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(54) **SOLID FUEL MATERIAL APPARATUS FOR HEAT GENERATION**

(57) A solid fuel material apparatus (1) for heat generation comprising a load-bearing outer casing (2) suitable to rest on a reference surface (S), a collection tank (3) of a solid fuel material (P), made in said outer casing (2), and combustion chamber (4) made in the outer casing (2) and communicating with the collection tank (3), provided with a burner member (5) suitable to be activated to burn in the combustion chamber (4) the solid fuel material (P) coming from the collection tank (3). In detail, the solid fuel material apparatus of the invention comprises an auxiliary heat storage chamber (6), at least partly filled with granular or sandy or dusty refractory material and at least partly in direct thermal contact with the combustion chamber (4), suitable to release, at least by irradiation, heat in a confined external environment comprising the reference surface (S).

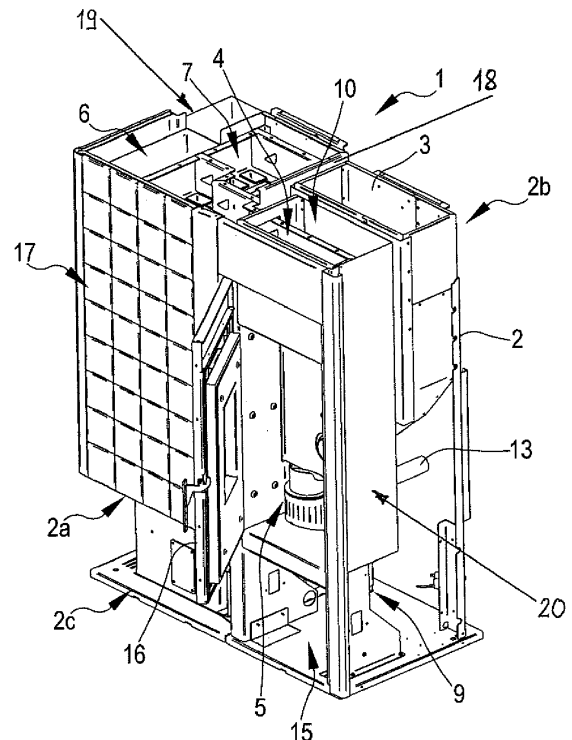


FIG.2

Description

[0001] The current invention is part of the heating of environments attended by people, typically dwellings, and, in particular, concerns a solid fuel material apparatus, such as pellets, coal, wood and/or wood chips, basically though not exclusively of the storage type and intended for the generation of heating heat.

[0002] It is known that a heating apparatus, such as a tiled stove (commonly known as "Tyrolean stove"), is a particular type of stove, also called "accumulation stove", built of refractory material and covered in majolica that heats by irradiation the air of a confined environment, such as a living room or a room of a dwelling, unlike other stoves that heat the environment concerned by convection.

[0003] The heat produced by the fire in the combustion chamber accumulates, indeed, in the refractory material with which the stove is built and coated and is subsequently released into the environment gradually, in a time frame generally varying between 5 hours and 8 hours.

[0004] For this reason, the so-called accumulation stoves do not require continuous feeding of fuel material but are usually turned on once or twice a day.

[0005] A typical accumulation heating apparatus has been for years an aesthetic nature connotation, acting not only as a functional device but also as a furnishing element of the environment in which it is installed, and this because of the materials with a pleasant impact, and often value, with which is finished and covered.

[0006] From a purely constructive point of view, instead, a well-known accumulation heating apparatus consists internally of three main components: the combustion chamber where the solid fuel material (such as wood or pellets) to be burned is placed, where the latter is combusted by a burner member and whose volume is directly proportional to the thermal power of the same, a heat exchanger (such as, in general, a coil) having a variable section and built of refractory material through which the fume coming from the combustion passes and a coating surface made of majolica tiles.

[0007] Operatively, the fumes produced by the combustion enter the coil with a temperature of about 600°C to exit at a temperature of about 150°C ÷ 120°C. The coil may have a horizontal development, in which the height of the planes decreases as it departs from the combustion chamber, and similarly decreases the thickness of the dividers, or vertical, in which the size of the vertical channels decreases with the path followed by the fumes, and similarly decreases the thickness of the dividers.

[0008] Particularly, prior art storage heating equipment equipped with vertical serpentes doesn't require periodic but cadenced opening manoeuvres to perform cleaning, as their inner volume gets much less dirty than equipment provided with horizontal serpentes, even considering the fact that, normally, soot falls to their bottom.

[0009] A storage heating apparatus (more commonly

called a stove, as yet mentioned), supplied by solid fuel material such as pellets, is also traditionally composed of the following components:

- 5 - a load-bearing outer casing (or frame), having a mainly vertical development and suitable to rest on a reference surface, such as the floor of a room in a dwelling;
- 10 - a collection or containment tank of the solid fuel material to be burned (pellets), usually consisting of a trunk-conical or trunk-pyramidal hoist with a capacity varying between 15 and 50 kilograms;
- 15 - conveyor means, such as a screw (or endless screw or Archimedes screw) insulating the combustion chamber from the collection tank, with which they anyway communicate, and that are operatively connected, through transmission means, to motorization means (such as a gear motor) suitable to be operated to rotate the conveyor means themselves and move the solid fuel material from the collection tank to the combustion chamber, at the burner member (otherwise also called hearth or brazier) installed inside;
- 20 - an ignition resistance (a common spark plug), useful to heat the oxidant air to a temperature of about 200°C which, in this way, suitably sucked into the brazier, causes the flame and the consequent burning of the solid fuel material;
- 25 - an inlet room emitting oxidant air useful for the combustion;
- 30 - optional ventilation means (such as a centrifugal fan) which enter the air inside the inlet room and convey it upwardly until hot air is released from the outer casing into the environment;
- 35 - a heat-exchanger (consisting of a coil or a plurality of tubes made of steel or cast iron) which transmits to the refractory material in contact with the external environment the heat stored by the exhaust fumes generated by the combustion of the solid fuel material from the burner member in the combustion chamber and which are conveyed inside the heat exchanger;
- 40 - extraction means (such as a centrifugal fan) suitable to eject exhaust fumes outside, through a through opening (not shown for depictive brevity) made in the back wall of the outer casing, the exhaust fumes at the end of their path inside the heat exchanger;
- 45 - a collection drawer, arranged under the burner member and if necessary (usually, at the end of a given period of operation) which can be taken or removed by the user to allow it to be emptied from the ash produced by the combustion of the solid fuel material;
- 50 - an access fire door, usually equipped with a perimeter frame made of steel or cast iron and inner slab, usually made of ceramic glass, revolvingly coupled to the outer casing at the front wall of the latter and arranged by the user in the opening position to allow to carry out more complete cleaning of the inner vol-
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ume of the outer casing and/or maintenance, repair or replacement operations of the components inside the outer casing.

[0010] The accumulation stove presents a simple and mechanical operation that allows to balance the speed of feeding of the solid fuel material both with the supply of air and with the expulsion of fumes and with the ignition of the flame.

[0011] From the collection tank in which the solid fuel material is housed, the screw picks up the fuel and releases it inside the hearth, dosing the necessary amount; here, forced air allows to mix in a balanced way the fuel with the oxidant, so as to turn it into heat.

[0012] In the meantime, the convention air is eventually forced by the centrifugal fan, so as to exchange with the heat produced by the combustion. The fumes produced by combustion and conveyed into the heat exchanger are ejected by the centrifugal fan located downstream the operating sequence.

[0013] This process is monitored by an electric central processing and control unit that is installed inside a control panel applied to the outer casing and that allows to supersede the operation of the various components, as well as to set the ideal temperature of the heat produced and released into the environment, the time of switching on and off.

[0014] However, even the most modern heating apparatuses, of the heat accumulation type (also known as majolica stoves or Tyrolean stube), of the known technique, just summed up, have some recognized drawbacks.

[0015] The main drawback of prior art derives precisely from the construction design of such a heating equipment, imposed by the type of refractory material with which the outer casing is covered and with which the heat exchange coil, travelled by the fumes of combustion, of the equipment itself is made.

[0016] Indeed, these components in refractory covering material of the accumulation heating equipment of the prior art, especially the majolica tiles covering, require manufacturers to produce such heating equipment according to external forms which, net of physiological differences between manufacturer and manufacturer, however minimal and sometimes imperceptible, are now well defined and standardized, certainly limited to a certain range.

[0017] A second drawback of known solid fuel heating apparatuses of the heat accumulation type is that the refractory material used for the thermal storage with which they're made presents a thermal inertia, once the heating apparatuses have been switched off, rather limited in time.

[0018] The apparatus described in prior art document WO2015/121848 A1 in which the thermal storage material (indicated by the numerical reference 7) is:

- composed of a plurality of blocks (each indicated with

the numerical reference 24), of preformed shape and one superimposed on the other;

- simply arranged inside a metal box structure (corresponding to the outer casing or load-bearing frame mentioned above);
- facing the combustion chamber (or burner, numerical reference 3) from which it is in any case partly separated and spaced apart due to the interposition of the combustion fumes transport ducts (indicated by numerical reference 5) and/or an air gap;
- presents a recess (indicated with the numerical reference 25) or, alternatively, a through hole in which the fumes transport ducts are housed,

does not escape from these drawbacks.

[0019] Beyond to not remedying the drawbacks listed above - the predetermined shape of the blocks of the thermal storage material requires the equipment be designed according to precise, fixed, standardized, little flexible and substantially non-customizable choices - the stove described in WO2015/121848 A1 has a rather articulated construction design, dictated not above all by the specific composition of the thermal storage material.

[0020] In addition, this constructive concept of the thermal storage material used in WO2015/121848 A1 - of composite type since characterized, as just mentioned, by blocks made in an unspecified material and in any case one superimposed on each other - inevitably forms air cavities between one block and the other which, however interstitial, negatively impact on the accumulation of heat in the time unit and, therefore, on the thermal efficiency of the stove.

[0021] For its part and in some ways similarly, the prior document DE3710014 A1 shows that the preformed elements 1 presenting a cavity (reference number 2) filled with refractory material, as quartz sand or gravel, are arranged at two opposite side walls (numerical reference 6) of the stove, outside the combustion chamber (numerical reference 4) from which they are separated and spaced apart at least by the cavity housing some springs (numerical reference 7).

[0022] Therefore, even the stove of document DE3710014 A1 provides first of all an even greater physical separation between the combustion chamber and the preformed elements housing the refractory material, as well as inevitable however interstitial air gap between each pair of elements housing the refractory material, since the latter are arranged one on the top of the other, with all the negative effects that this entails on the accumulation of heat in the unit of time, on the length of the thermal dispersion time the fuel material being the same and, ultimately, on the thermal efficiency of the stove.

[0023] Moreover, the quantity and mutual positioning of preformed elements filled with refractory material make the constructive design of DE3710014 A1 stove tricky, at least under this specific aspect, just as it happens for WO2015/121848 A1 stove. Starting, therefore, from the awareness of the aforementioned drawbacks of

known art, the current invention aims to fully and effectively remedy to them.

[0024] In particular, main purpose of the present invention is to provide a solid, usually but not limited pellets, fuel apparatus for heating heat generation, of the so-called "accumulation" type, which, compared to the known art, allows to increase the range of aesthetic forms obtainable, made available to the end user.

[0025] In the context of this purpose, it is task of the invention to indicate a solid fuel apparatus for heat generation, of the so-called "accumulation" type, which allows to decoupling the construction form of the apparatus itself from the design of the components in refractory material that distinguish it, in particular not only from the covering and finishing tiles, applied to at least part of the outer surface of the outer casing (or load-bearing frame) of the accumulation heating apparatus, but also from the components intended for the thermal storage.

[0026] It is another purpose of the invention to devise a solid fuel apparatus for heat generation, of the so-called "accumulation" type, which, when switched off after an operating cycle, presents thermal inertia (or dispersion) greater (in the sense of longer over time) and, therefore, a thermal efficiency, in the unit of time, higher than that one obtainable with equivalent heating equipment of the known type.

[0027] It is a further purpose of the invention to put into practice a solid fuel material apparatus for heat generation, of the so-called "accumulation" type, which presents a construction design simpler than known heating equipment, especially in relation to the thermal storage material.

[0028] It is a last but not least purpose of the present invention to provide a solid, usually but not limited to pellets, fuel apparatus for heat generation, of the so-called "accumulation" type, which is easier to assemble than the heating apparatuses of the known art comparable to it.

[0029] Said purposes are achieved by a solid fuel material or solid biomass, such as pellets, wood, coal and/or wood chipped material apparatus (or even storage stove) for heat generation, of the so-called "accumulation" type, according to the appended claim 1, as hereinafter referred for the sake of exhibition brevity.

[0030] Further detail constructive features of the solid fuel material apparatus for heat generation of the invention are reported in the respective dependent claims.

[0031] These claims, which are specifically and concretely defined below, are considered to be an integral part of the present description.

[0032] Advantageously, the solid fuel material, preferably pellets in the form of small thickened and pressed cylinders, apparatus (commonly also known as accumulation stove) used for heat generation and qualified as "at heat storage", object of the present invention, allows to free the shape with which it's built by the stringent constraint currently represented by the shape of the refractory material used to make its components suitable

for heat accumulation, in particular the finishing covering (for instance tiles) of at least part of the outer surface of the outer support and containment casing.

[0033] This is due to the fact that the accumulation heating equipment of the current invention includes an auxiliary heat storage chamber, at least partly filled with grainy, sandy or dusty refractory material and at least partly in direct thermal contact with the combustion chamber: the auxiliary heat storage chamber is suitable to release, at least by irradiation, into a confined external environment, including the reference surface on which the outer casing of the apparatus rests, the heat accumulated in the auxiliary chamber through the contact with the combustion chamber.

[0034] In essence, therefore, instead of, as is the case in the known technique, adapting the shape of the heating apparatus as a whole, and in particular of its outer casing, to the type and/or construction design of the refractory material useful for the heat exchange by irradiation with the external environment, in the invention it's possible to adapt the refractory material - as dusty and, therefore, shapeless - inserted into the outer casing to the desired and designed shape of the heating apparatus.

[0035] In other words, through the invention it's possible to multiply with respect to the current state of the art, including documents WO2015/121848 A1 and DE3710014 A1, the range of aesthetic forms possible and obtainable for a solid fuel material accumulation heating equipment, such as typically a pellet stove.

[0036] Still advantageously, the solid fuel material accumulation heating apparatus of the invention presents, the combust material being equal, thermal inertia (or dispersion) of heat release in the external environment to be heated greater - in the sense of longer - than that one provided by equivalent heating apparatuses of known type, thanks not only to the grainy, dusty or sandy nature of the refractory material used in the invention apparatus but also to the direct contact between the auxiliary heat storage chamber and the combustion chamber in at least one of their boundary walls which, preferably, is in common with each other.

[0037] In prior document WO2015/121848 A1 the stove is totally devoid of the auxiliary heat storage chamber provided by the solid fuel material apparatus of the invention and the heat storage material, in the form of blocks arranged one on the top of the other, is - as yet highlighted - simply contained into the outer box-shaped structure.

[0038] In such a prior art document, it's the heat storage material defining a chamber (having an open profile or a closed profile) that serves for the (at least partial) housing of the combustion fumes transport ducts, unlike what happens in the invention apparatus where it's a refractory material to be contained into an auxiliary heat storage chamber that is external and distinct from the combustion chamber.

[0039] Furthermore, preferably in the apparatus of the invention, such an auxiliary heat storage chamber is

monobloc and, again preferably, made of metallic material (the same as the combustion chamber and the heat-exchange - or conveying of the combustion fumes - circuit).

[0040] Moreover, in WO2015/121848 A1 the heat-exchange material is still and at least physically separated and spaced apart from the combustion chamber (or hearth), as well as in DE3710014 A1, with the obvious disadvantages already emphasized above, in terms of thermal efficiency, that this entails by the stove described therein compared to the solid fuel material apparatus of the invention.

[0041] In addition, the man skilled in the art, starting from the technical teachings of WO2015/151848 A1 and having at his disposal those ones of DE3710014 A1 (or even vice versa) could not derive the object of claim 1 herein attached.

[0042] This all the more so if, in the solid fuel material heat accumulation heating apparatus for the heat generation of the invention, the auxiliary heat storage chamber is one and unique (in other words monobloc), and presents at least one boundary wall in common with the combustion chamber, so that there is no interstitial air gap between said combustion chamber and said auxiliary heat storage chamber, at such a common boundary wall, as it is the case in those two prior documents.

[0043] Equally advantageously, the solid fuel material heat accumulation heating apparatus of the invention presents an assembly simpler than that one of the equivalent apparatus of the prior art, thanks, for instance, to provide the simple introduction of grainy or sandy or dusty refractory material into the auxiliary heat storage chamber and the application of covering and finishing materials on the outer surface of the outer casing of simple type, not necessarily in majolica that, as known, require a lot of attention (especially in the leaks) during installation.

[0044] Moreover, in an equally advantageous way, the use of grainy or sandy or dusty refractory material allows, in the invention, the (partial or complete) filling of the auxiliary heat storage chamber directly on site, at the time of installation of the heating apparatus of the invention at the end user where the grainy or sandy or dusty refractory material is delivered, preferably, separate (or apart) from the apparatus itself, resulting in a reduction in weight of the latter during transport and handling and, ultimately, of the physical efforts operators must perform to move it before its final installation.

[0045] Further characteristics and peculiarities of the current invention will appear to a greater extent from the following description, relating to a preferred embodiment of the solid fuel material, usually but not exclusively pellets, apparatus (or even stove) for heat generation claimed herein exclusively, given by indicative and illustrative, but not limiting, way with the help of the attached drawing tables in which:

- figures 1 and 2 are two distinct assonometric views of the solid fuel material heating apparatus (or even

stove), of the accumulation type, of the invention, under inspection conditions (access fire door opened);

- figures 3 and 4 are two distinct assonometric views of the solid fuel material heating apparatus (or even stove), of the accumulation type, of the invention, under inspection conditions (access fire door opened), which highlight the path of the combustion fumes;
- figures 5, 6 and 7 are three distinct simplified assonometric views of the apparatus of figures 1 and 2;
- figure 8 is the truncated assonometric view of a construction assembly of figures 1 and 2;
- figure 9 is the truncated assonometric view of the construction assembly of figure 8, from another angle.

[0046] The heat accumulation heating apparatus of the invention, operating with solid fuel material (such as typically but not exclusively a woody biomass pressed and in the shape of chips, typically pellets) and useful for producing usually domestic heating heat, is illustrated in figures 1 and 2 where it is globally numbered with 1.

[0047] The choice of a heating system fed preferably but not necessarily by pellets as solid fuel material is an intelligent choice for many reasons: pellet, indeed, is first and foremost economical, has a very high yield in terms of life and heat compared to other types of fuel material.

[0048] In addition, pellet does not dirty, leaves no dust or reassurances since it's compact and is sold in comfortable dirty-saving packages; moreover, when burned, it leaves very few combustion residues thus allowing the heating system of the stove to always work optimally and to not continuously force the ash to be removed from the brazier.

[0049] Last but not least, pellet is environmentally friendly, as it is made only of natural materials mainly from woodworking waste, it does not contain chemicals and is a renewable energy source that also helps to limit exploitation of forests, because it allows to prefer chips and sawdust to the trees that can be obtained from them. For these characteristics, pellet is considered a biomass, having twice the energy density of wood and generating low CO₂ and NOX emissions.

[0050] It should be noted that, in accordance with an established construction practice, the heating apparatus 1, of the heat accumulation and solid fuel material type, comprises:

- a load-bearing outer casing 2 made, for example, of metallic material (such as steel) and suitable to rest on a reference surface S, such as the finished floor of a dwelling;
- a collection tank 3 of a solid fuel material P, obtained in the outer casing 2 and consisting, for example, of a classic trunk-conical hoist;
- a combustion chamber 4 obtained in the outer casing 2 and communicating with the collection tank 3,

equipped with a burner member 5 (known or often referred to also, in the sector, as brazier, burner, crucible or hearth), suitable to burn in combustion chamber 4 the solid fuel material P coming from the collection tank 3.

[0051] According to the invention, the apparatus 1 also includes an auxiliary heat storage chamber 6, filled (in this case totally and preferably) with grainy or sandy or dusty refractory material and, always in this case, in direct thermal contact with the combustion chamber 4 without any interposition neither of components nor of chambers or air interstices in at least one boundary stretch 18 of the side wall 19: the grainy or sandy or dusty refractory material, not represented for exhibition simplicity, presents the function of resisting the high temperatures (which can also reach $200 \div 300^\circ\text{C}$ outside the combustion chamber and in the combustion fumes) that develop inside the solid fuel apparatus 1 and to allow the auxiliary storage chamber 6 to release, at least by progressive irradiation, in a confined external environment (including the reference surface S and attended by people) the heat accumulated in it through the contact with the combustion chamber 4.

[0052] More specifically and advantageously, the auxiliary heat storage chamber 6 and the combustion chamber 4 have a boundary stretch 18 of the respective side wall 19, 20 in common with each other: in other words, the side wall 19 of the auxiliary heat storage chamber 6 has a boundary stretch 18 in common with the side wall 20 of the combustion chamber 4.

[0053] In particular but non-binding way, the auxiliary heat storage chamber 6 is defined in the outer casing 2 (thus being appropriately delimited, in this case, by a side wall made of metallic material) and is equally suitably arranged (in this executive solution only in part) directly adjacent to, and in physical contact with, the combustion chamber 4 at the boundary stretch 18.

[0054] In practice, the auxiliary heat storage chamber 6 is defined inside the outer casing 2 without creating, advantageously, a special structure for it but taking advantage of some boundary stretches of the side walls 19, 20 of some elements of the heat accumulation apparatus (or stove) 1 of the invention, such as mainly and at least the outer casing 2 and the combustion chamber 4 and, subject to, the overall conveying and heat-exchange circuit indicated with 7 and better described later.

[0055] This allows the solid fuel material apparatus 1 of the invention to significantly differ from similar equipment of known type, for instance of the type shown in DE3710014 A1, against which it presents a simpler construction design and assembly system, to the benefit of cost reduction (the other cost items, such as those ones for materials and labour, used for the production of such apparatus 1, being equal).

[0056] The auxiliary storage chamber 6 is, in this case, arranged laterally to the combustion chamber 4, observing frontally the heating apparatus 1 when placed in ap-

plication conditions, installed in the environment to be heated, while it is understood that, in other embodiments of the invention, not illustrated in the attached figures, the auxiliary storage chamber could be installed posteriorly or superiorly to the combustion chamber (however always adjacent to it and distinguished by it).

[0057] In addition, other embodiments of the invention heating equipment, not shown in the following, could provide that the auxiliary storage chamber is a separate component from the outer casing, permanently coupled to it by stable junction means, such as screw means or one more welding sections/points.

[0058] In addition, preferably, the auxiliary heat storage chamber 6 is a monoblock (or monolithic piece) that develops dimensionally along a mainly vertical linear axis Y. Preferably but not necessarily, the grainy or sandy or dusty refractory material occupies in this case substantially 100% of the volume 6a of the auxiliary heat storage chamber 6, although it is understood that in alternative embodiments of the heating apparatus of the heat accumulation type of the invention, not accompanied in the following by reference figures, the refractory material of grainy or sandy or dusty type may occupy a percentage of the volume of the auxiliary heat storage chamber lower than that one indicated above, however not less than 50% (minimum percentage of refractory material of a grainy or sandy or dusty type useful to ensure a satisfactory thermal efficiency).

[0059] According to the preferred executive embodiment described herewith of the invention, the grainy or sandy or dusty refractory material includes natural sand (found in nature without environmental damage), not subjected to any industrial processing.

[0060] More specifically, the aforesaid natural sand is any of the types of sand chosen by the group consisting of quartz sand, sand loaded with metallic material powder, partly metallic material powder (such as aluminum oxide, also known as alumina), clay, ceramic fiber and their combinations.

[0061] The natural sand with which, in the invention, the auxiliary heat storage chamber 6 is filled is preferably taken from the river bed and has a high density (or a very fine grain, having a relative density value including, for example, in the range $0.5 \div 5 \text{ g/cm}^3$ and a maximum size, for example, in the range $0.1 \div 5 \text{ mm}$, as it is better from a thermal yielding point of view).

[0062] In a preferred but non-binding way, the heat accumulation heating apparatus 1 of the invention includes a conveying and heat-exchange circuit, indicated overall with 7, operatively connected to the combustion chamber 4 and communicating with the external environment, interposed between the combustion chamber 4 and the auxiliary storage chamber 6 with which it presents at least a boundary portion of the perimetric wall in common and suitable to receive the fumes F (indicated schematically, by the directional arrows W, in figures 3 and 4), resulting from or produced by the combustion of the solid fuel material P caused by the possible activation of an ignition

resistance of the burner member 5 when affected by combustion air, to convey the fumes F themselves into the external environment. In a particular and preferred way, the conveying and heat-exchange circuit 7 is defined inside the outer casing 2 and presents a tortuous, diffused or distributed development, depending on the constructive choices.

[0063] In this case, for example, the conveying and heat-exchange circuit 7 comprises a plurality of tubular elements 8 parallel each other, facing the auxiliary storage chamber 6 and communicating superiorly with the combustion chamber 4 and inferiorly with the external environment through a through opening, not illustrated for the sake of exposure brevity, made in the outer casing 2, in particular in its rear wall 2b.

[0064] It follows that, in this case, the tubular elements 8 of the conveying and heat-exchange circuit 7, better visible in the details of figures 8 and 9, do not communicate with each other by means of curved fittings to them monolithic, as it is the case in a typical coil installed in the accumulation heating apparatuses of the known art, but are simultaneously travelled by the fumes F coming from the combustion chamber 4.

[0065] In other embodiments of the solid fuel material heat accumulation heating apparatus of the invention, not shown in the attached figures, the conveying and heat-exchange circuit could include smooth walls defined directly in the auxiliary storage chamber, so that the combustion fumes directly affect the grainy or sandy or dusty refractory material contained thereto.

[0066] Optionally though advantageously, the solid fuel material heating apparatus 1 of the invention also includes suction means, as a whole numbered with 9, contained in a lower part 2c of the outer casing 2, to which they are firmly coupled, and communicating with the inner volume 10 of the outer casing 2 to introduce into the latter air at room temperature coming from the external environment and to convey to the external environment by convection, through one or more through outlet vents, not illustrated for the sake of simplicity exhibition in the attached figures, made in a front wall 2a of the outer casing 2, heated air, having a temperature higher than the room temperature.

[0067] At preferred but not exclusive title, the suction means 9 include any of the devices chosen from the group consisting of centrifugal fans (favourably), tangential fans and the like.

[0068] Preferably and appropriately, the heating apparatus 1 of the heat accumulation type of the current invention also includes expulsion means, overall marked with 11, contained in a lower part 2c of the outer casing 2 which they are firmly coupled to and communicating with the conveying and heat-exchange circuit 7, in relation to which they're functionally arranged downstream, as seen in figures 1 and 3.

[0069] The expulsion means 11 suck combustion air into the combustion chamber 4 useful to initialize the combustion of the solid fuel material P, and push (recall-

ing it) towards the external environment, through the aforesaid through opening made in a rear wall 2b of the outer casing 2, the fumes F produced by the combustion of the solid fuel material P by the burner member 5 in the combustion chamber 4.

[0070] Preferably but not binding, the ejection means 11 include a centrifugal fan 12 of the type in itself known in the industry for this type of equipment.

[0071] Preferably but not limited to, the suction means 9 and ejection means 11 are arranged substantially symmetrically with respect to the vertical linear axis Y defined by the outer casing 2.

[0072] Figures 1-7 also highlight some of the other important components (although not directly related to the technical concept claimed by this invention and not fundamental for the resolution of the technical problems listed above) of the heating equipment 1 storage and solid fuel of the invention, traditionally also provided for by the equivalent heating equipment of the known art, such as:

- conveyor means, such as a screw (not visible but operating in the tubular body with an inclined axis 13) which communicate the combustion chamber 4 with the collection tank 3;
- the lower room 15 where the collection drawer (not shown for simplicity) is housed, placed below the burner member 5 and, if necessary, removeable by the user to empty it from the ash produced by the combustion of the solid fuel material P in the combustion chamber 4;
- an access fire door 16, usually made of ceramic glass, revolvingly coupled to the outer casing 2 at the front wall 2a of the latter and positioned by the user in the opening position to perform cleaning of the inner volume 10 of the outer casing 2 and/or maintenance, repair or replacement of the components inside the outer casing 2 itself;
- the covering and finishing material 17, in this case consisting, for example, of ceramic tiles of simple type (therefore, not necessarily in majolica, as in the accumulation heating equipment of the known art).

[0073] It is also possible to provide for the installation, inside the auxiliary storage chamber, of an additional heat exchanger useful for the combined heating of the water intended to the hydraulic plant of a building, such as a dwelling.

[0074] On the basis of the description just given, it is, therefore, understood that the solid fuel material or solid biomass, such as pellets, wood, coal and/or wooded material apparatus (or even storage stove), used for heating heat generation of the invention, achieves the purposes and reaches the advantages yet mentioned.

[0075] As proposed above, the solid fuel material apparatus, of the thermal accumulation type, for heat generation of the present invention presents a construction concept simpler than the heating apparatuses of the prior art comparable to it, with the consequence, on one hand,

of achieving a reduction in production costs and, on the other hand, of increasing the competitiveness of sales prices to the public, the other factors involved in the calculation of the cost of the finished product such as, for example, the cost of raw materials and the cost of labour being equal.

[0076] Thanks to the specific type of refractory material provided in the heating apparatus of the thermal accumulation type of the invention, it is possible to get several, almost infinite, aesthetic forms for the apparatus itself, in order to meet the increasingly diversified and personified needs of the customers in a much better way than the known technique.

[0077] Upon implementation stage, changes could be made to the essential components of the solid fuel material apparatus for heat generation of the present invention, consisting, for example, in a number of auxiliary heat storage chambers greater than one, in which case they may preferably be side-by-side each other and, for example, contained always into the outer casing.

[0078] Beyond this, there could be additional embodiments of the heating apparatus of the invention, not represented, in which the (at least one) auxiliary heat storage chamber can be only partly filled with grainy or sandy or dusty refractory material and can be only partly in thermal contact with the combustion chamber.

[0079] It is, finally, clear that several other changes could be made to the solid fuel material heating apparatus concerned, without departing from the principle of novelty intrinsic in the inventive idea expressed herein, as it is clear that, in the practical implementation of the invention, materials, shapes and sizes of the illustrated details could be changed, as needed, and replaced with others technically equivalent.

[0080] Where the constructive features and techniques mentioned in the following claims are followed by reference numbers or signs, those reference signs have been introduced with the sole objective of increasing the intelligibility of the claims themselves and therefore they have no limiting effect on the interpretation of each element identified, by way of example only, by these reference signs.

Claims

1. Solid fuel material apparatus (1) for heat generation comprising:

- a load-bearing outer casing (2) suitable to rest on a reference surface (S);
- a collection tank (3) of a solid fuel material (P), made in said outer casing (2);
- a combustion chamber (4) made in said outer casing (2) and communicating with said collection tank (3), provided with a burner member (5) suitable to be activated to burn in said combustion chamber (4) said solid fuel material (P) com-

ing from said collection tank (3),

characterized in that it comprises at least one auxiliary heat storage chamber (6), at least partly filled with granular or sandy or dusty refractory material and at least partly in direct thermal contact with said combustion chamber (4), suitable to release, at least by irradiation, in a confined external environment comprising said reference surface (S), said heat accumulated in said auxiliary chamber (6) through said contact with said combustion chamber (4).

2. Apparatus (1) according to claim 1), **characterized in that** said auxiliary storage chamber (6) and said combustion chamber (4) present a boundary stretch (18) of the side wall (19, 20) in common each other.

3. Apparatus (1) according to claim 1) or 2), **characterized in that** said auxiliary heat storage chamber (6) is arranged in physical contact with said combustion chamber (4) and is defined by one or more boundary stretches of the side wall (19, 20) of said outer casing (2) and of said combustion chamber (4).

4. Apparatus (1) according to claim 1), 2) or 3), **characterized in that** said auxiliary heat storage chamber (6) is a single piece which develops dimensionally along a mainly vertical linear axis (Y).

5. Apparatus (1) according to any of the preceding claims, **characterized in that** said refractory material of grainy or sandy or dusty type occupies at least 50% of the volume of said auxiliary heat storage chamber (6).

6. Apparatus (1) according to any of the preceding claims, **characterized in that** said refractory material of grainy or sandy or dusty type comprises natural sand.

7. Apparatus (1) according to claim 6), **characterized in that** said natural sand is any of the types of sand chosen from the group consisting of quartz sand, sand loaded with powder in metallic material or with powder in partly metallic material, clay, ceramic fiber and their combinations.

8. Apparatus (1) according to claim 6) or 7), **characterized in that** said natural sand is taken from the river bed.

9. Apparatus (1) according to any of the preceding claims, **characterized in that** it comprises a conveying and heat-exchange circuit (7), operatively connected to said combustion chamber (4) and communicating with the external environment, interposed between said combustion chamber (4) and said auxiliary storage chamber (6) with which it

present at least one boundary portion of the perimet-
ric wall in common and suitable to receive the fumes
(F), deriving from the combustion of said solid fuel
material (P) caused by the activation of said burner
member (5) when affected by combustion air, to con-
vey said fumes (F) to the external environment. 5

vertical linear axis (Y) defined by said outer casing
(2).

10. Apparatus (1) according to claim 9), **characterized in that** said conveying and heat-exchange circuit (7) is defined inside said outer casing (2) and presents a tortuous, diffuse or distributed development. 10
11. Apparatus (1) according to claim 9) or 10), **characterized in that** said conveying and heat-exchange circuit (7) includes one or more tubular elements (8) parallelly side-by-side each other, facing said auxiliary storage chamber (6) and communicating at the top with said combustion chamber (4) and at the bottom with the external environment through at least one through opening made in said outer casing (2). 20
12. Apparatus (1) according to any of the claims 9) to 11), **characterized in that** it comprises suction means (9), contained in a lower part (2c) of said outer casing (2) to which they are stably coupled and communicating with the inner volume (10) of said outer casing (2) to introduce into said outer casing (2) air at room temperature coming from the external environment and to convey to the external environment by convection, through one or more through outlet vents made in a front wall (2a) of said outer casing (2), heated air, having a temperature higher than said room temperature. 25 30
13. Apparatus (1) according to claim 12), **characterized in that** said suction means (9) comprise at least any of the devices chosen from the group consisting of centrifugal fans, tangential fans and the like. 35
14. Apparatus (1) according to any of the claims 9) to 11), **characterized in that** it comprises expulsion means (11), contained in a lower part (2c) of said outer casing (2) to which they're stably coupled and communicating with said conveying and heat-exchange circuit (7), compared to which they're functionally arranged downstream, suitable to suck combustion air into said combustion chamber (4) useful for said combustion of said solid fuel material (P), and push towards the external environment, through a through opening made in a rear wall (2b) of said outer casing (2), said fumes (F) produced by said combustion of said solid fuel material (P) by said burner member (5) in said combustion chamber (4). 40 45 50
15. Apparatus (1) according to claim 14) when dependent on claim 11), **characterized in that** said suction means (9) and said expulsion means (11) are arranged substantially symmetrically with respect to a 55

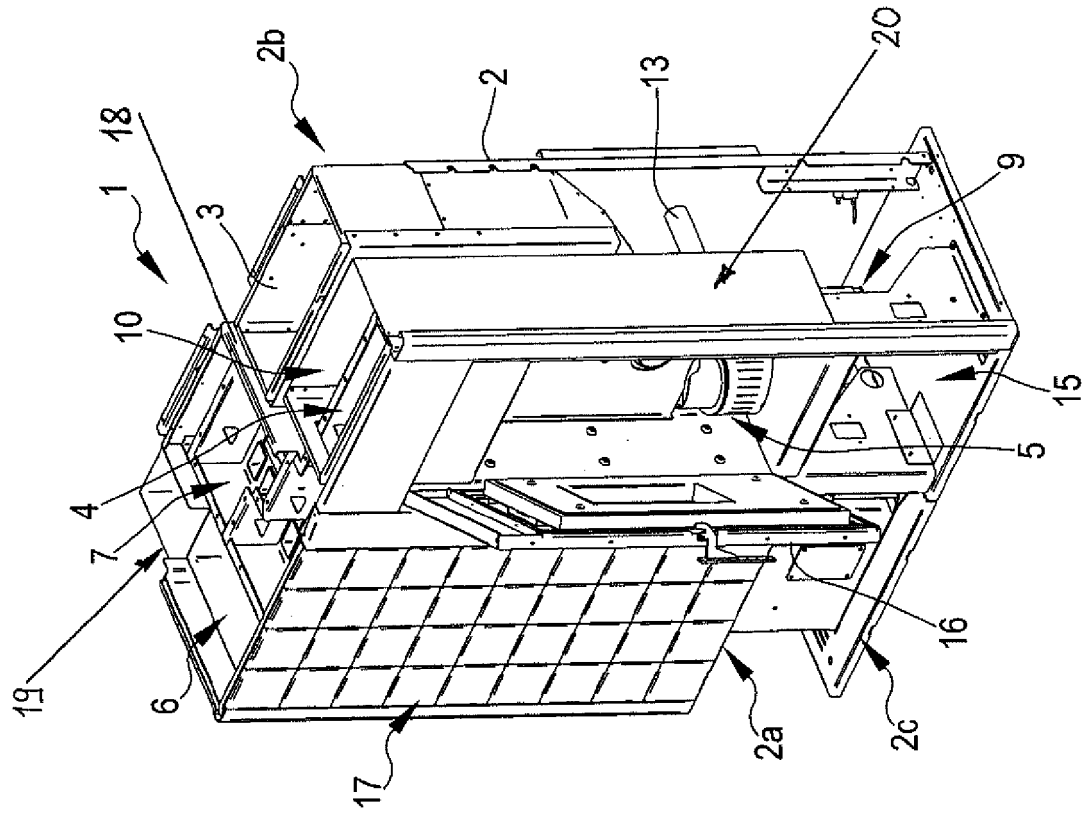


FIG.2

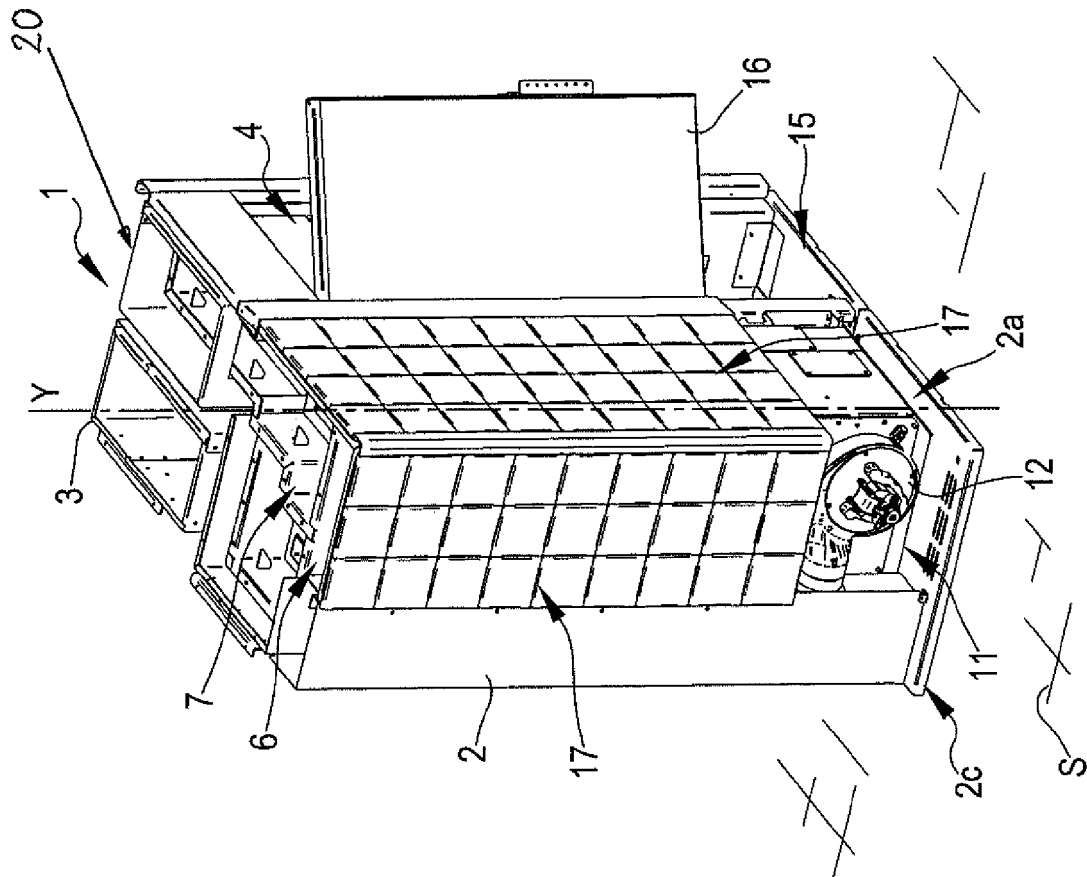


FIG.1

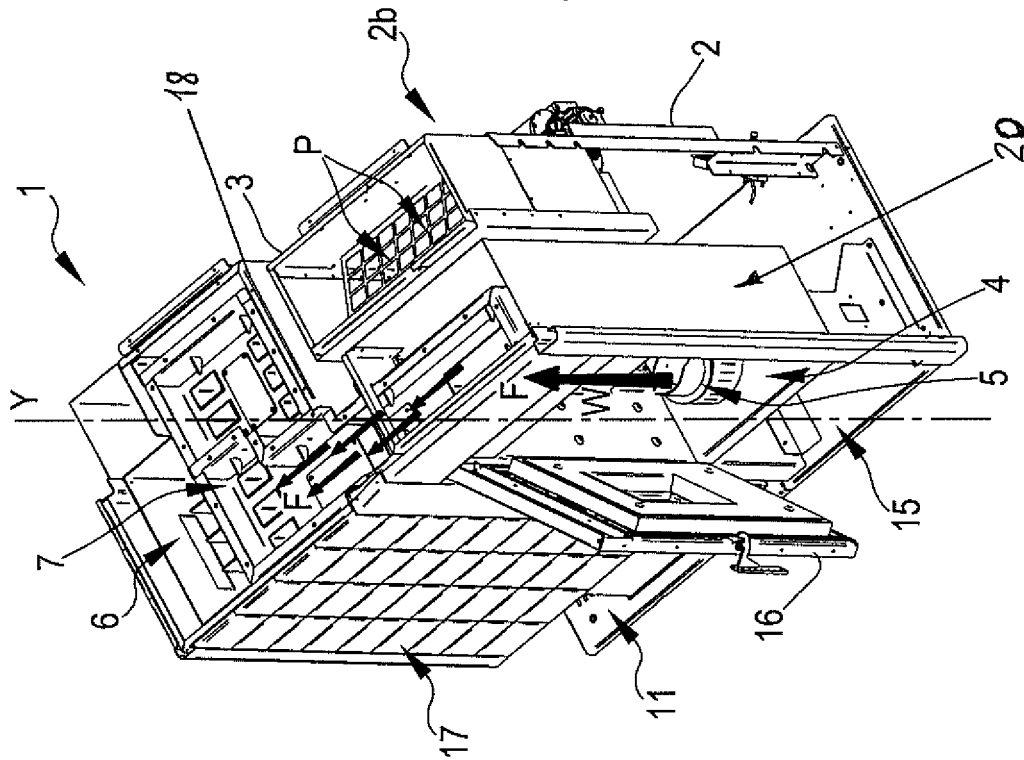


FIG.4

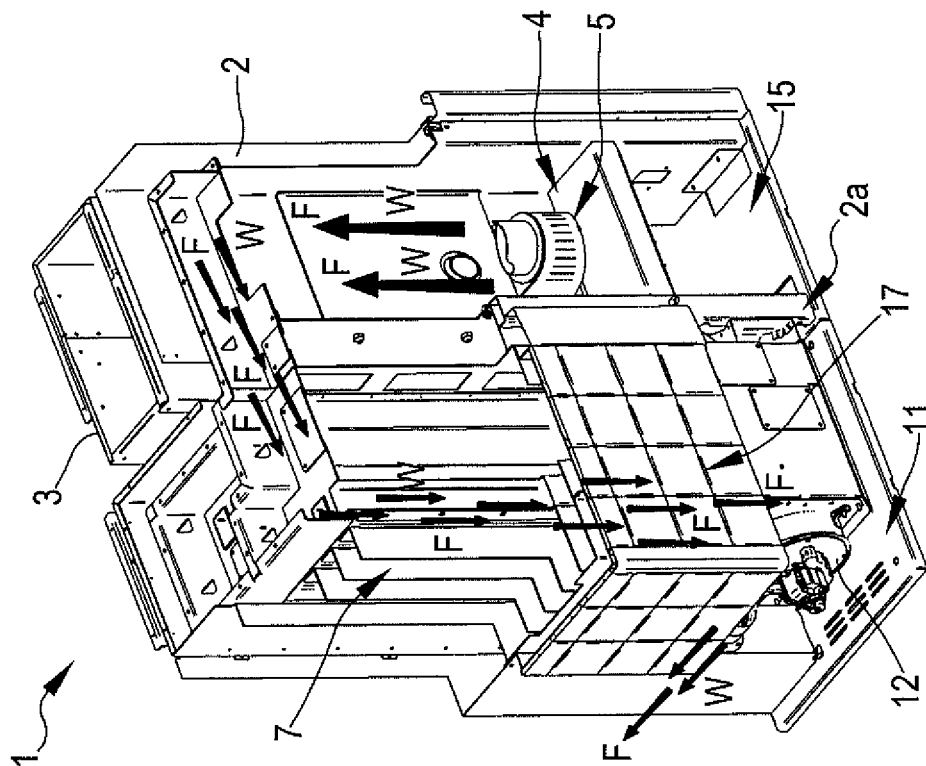


FIG. 3

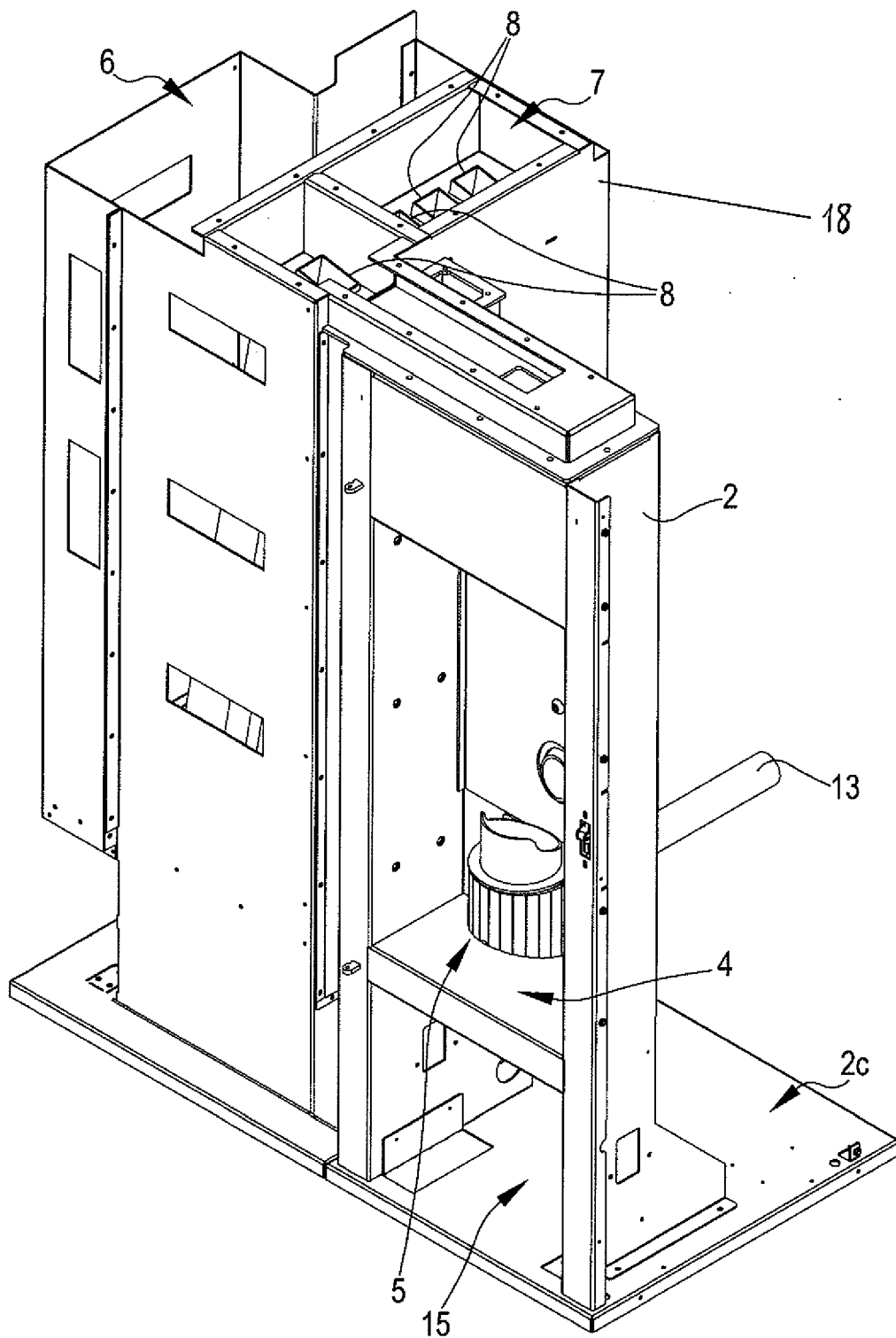


FIG.5

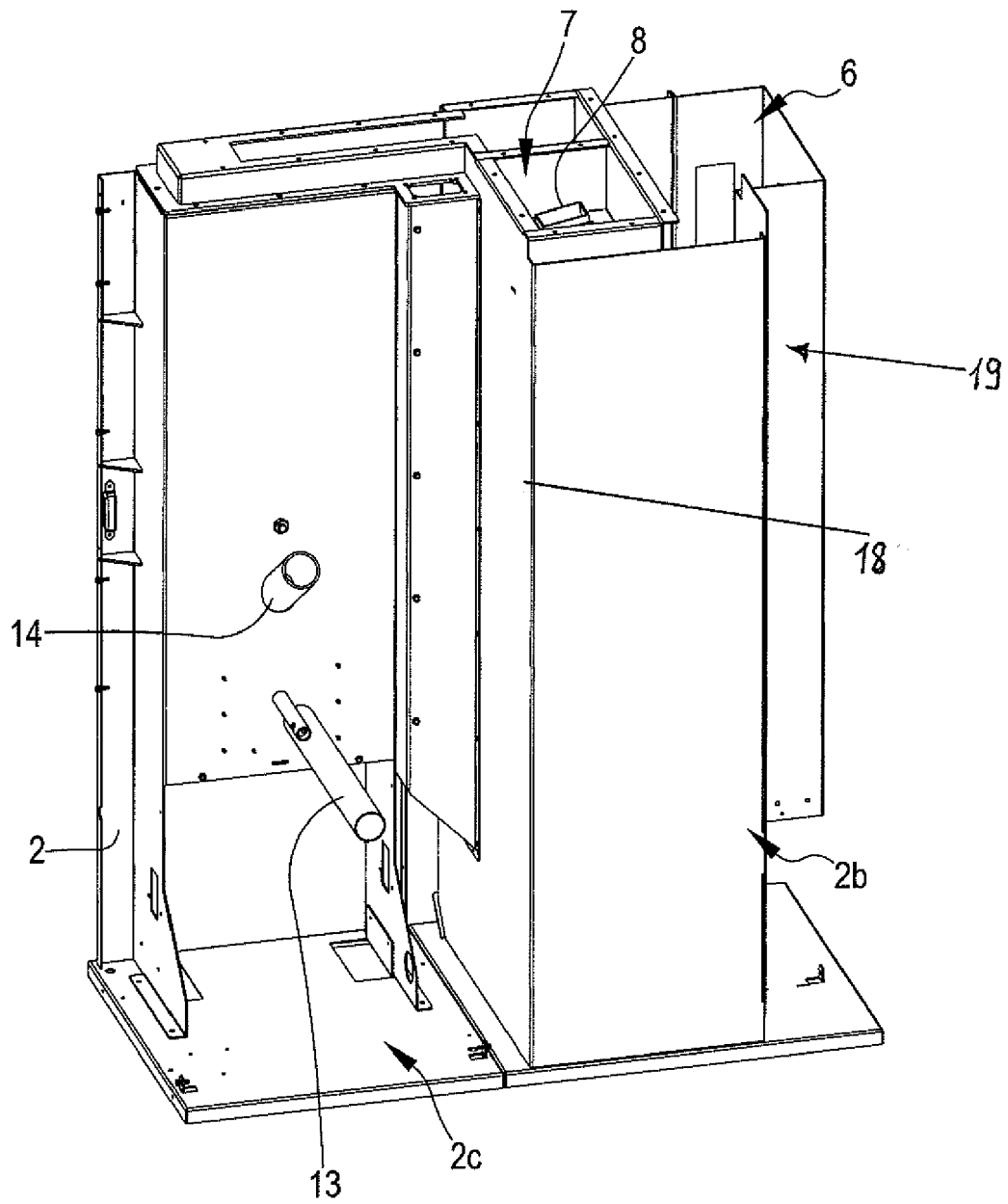


FIG.6

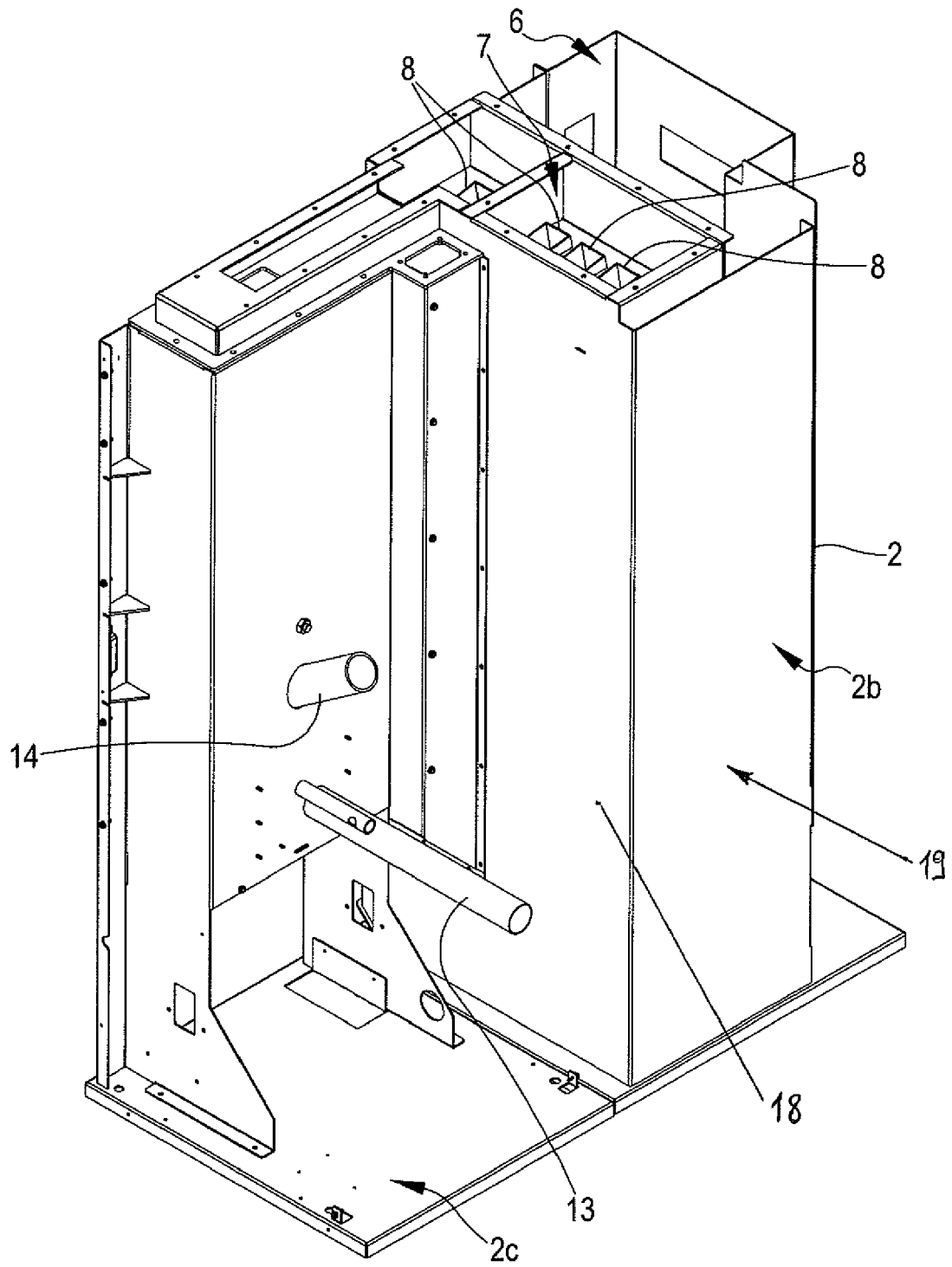


FIG.7

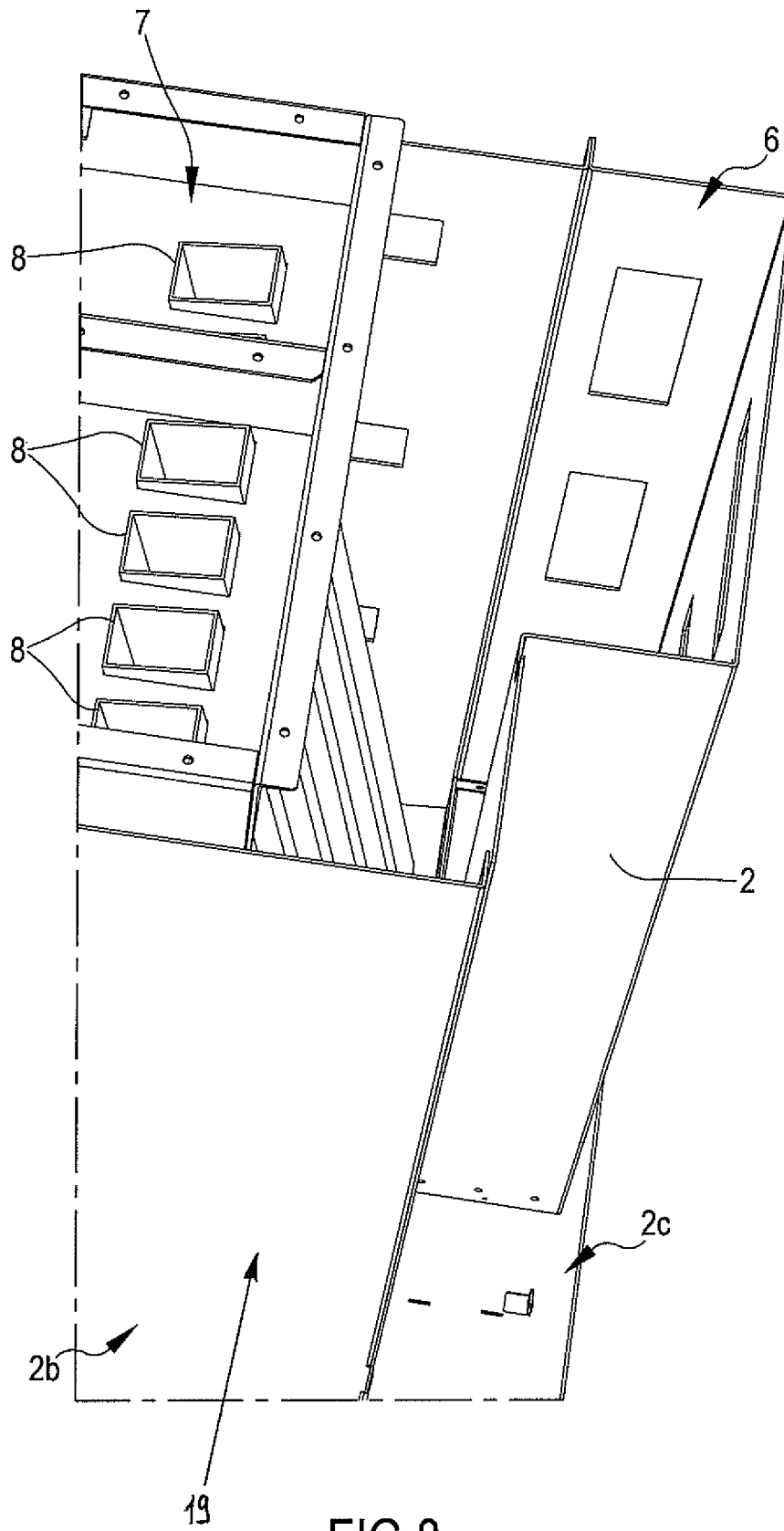


FIG. 8

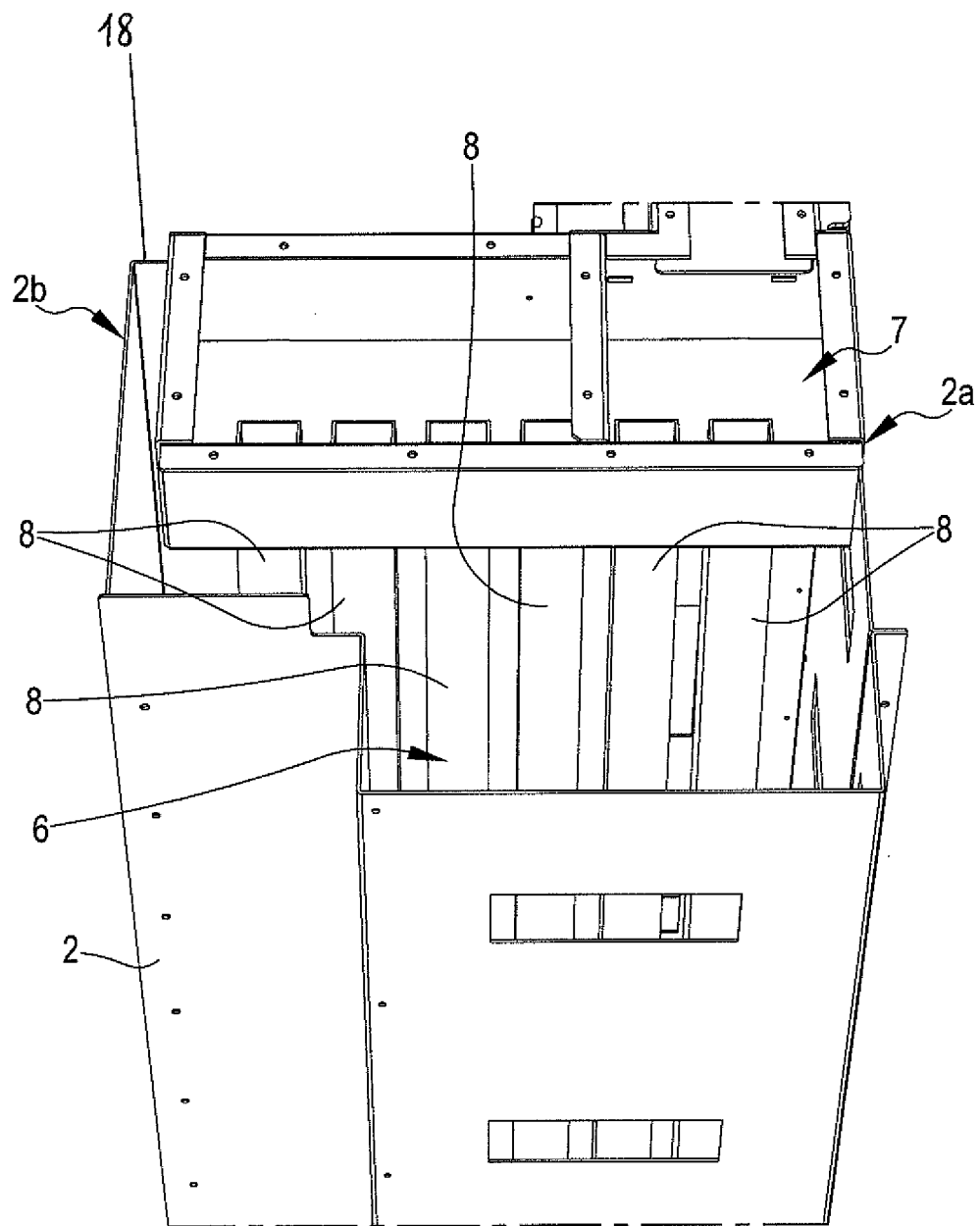


FIG.9



EUROPEAN SEARCH REPORT

Application Number
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Place of search The Hague		Date of completion of the search 17 May 2021	Examiner Adant, Vincent
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