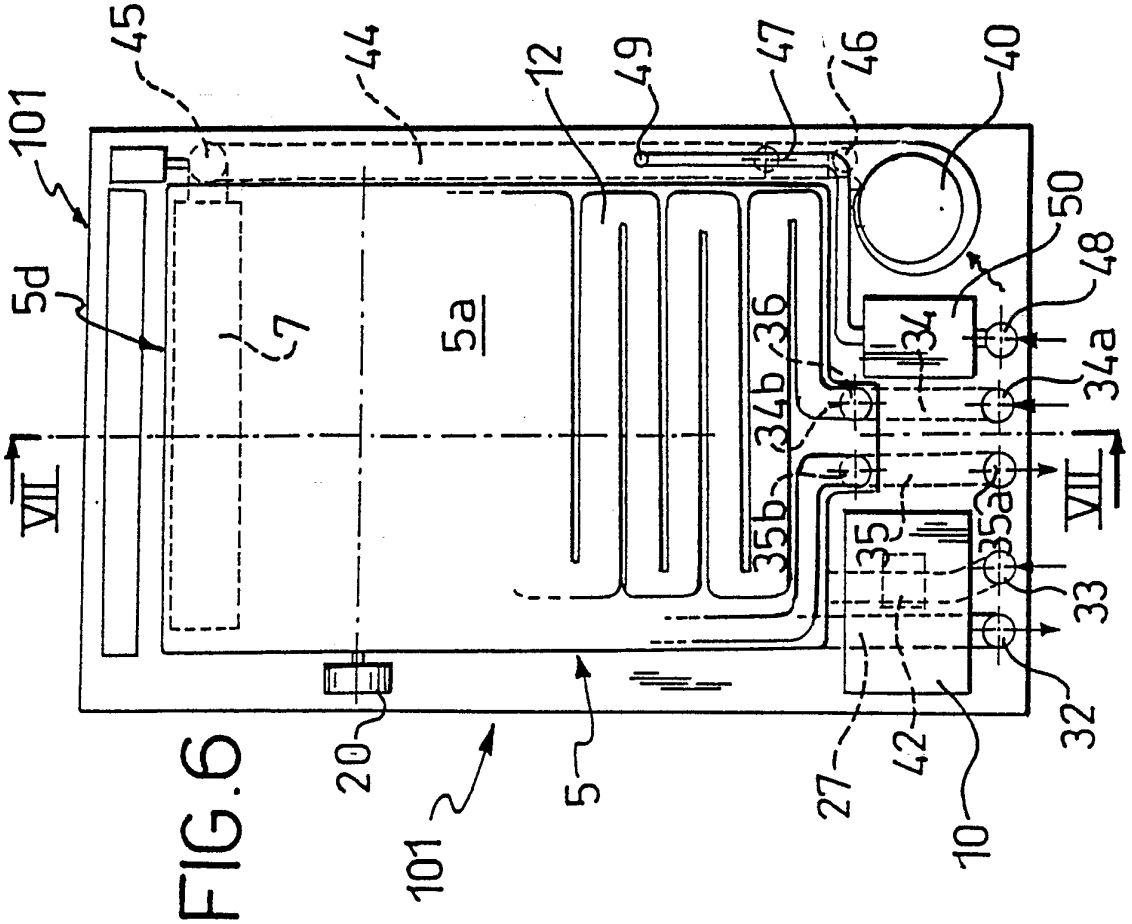

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FIG.6

INTERNATIONAL SEARCH REPORT

PCT/EP 91/02482

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 F24H1/48; F24H9/14; F24H9/00

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	F24H

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X Y	CH,A,365 198 (MÜLLER) 15 December 1962 see the whole document	1 2,3,5
Y	DE,A,1 912 629 (RADIATION LTD) 9 October 1969 see figure 4	2,3
Y	EP,A,0 340 370 (MULLER & CIE SA) 8 November 1989 see abstract	3
Y	DE,A,2 141 785 (RHEINSTAHL AG) 22 February 1973 see figures	5
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 322 (M-440)(2045) 18 December 1985 (MATSUSHITA DENKI SANGYO K.K.) 15 August 1985 & JP,A,60 155 848 see abstract	1

° Special categories of cited documents :[10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
09 MARCH 1992	17. 03. 92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	VAN GESTEL H.M.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. EP 9102482 SA 54423

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/03/92
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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