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(54) **HEATING APPLIANCE**

(57) The invention relates to power engineering, in particular to devices intended for heating of premises, and more particularly to the combustion heating devices.

A heating appliance comprising a housing with a combustion chamber divided into an ignition chamber arranged in the lower part of the housing, a gasifying chamber, separated from the ignition chamber with a grill and arranged thereabove, a flue, communicated with the gasifying chamber, an air supply duct for supplying air to the ignition chamber and the fuel feeding device, and an ignition device, arranged within the ignition chamber, wherein the upper part of the gasifying chamber being communicated with the area under the grill through the gas circulation channel.

In such a way, it is provided a heating appliance, whose construction will provide a technical result, lying in increasing of the solid fuel combustion efficiency and correspondingly increasing of the heating appliance performance. Wherein the construction of the appliance as provided allows for using several modes of fuel combustion, as well as for using the obtained combustion products as an additional heat energy source, thus providing reduction of contaminants in the gases, ejected from the heating appliance flue.

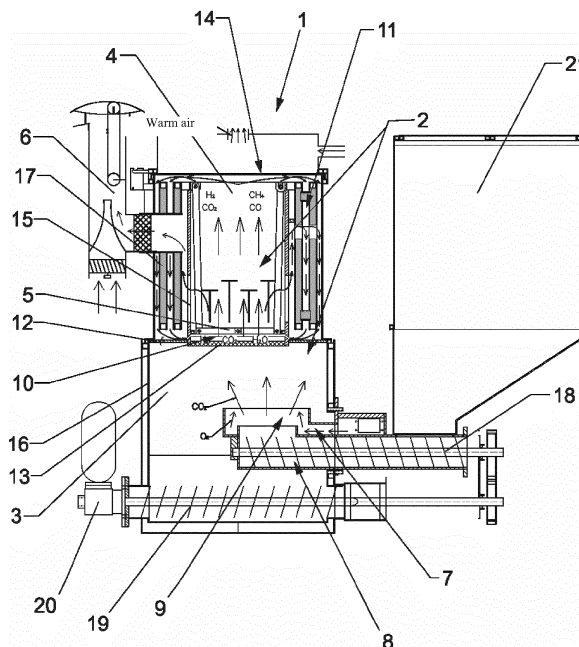


Fig. 2

Description

[0001] The invention relates to power engineering, in particular to devices intended for space heating, and more particularly to the combustion heating devices.

[0002] The energy saving problems from year to year becomes more pressing. A great number of technical developments are undertaken to make the use of energy obtained from energy sources maximally efficient. Some technologies aimed at obtaining energy/energy sources from natural sources, such as wind turbines, solar panels, others are aimed at obtaining new types of energy sources, such as biofuels, besides some developments are aimed at the improvement of the existing technologies of using the energy sources, for example, by reducing energy losses. Along with this keen problem, a question concerning the ecological compatibility factor increase of the technologies developed still remains of keen interest.

[0003] There exists a problem concerning the winter period accommodation heating in the moderate and subpolar climatic zones for inhabitants of these zones. Most often, heat consumers have to choose between functionality, efficiency and cost effectiveness of a heating appliance. A high cost of heating appliances make the consumers buy appliance according to their budget, and not with regard to the cost effective use of energy sources. Usually the simplest solution in the field of heating appliances represent a housing with a combustion chamber, where the fuel combustion takes place, resulting in about 70% of the energy and the fuel itself in the form of fumes are blown out through the flue. Obviously, the performance of such an appliance is not high, as well as its ecological compatibility factor. In the developed countries the use of the appliances having the ecological compatibility factor lower than the conventional one is prohibited thus making the consumers spend more costs for the heating appliance or change the energy source, for example, replacing solid fuel with natural gas. Such reconstructions increase cost of heating for the consumers by several times. At present a range of developments are carried to allow for the use of the solid fuel appliances anywhere. First, it is due to the fact that the solid fuel has relatively low cost and is a renewable one. As for the heating appliance, operating on a solid fuel can be used with no survey for any main lines, either gas lines or electricity mains. However, the performance of the solid fuel appliances is still relatively low. Consequently, at present it is still an issue to develop solid fuel heating appliances able to provide a greater performance.

[0004] It is known a pyrolysis gasifier, described in a Chinese application N 202852829 (publ. 04.03.2013). According to the description, the gasifier comprises a base and a combustion device, mounted onto the base. The combustion device comprises five sections. The first section has an oxidation layer, over which the second section comprising a reduction layer is provided. Above the second section there is a third section comprising a carbonization layer, and above the latter the forth section with a destructive distillation layer is provided, followed by a drying layer and the fifth section of the combustion appliance, correspondingly. The combustion appliance sections are arranged in a water-jacket.

[0005] Among the drawbacks of the appliance as described there should be mentioned a complicated construction and the necessity to feed a great amount of solid fuel. Besides when operated, if the oxygen entering the chamber exceeds a predetermined volume a common burning may occur in the chamber thus leading to losses of the appliance performance. Moreover, the gases obtained when gasifying and combusting the fuel are not burnt inside the combustion chamber, being ejected into the atmosphere, which causes significant heat losses, thus reducing the appliance performance.

[0006] The closest prior art, chosen as an analogue, is a solid fuel heating appliance described in the patent N 25588 of Kazakhstan (publ. 03.15.2012). According to the description the appliance comprises a housing with a combustion chamber, divided into several chambers, one being fillable with fuel for combustion, and another one, placed above, being a fuel gasifying chamber. The appliance operates as follows: at the first step, an operator fills the first chamber with solid fuel and inflames it, then the operator charges coal into the gasification chamber. It is followed by a step of warming the heating appliance within the housing up to a predetermined temperature, and then at the next step the operator should manually regulate air feeding. The heating appliance transfer to the operation mode is characterized by fumeless burning comprising a partial pyrolysis of the fuel inside the gasifying chamber.

[0007] Among the drawbacks of the heating appliance as described, first there is a necessity of manual regulation of the air being fed to the chamber to be performed by the operator that obviously make impossible the heating appliance transferring to the operation mode required. Besides the necessity of warming the heating appliance up may cause a complete combustion of the fuel first to heating appliance transfer to the operation mode. Further, the flue is directly connected to the gasifying chamber thus making all the pyrolysis gases generated within the chamber, blown out through the flue, prior to complete combustion, thus definitely reducing the heating appliance performance.

[0008] The invention is based on the task to develop a heating appliance, whose construction will provide a technical result, lying in increasing of the solid fuel combustion efficiency and correspondingly increasing of the heating appliance performance. Wherein the construction of the appliance as provided allows for using several modes of fuel combustion, as well as for using the obtained combustion products as an additional heat energy source, thus providing reduction of contaminants in the gases, ejected from the heating appliance flue.

[0009] The problem is resolved through providing a heating appliance comprising a housing with a combustion chamber

divided into an ignition chamber arranged in the lower part of the housing, a gasifying chamber, separated from the ignition chamber with a grill and arranged thereabove, a flue, communicated with the gasifying chamber, an air supply duct for supplying air to the ignition chamber and the fuel feeding device, and an ignition device, arranged within the ignition chamber, wherein the upper part of the gasifying chamber being communicated with the area under the grill through the gas circulation channel. The gasifying chamber is designed for receiving solid fuel generating pyrolysis gases in the course of the appliance operation. The gases obtained enter the gas circulation channel. Hereafter the gases generated in the gasifying chamber enter the combustion zone, where their secondary combustion takes place. Thus such the solution as observed, allows for significant increase of the solid fuel combustion efficiency and obvious increase of the heating appliance performance. The increase of the solid fuel combustion efficiency and of the heating appliance performance are achieved through separating the appliance combustion chamber into an ignition chamber and gasifying chamber, providing several modes of fuel combustion inside the combustion chamber. At that, the gases obtained in the gasifying chamber and the fuel combustion products from the ignition chamber are used repeatedly for warming the next fuel portion, and undergo secondary combustion for obtaining heat energy.

[0010] It should be noted, that the gasifying chamber could be virtually divided into two zones, a combustion zone and a pyrolysis zone. In this case, the combustion zone will appear at the air passing from the ignition chamber to the gasifying chamber, that is, upon incomplete combustion within the ignition chamber in the area under the grill. The gasifying chamber contains slots, providing a significant draft flow. In particular, the slots provide the excessive air outflow from the gasifying chamber to the gas circulation channel. In such a way, in particular, the chamber is virtually divided into zones along the slot line, that is, above said line, the pyrolysis process starts, and below the line, the combustion process can be started accompanied with emission of the combustion products, passing through the layer of solid fuel remained and providing fuel warming for the pyrolysis. It should be noted as well, that a portion of the flame from under the grill area enters the gas circulation channel, where gases from the gasifying chamber are partially combusted. The energy obtained upon combusting gases as described is used for warming the fuel, contained in the gasifying chamber.

[0011] Hereinafter the term «pyrolyses gases» should be interpreted as mixture of gases, some of which being combustion products of the fuel within the ignition chamber, and the rest being products of pyrolysis, taken place in the gasifying chamber.

[0012] The gasifying chamber may be fed with a solid fuel, e.g., coals or wood. This fuel functions as a pyrolysis catalyst. To enhance the heating appliance operation the solid fuel should be add to the gasifying chamber in a thick layer in order to provide a greater volume of the fuel to be subjected to the pyrolysis process, and cause an outflow of the air having not reacted within the ignition chamber and under the grill area, through the gasifying chamber slots so as not to extend the flame zone within the gasifying chamber.

[0013] Preferably, between the gasifying channel and the housing it is gas circulation channel. This makes the incandescent gases partially transfer their heat to the walls of the heating appliance housing thus heating the fuel comprised in the gasifying chamber with no access of oxygen through the walls of the gasifying chamber.

[0014] In one embodiment of the heating appliance as claimed, the combustion chamber comprises a water-jacket. The presence of the water-jacket in the heating appliance allows for its use in heating of large premises, where the air heating is not efficient. Preferably, a double-circuit water-jacket is provided in the gasifying chamber. The gas circulation channel is defined by the water-jacket circuits. Such a solution allows for extracting heat from the pyrolysis gases and transferring it to the water-jacket performing this in parallel within several circuits. Also several circuits of water-jacket allows for circulation of gases within the channel with no entering the flue at once, thus reducing the amount of heat released into the atmosphere. In such a way, it results in an increase of the combustion products thermal efficiency of the solid fuel fed to the heating appliance, which obviously contributes to efficiency of such a heating appliance.

[0015] The water-jacket is provided with at least one electrical krypton halogen heat radiator. The heat radiator can be used for heating premises when even minimal power of the heating appliance exceeds the required heat effect of the heating appliance, in other words the heat radiator is an alternative thermal energy source of the heating appliance. The possibility of operation of the heat radiator as described depends on the possibility of connecting the heating device to electricity mains. The krypton heat radiator relates to the infrared type of heat radiators with a radiation maximum of 1-1.5 μm and a colour temperature of 2000-2800 K. Such heat radiators has a number of advantages, e.g. high efficiency - at least 85% of the energy consumed turns into IR-radiation, quick heating after activation, heat shock resistance, IR-radiation stability during the whole operating life. So in the case of the ambient temperature slight reduction when it is warm in the day-time and gets colder in the night, the consumer is provided with possibility of heating a premise by means of the heat radiators. Besides, one more advantage of such heat radiators is low power consumption, e.g., compared to ohmic heaters, the heat radiators consume 3-4 times less electric energy, enabling consumer to use the heating appliance as described anytime without increasing costs, besides in the case of the solid fuel lacking for some reason. Correspondingly, the heating devise as claimed is a multi-purpose one.

[0016] In a preferred embodiment, at least one iron meshwork cartridge is located under the grill. The iron meshwork cartridge is mounted in the area under the grill between the ignition chamber and the gasifying chamber. The heating appliance construction is provided with a closure with openings made therein to let the air from the ignition chamber

enter the area under the grill, wherein at least one iron meshwork cartridge is mounted into the closure.

[0017] In a preferred embodiment, an ignition device is provided with a dropper for feeding water and/or liquid fuel. Such an ignition device construction allows for inflaming the fuel charged to the ignition chamber. The dropper for feeding liquid fuel and water is provided to obtain synthesized gas in the ignition chamber. For providing vapour the ignition device may be further equipped with additionally mounted krypton halogen heat radiator, and an ultrasonic membrane may be provided as well. The membrane allows for enhancing the water evaporation process. The evaporated water rises up within the ignition chamber reaching the iron meshwork cartridge, heated up to about 700°C. Due to the vapour passing through, the meshes are oxidized, resulting in release of hydrogen to be subsequently oxidized until obtaining water and releasing heat. In such a way due to the ignition device construction, extra energy is obtained within the ignition chamber, resulting in a process similar to a pyrolysis process partially taking place within the gasifying chamber. Whereat in a possible embodiment of the heating appliance the ignition device is provided with an air supply duct mounted therein. Therefore, the air enters the ignition chamber through the ignition device only, thus providing an efficient fuel combustion within the ignition chamber along with reducing the air entering the gasifying chamber that ensures normal pyrolysis behavior. It should be noted that, the gases escaping the gasifying chamber undergo secondary combustion in the area under the grill due to the excessive oxygen, entered the ignition chamber. Furthermore, within the heating appliance air supply duct at least one krypton halogen heat radiator can be provided, allowing for the water vapour quick heating.

[0018] In another embodiment, the ignition device is a burner. Such an embodiment is used for stationary heating appliances, meant for producing significant amount of heat and correspondingly to burn great fuel volumes.

[0019] For operation convenience when heating large areas the appliance includes a fuel feeding system and an ash removing system. Such systems provide for the heating appliance automated operation and need no operator's constant control yet in this case the heating appliance is to be connected to the electricity mains. In a particular embodiment of a heating appliance as claimed, the fuel feeding system contains a fuel tank, connected to the ignition chamber by means of a fuel feeding conveyor screw generally representing a screw. It is also possible a particular embodiment of the appliance as claimed wherein the ash is collected within the ignition chamber. Other embodiments are possible wherein the fuel feeding system is provided with sensors to determine the fuel level.

[0020] According to a preferred embodiment, the flue contains a filter and/or a fan exhauster. The filter allows for entrapping the incompletely combusted fuel particles thus limiting their emission into the environment. Furthermore, the fan exhauster allows for varying the draft that in the case of installing extra sensors and a control system allows for regulating the processes that occur inside the heating appliance after activating its operation mode. Additionally the flue may comprise a device meant for cleaning the flue. A non-limiting example of such a device for cleaning the flue may represent a cable tipped with a brush and extending all along the flue length.

[0021] The flue is equipped with a plate deflector, contributing into the back draft limiting, that is the shape of such a deflector ensures non-occurrence of the back draft at any wind speed and direction. Such a phenomenon is simply explained by Bernoulli law, according to which the higher is the flowrate the lesser is the pressure and vice versa. Thus, a reduced pressure is provided within the plate deflector in the gas outlet area eliminating the back draft occurrence.

[0022] In a preferred embodiment, the housing contains a closure for fuel to be charged into the gasifying chamber pyrolysis zone. The closure enables the user to charge solid fuel into the gasifying chamber relatively easy. Also in some particular yet non-limiting cases, said closure allows for using the heating appliance, for example, while preparing food, or for instance in smoke curing. The embodiments as described not only simplify the heating appliance maintaining for a user, but also expand its functionality. In addition, the closure may be provided with a collector. The collector enables a directed hot air supply. Upstream the collector at its input a blower can be provided and at its output, the collector may be connected to a ventilation duct for further transportation of the hot air to a chosen premise.

[0023] A heating appliance as claimed is further explained by means of the following drawings.

Fig. 1 - schematic view of heating appliance, which is combined with a gas distribution scheme.

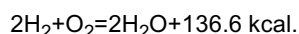
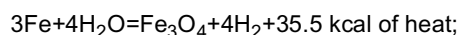
Fig. 2 - schematic view of heating appliance equipped with a water-jacket, which is combined with a gas distribution scheme.

[0024] Fig. 1 shows schematic view of a heating appliance, which is combined with a gas distribution scheme. The heating appliance comprises a housing 1 with a combustion chamber 2, divided into an ignition chamber 3 and gasifying chamber 4 separated from the ignition chamber 3 with a grill 5, a flue 6, communicated with the gasifying chamber 4, an air supply duct 7, a fuel feeding device 8 and ignition device 9, an area 10 under the grill 5, a gas circulation channel 11 and a closure 12, fitted with at least one cartridge 13. Besides, it is shown a closure 14 of the housing 1 for charging the fuel into the gasifying chamber 4. In the embodiment as shown the ignition chamber 3 is an attachable bucket for receiving the fuel, envisaging the functions of the gas circulation channel 8. Also there are shown slots 15 of the gasifying chamber 4.

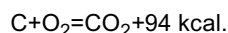
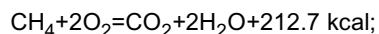
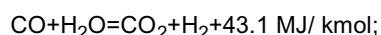
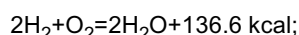
[0025] Fig. 2 shows a schematic view of a heating appliance equipped with a water-jacket, which is combined with a gas distribution scheme. The reference numbers of Fig. 2 correspond to the ones of Fig. 1. Besides, references are made for a water-jacket 16 of the ignition chamber 3 and a double-circuit water-jacket 17 of the gasifying chamber 4, a fuel feeding system 18 and an ash removing system 19, an operating mechanism 20 of the fuel feeding system 18 and the ash removing system 19, and a fuel tank 21 as well. In the embodiment as claimed the ignition device 9 is a burner having the same reference number.

[0026] The appliance as claimed is operated as follows.

[0027] Prior to start the heating appliance operation it is necessary to open the closure 14 and to charge solid fuel, e.g. coal, into the gasifying chamber 4. Then the bucket of the ignition chamber 3 is taken off from the housing 1 and fuel is inserted into the ignition chamber 3. The ignition device 9 is charged with motor fuel and water. Then the bucket of ignition chamber 3 is mounted onto the housing 1. It is necessary to warm the housing 1 for a while by virtue of heat of the ignition device 9. After warming the heating appliance, the fuel starts burning within the ignition chamber 3. The fuel combustion products from the ignition chamber 3 rise up to the gasifying chamber 4. In parallel to the process, the water fed to the ignition device 9 is heated and evaporated, the vapour rising up. Over the ignition chamber 3 it is provided a closure 12, fitted with an iron mesh cartridge 13. The iron meshwork of the cartridge 13 glows due to the energy of the fuel combusted in the ignition chamber 3. The water vapour passing through the iron meshwork of the cartridge 13, oxidizes the meshes to form hydrogen from the vapour. The hydrogen obtained is subsequently combusted once again to release much heat, as illustrated by the exothermal reactions below.



[0028] Further, the combustion products and non-combusted oxygen supplied from the air supply duct 7 enter the gasifying chamber 4. In the lower part of the gasifying chamber 4 due to the oxygen presence a combustion zone is formed. A portion of combustion products and non-combusted oxygen within the zone rise up, and a portion exits through the slots 15 of the gasifying chamber 4. In such a way, the coal placed over the slots 15 are heated with the wall of gasifying chamber 4 without access of oxygen that is a process similar to pyrolysis takes place. In the course of the process as described, a gas is released containing hydrogen H_2 - of about 55%, methane CH_4 - of about 30%, carbonic oxide CO - of about 4%. The gas reaches the closure 14 and enters the air circulation channel 11. By the air circulation channel 11 a portion of gases from the gasifying chamber 4 is transported to the area 10 under the grill, thus creating a combustion zone within the gasifying chamber 4, where they are combusted resulting in heat release while a portion of gases exits through the flue 6. When passing through the air circulation channel 11 the gases transfer a portion of their heat to the gasifying chamber 4 walls for warming the fuel, contained therein, as illustrated by the exothermal reactions below.



[0029] Besides a portion of carbon dioxide CO_2 and a portion of non-combusted carbon C enter the area 10 under the grill, where CO_2 passes through the glowing coal turning into CO to be subsequently combusted together with the particles of non-combusted carbon, thus leading to a fumeless combustion.

[0030] In such a way, the combustion of a fuel portion results in releasing heat of about 793.7 kcal. In this example, the coal acts as a fuel and a catalyst for transformation of CO_2 into CO . Further, the iron acts as a catalyst and after oxidizing releases hydrogen, and the coal provides high temperatures (beyond 700°C) for conducting pyrolysis.

[0031] The heating appliance equipped with a water-jacket is operated as follows.

[0032] First, the heating device is mounted and connected to a heat supply system of the premise by means of the water-jacket. Prior to start the appliance operation the gasifying chamber 4 is fed, e.g., with coal through the closure 12. Then motor fuel and water are charged into the burner 9, the heat radiator of the burner 9 is turned on and the air is supplied through the air supply duct 7. In a short period the fuel turns into a gaseous substance, water turns into vapour, and the vapour subsequently turns into synthesized gas, after that the burner 9 is ignited and the combustion process

is started within the ignition chamber 3. The fuel combustion products from the ignition chamber 3 ascend to the gasifying chamber 4. The water vapour rises upward. Over the ignition chamber 3 a closure 12 is provided fitted with an iron mesh cartridge. The iron meshwork of the cartridge 13 glows due to the energy of the fuel combusted in the ignition chamber 3. The water vapour passing through the iron meshwork of the cartridge 13 oxidizes the meshes resulting in release of hydrogen out of the water vapour. The carbon obtained is subsequently combusted once again to release much heat. The heat obtained in the ignition chamber 3 is transferred to the chamber walls and to the water-jacket 16 of the ignition chamber 3. Further, the combustion products and non-combusted oxygen supplied from the air supply duct 7 enter the gasifying chamber 4. In the lower part of the gasifying chamber 4 due to the oxygen presence a combustion zone is formed. A portion of combustion products and non-combusted oxygen within the zone rise up, and a portion exits through the slots 15 of the gasifying chamber 4 and enters the double-circuit water-jacket 17 circuits that define the gas circulation channel 11. Along the water-jacket circuits 17 a portion of these gases enters the flue, a portion is transported to the area 10 under the grill. In such a way, the coal placed over the slots 15 is heated from the wall of the gasifying chamber 4 with no oxygen present, that is a process similar to pyrolysis takes place. The gas reaches the closure 14 and enters the gas circulation channel 11, defined by the water-jacket 17 circuits. By the gas circulation channel 11 a portion of gases from the gasifying chamber 4 is transported to the area 10 under the grill, thus creating a combustion zone within the gasifying chamber 4, where they are combusted resulting in heat release while a portion of gases exits through the flue 6. When passing through the air circulation channel 11 the gases transfer a portion of their heat to the gasifying chamber 4 walls for warming the fuel, contained therein, and another portion of their heat is transferred to the water-jacket 17 of the ignition chamber 3.

[0033] In such a way, it is provided a heating appliance, whose construction will provide a technical result, lying in increasing of the solid fuel combustion efficiency and correspondingly increasing of the heating appliance performance. Wherein the construction of the appliance as provided allows for using several modes of fuel combustion, as well as for using the obtained combustion products as an additional heat energy source, thus providing reduction of contaminants in the gases, ejected from the heating appliance flue.

Claims

1. Heating appliance comprising a housing with a combustion chamber divided into an ignition chamber arranged in the lower part of the housing, a gasifying chamber, separated from the ignition chamber with a grill and arranged thereabove, a flue, communicated with the gasifying chamber, an air supply duct for supplying air to the ignition chamber and the fuel feeding device, and an ignition device, arranged within the ignition chamber, **characterized in that** the upper part of the gasifying chamber being communicated with the area under the grill through the gas circulation channel.
2. Heating appliance of claim 1, **characterized in that** a gas circulation channel is provided between the gasifying chamber and the housing.
3. Heating appliance of claim 1, **characterized in that** at least one iron meshwork cartridge is located under the grill.
4. Heating appliance of claim 1, **characterized in that** the combustion chamber comprises a water-jacket.
5. Heating appliance of claim 4, **characterized in that** the water-jacket is provided with at least one electrical krypton halogen heat radiator.
6. Heating appliance of claim 4, **characterized in that** the water-jacket is a double-circuit one located between the gasifying chamber and the housing.
7. Heating appliance of claim 6, **characterized in that** the gas circulation channel is defined by the water-jacket circuits.
8. Heating appliance of claim 1, **characterized in that** the ignition device is provided with a dropper for feeding water and/or liquid fuel.
9. Heating appliance of claim 1, **characterized in that** the ignition device is a burner.
10. Heating appliance of claim 1, **characterized in that** an air supply duct is located in the ignition device.
11. Heating appliance of claim 1, **characterized in** comprising a fuel feeding system and an ash removing system.

12. Heating appliance of claim 1, **characterized in that** the flue contains a filter and/or a fan exhauster.

13. Heating appliance of claim 1, **characterized in that** the housing contains a closure for charging the fuel to the pyrolysis zone.

14. Heating appliance of claim 13, **characterized in that** the closure is provided with a collector.

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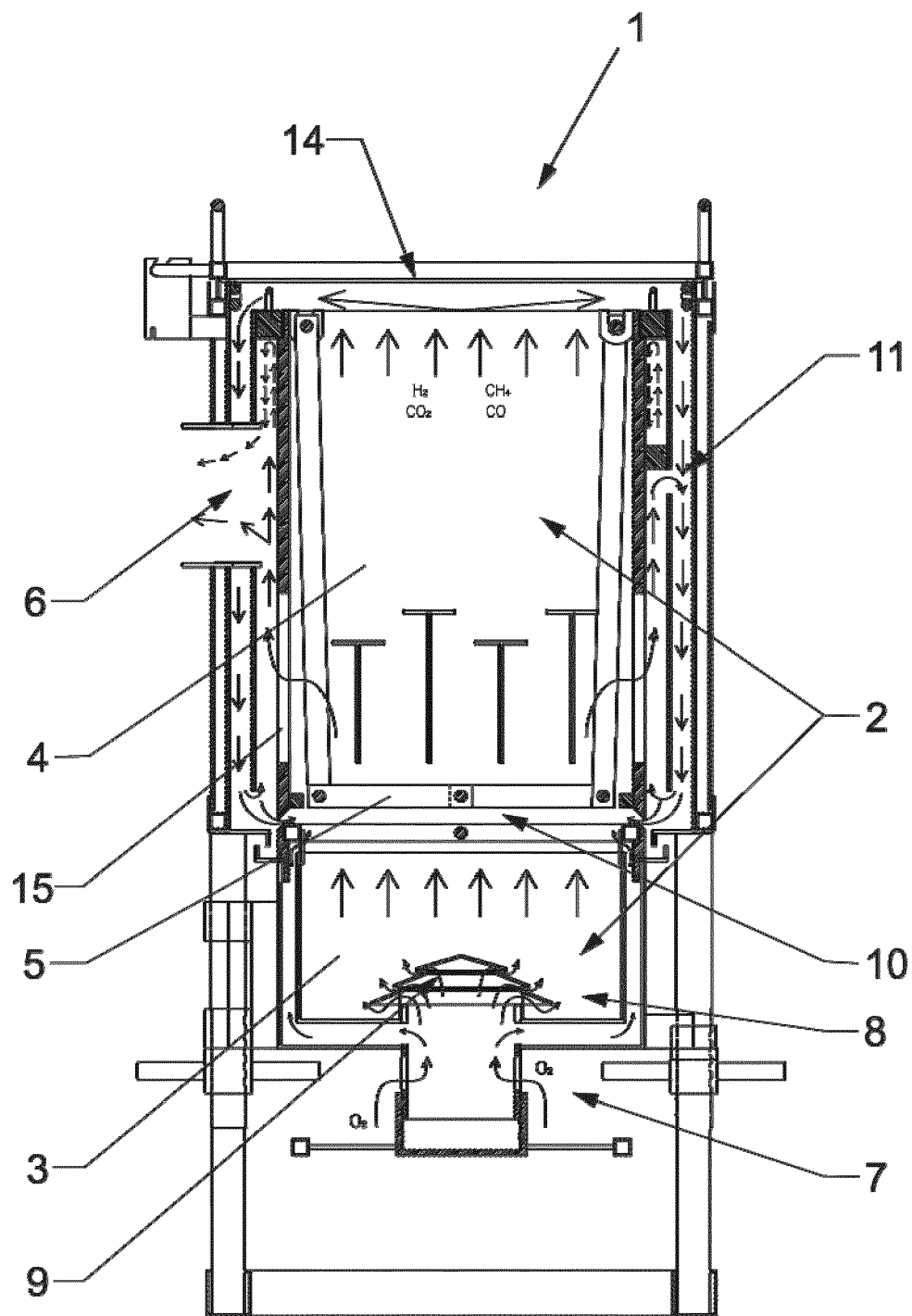


Fig. 1

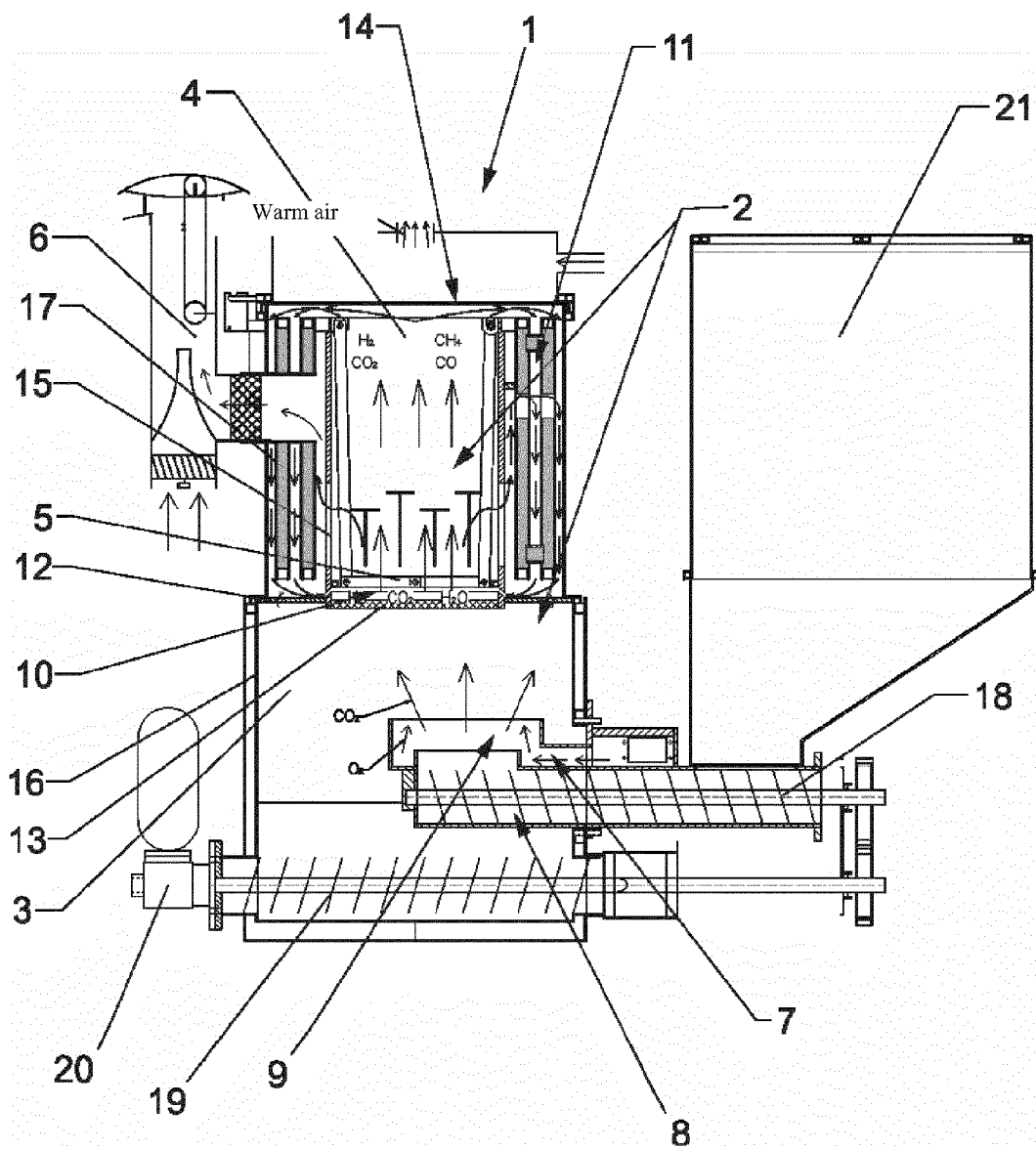


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
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EPO FORM 1503 03.82 (P04C01)

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 December 2015	Examiner Christen, Jérôme
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- CN N202852829 [0004]
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