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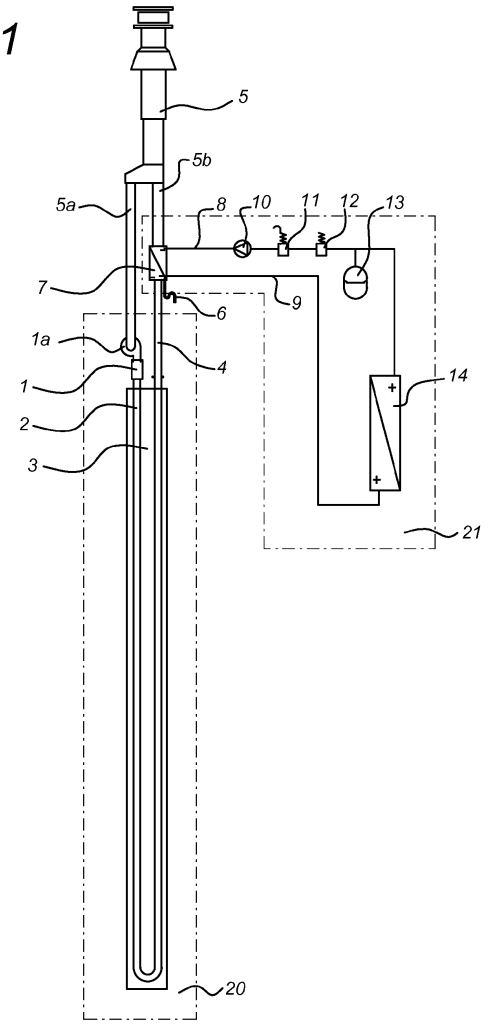
(54) Direct gas fired heating system

(57) Heating system with a gas fired radiant heater (20) and a primary heat exchanger (7) which is in thermal contact with the gas fired radiant heater (20). Furthermore, a fluid based radiant heater (21) is present, and the primary heat exchanger (7) is comprised in a fluid circuit of the fluid based radiant heater (21). An extension set is furthermore provided for a gas fired radiant heater (20) with a fluid based radiant heater (21) and a primary heat exchanger (7) which is comprised in a fluid circuit of the fluid based radiant heater (21), which extension set is thermally connectable with the at least one gas fired radiant heater (20).

Fig. 1



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Description

Technical field of the invention

[0001] The present invention relates to a heating system comprising at least one gas fired radiant heater, and a primary heat exchanger which is in thermal contact with the at least one gas fired radiant heater.

Background of the invention

[0002] The German utility model DE-U-20304733 discloses a gas fired space heating system wherein a burner, reflector and radiant tube are integrated in a housing. In an embodiment, a heat exchanger is provided which is used to cool the flue gases.

[0003] German patent DE 10 2007 047661 discloses a heating system suitable for heating two separate buildings, using a gas fired radiant heater in one building and a fluid based radiant heater in another building. A primary heat exchanger is coupled to an exhaust duct of the gas fired radiant heater. Recuperated heat energy is used in a heating system for another building.

Summary of the invention

[0004] The present invention aims to provide a heating system with an improved efficiency over conventional gas fired heating systems.

[0005] According to the present invention, a heating system according to the preamble defined above is provided, which further comprises at least one fluid based radiant heater, wherein the primary heat exchanger is comprised in a fluid circuit of the fluid based radiant heater and the at least one gas fired radiant heater and the at least one fluid based radiant heater are co-located for irradiating the same space.. By re-using the residual heat of the flue gas exhaust by means of the heat exchanger in the fluid based radiant heater, the consumed energy is better used to heat a space.

[0006] In a further aspect, the present invention relates to an extension set for a gas fired radiant heater, comprising at least one fluid based radiant heater, and a primary heat exchanger which is comprised in a fluid circuit of the fluid based radiant heater, wherein the extension set is thermally connectable with the at least one gas fired radiant heater. Using this extension set a conventional gas fired radiant heater can be combined into a heating system with a much improved efficiency.

Brief description of the drawings

[0007] The present invention will be explained in further detail hereinafter based on a number of exemplary embodiments with reference to the drawings, wherein:

Fig. 1 is a schematic view of a first embodiment of the heating system according to the present invention;

Fig. 2 is a schematic view of a second embodiment of the heating system according to the present invention;

Fig. 3 is a schematic view of a third embodiment of the heating system according to the present invention;

Fig. 4a is a schematic cross sectional view of a combination of two fluid based radiant panels and a gas fired radiant panel; and

Fig. 4b is a schematic cross sectional view of the combination of Fig 4a and an additional fluid based radiant panel.

Detailed description of the exemplary embodiments

[0008] Space heating in e.g. office, factory or residential buildings can be accomplished by means of known direct gas fired radiant heaters. Utilizing such devices allows objects to be heated that are within the radiation range of the device. The air is not directly heated, only the irradiated object.

[0009] The efficiency of a direct gas fired radiant heaters is described in two ways: 1) flue gas exhaust channel efficiency, and 2) radiant efficiency. The embodiments of the present invention relate to an improved flue gas exhaust channel efficiency, wherein waste energy in flue gases from the combustion process is used to improve the overall efficiency.

[0010] Flue gas exhaust channel efficiency is determined by the excess air during combustion and flue gas temperature: less excess air and lower flue gas temperature implies a higher flue gas exhaust channel efficiency.

[0011] Nevertheless, a certain amount of excess air will always have to be accepted. When too small an amount of excess air is present, toxic CO will be released, rendering the heating system unsafe. The excess air is thus intended to allow for fluctuations in gas supply pressure and tolerances in gas composition.

[0012] A direct gas fired radiant heater has a relatively limited flue gas exhaust channel efficiency compared to other gas fired heating systems that are used for space heating. One of the reasons for this is that it is generally undesirable to further cool the flue gases. The radiant tube of a gas fired radiant heater must be as hot as possible to optimize radiation efficiency. The problem is that an increase in flue gas exhaust channel efficiency causes a decrease in radiation efficiency, and the opposite is also often true.

[0013] With any form of heating it is desirable to obtain a flue gas exhaust channel efficiency as high as possible. It is also desirable in relation to these products to obtain a radiant efficiency as high as possible. The present invention embodiments allow for an improved flue gas exhaust channel efficiency without sacrificing radiation efficiency. This is achieved by using energy in the flue gases for heating a fluid and by actually using this heat. Vir-

tually all of the energy released during combustion of the gas/air mixture is used, by means of a flue gas cooler which cools flue gases from a gas fired radiant heater and heats a fluid such as water. The radiation related efficiency of the gas fired radiant heater does not suffer from this method.

[0014] Fig. 1 is a schematic view of a heating system according to a first embodiment of the present invention.

[0015] A gas fired radiant heater 20 comprises a radiant tube 2 (e.g. in the form of a U-shaped tube), whereof one end is connected to a gas burner 1. The other end of the radiant tube 2 is connected to a flue gas exhaust channel 4. The radiant tube 2 is suspended in a reflector 3 (e.g. in the form of a metal cap). The gas burner 1 burns a gas/air mixture. The flame which is generated heats the radiant tube 2. As the radiant tube 2 heats up, it starts to radiate (infrared energy), and the reflector 3 amplifies the heat radiation. The flame, and further into the trajectory of the radiant tube 2 the flue gasses, are pushed or pulled by the (flue gas) fan 1a.

[0016] An air inlet/outlet combination 5 comprises an inlet duct 5a and an outlet duct 5b so that the gas fired radiant heater 20 can be operated with a closed combustion system, wherein air is sucked in from the outside environment of the building, and wherein flue gases are discharged to the outside environment. In the depicted embodiment, the inlet duct 5a is connected to the gas burner via a fan 1a. The flue gas exhaust duct 4 is connected to the outlet duct 5b.

[0017] The embodiments of the present invention are also applicable to gas fired radiant heaters 20 comprising an open combustion system 20. The inlet duct 5a then extracts air from the direct surrounding and is not part of a combined air inlet/outlet combination 5. Only the flue gas exhaust channel 4 is then connected to the outlet duct 5b in order to discharge flue gases to the outside environment.

[0018] The heating system further comprises a fluid based radiant heater 21, which is co-located with the gas fired radiant heater 20 for irradiating in the same space. The fluid based radiant heater 21 comprises a fluid fed radiant panel 14 (or radiator) with a closed fluid circuit, e.g. based on water. In the closed fluid circuit a fluid supply line 8, a fluid return line 9, and a pump 10 are present.

[0019] Additionally, further elements known as such may be present in the fluid circuit, such as an overpressure valve 11, a (automatic) purge vent 12 , and an expansion vessel 13. The possible pressure variations in the closed fluid circuit is absorbed by the expansion vessel 13, and when an overpressure is generated in the system the overpressure valve 11 will engage. The purge vent 12 avoids the occurrence of trapped air pockets inside the system.

[0020] As combining element in the heater, a primary heat exchanger 7 is further comprised in the closed fluid circuit. The primary heat exchanger 7 functions as the flue gas cooler described above, by also providing this in the flue gas exhaust channel 4 upstream of the connection of the flue gas exhaust channel 4 to the outlet duct 5b. At this location the temperature of the flue gases can still be between 200 en 250°C, as a result of which the primary heat exchanger 7 is able to increase the temperature in the fluid circuit of the fluid based radiant heater 21 to a usual 70-90°C. Because the primary heat exchanger 7 cools the flue gases coming from the gas fired radiant heater 20, water condenses, which can be drained via a siphon 6 connected to the primary heat exchanger 7.

[0021] This embodiment of the heating system has a significantly improved flue gas exhaust channel efficiency compared to a gas fired radiant heater 20 on its own. Water which is heated by the flue gas in the primary heat exchanger 7, is circulated through the fluid based radiant panel 14 by means of the pump 10. The energy gained from the flue gases is then indirectly supplied to the space via the fluid based radiant panel 14 in the form of radiation and convection. The flue gas exhaust channel efficiency is significantly improved, and the energy that would otherwise be lost to the outside air is supplied to the space in the same manner, i.e. as radiation.

[0022] As described, the present invention embodiments combine two different radiant heaters. The use of a gas fired radiant heater 20 in combination with a fluid based radiant heater 21 increases the flue gas exhaust channel efficiency in the assembly as described. The water circuit in this system is a closed circuit.

[0023] The heating system can be embodied in a number of variants, of which a first is shown in Fig. 1 and described above. A further variant is shown in the schematic view in Fig.2. Compared to the Fig. 1 embodiment, three elements are alternatively configured, which each can be present on their own or in combination.

[0024] Firstly, the fan 1a is not positioned just upstream of the gas burner 1, but in the flue gas exhaust channel 4 of the gas fired radiant heater 20. The outside air is thus sucked in the entire radiant tube 2 and the fan 1a acts as a flue gas fan.

[0025] As the second element of the embodiment in Fig. 2, the flow direction in the fluid based radiant heater is reversed: the pump 10 works the other way around and the function of the fluid supply line 8 and fluid return line is also reversed in this embodiment.

[0026] As a third element a secondary heat exchanger 15 is comprised in the fluid circuit of the fluid based radiant heater 21. By way of example, the secondary heat exchanger 15 is placed in the reflector 3 and in thermal contact with the radiant tube 2, or above the radiant tube 2. When the gas fired radiant heater 20 is in operation, it is possible to transfer heat to the fluid circuit via the secondary heat exchanger 15.

[0027] In the shown embodiment, the secondary heat exchanger 15 is comprised in the fluid circuit by means of a connection to the fluid fed radiant panel 14 via the fluid return line 9 at one end, and at the other end via a connection line 9a to the primary heat exchanger 7. The mutual sequence of primary heat exchanger 7, second-

ary heat exchanger 15, pump 10, and radiant panel 14 can be changed as the fluid circuit of the fluid based radiant heater 21 is a closed circuit. This can also be applied in other embodiments.

[0028] In Fig. 3 a further embodiment of the heating system according to the present invention is shown schematically. This example also includes a number of optional elements that can be used in one of the other embodiments as well. For example, this is the optional buffer vessel 16 included in the fluid circuit of the fluid based radiant heater 21, in which heated water can be stored.

[0029] The most important element of the embodiment shown in Fig. 3 is that two gas fired radiant heaters 20 are used, i.e. the gas fired radiant heater 20 discusses above and at least one further gas fired radiant heater 20. The associated primary heat exchangers 7 (and (optional) secondary heat exchangers 15) can be connected in parallel to each other by connecting lines 8a and 9a.

[0030] Furthermore, the fluid based radiant heater 21 is provided with two radiant panels 14 connected in parallel.

[0031] Further embodiments are conceivable wherein a plurality of gas fired radiant heaters 20 are present, possibly combined with a fluid based radiant heater 21 which is provided with a plurality of radiant panels 14.

[0032] In Fig. 4a a cross sectional view is shown of an embodiment according to the present invention, wherein a radiant tube 2 (with reflector 3) of one gas fired radiant heater 20 is combined with two radiant panels 14 of one fluid based radiant heater 21 in order to form a composite panel. Each radiant panel 14 comprises a plurality of pipes 24 connected to each other in parallel and a panel 25 thermally coupled to the pipes 24. In the embodiment of Fig. 4a, each radiant panel 14 comprises four pipe/panel combinations 24, 25. The radiant panels 14 are positioned on both sides of the radiant tube 2 (which as such is mounted in a reflector 3). In Fig. 4b a further embodiment is shown wherein inside of the reflector 3 of the gas fired radiant heater 20 a number of pipes 24 of an additional radiant panel 14 of a fluid based radiant heater 21 are added.

[0033] In an even further embodiment, the assembly according to the embodiments of Fig. 4a or Fig. 4b can be included in a second reflector. This yields an integrated set-up that can be easily installed in a space, e.g. suspended from the ceiling. Also other configurations of numbers of radiant tubes 2 and radiant panels 14 are conceivable.

[0034] In yet a further variant a plurality of gas fired radiant heaters 20 are combined and connected to a single inlet duct 5a and a single outlet duct 5b. A minimum of two gas fired radiant heaters are then present in this embodiment. The flue gases are transported from the radiant tubes 2 of the individual radiant heaters 20 towards one common flue gas exhaust channel 4. The heat exchanger 7 is connected to this single flue gas exhaust channel 4 in order to heat the fluid of the fluid based radiant heater 21, so that the radiant panels 14 can be used efficiently. The primary heat exchanger 7 is then in thermal contact with the common flue gas exhaust channel 4 of the at least two gas fired radiant heaters 20.

[0035] The embodiments of the present invention are also applicable to gas fired radiant heaters 20 with an open combustion system. The inlet duct 5a in this case retrieves air from the direct environment and does not form part of a combined air inlet/outlet combination 5. Only the common flue gas exhaust channel 4 is then connected to the outlet duct 5b for discharging flue gases to the outside environment.

[0036] A further aspect of the present invention relates to an extension set for a gas fired radiant heater 20. The extension set comprises a fluid based radiant heater 21, a primary heat exchanger 7 which is comprised in a fluid circuit of the fluid based radiant heater 21. The primary heat exchanger 7 can be put in thermal contact with the at least one gas fired radiant heater 20, yielding a heating system as described above. In an embodiment, the extension set further comprises a secondary heat exchanger 15 comprised in the fluid circuit in series with the primary heat exchanger 7. In yet a further embodiment, the extension set comprises a buffer vessel connectable to the fluid circuit of the fluid based radiant heater 21.

Claims

1. Heating system comprising at least one gas fired radiant heater (20), and a primary heat exchanger (7) in thermal contact with the at least one gas fired radiant heater (20), the heating system further comprising at least one fluid based radiant heater (21), wherein the primary heat exchanger (7) is comprised in a fluid circuit of the fluid based radiant heater (21), and the at least one gas fired radiant heater (20) and the at least one fluid based radiant heater (21) are co-located for irradiating the same space.

2. Heating system according to claim 1, wherein the at least one gas fired radiant heater (20) comprises a flue gas exhaust channel (4), and wherein the primary heat exchanger (7) is in thermal contact with the flue gas exhaust channel (4).

3. Heating system according to claim 1 or 2, further comprising a secondary heat exchanger (15), which is positioned in the fluid circuit in series with the primary heat exchanger (7).

4. Heating system according to claim 3, wherein the at least one gas fired radiant heater (20) comprises a radiant tube (2), and wherein the secondary heat exchanger (15) is in thermal contact with the radiant tube (2).

5. Heating system according to any one of claims 1-4, further comprising a combined air inlet and air outlet

(5) connected with the gas fired radiant heater (20), wherein a fan (1a) is connected with the air inlet (5a), and wherein an outlet of the fan (1a) is connected with a gas burner (1) of the gas fired radiant heater (20).

6. Heating system according to any one of claims 1-4, further comprising a combined air inlet and air outlet (5) connected with the gas fired radiant heater (20), wherein a fan (1a) is connected with the air outlet (5b), and wherein the air inlet (5a) is connected with a gas burner (1) of the gas fired radiant heater (20).

7. Heating system according to any one of claims 1-6, comprising at least one further gas fired radiant heater (20), wherein each of the gas fired radiant heater and the at least one further gas fired radiant heater (20) is provided with a primary heat exchanger (7), and wherein the primary heat exchangers (7) are connected in parallel in the fluid circuit of the fluid based radiant heater (21).

8. Heating system according to any one of claims 1-6, comprising at least one further gas fired radiant heater (20), provided with a primary heat exchanger (7) in thermal contact with a common flue gas exhaust channel (4) of the gas fired radiant heater and the at least one further gas fired radiant heaters (20)

9. Heating system according to any one of claims 1-8, wherein a radiant tube (2) of the at least one gas fired radiant heater (20) and one or more radiant panels (14) of the at least one fluid based radiant heater (21) are combined into a composite radiant panel.

10. Heating system according to any of the claims 1-9, wherein the fluid based radiant heater (21) further comprises a buffer vessel (16) connected with the fluid circuit.

11. Extension set for a gas fired radiant heater (20), comprising: at least one fluid based radiant heater (21), and a primary heat exchanger (7) comprised in a fluid circuit of the fluid based radiant heater (21), and wherein the extension set is thermally connectable with the at least one gas fired radiant heater (20).

12. Extension set according to claim 11, further comprising a secondary heat exchanger (15) positioned in the fluid circuit in series with the primary heat exchanger (7).

13. Extension set according to claim 11 or 12, wherein the fluid based radiant heater (21) further comprises a buffer vessel (16) connectable to the fluid circuit.

Fig. 1

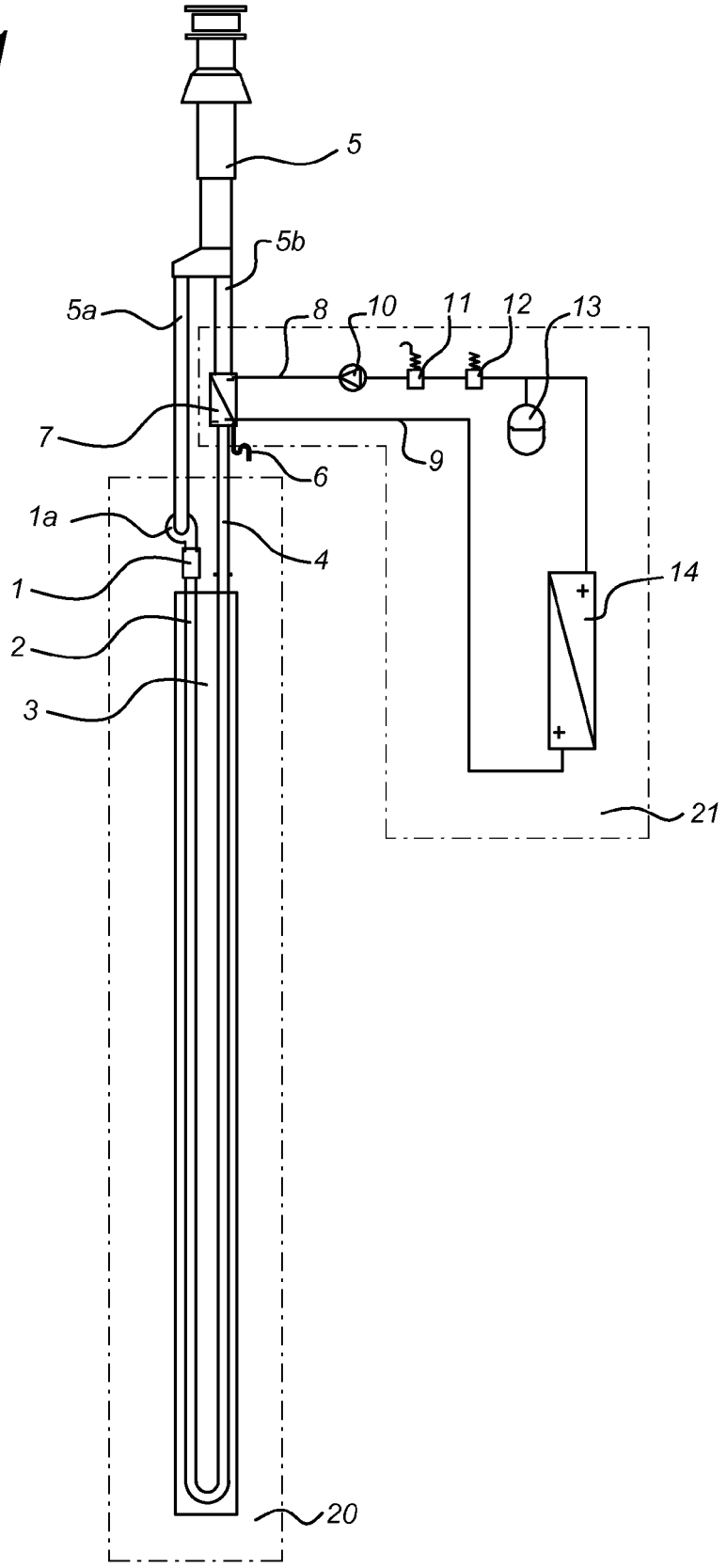


Fig. 2

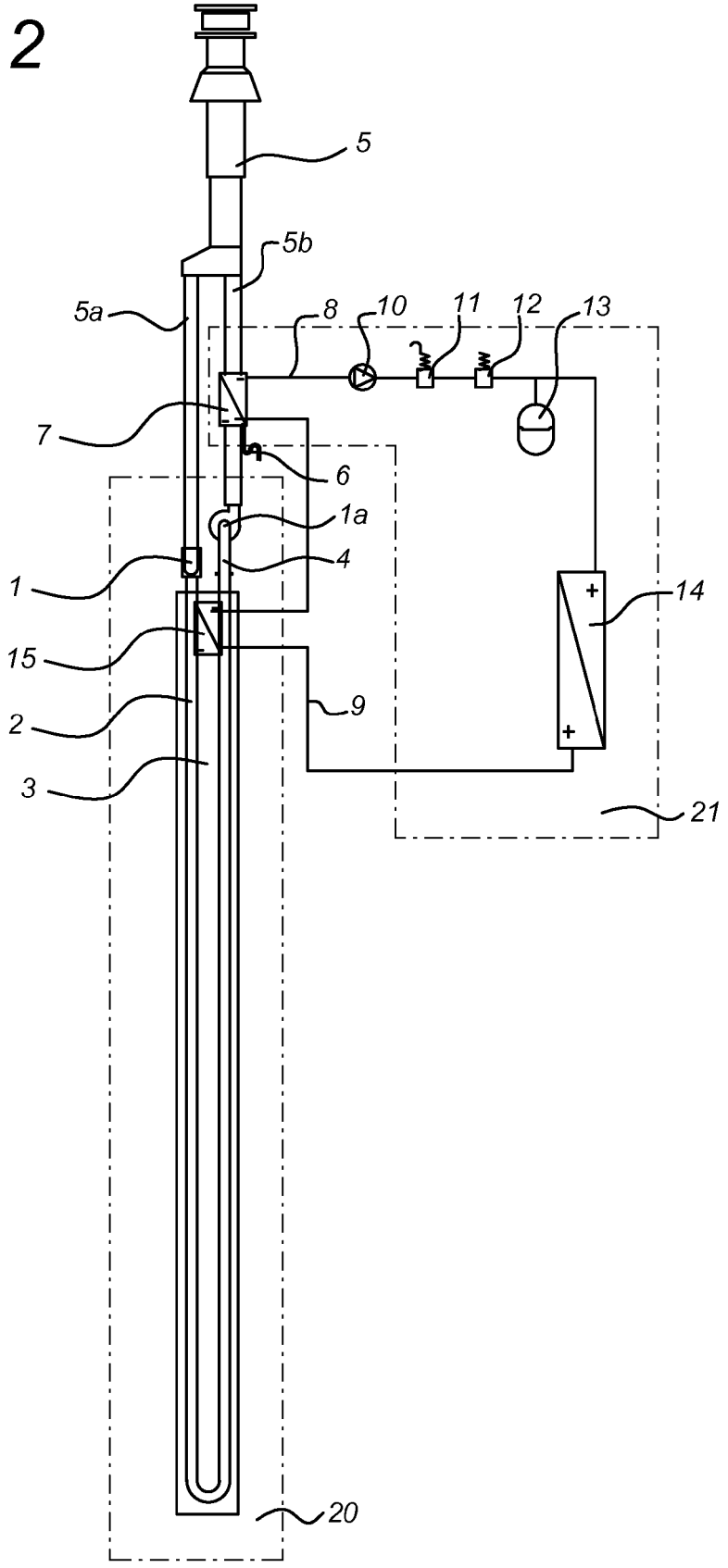


Fig. 3

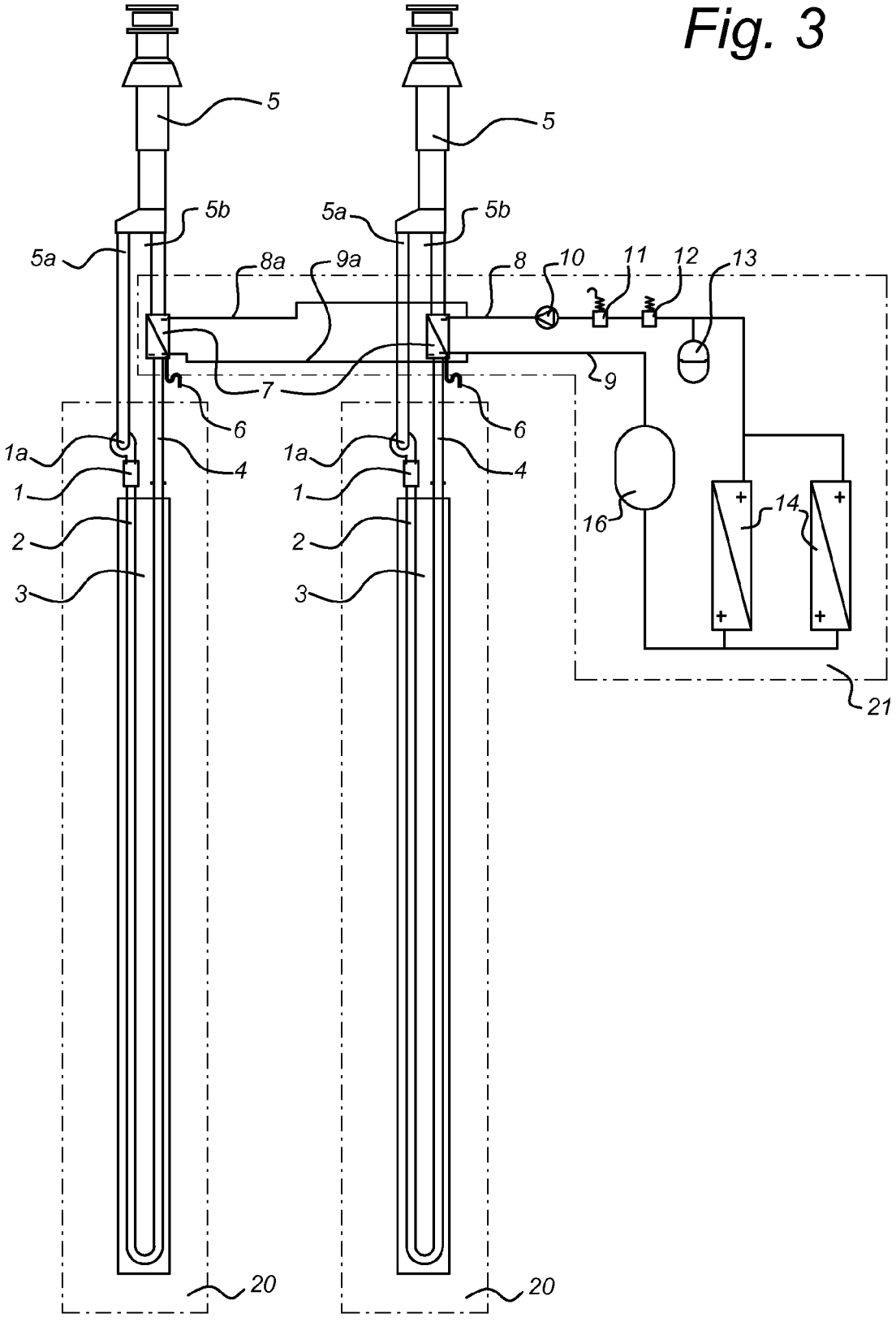


Fig. 4a

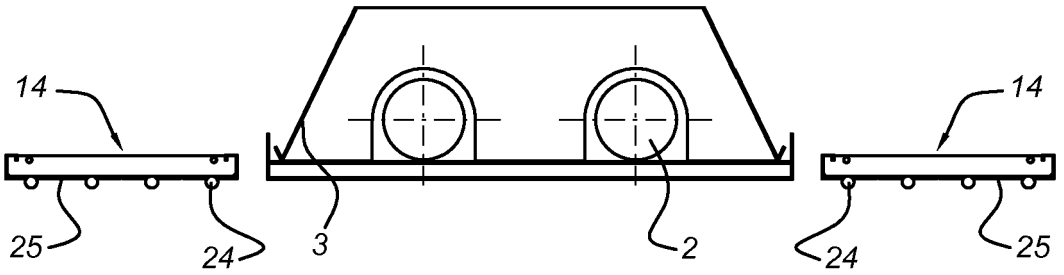
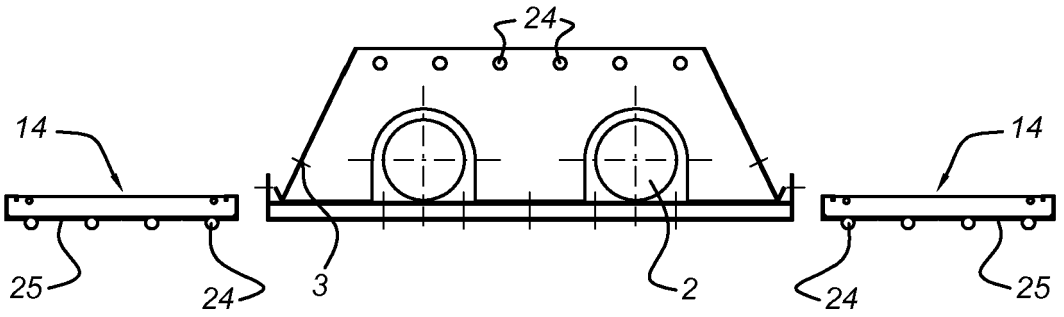


Fig. 4b



REFERENCES CITED IN THE DESCRIPTION

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