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(54) Solid fuel apparatus for heating, using air, one or more user devices and corresponding heating method

(57) An apparatus (10) for heating, using air, one or more user devices (11) connected thereto, comprising a closed heat generator (12) fed with solid fuel, in particular a biomass, has inside it a closed combustion chamber (17) and first liquid heat exchange means (14) cooperating with the combustion chamber (17), to carry out the heat exchange between the fumes deriving from the combustion of said biomass and a heat-carrying liquid which flows in said first heat exchange means (14). The apparatus (10) for heating, using air, also comprises second heat exchange means (18), of the air-liquid type, external and distanced from said closed heat generator (12), in which air flows to be heated and distributed to said one or more user devices (11) to be heated. Said second heat exchange means (18) are fluidically connected to said first heat exchange means (14) to heat said air by means of said heated liquid coming from said first heat exchange means (14).

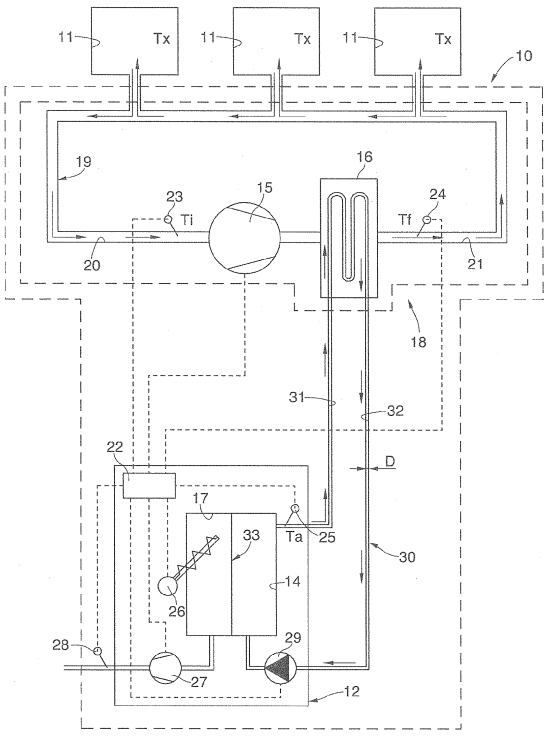

fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a heating apparatus and method using air, fed with solid fuel, such as a biomass, in which the heat produced by a closed heat generator, such as a pellet-burning stove, is used to increase the temperature of air to be distributed to one or more rooms to be heated.

[0002] In particular, the present invention is usable in the home, without however excluding other places or applications in which one or more user devices are heated using air.

BACKGROUND OF THE INVENTION

[0003] The use of heat generators fed by biomass is known, such as pellet-burning stoves for example, or wood-burning stoves or fireplaces, to heat homes using air. In particular it is advantageous to channel and distribute the hot air, which is generated thanks to the heat exchange with the combustion fumes, in the rooms to be heated by means of distribution or channeling means, such as for example ventilators or conveyors associated with channeling pipes or tubes.

[0004] Moreover, the need to contain the bulk of said heat generators, above all in the home, can limit the thermal power which these are able to develop, and can therefore be insufficient to heat a home, in particular a large one, using the hot air blown in.

[0005] An increase in the power of a heat generator using biomass used for this type of heating would entail a significant increase in the sizes of the generator and the corresponding pipes for the exit of the fumes and the delivery of the air, making it inconvenient, cumbersome and costly, as well as not aesthetic, for domestic use.

[0006] Moreover, the heat distribution means able to move large air masses are also cumbersome and would have the disadvantage of being noisy and unsuitable for installation inside a fireplace of the type in question.

[0007] Document US-A-4,163,199 describes an open wood-burning fireplace to which a heating apparatus is associated to supply supplementary heat to a main heating system using forced hot air. The heating apparatus comprises a grating on which logs of wood burn and which provides a base support for the logs formed by pipes for water which follow a tortuous path. The water, once heated by the logs which burn above the grating, is pumped to a heat exchanger mounted in a hot air pipe of the main heating system using forced air. A temperature sensor is provided in the hot air pipe, which supplies signals about the temperature of the hot air to consequently command the pump which determines the flow of hot water in the heat exchanger.

[0008] However, the heating apparatus described in US-A-4,163,199 suffers from great heat inefficiency of the open wood fireplace which, being open and without any type of energy recovery, disperses a large quantity of heat to the outside with the combustion fumes. Indeed, only a minimum part of the heat produced by the combustion of the logs can be used, while a large part is dispersed into the environment or with the combustion fumes. In any case, the water circulating in the pipes that form the base of the grating is heated only through contact with the burning logs resting on the base of the grating, and therefore the heat exchange obtained is low efficiency. Consequently, at least for the reasons explained above the heating apparatus described in US-A-4,163,199 can only be used to supply supplementary heat to a main heating system and is not able to supply all the heating power needed for a building or home.

[0009] Document US-A-2010/0324741 describes a system and method for detecting defects in air circulation units for heating or cooling.

[0010] Document FR-A-2.920.222 describes a water heating device comprising a heating body, a primary circuit for the circulation of a first liquid and a secondary hydraulic circuit associated with a heat exchanger and an electronic temperature regulator.

[0011] Document US-A-4,454,827 describes an ignition and control system of a combustion device fed with solid fuel such as fragmented wood, such as chip or pellets.

[0012] One purpose of the present invention is to obtain an apparatus and a method for the complete heating of one or more user devices of the domestic type, fed with solid fuel, which does not need to receive supplementary heat and which allows to render more effective and efficient the distribution of the heat produced by a biomass generator, allowing to increase the thermal power delivered by the generator, given the same bulk thereof.

[0013] Another purpose of the present invention is to obtain a heating apparatus and method which is able to heat a home completely using air as the heating fluid, and which is silent, economical, not bulky and easy to install.

[0014] Another purpose of the invention is to obtain a heating apparatus and method which is able to deal with variations in temperature punctually and promptly, limiting the length of the transitories both when switched on and when switched off

[0015] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0016] The present invention is set forth and characterized in the independent claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0017] In accordance with the above purposes, a heating apparatus according to the present invention uses

heated air to heat one or more user devices connected to it, such as for example one or more rooms of a home.

[0018] The apparatus according to the present invention comprises a closed heat generator fed with solid fuel, in particular a biomass, having a closed combustion chamber and first heat exchange means that cooperate with the combustion chamber.

[0019] According to one aspect of the invention, the first heat exchange means are configured to carry out the heat exchange between the fumes deriving from the combustion of the biomass and a heat-carrying liquid which flows in the first heat exchange means.

[0020] Furthermore, the heating apparatus also comprises second heat exchange means, of the air-liquid type, external and distanced from the closed heat generator, in which air flows to be heated by means of heat exchange with the heated liquid and is distributed or channeled to the user devices to be heated. The second heat exchange means are fluidically connected to the first heat exchange means, so as to heat the air by means of the heated liquid coming from the first heat exchange means.

[0021] Advantageously, by providing a closed heat generator in which the combustion chamber is closed and possibly insulated toward the outside, not open toward the room like an open fireplace, the present invention allows great heat efficiency and an effective heat recovery, to the great advantage of the heat exchange with the heat-carrying liquid in the first heat exchange means. Thanks to the high energy yield of the closed heat generator, the thermal power exchanged in the first and second heat exchange means will also be very high, allowing to heat the room, home or building autonomously and completely, without needing supplementary heating, where the present invention is installed. In other words, thanks to the high energy efficiency of the closed heat generator, it is possible to consequently supply a high thermal power available for heating which, by suitably sizing the closed heat generator, can completely satisfy the requirements of the user device, home or building where the apparatus of the present invention is installed.

[0022] The present invention obtains a first heat exchange between the heat deriving from the combustion of the biomass, in particular the combustion fumes, and the heat-carrying liquid, allowing to increase the potential of the closed heat generator, given the same sizes, compared with a known type of biomass generator, and all the more so compared with an open wood-burning fireplace which has low heat efficiency, thanks to the greater specific heat of the liquid used compared with air.

[0023] Furthermore, since there is a second heat exchange between the heated liquid and the air, in an external zone that is distanced from the closed heat generator, the apparatus according to the present invention is efficient from the energy point of view, easy, convenient to use also in the home environment.

[0024] Indeed, also because of the higher thermal powers required, the necessary increase in sizes of the closed heat generator is compensated by the greater efficiency of heat exchange between the liquid and the combustion fumes, taking into account that, thanks to the closed configuration of the heat generator and the closed combustion chamber which is possibly insulated toward the outside, the heat dispersion is drastically reduced, and it is possible to exploit to the utmost the heat produced by the combustion of the solid fuel. Furthermore, the necessary over-sizing of the air-type heat exchange means does not affect either the heating apparatus itself, or the space where the apparatus is installed because, as described above, they can be advantageously installed in a separate room or compartment, distanced from the space where the closed heat generator is installed.

[0025] According to one aspect of the present invention, the second heat exchange means comprise at least a heat exchanger and a first distribution circuit, for the circulation of hot air from the heat exchanger to the user devices, and vice versa. The first circuit has at least a feed segment to the user devices and a return segment from the user devices, to direct the air toward the heat exchanger, in which a second circuit is also provided, provided with a feed pipe and a return pipe, for the circulation of the heated liquid from the first heat exchange means toward the heat exchanger, and vice versa.

[0026] Another aspect of the invention provides that the second heat exchange means also comprise air movement means, such as for example a ventilator, associated to the return segment of the first distribution circuit, to take the air from the user devices and thrust it at least toward the heat exchanger.

[0027] Another aspect of the invention provides that the apparatus comprises first temperature measuring means, such as probes, sensors or suchlike, associated to the return segment of the first circuit and suitable to transmit an electric signal relating to the temperature of the air in the return segment, and an electronic control unit, inside the closed heat generator, suitable to receive and process the electric signal to carry out a feedback control of the combustion of the biomass, in order to maintain the temperature around a value set by a user.

[0028] An apparatus made according to the invention can also comprise second temperature measuring means associated to the feed segment of the distribution circuit and suitable to transmit an electric signal relating to the temperature of the air in the feed segment. An electronic control unit, inside the heat generator, is suitable to receive and process the electric signal to carry out a control of the quantity of liquid circulating in the second circuit, in order to maintain the temperature in a range suitable to guarantee a suitable comfort in the user devices.

[0029] Another aspect of the invention provides that the apparatus comprises third temperature measuring means associated at least to the feed pipe of the second circuit and suitable to transmit an electric signal relating

to the temperature of the liquid in the feed pipe, and an electronic control unit, inside the closed heat generator, suitable to receive and process the electric signal to carry out a control of the operating conditions of the liquid in the second circuit, and in the first heat exchange means.

[0030] According to a variant, the apparatus comprises second heat exchange means concentrated in a single position from which to send the heated air to the different user devices.

[0031] According to another variant, the apparatus comprises a plurality of second heat exchange means distributed in the rooms of the different user devices and fluidically connected to the first heat exchange means of the closed heat generator.

[0032] In some forms of embodiment, the closed heat generator is a pellet-burning stove.

[0033] In variant forms of embodiment, the first heat exchange means comprise a heat exchange chamber, adjacent to the combustion chamber and containing a heat-carrying liquid.

[0034] In variant forms of embodiment, the first heat exchange means comprise a fumes-heat-carrying liquid exchanger, in particular fumes-water. This heat exchange can have a great efficiency, greater for example than a heat exchange from contact between the fuel and pipes in which a heat-carrying liquid flows.

[0035] In possible implementations, a heat exchange wall is provided between the first heat exchange means and the combustion chamber.

[0036] Again, in possible forms of embodiment, the closed heat generator comprises automatic or semi-automatic feed means of the fuel toward the combustion chamber. This allows, for example, to program the heating cycles, which improves energy efficiency.

[0037] The present invention also concerns a method to heat, using air, one or more user devices, which comprises a first step in which the combustion of a biomass is carried out, in a combustion chamber closed toward the outside of a closed heat generator, and in which the heat exchange between the fumes deriving from the combustion and a heat-carrying fluid flowing inside the first heat exchange means is also carried out, said first heat exchange means being inside the closed heat generator and cooperating with the combustion chamber. The method in question also comprises a second step in which air to be heated and distributed to the user devices is made to flow inside second heat exchange means, of the air-liquid type, external and distanced from the closed heat generator, and connected fluidically to the first heat exchange means, to be heated by means of the heated liquid coming from the first heat exchange means.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] These and other characteristics of the present invention will become apparent from the following description of some forms of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a functioning diagram of an apparatus according to the invention;
- fig. 2 is a schematic representation of a possible installation of the apparatus in fig. 1;
- fig. 3 is a variant of fig. 2;
- fig. 4 is another variant of fig. 2.

DESCRIPTION OF SOME FORMS OF EMBODIMENT

[0039] With reference to fig. 1, a heating apparatus according to the present invention is indicated by the reference number 10 and can be used to heat and distribute hot air toward one or more user devices 11, in this case one or more rooms of a house.

[0040] The apparatus 10 comprises a closed heat generator for the combustion of a biomass, in this case a stove 12 fed with pellets, positioned in a space 13 that is distant from, adjacent to or below the user devices 11. The stove 12 is provided with a combustion chamber 17, closed for example by a closing door, and possibly advantageously insulated toward the outside by suitable insulation means, and with first heat exchange means, in this case a heat exchange chamber 14, adjacent to the combustion chamber 17 and containing a heat-carrying liquid, in this case water. The heat exchange chamber 14 is substantially a fumes-water heat exchanger, or fumes-heat-carrying liquid in general. The proximity of the combustion chamber 17 and the heat exchange chamber 14 allows the fumes, generated by the combustion of biomass taking place in the combustion chamber 17, to give up its heat to the water present and circulating in the heat exchange chamber 14, which functions as a first heat exchange mean. In some forms of embodiment, a heat exchange wall 33 may be provided between the heat exchange chamber 14 and the combustion chamber 17, to allow the heat exchange between the combustion fumes that develop from the combustion chamber 17 and the heat-carrying liquid in the heat exchange chamber 14.

[0041] The apparatus 10 also comprises second heat exchange means 18, air-water or in general air-liquid which, unlike in the state of the art, are an external entity, separate and distanced from the stove 12.

[0042] The second heat exchange means 18 comprise a ventilator 15, which functions as a mean to move the heating air, and a heat exchanger 16, which can be for example an air-water heat exchange battery, such as a heat exchanger with bundles of tubes or another type of heat exchanger able to exchange heat between a liquid, such as water, and the heating air.

[0043] The function of the ventilator 15 is to make the heating air circulate inside a first circuit, or distribution circuit 19, taking the air from a return segment 20 of the circuit 19. In fig. 2, the arrows F indicate the path of the air along the distribution circuit 19. The return segment 20 functions as an intake pipe for the ventilator 15, which takes in the air arriving from the user devices 11 and

thrusts it forcedly through the heat exchanger 16, in which the air is heated by the hot water arriving from the heat exchange chamber 14. The air thus heated then exits from a feed segment 21 of the distribution circuit 19, which functions as a distributor pipe through which the hot air is distributed to the user devices 11. The ventilator 15 also provides the necessary thrust to the heated air toward the user devices 11.

[0044] The heat exchange inside the heat exchanger 16 is controlled by an electronic control unit 22, integrated into the stove 12, to which a first sensor 23 and a second sensor 24 transmit the electric signals relating to the measurement of the air temperature respectively inside the return segment 20 and the feed segment 21, that is, upstream and downstream of the heat exchanger 16.

[0045] The first sensor 23 thus measures the temperature Ti of the air entering the ventilator 15, which in practice corresponds to the temperature of the air in the user devices 11, and which allows the electronic control unit 22 a constant comparison with a desired temperature Tx set by the user. The comparison is part of a feedback control process of the heating of the user devices 11, carried out by the electronic control unit 22. In fact, depending on the value of the temperature Ti, the electronic control unit 22, according to predefined programs and procedures, manages the combustion and heat exchange inside the stove 12.

[0046] A third sensor 25, which measures the temperature of the water exiting from the heat exchange chamber 14, automatic or semi-automatic feed means of the fuel, such as for example a feed motor 26, for example of the screw type, to feed pellets into the combustion chamber 17, a fume ventilator 27, to discharge the fumes from the combustion chamber 17, and a fourth sensor 28, which allows to measure the temperature of the fumes exiting from the combustion chamber 17, are all connected to the electronic control unit 22.

[0047] The electronic control unit 22 is also able to process the electric signals arriving from the third sensor 25 and the fourth sensor 28 referring to the temperatures respectively of the water and the fumes, in order to consequently vary the speed of rotation of the fumes ventilator 27 and the feed motor 26. In this way, the electronic control unit 22 guarantees the thermal power needed to generate the desired quantity of heat, and maintains a ratio between fuel and comburent that is suitable for a correct combustion.

[0048] The same electronic control unit 22 also controls a pump 29, also integrated into the stove 12, disposed upstream of the heat exchange chamber 14 and with the function of forcing the circulation of the water inside a second circuit, or hydraulic circuit 30, from the heat exchange chamber 14 to the heat exchanger 16 and vice versa.

[0049] In particular, the water exiting from the heat exchange chamber 14 at a desired temperature Ta, measured by the third sensor 25, is transferred through a feed pipe 31 to the heat exchanger 16, in which it gives up heat to the air transiting therein due to the effect of the thrust of the ventilator 15, in order to heat it.

[0050] The heat exchange described above allows to obtain a desired temperature Tf of the air transiting in the feed segment 21, dependent on the temperature Ta of the water and on temperature Ti.

[0051] The water thus cooled passes through a return pipe 32 and returns, pumped by the pump 29, into the heat exchange chamber 14, to be heated again by the heat of the fumes present in the combustion chamber 17.

[0052] The feed pipe 31 and the return pipe 32 fluidically connect the second heat exchange means 18 and the heat exchange chamber 14 of the stove 12, and have limited sizes, defined by a cross section having a diameter D comparable to the pipes commonly used in domestic heating plants and coming within a range of values comprised between 16 mm and 37 mm. This limited size does not affect the bulk of the apparatus 10 and allows the pipes to be disposed in view, without compromising the esthetic appearance of the apparatus 10.

[0053] The combustion is advantageously controlled continuously and Ti is used as feedback value, so as to allow the electronic control unit 22 a constant and prompt response, to prevent transitories in which an excessive lowering of temperature can occur in the user devices 11.

[0054] Furthermore, the electronic control unit 22 is able to continuously compare the temperature Ti with temperature Tf at the end of heat exchange, measured by the second sensor 25, allowing the electronic control unit 22 to constantly control the operating effectiveness of the heat exchanger 16.

[0055] The ventilator 15 is connected to the control unit 22, which is able to vary the speed of rotation thereof, in order to manage the quantity of air transiting in the heat exchanger 16 and which consequently is distributed to the user devices 11. The control of the ventilator 15 depends on the increase in air temperature (Tf-Ti) registered by the second sensor 25 and allows to not excessively over-heat the air intended for the user devices 11, to promote in them optimum comfort.

[0056] It should be noted that the thermal power required for heating an average size home is generally comprised between 5 kW and 12 kW.

[0057] With the present invention, since the heating and distribution of air are separate and distanced from the stove 12, the latter can have limited bulk, compatible with installation in a single domestic space, such as the room of a home.

[0058] In fact, with the present invention, it is no longer necessary to have a big combustion chamber inside the stove 12, able to heat all the air, nor to locate the ventilator 15 inside it: the ventilator 15, even if large and noisy, is in any case separate and distanced from the stove 12 and the space 13 in which the stove 12 is installed.

[0059] Furthermore, with the present invention, the air distribution circuit 19, even if considerable in size, in particular with regard to the diameter of the pipes, which generally have a diameter from about 80 mm to about

200 tnm, is no longer directly connected at exit from the stove 12 and can be located, so as to be hardly visible or not visible at all, in an installation zone, or housing compartment 35, made for the purpose, possibly insulated acoustically, such as for example a false ceiling made in the space 13 in which the stove 12 is installed, or in another technical compartment.

[0060] In particular, according to the present invention, connected to the stove 12, apart from the discharge of the combustion fumes, only the water feed pipe 31 and return pipe 32 are provided, which typically have very limited diameters, bulk and esthetic impact.

[0061] Therefore, by separating the stove 12 and the air-water heat exchange means, the present invention solves the problem of bulk and noisiness of the ventilator 15, which can easily be positioned in the installation zone, or housing compartment 35.

[0062] It is clear that modifications and/or additions of parts may be made to the apparatus 10 as described heretofore, without departing from the field and scope of the present invention.

[0063] In particular, in figs. 1 and 2 the second heat exchange means 18 are shown by way of example, concentrated in a single position from which the heated air is sent to the different user devices 11 by means of the distribution circuit 19.

[0064] On the contrary, figs. 3 and 4 show variants in which a plurality of second heat exchange means 18 are provided, distributed in the spaces of the different user devices 11 and fluidically connected, on the water or in general liquid side, to the heat exchange chamber 14 of the stove 12. In these variants, the functioning principle is the same as in the forms of embodiment described with reference to figs. 1 and 2, with a first heat exchange between combustion fumes and water, or in general liquid, in correspondence with the stove 12, but in any case providing to carry out a plurality of localized heat exchanges in the different user devices 11. Each of the second heat exchange means 18, by means of local heat exchange with the hot water arriving from the stove 12, heats its own quantity of air that is taken locally from the corresponding room, and spreads it in the same room. In this case, the distribution circuit 19 can be considered locally, for each user device 11, as the local stream of air entering and exiting from the second heat exchange means 18, indicated by arrows C in figs. 3 and 4.

[0065] Fig. 3 shows in particular a variant in which the second heat exchange means 18 are connected, on the water or liquid side, along a circuit 39 in series one to the other with respect with the stove 12 and the corresponding heat exchange chamber 14.

[0066] Fig. 4 shows instead the variant in which the different second heat exchange means 18 are each connected, on the water or liquid side, by means of their own feed and return circuit 49 to the stove 12 and the corresponding heat exchange chamber 14, associated with which a suitable collector is provided, to which the various circuits 49 refer.

[0067] It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of apparatus 10, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

Claims

1. Apparatus for heating, using air, one or more user devices (11) connected thereto, comprising a closed heat generator (12) fed with solid fuel, in particular a biomass, having inside it a closed combustion chamber (17) and first heat exchange means (14) cooperating with said combustion chamber (17), **characterized in that** said first heat exchange means (14) are configured to carry out the heat exchange between the fumes deriving from the combustion of said biomass and a heat-carrying liquid which flows in said first heat exchange means (14), and **in that** said apparatus for heating, using air, also comprises second heat exchange means (18), of the air-liquid type, external and distanced from said closed heat generator (12), in which air flows to be heated and distributed to said one or more user devices (11) to be heated, said second heat exchange means (18) being fluidically connected to said first heat exchange means (14) to heat said air by means of said heated liquid coming from said first heat exchange means (14).

2. Apparatus as in claim 1, **characterized in that** said second heat exchange means (18) comprise at least a heat exchanger (16) and a first distribution circuit (19), for the circulation of hot air from said heat exchanger (16) to said one or more user devices (11), and vice versa, having at least a feed segment (21) to the one or more user devices (11) and a return segment (20) from the one or more user devices (11) to direct the air toward said heat exchanger (16), wherein a second circuit (30) is also provided, provided with a feed pipe (31) and a return pipe (32), for the circulation of the heated liquid from said first heat exchange means (14) toward said heat exchanger (16), and vice versa.

3. Apparatus as in claim 2, **characterized in that** said second heat exchange means (18) also comprise air movement means (15), associated to said return segment (20) of said first distribution circuit (19), to take said air from said one or more user devices (11) and thrust it at least toward said heat exchanger (16).

4. Apparatus as in claim 2 or 3, **characterized in that** said air movement means comprise a ventilator (15).

5. Apparatus as in any claim from 2 to 4, **characterized in that** it comprises first temperature measuring means (23), associated to said return segment (20) and suitable to transmit an electric signal relating to the temperature (Ti) of the air in said return segment (20), and an electronic control unit (22), inside said closed heat generator (12), suitable to receive and process said electric signal to carry out a feedback control of the combustion of the biomass, in order to maintain said temperature (Ti) around a value (Tx) set by a user.

6. Apparatus as in claim 5, **characterized in that** it comprises second temperature measuring means (24) associated to said feed segment (21) of said distribution circuit (19) and suitable to transmit an electric signal relating to the temperature (Tf) of the air in said feed segment (21), and an electronic control unit (22), inside said heat generator (12), suitable to receive and process said electric signal to carry out a control of the quantity of liquid circulating in said second circuit (30), in order to maintain said temperature (Tf) in a range suitable to guarantee a suitable comfort in said one or more user devices (11).

7. Apparatus as in claim 6, **characterized in that** it comprises third temperature measuring means (25) associated at least to said feed pipe (31) of said second circuit (30) and suitable to transmit an electric signal relating to the temperature (Ta) of said liquid in said feed pipe (31), and an electronic control unit (22), inside said closed heat generator (12), suitable to receive and process said electric signal to carry out a control of the operating conditions of said liquid in said second circuit (30), and in said first heat exchange means (14).

8. Apparatus as in any claim hereinbefore, **characterized in that** it comprises second heat exchange means (18) concentrated in a single position from which to send the heated air to the one or more user devices (11).

9. Apparatus as in any claim from 1 to 7, **characterized in that** it comprises a plurality of second heat exchange means (18) distributed in the rooms of the different user devices (11) and fluidically connected to the first heat exchange means (14) of the closed heat generator (12).

10. Apparatus as in any claim hereinbefore, **characterized in that** the closed heat generator (12) is a pellet-burning stove.

11. Apparatus as in any claim hereinbefore, **characterized in that** the first heat exchange means comprise a heat exchange chamber (14), adjacent to the combustion chamber (17) and containing a heat-carrying liquid.

12. Apparatus as in any claim hereinbefore, **characterized in that** the first heat exchange means (14) comprise a fumes-heat-carrying liquid exchanger, in particular fumes-water.

13. Apparatus as in any claim hereinbefore, **characterized in that** a heat exchange wall (33) is provided between the first heat-exchange means (14) and the combustion chamber (17).

14. Apparatus as in any claim hereinbefore, **characterized in that** the closed heat generator (12) comprises automatic or semi-automatic feed means (26) of the fuel toward the combustion chamber (17).

15. Method to heat, using air, one or more user devices (11), comprising a first step in which, in a closed combustion chamber (17) of a closed heat generator (12), the combustion of a biomass is carried out, to effect the heat exchange between the fumes deriving from said combustion and a heat-carrying fluid, **characterized in that** in said first step the heat exchange is carried out between the fumes and a heat-carrying liquid, which flows inside first heat exchange means (14), inside said closed heat generator (12) and cooperating with said combustion chamber (17), and **in that** it comprises a second step in which air to be heated and distributed to said user devices (11) is made to flow inside second heat exchange means (18), of the air-liquid type, external and distanced from said closed heat generator (12), and connected fluidically to said first heat exchange means (14), to be heated by means of said heated liquid coming from said first heat exchange means (14).

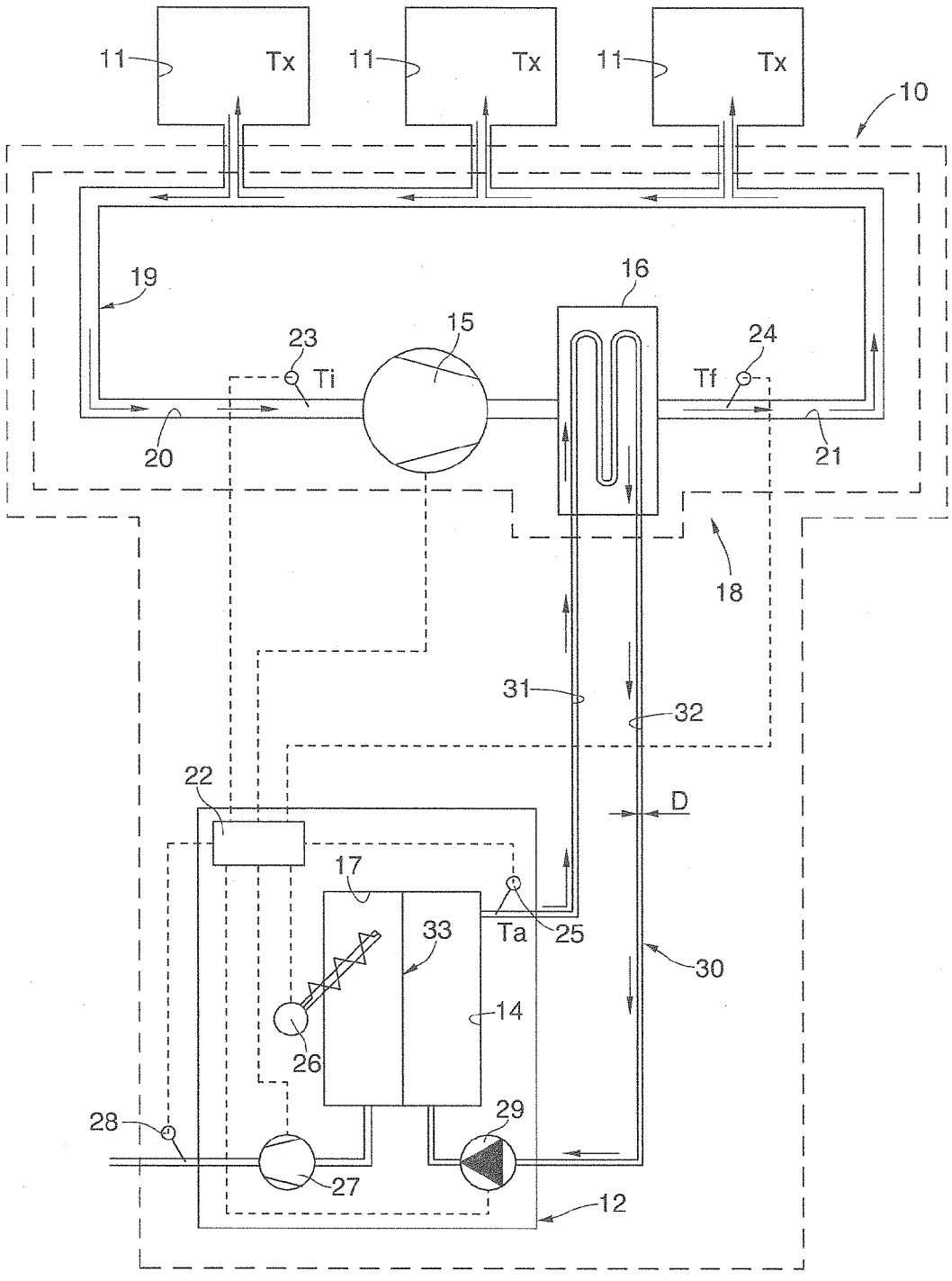
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fig. 1

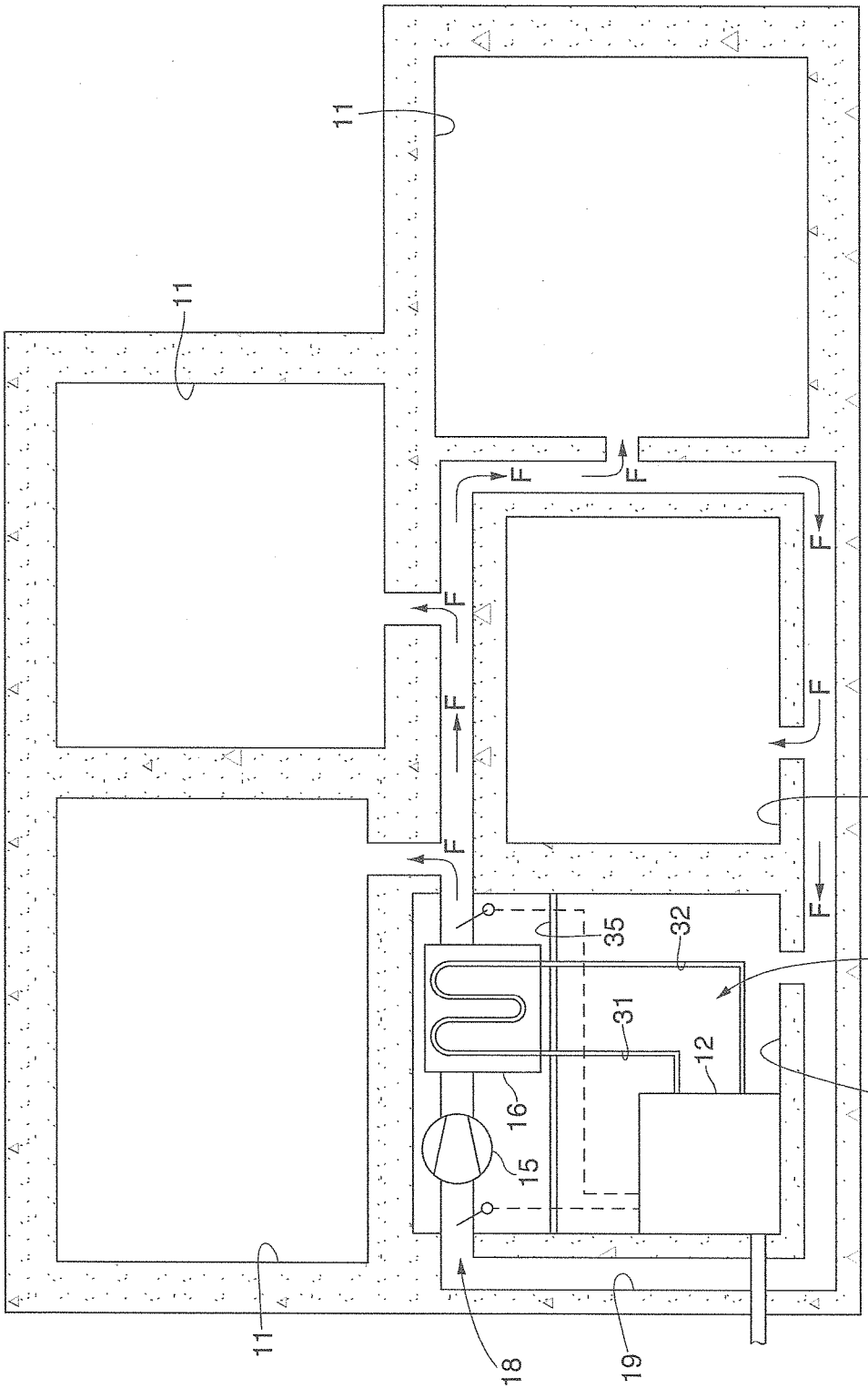

fig. 2

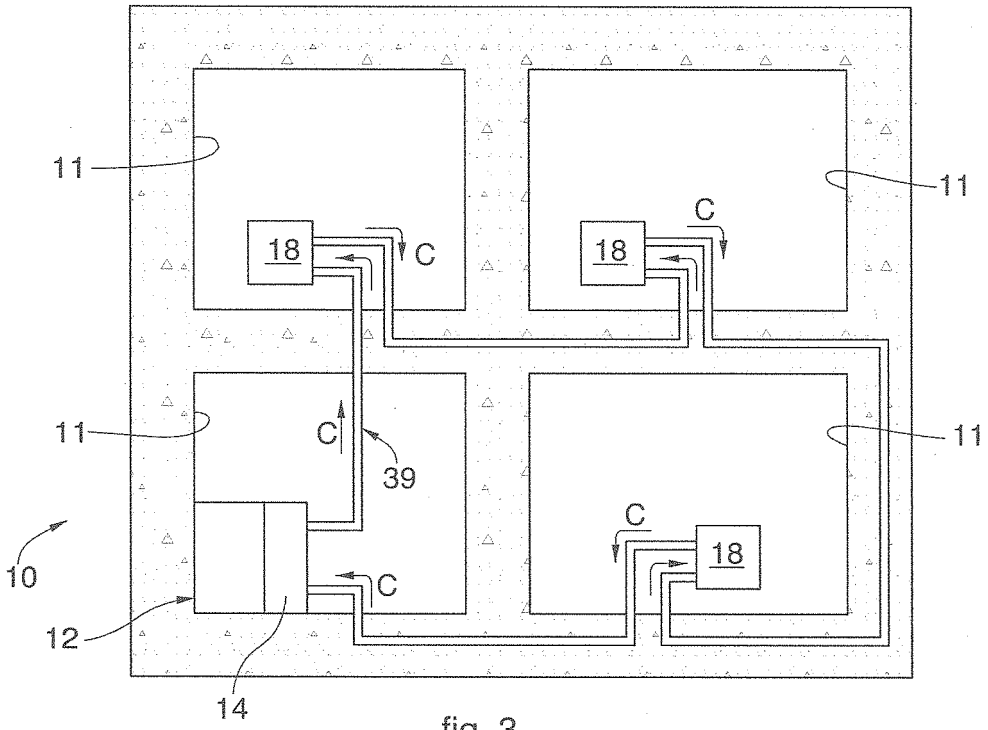
11
11
18
C
18
C
11
11
C
39
C
18
10
C
12
14

fig. 3

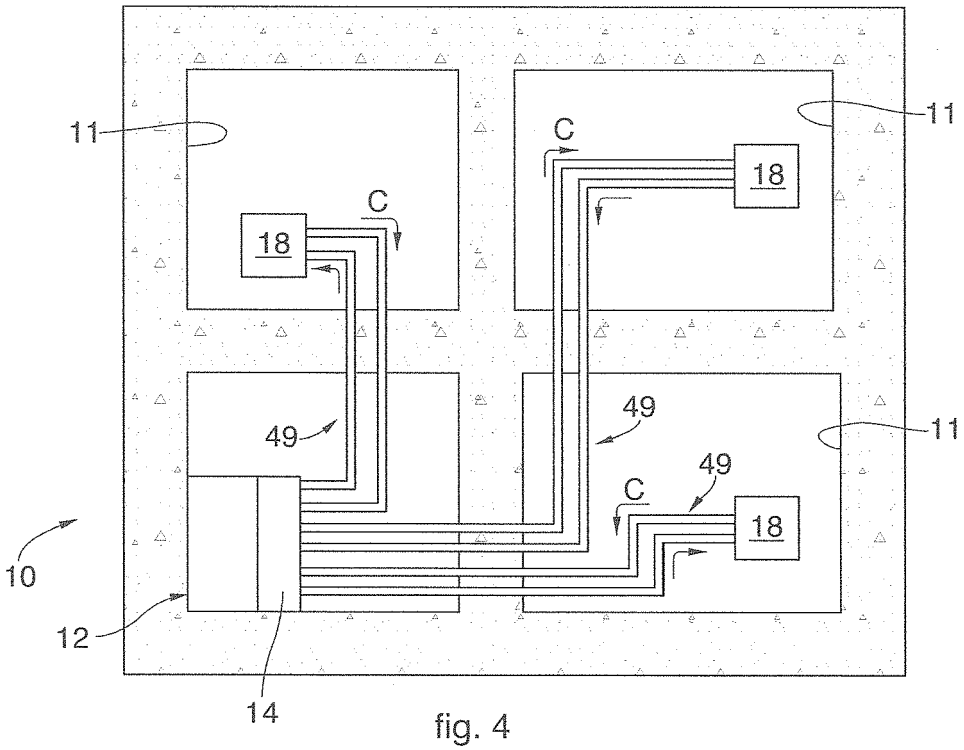
11
11
C
18
C
18
49
49
11
C
49
18
10
12
14

fig. 4

REFERENCES CITED IN THE DESCRIPTION

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