



(51) International Patent Classification:

F24D 5/08 (2006.01) *F24H 8/00* (2006.01)
F24D 12/02 (2006.01) *F24D 1/00* (2006.01)
F24H 6/00 (2006.01)

(21) International Application Number:

PCT/IB2010/054320

(22) International Filing Date:

24 September 2010 (24.09.2010)

(25) Filing Language:

Italian

(26) Publication Language:

English

(30) Priority Data:

VI2009A000234 25 September 2009 (25.09.2009) IT

(71) Applicant (for all designated States except US): **OFFICINE TERMOTECNICHE FRACCARO S.R.L.**
 [IT/IT]; Via Sile, 32 - Z.I., I-31033 Castelfranco Veneto (TV) (IT).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **FRACCARO, Gimmi**
 [IT/IT]; Via Sile, 34, I-31033 Castelfranco Veneto (TV) (IT).

(74) Agent: **MAROSCIA, Antonio**; Maroscia & Associati S.r.l., Contrà Porti, 21, I-36100 Vicenza (IT).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: HIGH EFFICIENCY DEVICE FOR HEATING ENVIRONMENTS AND HEATING SYSTEM COMPRISING SUCH DEVICE

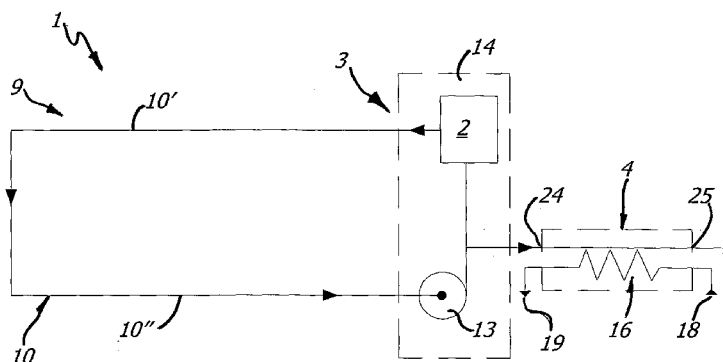


FIG. 1a

(57) Abstract: A device for radiance heating of rooms (A) comprising a burner (2) with a combustion chamber (5), a chimney (4) in fluid connection with said chamber (5) for ejecting the combustion products of said burner (2), heating means (3) in operative connection with said combustion chamber (5) and configured to produce a heat carrier fluid comprising at least one gaseous phase, wherein said heating means (3) comprise a circuit (9) with an outer heat-conducting radiating surface (12) designed for direct contact with the room (A) for radiant heating thereof. The combustion chamber (5) has an outlet (8) for said combustion products directly connected to said radiant circuit (9), and said chimney (4) comprises a heat recuperator (16) for at least partial recovery of sensible heat and latent heat from the combustion products of said burner (2), said recuperator (16) comprising a secondary circuit (17) for a recuperator fluid to flow therethrough, which can be associated with a heating circuit (9; 21) susceptible of at least partially returning the recovered heat to the room (A).

HIGH EFFICIENCY DEVICE FOR HEATING ENVIROMENTS AND HEATING SYSTEM COMPRISING SUCH DEVICE

Field of the invention

5

The present invention generally finds application in the field of heating devices and systems, and particularly relates to a room heating device, as well as a heating system comprising such device.

10

Background art

Room heating, for both industrial and civil uses, is known to be obtained using various technologies.

15 A typical heating system comprises a burner adapted to burn an air-fuel mixture, generally methane gas, to produce high temperature combustion products.

The latter may be used to heat a working fluid, such as water, which is
20 designed to circulate in a radiant circuit at least partially located in the room to be heat to transfer part of the heat thereto.

For instance, EP0228569 discloses a heating system in which combustion products exchange heat with a heating system in which water is forcibly
25 circulated to be conveyed, in heated form to a radiator located in the room to be heated.

Once combustion products have released part of their heat to the liquid, they are exhausted through an exhaust chimney.

30

A similar system is also disclosed in US 4079778, in which combustion

products from a furnace are forced to circulate in an exhaust conduit about which a circuit, with liquid circulating therein, is coiled. The liquid so heated is conveyed to a radiator located in the room to be heated.

- 5 Nevertheless, these solutions have the apparent drawback of not allowing optimal exploitation of heat of combustion products, due to the heat exchange with the liquid and inevitable heat losses along the path followed by the liquid from the heat exchange zone to the radiant element.
- 10 WO02/44627 discloses a heating system comprising, as is known, a boiler designed to contain water to be heated by gas combustion.

Combustion products are conveyed to a radiant circuit that extends through a room to release part of the residual heat thereto, thereby providing radiant
15 heating and to be later exhausted through an exhaust chimney.

Nevertheless, radiant heating produced by flue gases is secondary and irrelevant, because most of the heat of the combustion products is released to the liquid in the boiler, whereby combustion products reach the radiant
20 circuit in relatively cold form.

Furthermore, one or more heat exchangers are also placed in the radiant circuit, for reclaiming a further part of heat from flue gases to release it to a liquid designed to be conveyed to another room to be heated.
25

Nevertheless, this additional heat exchange step is also affected by serious inefficiencies, because a considerable part of the heat released to the liquid is lost in its flow toward the room to be heated.

30 Furthermore, the carrier fluid downstream from these heat exchangers is at an excessively low temperature, which is not sufficient to maintain adequate

radiant efficiency, and considerably lowers performance.

A further drawback of the above systems is that none of them affords sufficient reclamation of heat associated with combustion products, which
5 flow out of the chimney at a much higher temperature than ambient temperature.

Finally, the European Patent EP-B1-0647819 discloses a heating system which essentially includes a burner, a radiant circuit and a chimney for
10 exhaustion of the combustion products of the burner.

The burner is adapted to burn an air-fuel mixture to introduce the combustion products into the radiant circuit. The latter is placed in the room to be heated and generally has one or more tubular conduits having a heat-conducting
15 peripheral surface, which is designed to be in direct contact with the room to be heated, to transfer the heat of the products thereto by radiation.

This device has been found to be particularly efficient, and to exhibit a high thermal efficiency, but is still susceptible of improvements concerning energy
20 efficiency itself.

Disclosure of the invention

The object of the present invention is to at least partially overcome the above
25 drawbacks, by providing a highly energy-efficient radiant heating device.

Another object of the invention is to provide a system that effectively returns the heat reclaimed from the flue gases of a radiant heating device.

30 These and other objects, as better explained hereafter, are fulfilled by a radiant heating device as defined in claim 1.

The provision of a radiant circuit having a conduit with an outer heat-conducting peripheral surface in direct contact with the room to be heated and through which a fluid having a high-temperature gaseous phase is conveyed, will provide highly efficient room heating.

Furthermore, the provision of the heat recuperator affords reclamation of both the sensible heat from the flue gases and the latent heat from evaporation of the combustion products of the burner, which considerably increases the energy efficiency of the device.

The output of the cooling circuit may be adapted to be in fluid connection with a heating circuit of a second heating device that can be located in the room to heat it in cooperation with the radiant circuit.

As used herein, the term "cooling circuit" or derivatives thereof is intended to designate a fluid path in which fluid circulates in the liquid and/or gaseous states, for acquiring heat by exchange with another fluid.

As used herein, the term "recuperator fluid" or derivatives thereof is intended to designate a fluid in the gaseous and/or liquid states, circulating in a cooling circuit and designed to acquire heat by exchange with another fluid.

As used herein, the term "heating circuit" or derivatives thereof is intended to designate a fluid path in which fluid circulates in the liquid and/or gaseous states, for releasing heat by exchange with another fluid.

As used herein, the term "heating fluid" or derivatives thereof is intended to designate a fluid in the gaseous and/or liquid states, circulating in a heating circuit and designed to release heat by exchange with another fluid.

As used herein, the term "radiant circuit" or derivatives thereof is intended to designate a fluid path in which a heat carrier fluid circulates to heat, mainly by radiation, the room in which the circuit is integrated.

- 5 In a further aspect, the invention relates to a room heating system as defined in claim 12. The first heating device may have one or more of the characteristics as defined in claims 1 to 11.

Thus, the sensible heat and/or the latent evaporation heat reclaimed from the
10 combustion products of the burner may be effectively returned to the room.

Advantageous embodiments of the invention are defined in accordance with the dependent claims.

15 Brief description of the drawings

Further characteristics and advantages of the invention will become more apparent upon reading of the detailed description of a few preferred, non exclusive embodiments of a device and a system of the invention, which are
20 described as non limiting examples with the help with the accompanying drawings in which:

FIG. 1a is a schematic view o a first embodiment of the device 1;

FIG. 1b is a schematic view of a second embodiment of the device 1;

FIG. 1c is a schematic view of a third embodiment of the device 1;

25 FIG. 2 is a schematic sectional view of a burner 2 of the device of Fig. 1a;

FIG. 3 is a schematic sectional view of an exemplary embodiment of the chimney 4 of the device 1, in which the fluid path of flue gases is shown by empty arrows, whereas the fluid flow path of the cooling fluid is shown by
30 solid arrows;

FIG. 4a is a schematic view of a first embodiment of the system 31,

which integrates the embodiment of the device 1 of FIG. 1a;

FIG. 4b is a schematic view of a second embodiment of the system 31, which integrates the embodiment of the device 1 of FIG. 1a.

5 Detailed description of a preferred embodiment

Referring to the above figures, the device of the invention, generally designated by numeral 1, is particularly useful for radiant heating of rooms A, preferably medium-to-large, preferably closed rooms, as shown in Figures 4a and 4b by broken lines.

Three different exemplary configurations for the device of the invention are shown in Figs. 1a, b, c.

15 Basically, the device 1 comprises a burner 2, that can burn an air/fuel mixture, heating means 3 and a chimney 4 for exhaustion of the combustion products of the burner 2.

For example, the fuel may be a fluid selected, by way of example, from the group comprising methane, butane, propane, gasoil or the like.

As shown in the scheme of Fig. 2, the burner 2 basically comprises a combustion chamber 5 having an inlet 6 for the fluid or fuel mixture, mixture burning means 7 for obtaining combustion products having at least one gaseous phase.

The combustion products have a predetermined combustion temperature, whose value depends on the particular fluid being burnt.

30 The combustion chamber 5 also has an outlet 8 for the combustion products that are still substantially at the combustion temperature. The heating means

3 comprise in turn a radiant circuit 9 that may be basically composed, as is known, of at least one closed-loop conduit or pipe 10, with a forward branch 10' and a backward branch 10". The conduit 10 can be placed in the room A, preferably in the higher part thereof, where it can be heated by radiant heat.

5

Furthermore, the heating means 3 are operably connected with the outlet 8 of the combustion chamber 5 and are configured to produce a heating fluid having at least one gaseous phase, which is designed to be carried into the conduit 10 and circulate therein.

10

For this purpose, the latter has an inlet 11 for the heating fluid and an outer heat-conducting peripheral surface 12 designed to be in direct contact with the room A to be heated, so that the heat of the heating fluid may be directly transferred thereto by radiant heating.

15

In order to further improve heat efficiency, the conduit 10 may be held in an insulated housing frame, not shown, e.g. made of galvanized steel, coextending with the conduit 10 and having an open-sided cross section, so that the only exposed portion is the longitudinal portion of the outer peripheral surface 12 designed to face downwards toward the room to be heated A.

20

In a first embodiment, as shown in FIG. 1a, the burner 2 is directly connected with the radiant circuit 9, so that high temperature flue gases of the former are directly introduced into the latter and act as a carrier fluid for radiant heating of the room A.

25

In this case, the device 1 may include a fan or a similar means 13, which is adapted to circulate the flue gases in the closed-loop conduit 10 that forms the radiant circuit 9. For minimized space requirement, both the burner 2 and the fan 13 may be contained in a box-like body 14.

30

In a further embodiment, as shown in Fig. 1b, the burner 2 may operably interact with a steam generator 15. The latter may be in fluid connection with the radiant conduit 10, so that the generated steam may be introduced therein, and act as a carrier fluid for radiant heating of the room A. Both the
5 burner 2 and the steam generator 15 may be contained in the box-like body 14.

The chimney 4 may comprise a heat recuperator 16, e.g. a capacitor, more clearly shown in Fig. 3, which has a secondary cooling circuit 17 adapted to
10 exchange heat with the flue gases flowing out of the burner 2 to at least partially draw both sensible heat and latent evaporation heat therefrom.

For this purpose, the secondary circuit 17 may include an inlet 18 for a recuperator fluid, which may preferably be a liquid. Advantageously, the
15 latter may be selected from water and/or glycol.

In a preferred, non limiting embodiment of the device 1, as shown in FIG. 1c, the burner 2 may operably interact with a steam generator 15, which may be in fluid connection with the radiant circuit 9 so that the generated steam may
20 be introduced therein.

The radiant circuit 9 may in turn be in fluid connection with the inlet 18 of the secondary circuit 17, for the fluid circulating therein to both act as a carrier fluid in the radiant circuit 9 for radiant heating of the room A and as a cooling
25 fluid in the circuit 17.

Thus, the latter will be preheated in the chimney 4 before accessing the steam generator 15, thereby increasing the energy efficiency of the device 1.

30 On the other hand, as shown for instance in FIGS. 4a and 4b, the cooling circuit 17 may have an outlet 18 that may be connected to the inlet 20 of the

heating circuit 21 of a second heating device 22, also designed to be placed in the room A, for heating thereof in combination with the radiant circuit 9.

5 The cooling circuit 17, that may be of any type, may operably interact with the heating circuit of the chimney 4, also of any type, so that the fluids circulating therein, i.e. the recuperator or cooling fluid and the heating fluid respectively, exchange heat with each other.

10 As a result, the flue gases from the burner 2 will flow over the secondary circuit 17 that contains the recuperator fluid, as shown in Fig. 3. Thus, the heat drawn from flue gases may be effectively returned to the room A.

15 Preferably, the chimney 4 may include a heat exchange chamber 23 that may define a heating circuit of the chimney 4, with an inlet in fluid connection with the burner 2 for collecting combustion products, and an outlet 25 in fluid connection with the outside, to disperse the flue gases outside once they have been cooled, thereby minimizing thermal pollution thereof.

20 Still as shown in Fig. 3, the secondary circuit 17 may consist of a pipe 26, advantageously located in the chamber 23, so that the flue gases of the burner 2 flowing in the chamber 23 can flow over the outer surface 27 of the pipe 26.

25 Furthermore, in order to maximize the heat exchange surface, the pipe 26 may be a coil having a generally elliptical plan shape, with a maximum dimension D_1 smaller than the diameter D_2 of the chamber 23.

30 This particular configuration of the pipe 26 allows flue gases to be directed between the turns thereof, thereby increasing the heat exchange surface and hence the energy efficiency of the device 1.

Also, a plurality of baffles 28 may be provided, appropriately arranged to increase the flue gas turbulence, thereby further improving heat exchange and hence energy efficiency of the device 1.

- 5 Also, the chamber 23 may conveniently comprise an insulation jacket 29 at its periphery.

Advantageously, the pipe 26 that forms the secondary circuit 17 may be of modular type, i.e. comprising a plurality of pipe branches of known surface
10 area, for instance and without limitation the two branches 26', 26'' in fluid connection with each other.

This configuration imparts a higher versatility to the heat recuperator 16, which may be conveniently sized, according to the required exchange
15 surface, by assembling multiple prefabricated modules.

A condensation drain 30 may be conveniently provided on the bottom of the chamber 23.

- 20 In a further variant, not shown, that may be particularly implemented with devices as shown in Figs. 1b, c, vacuum means may be provided for creating a negative pressure in the radiant conduit 10, thereby facilitating the formation of steam at low temperatures.

- 25 The device 1 may be part of a room A heating system 31 as shown in FIGS. 4a and 4b. While these figures show embodiments of the system 31 that include the device 1 as shown in FIG. 1a, it shall be understood that the system 31 may include the device 1 as shown in FIG. 1b or 1c, or possibly a combination of two or more of these, without departure from the scope as set
30 forth in the annexed claims.

In short, the system 31 may generally comprise a first heating device, consisting of the device 1, and a second heating device 22. The two heating devices 1 and 22 may have heating means 3, 3', both located in the room A, for combined heating thereof.

5

The heating circuit 21 of the second heating device 22 may have the inlet 20 in fluid connection with the outlet 19 of the secondary circuit 17 of the heat recuperator 16, so that the heat extracted from the flue gases of the burner 2 may be returned to the room A.

10

Advantageously, the outlet 37 of the heating circuit 21 of the second heating device 22 may be in fluid connection with the inlet 18 of the secondary circuit 17 of the heat recuperator 16, with suitable cooling fluid pumping means 32 interposed therebetween.

15

Advantageously, these pumping means 32 may include either a pump or the like if the cooling fluid is a liquid, or a compressor or the like if the cooling fluid is a gas.

20 Valve means 33, e.g. a ball valve, may be suitably provided to regulate the flow of cooling fluid in the circuits 17 and 21.

The second heating device 22 may be of any type, provided its heating circuit 21 is in fluid connection with the secondary circuit 17 of the heat recuperator 16 so that the cooling fluid circulating therein is also the heating fluid that circulates in the first.

25

The second heating device 22 may heat the room A by convection heating and/or radiant heating.

30

In a preferred, non-limiting embodiment, as shown in FIG. 4a, the second

heating device 22 may include a box-like body 34, with the heating circuit 21 contained therein, and means for forced convection of outside air on said heating circuit 21 and introduction of the air so heated into the room A.

- 5 For instance, there may be a fan, not shown and known per se, for drawing air from outside, causing it to flow over the heating circuit 21 and introducing it into the room A once it has been heated.

10 The fan may draw air both directly from the room A to be heated and outside it, for pre-heating fresh air, thereby further increasing the efficiency of heat exchange in the second heating device 22.

For this purpose, the box-like body 34 may have one or more apertures for putting the heating circuit 21 in fluid communication with the outside and/or
15 with the room A, which are not shown and also known per se.

Particularly, in this embodiment, the second heating device 22 may be a fan heater or a similar device.

- 20 In another embodiment, as shown in Fig. 4b, the second heating device 22 may comprise a main body 35 with a plurality of radiant tubes 36, which are located in the room for radiant heating thereof.

In this embodiment, the heating circuit 21 is composed of the radiant tubes
25 36 of the main body 35. As a result, the heating fluid also acts as a heat carrier fluid, and heats the room A directly, with no further intermediate heat exchange.

Therefore, the fluid that circulates in the closed loop for fluid connection
30 between the inlet 18 and the outlet 19 of the cooling circuit 17, the inlet 20 and the outlet 37 of the heating circuit 21 will first act as a cooling fluid in the

secondary circuit 17 of the heat recuperator 16 and then also both as a heating fluid and as a heat carrier in the heating circuit 21, to entirely return the extracted heat to the room.

- 5 Particularly, in this embodiment, the second heating device 22 may be one or more water and/or steam radiant panels.

The above disclosure clearly shows that the device and system of the invention achieve the intended objects. Particularly, by mounting the heat
10 recuperator 16 to the chimney 4, both sensible and latent heat may be reclaimed from the flue gases of the burner 2, which will increase the energy efficiency of the device 1.

Fluid connection between the secondary circuit 17 and the heating circuit 21
15 also allows the reclaimed heat to be effectively returned to the room A. Therefore, a single evolving fluid circulates in both circuits, and acts as a cooling fluid in the circuit 17 and as a heating fluid in the circuit 21.

The device and system of the invention are susceptible to a number of
20 changes or variants, within the inventive concept disclosed in the appended claims. All the details thereof may be replaced by other technically equivalent parts, and the materials may vary depending on different needs, without departure from the scope of the invention.

25 While the device and system have been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

CLAIMS

1. A device for radiance heating of rooms (A), comprising:
- a burner (2) with a combustion chamber (5);
 - 5 - a chimney (4) in fluid connection with said chamber (5) for the expulsion of the combustion products of said burner (2);
 - heating means (3) operably connected with said combustion chamber (5) and designed to produce a heating carrier fluid comprising at least one gaseous phase;
- 10 wherein said heating means (3) comprise a circuit (9) with an outer heat-conducting radiating surface (12) designed for direct contact with the room (A) for radiance heating thereof.
- characterized in that said combustion chamber (5) has an outlet (8) for said combustion products directly connected to said radiant circuit (9), and
- 15 that said chimney (4) comprises a heat recuperator (16) for at least partial recovery of sensible heat and latent heat from the combustion products of said burner (2), said recuperator (16) comprising a secondary circuit (17) for a recuperator fluid to flow therethrough, which can be associated with a heating circuit (9; 21) adapted for at least partially returning the recovered
- 20 heat to the room (A).
2. A device as claimed in claim 1, characterized in that said chimney (4) comprises a heat exchange chamber (23) with an inlet (24) in fluid connection with said burner (2) for collecting the combustion products thereof
- 25 and an outlet (25) in fluid connection with the outside, said secondary circuit (17) comprising a pipe (26) located in said heat exchange chamber (23) for the flue gases of the burner (2) to lick over the outer surface (27) thereof.
3. A device as claimed in claim 2, characterized in that said pipe (26) is a
- 30 coil having a generally elliptical plan shape, with a maximum dimension (D_1) smaller than the diameter (D_2) of said heat exchange chamber (23).

4. A device as claimed in claim 2 or 3, characterized in that said heat exchange chamber (23) comprises a plurality of baffles (28) for increasing flue gas turbulence.

5

5. A device as claimed in one or more of claims 2 to 4, characterized in that said pipe (26) is of modular type, with a plurality of prefabricated piping branches (26', 26'') in fluid connection with each other.

10 6. A device as claimed in one or more of claims 2 to 5, wherein said heat exchange chamber (23) comprises an insulation jacket (29).

15 7. A device as claimed in one or more of claims 2 to 6, wherein said heat exchange chamber (23) comprises an opening (30) for condensation drainage.

8. A device as claimed in one or more of the preceding claims, wherein said burner (2) is directly connected to a radiant conduit (10) to introduce therein said combustion products substantially at said combustion
20 temperature.

9. A device as claimed in one or more of claims 1 to 7, comprising a steam generating device (15) in fluid connection with said outlet (8) of said combustion chamber (5) of said burner (2) and with said inlet (11) of said
25 radiant conduit (10) to introduce the generated steam therein.

10. A device as claimed in the preceding claim, wherein said radiant conduit (10) is in fluid connection with the inlet (18) of said secondary circuit (17).

30

11. A device as claimed in one or more of the preceding claims, wherein

said recuperator fluid is a liquid, preferably selected from water and/or glycol.

12. A system for heating of rooms (A), comprising:

5 - at least one first radiant device (1) as claimed in one or more of the preceding claims, and having a radiant circuit (9) with at least one radiant conduit (10) having an outer heat-conducting radiating surface (12) designed for direct contact with the room (A) for radiant heating thereof;

10 - at least one second heating device (22) also located in the room (A) for heating it in combination with said first device (1), said at least one second heating device (22) comprising a heating circuit (21);

 wherein said heat recuperator (16) has the outlet (19) in fluid connection with the inlet (20) of the heating circuit (21) of said at least one second heating device (22).

15 13. System as claimed in the preceding claim, wherein the outlet (37) of said heating circuit (21) of said at least one second heating device (22) is in fluid connection with the inlet (18) of said cooling circuit (17) of said heat recuperator (16), with cooling fluid pumping means (23) possibly interposed therebetween.

20 14. System as claimed in claim 12 or 13, wherein said at least one second heating device (22) includes a box-like body (34), with the heating circuit (21) contained therein, and means for forced convection of outside air on said heating circuit (21) and introduction of the air so heated into the room (A).

25 15. System as claimed in claim 12 or 13, wherein said at least one second heating device (22) comprises a main body (35) with a plurality of radiant tubes (36) placed in the room (A) for radiance heating thereof, said heating circuit (22) being constituted by said radiant tubes (22).

30

1 / 4

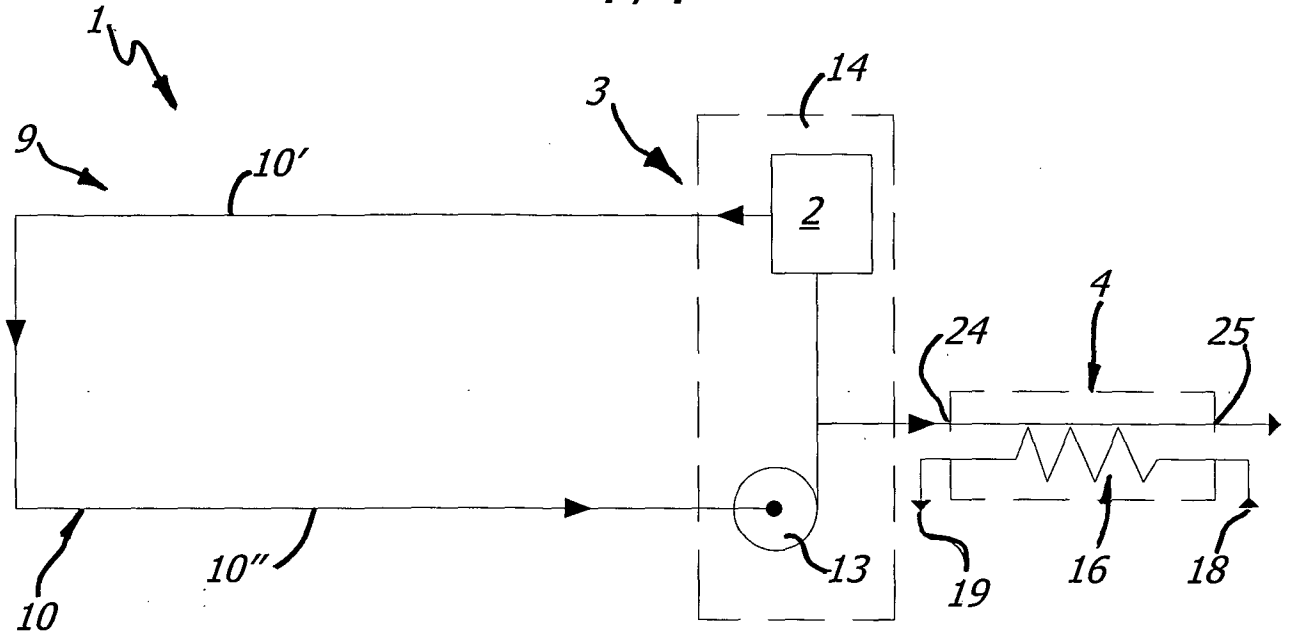


FIG. 1a

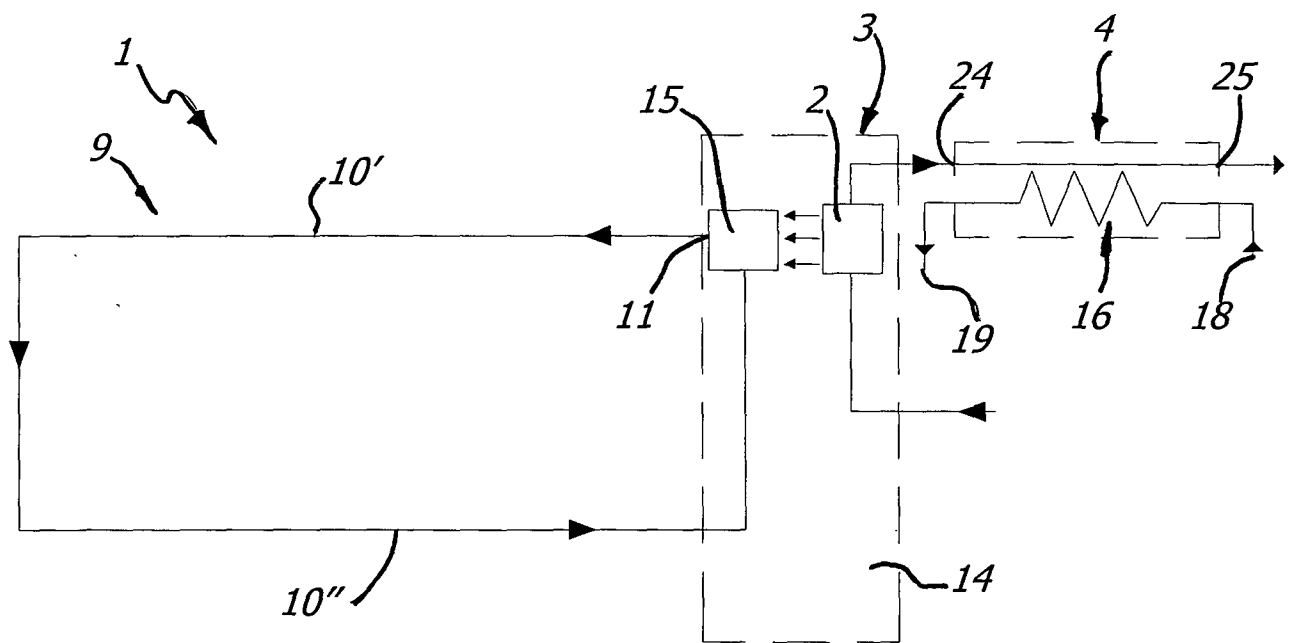


FIG. 1b

2 / 4

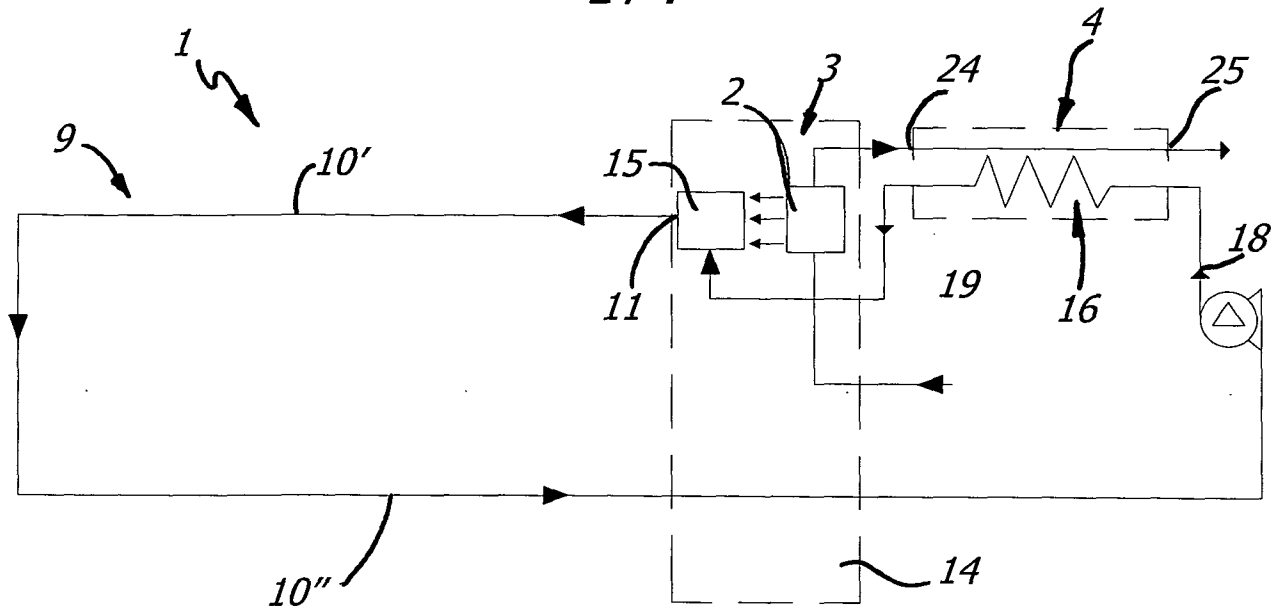


FIG. 1c

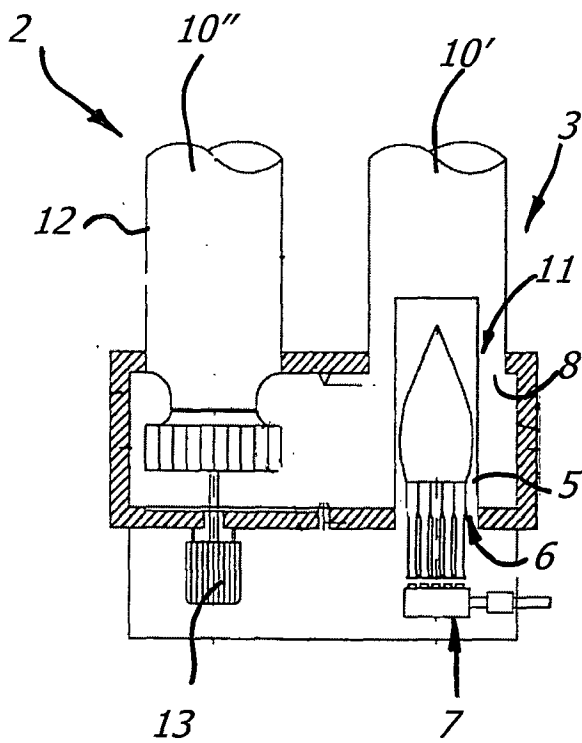


FIG. 2

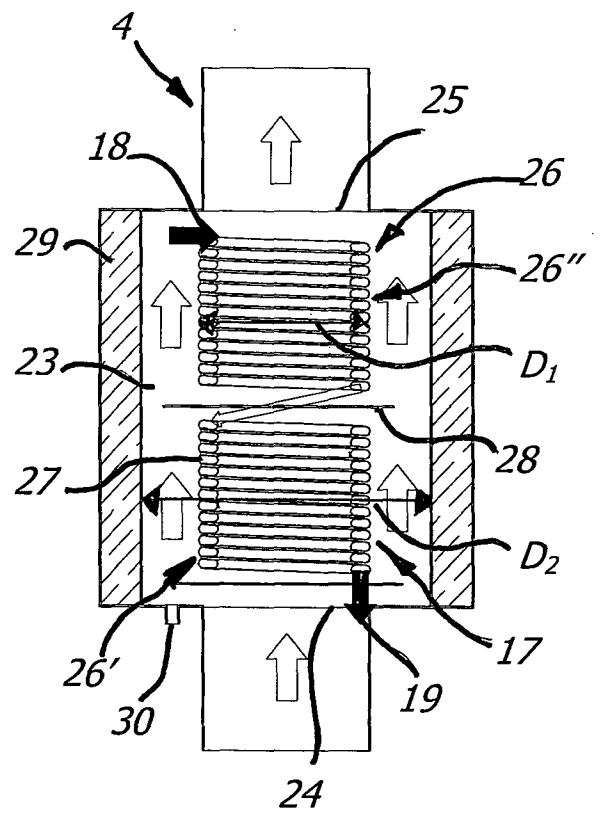


FIG. 3

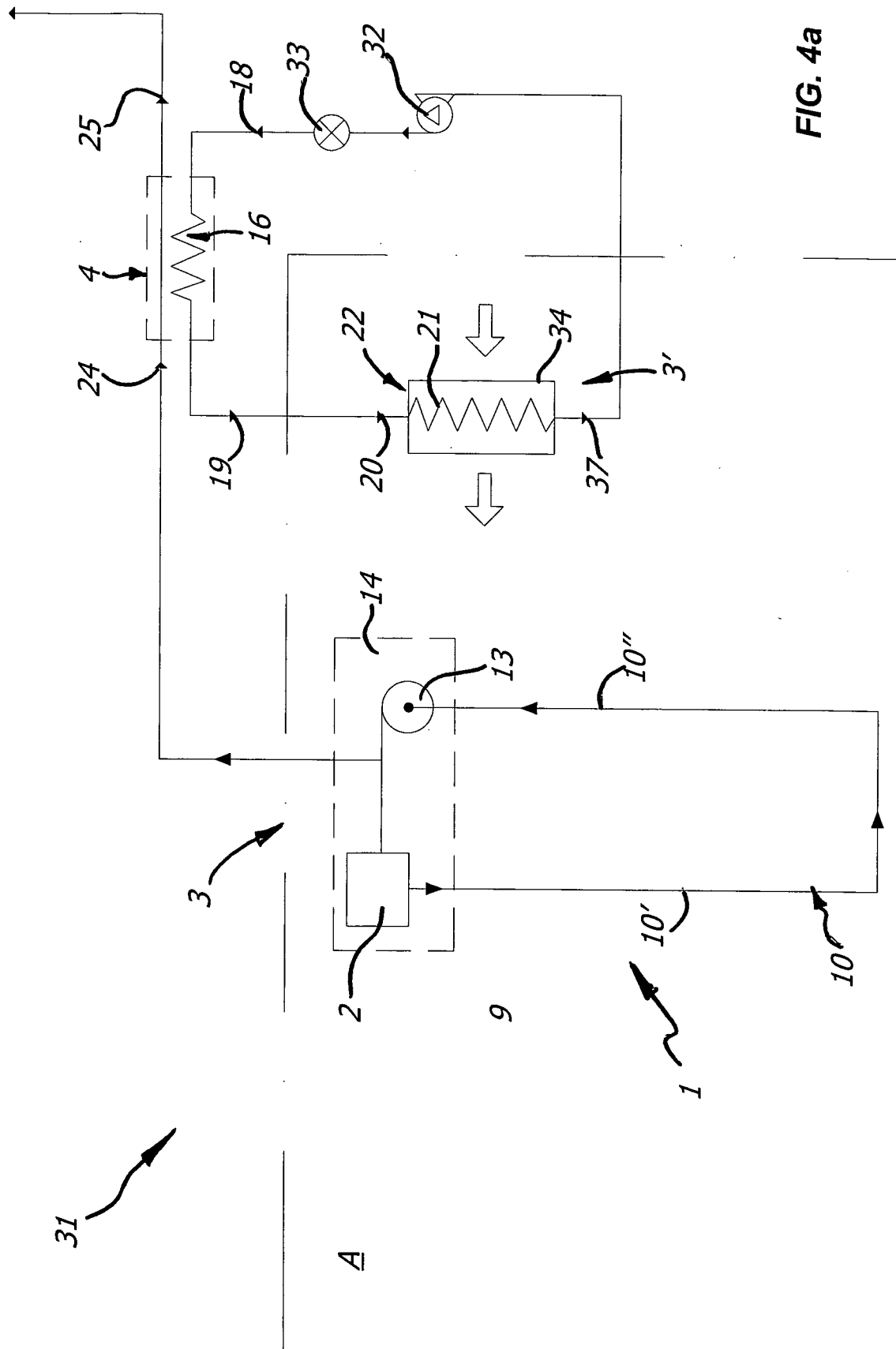


FIG. 4a

4 / 4

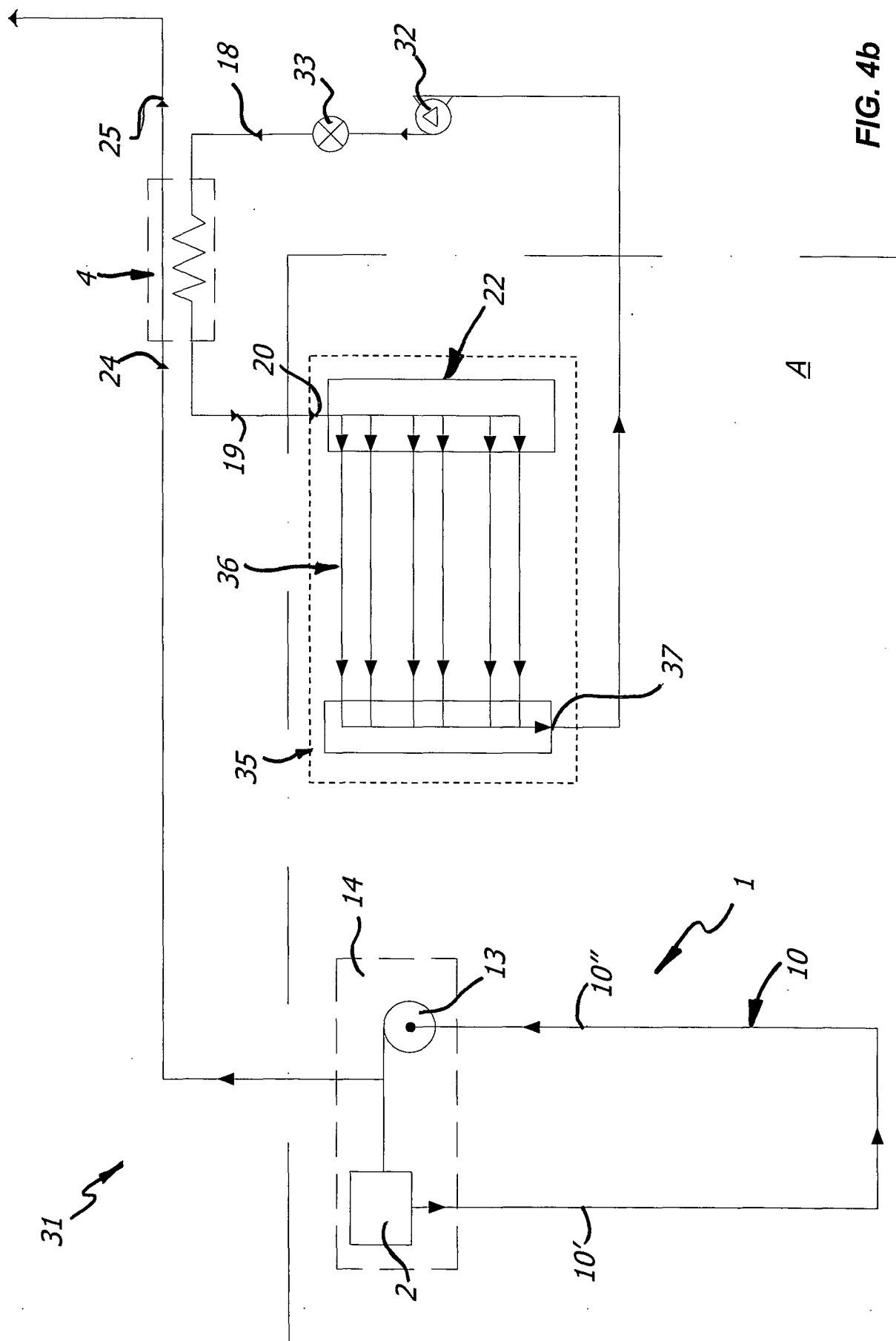


FIG. 4b

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/054320

A. CLASSIFICATION OF SUBJECT MATTER

INV. F24D5/08 F24D12/02 F24H6/00 F24H8/00
ADD. F24D1/00

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

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 practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/44627 A1 (LIM JUNG SOO [KR]) 6 June 2002 (2002-06-06)	1,2,6-8
Y	page 2, line 8 - line 20; figures 1-7	3-5,9-11
A	page 5, line 9 - page 6, line 10 page 7, line 7 - line 19 page 9 page 11 page 12, line 11 - line 19	12-15
Y	FR 2 854 229 A1 (REALISATION MECANIKES ENGINEE [FR]; LE MER JOSEPH [FR]) 29 October 2004 (2004-10-29) * abstract; figures 1,2,10	3-5
Y	JP 58 148320 A (SANYO ELECTRIC CO; TOKYO SANYO ELECTRIC CO) 3 September 1983 (1983-09-03) * abstract; figures 1,2	9-11
----- -/--		



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

7 February 2011

Date of mailing of the international search report

11/02/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

García Moncayo, O

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/054320

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 079 778 A (TRUMP GEORGE S) 21 March 1978 (1978-03-21) column 2, lines 21-25, 57-61; figures 1-8 column 4 - column 5 -----	1-15
A	EP 0 228 569 A1 (SCHOTT RUHRGLAS [DE]) 15 July 1987 (1987-07-15) * abstract; figure 1 -----	1-15
A	GB 2 324 146 A (JONES PHILOMENA JOAN [GB]) 14 October 1998 (1998-10-14) * abstract; figures 1-5 -----	14
A	GB 384 983 A (KARNTNERISCHE EISEN UND STAHLW; KOLOMAN PFEIFFER) 15 December 1932 (1932-12-15) figures 1-3 -----	15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2010/054320

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0244627	A1	06-06-2002	AU 1856502 A 11-06-2002
			CN 1478190 A 25-02-2004
			JP 3842216 B2 08-11-2006
			JP 2004514871 T 20-05-2004
			KR 20010016268 A 05-03-2001
			US 2003205209 A1 06-11-2003
FR 2854229	A1	29-10-2004	CA 2535220 A1 11-11-2004
			CA 2535222 A1 11-11-2004
			CN 1809715 A 26-07-2006
			CN 1809716 A 26-07-2006
			DE 602004012245 T2 19-03-2009
			EP 1618341 A1 25-01-2006
			EP 1625332 A1 15-02-2006
			WO 2004097310 A1 11-11-2004
			WO 2004097311 A1 11-11-2004
			KR 20060013642 A 13-02-2006
			KR 20060012277 A 07-02-2006
			US 2006266306 A1 30-11-2006
			US 2006219395 A1 05-10-2006
JP 58148320	A	03-09-1983	NONE
US 4079778	A	21-03-1978	US 3916991 A 04-11-1975
EP 0228569	A1	15-07-1987	DE 3543051 A1 11-06-1987
			DK 583886 A 06-06-1987
GB 2324146	A	14-10-1998	AU 748894 B2 13-06-2002
			AU 7058998 A 11-11-1998
			CA 2286040 A1 22-10-1998
			CN 1252124 A 03-05-2000
			CZ 9903593 A3 14-03-2001
			EP 0974032 A1 26-01-2000
			WO 9846946 A1 22-10-1998
			HU 0001901 A2 28-10-2000
			JP 3862180 B2 27-12-2006
			JP 2001519018 T 16-10-2001
			NO 994940 A 09-12-1999
			NZ 500723 A 30-03-2001
			PL 336232 A1 19-06-2000
			RU 2208741 C2 20-07-2003
			SK 140299 A3 12-06-2000
			US 6286500 B1 11-09-2001
GB 384983	A	15-12-1932	FR 712924 A 15-10-1931