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(54) **DISCHARGE OF FLUE GASES**

(57) Stove (1) with a combustion chamber (2) for burning a fuel, wherein the stove has an inlet (4) for combustion air and an outlet (3) for flue gases, which outlet for flue gases is provided with a flue gas extractor (11) for active discharge of flue gases, which flue gas extractor

is controllable by a controller to at least two extraction positions in order to minimize an excess of air during burning of the fuel, wherein the flue gas extractor is placed at a distance of at least 1 metre from the combustion chamber (2).

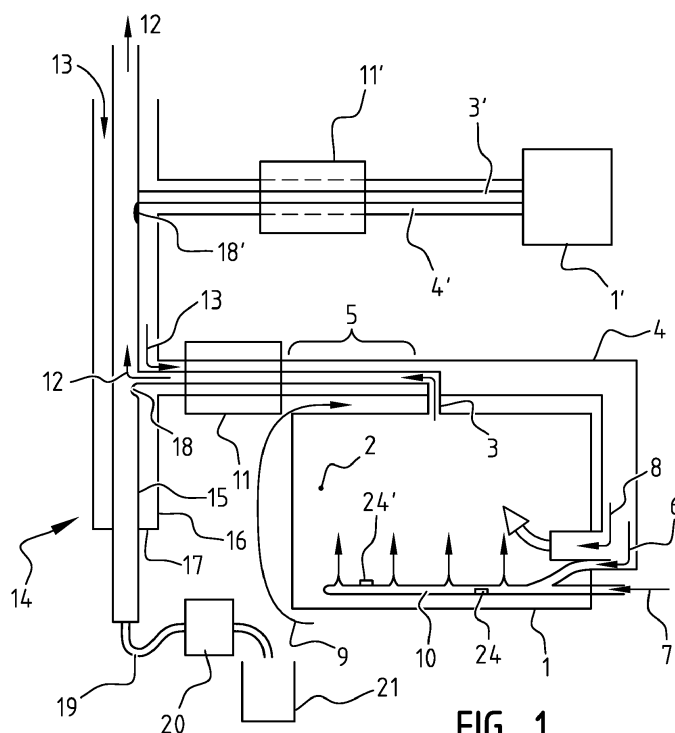


FIG. 1

Description

[0001] The present invention relates to a stove with a combustion chamber for burning a fuel, wherein the stove has an inlet for combustion air and an outlet for flue gases.

[0002] Stoves are generally known heating means for homes. Where in the past a stove was usually provided for the purpose of burning wood and/or coal, there is a trend in recent years to provide more gas stoves and pellet stoves which are optimized for burning respectively gas and pellets. The advantage of gas or pellets as fuel is that the supply of the fuel can be controlled mechanically in a simple manner such that the energy output of the stove can be controlled.

[0003] There is a trend in the house building sector toward better insulation of houses, whereby the heat energy output necessary to heat a house is minimal. Recent building regulations also lay down minimum efficiency for all heating devices. As a result the process of combustion in a stove placed in such a modern home must be more readily controllable so as to also enable good performance at low energy outputs. The stove must be designed so that it can function with a high efficiency, i.e. optimal conversion of the energy from the fuel to heat must be possible. In addition, there are regulations regulating the quality of the combustion so as to minimize formation of soot and CO.

[0004] It is an object of the invention to provide a stove with a high efficiency wherein the process of combustion can be better controlled.

[0005] The invention provides for this purpose a stove with a combustion chamber for burning fuel, wherein the stove has an inlet for combustion air and an outlet for flue gases, which outlet for flue gases is provided with a flue gas extractor for active discharge of flue gases, which flue gas extractor is controllable by a controller to at least two extraction positions in order to optimize an excess of air during burning of fuel, wherein the flue gas extractor is placed at a distance of at least 1 metre from the combustion chamber.

[0006] The stove according to the invention comprises a flue gas extractor placed in the outlet for flue gases. The placing of a flue gas extractor in an outlet for flue gases is made difficult in practice by the temperature of the flue gases. The temperature of the flue gases will typically heat the outlet for flue gases, and thereby also heat the flue gas extractor, so that this latter must be able to operate properly at high temperatures. However, because in the invention the flue gas extractor is placed at a distance of at least 1 metre from the combustion chamber, flue gases coming out of the combustion chamber have the time to at least partially cool before they arrive at the flue gas extractor. The controller assists here in further reducing the effect of heating of the flue gas extractor by setting the flue gas extractor so that the excess air is optimal during combustion of the fuel, i.e. is typically greater than 1 and is minimal. Excess air is related to the quantity of combustion air which flows into the combus-

tion chamber of the stove and wherein the oxygen elements in the air are not utilized to combust fuel. All oxygen from the combustion air is ideally used to combust fuel such that the total quantity of air flowing through the combustion chamber is minimal. Because air has only a limited capacity to transport heat and thereby carry it out of the combustion chamber, limiting the total quantity of air which flows through the combustion chamber has the direct consequence that the amount of energy transported out of the combustion chamber via the flue gases is minimal. By adjusting the flue gas extractor in the stove according to the invention to a minimal excess of air greater than 1, the total quantity of flue gases flowing out of the stove is minimal. The temperature of the outlet for flue gases will hereby only rise minimally, and as a result hereof the flue gas extractor which is placed at 1 metre from the combustion chamber will be heated less than conventionally by the flue gases. The flue gas extractor of the stove according to the invention will hereby continue to function optimally.

[0007] The process of combustion is largely dependent on the ratio of fuel and air in the combustion chamber. The flue gas extractor can determine the quantity of air which flows through the combustion chamber, whereby the flue gas extractor can control the combustion via the controller. Keeping the excess air to a minimum and preventing the excess air becoming less than 1 will result in a good combustion at a high efficiency.

[0008] The invention further has an unexpectedly positive effect. Because the flue gas extractor is placed in the outlet for flue gases, the flue gas extractor will draw air through the stove. The result hereof is that the combustion chamber of the stove is subjected to underpressure. Because a combustion chamber and the elements mounted thereon, such as an outlet for flue gases and inlet for combustion air, can never be manufactured so as to be 100% airtight, it is an advantage to have an underpressure in the stove because the underpressure ensures that possible soot or CO or other harmful by-products of a combustion will not leak out of the stove, or hardly so. This in contrast to stoves which actively blow combustion air to the combustion chamber, which is thereby at overpressure, and which do tend to allow soot, CO and other harmful combustion products to leak to the area surrounding the stove. This effect of leakage from the combustion chamber is enhanced in practice by modern airtight insulated houses wherein the air is refreshed by means of a balanced ventilation system and wherein in accordance with recent building regulations the space in the house may be subject to slight underpressure.

[0009] In summary, the minimal excess air greater than 1 during combustion of fuel will have the result that the total volume of the flue gases is minimal, and thereby that the outlet for flue gases is only heated minimally such that the flue gas extractor placed in the outlet for flue gases can continue to function optimally. A further advantage of placing the flue gas extractor in the outlet for

flue gases is that the stove is subjected to underpressure so that leakage of harmful substances, soot and CO is avoided.

[0010] The flue gas extractor preferably comprises a fan and a valve, wherein the valve has a closed position and at least two open positions, which at least two open positions respectively determine the at least two extraction positions. Tests have shown that controlling airflow by means of a combination of a fan and a valve is optimal for flue gases. A further advantage is that the valve can be closed, for instance when the stove is not in use, such that air from the chimney cannot flow into the stove through the outlet for flue gases when the stove is not in use. Particularly in a space which is subject to underpressure as a result of a balanced ventilation system, this is a considerable advantage. This is also a considerable advantage when a plurality of stoves are connected to one chimney.

[0011] The flue gas extractor preferably has at least five extraction positions. Because it has at least five extraction positions the controller can control the flue gas extractor more precisely in order to optimize an excess of air during combustion of fuel.

[0012] The flue gas extractor is preferably placed at a distance of at least 3 metres from the combustion chamber, more preferably at a distance of at least 4 metres from the combustion chamber and most preferably at a distance of at least 5 metres from the combustion chamber. The influence of the temperature of the flue gases on the flue gas extractor will be further minimized by increasing the distance between flue gas extractor and combustion chamber.

[0013] The stove preferably has infeed means for introducing a predetermined quantity of fuel into the combustion chamber. The fuel is preferably chosen here from gas or pellets. The control of a gas supply or the introduction of pellets into a combustion chamber can be performed mechanically in simple manner, on the basis of which the energy output of the stove can be adjusted.

[0014] The controller preferably controls the flue gas extractor on the basis of an input value. The input value is for instance related here to the predetermined quantity of fuel introduced into the combustion chamber by the infeed means. By on the one hand controlling the infeed means, i.e. controlling the quantity of gas introduced into the combustion chamber or by controlling the quantity of pellets introduced into the combustion chamber, an estimate can be made by a skilled person of the quantity of air necessary to combust the introduced gas or the introduced pellets in optimal manner, i.e. with an optimal excess of air. The flue gas extractor can then be controlled on the basis of this estimate. The flue gas extractor will hereby be controlled on the basis of an input value related to the amount of fuel introduced into the combustion chamber. The skilled person will appreciate that this can be performed in different ways, for instance on the basis of an input measurement of the infeed means or on the basis of predetermined energy output settings,

wherein both the infeed means and the flue gas extractor are adjusted to a predetermined setting.

[0015] The stove is preferably a gas stove for burning gas and the stove has at least one injector for injecting gas into a combustion chamber, and wherein the injector is provided with a temperature sensor which is operatively connected to the controller. Tests have shown that the temperature of the injector is related to the excess air present in the combustion chamber. Tests have shown particularly that a large excess of air has the result that the gas ignites closer to the injector. Because the gas ignites closer to the injector, the injector will be heated more by radiant heat from the flame than if the gas ignites at a greater distance from the injector. It is noted here that placing a temperature sensor on an injector is easy and inexpensive, whereby the excess air can also be measured in a simple and inexpensive manner.

[0016] The controller is preferably provided so as to set the flue gas extractor to a higher extraction position when the temperature sensor measures a temperature which is lower than a predetermined temperature. The controller is more preferably provided so as to set the flue gas extractor to a lower extraction position when the temperature sensor measures a temperature which is higher than a predetermined temperature. When the temperature sensor measures a temperature of the injector below a predetermined temperature, this means that the gas ignites relatively far away from the injector, this being an indication that too little air is present in the combustion chamber, or in other words that an excess of air lower than 1 could occur, which results in an incomplete combustion with all the consequences this entails. Incomplete combustion has the result that soot particles and other harmful combustion products occur due to a deficiency of oxygen for the combustion. By setting the flue gas extractor to a higher extraction position more flue gases will be drawn out of the combustion chamber and as a result more combustion air will also be supplied so that the air-fuel ratio is restored. When the temperature sensor measures a temperature above a predetermined temperature, this means that the gas ignites close to, or too close to the injector, this indicating that too much air is present in the combustion chamber in proportion to the fuel. This results in an excess of air, whereby the stove operates less efficiently. By setting the flue gas extractor to a lower extraction position fewer flue gases are discharged and the air fuel ratio will be restored to a predetermined optimal ratio at which the excess air is minimal and greater than 1.

[0017] The stove preferably has a user interface which allows a user to set an energy output of the stove. By setting an energy output the stove will carry a predetermined amount of fuel into the combustion chamber. By adjusting the controller of the flue gas extractor this introduced amount of fuel can be combusted in an optimal manner such that the stove produces the set energy output with a high efficiency.

[0018] The invention will now be further described with

reference to an exemplary embodiment shown in the drawing.

[0019] In the drawing:

figure 1 shows a CLV (collective concentric flue duct) according to an embodiment of the invention in which a stove is connected; and

figure 2 shows a flue gas extractor which can be applied in the invention.

[0020] The same or similar elements are designated in the drawing with the same reference numerals.

[0021] Figure 1 shows a stove 1 with a combustion chamber 2 for a fuel. A stove is hereby defined as a heating device wherein the primary object is direct heating of the immediate area around stove 1. A stove is more preferably defined as a heating device wherein the secondary object is to achieve an aesthetically appealing combustion in stove 1. Combustion chamber 2 is for this purpose typically formed as a casing in which the combustion can take place and wherein at least a segment of the casing is formed by a transparent material, for instance glass. The transparent material has the function here of simultaneously allowing several people in the surrounding area to see the flames created during the combustion process.

[0022] Combustion chamber 2 further comprises a flue gas outlet 3 which is provided for discharge of the flue gases which are the consequence of the process of the combustion of the fuel. Combustion chamber 2 further comprises a combustion air inlet 4 for supplying air with which the combustion process is performed. In the embodiment as shown in figure 1 flue gas outlet 3 and combustion air inlet 4 are formed via a concentric pipe 5 such that a heat exchange takes place between the relatively cold supplied air and the relatively hot flue gases. The supplied air, which is supplied via combustion air inlet 4, is hereby preheated whereby the energy efficiency of stove 1 is increased. It is however noted in this context that it is not essential for flue gas outlet 3 and combustion gas inlet 4 to be formed concentrically. In residential environments for instance combustion air can be supplied from a location other than that where the flue gases are discharged. When CLVs are applied as shown in figure 1, it is also an option to provide flue gas outlet 3 and combustion air inlet 4 via separate pipes.

[0023] Shown in figure 1 is a stove which is provided for combustion of gas as fuel. Stove 1 is provided for this purpose with at least one gas injector 10. Stove 1 can alternatively be provided so as to burn pellets or wood. The advantage of gas or pellet stoves compared to wood stoves is that the supply of fuel, being respectively gas or pellets, is mechanically dosable in simple manner such that the energy value of the fuel introduced into the combustion chamber is controllable over time. This mechanical control of the fuel supply forms a good basis for also controlling, and preferably automating, the other parameters of the stove, such as energy output and efficiency.

It will be apparent to the skilled person that the stated fuels are not limitative and that different types of stove can be designed to burn different types of fuel.

[0024] Several airflows, passive or active, are conventionally created in stoves which affect and seek to optimize the operation of the stove. Fuel is typically introduced into a lowest zone of combustion chamber 2. Primary air 6 is air which is introduced into the combustion chamber at, below or at least close to the fuel 7. Primary air 6 is in other words introduced into said lowest zone. Secondary air 8 is combustion air which is introduced into combustion chamber 2 at a height above the fuel. Secondary air 8 is in other words introduced above said lowest zone. Secondary air 8 is typically introduced along the sides of the combustion chamber or along the upper side of the combustion chamber into an upper zone of combustion chamber 2.

[0025] Tertiary air 9 is ambient air which is blown over an outer surface of combustion chamber 2 so as to be heated by the casing of combustion chamber 2, which heated air is then typically blown back into the surrounding area so as to thus heat the surrounding area. Tertiary air 9 does not enter combustion chamber 2 and does not therefore comprise any harmful substances which can be created by the combustion process. The ratio of primary air 6 and secondary air 8 is substantially fixed. The primary air 6 and the secondary air 8, together with the residual products of the combustion process, form the flue gases 12.

[0026] During the combustion process the quantity of primary and secondary air is preferably held in balance with the quantity of fuel introduced into the combustion chamber. Fuel typically comprises an amount of hydrocarbons which are converted during combustion substantially to water and carbon dioxide and, to limited extent, also possibly harmful byproducts. Necessary for the conversion of hydrocarbons to water and carbon dioxide is oxygen which is taken from the primary and secondary air. In this context excess air is used in the art. Excess air is defined as the effective ratio of oxygen/fuel divided by the stoichiometric ratio of oxygen/fuel. The excess air hereby denotes a surplus (or deficiency) of oxygen in the primary and secondary air after all hydrocarbons of the fuel have been converted to water and carbon dioxide. An excess of air of 1 means that all oxygen from the primary and secondary air has been used up in the conversion of the fuel to CO_2 and H_2O . This is a theoretical situation which can never be realized in practice. An excess of air greater than 1 will always have to be available in practice to allow the chemical reaction of hydrocarbons from the fuel to take place. The excess of air can become too large, whereby too much oxygen is present in the primary and secondary air for converting the hydrocarbons. The volume of flue gases will hereby be greater than in the case of a lower excess of air. Because the quantity of flue gases is greater, the amount of energy discharged by means of the flue gases will also be greater. It is assumed here that a predetermined quantity of

flue gases can transport a substantially fixed predetermined amount of energy. More incoming air will also have to be heated, so that more energy is lost. In addition, this also causes waste of fan energy when the airflow is actively driven. When the excess air is lower than 1, i.e. there are more hydrocarbons to be converted than there is oxygen to allow the reaction to take place, harmful byproducts such as soot will be formed because the combustion is then incomplete. This can also result in problems in start-up of the stove. An excess of air lower than 1 is therefore to be avoided. In order to maximize the energy efficiency of the stove and to optimize the combustion the goal is to achieve a minimal excess of air greater than 1. A preferable goal is an excess of air greater than 1.05, preferably greater than 1.1, most preferably greater than 1.2. A more preferable goal is an excess of air of less than 1.9, preferably less than 1.7, more preferably less than 1.5. Excess air can conventionally be measured using a lambda probe at the location of the flue gas outlet for the purpose of measuring the remaining content of oxygen in the flue gases.

[0027] Figure 1 shows a flue gas extractor 11 in principle. Flue gas extractor 11 is provided for the purpose of active discharge of the flue gases 12. Via the flue gas extractor the flow rate of the discharged flue gases 12 can be determined, and the flow rate of the primary air 6 and the secondary air 8 can hereby also be determined, i.e. the primary air and secondary air together with the combustion products form the flue gases 12. Flue gas extractor 11 is placed at a distance from combustion chamber 2, this distance preferably being greater than 1 metre, more preferably greater than 2 metres and most preferably greater than 3 metres. Because flue gas extractor 11 is placed at a distance from the combustion chamber, the flue gases coming from combustion chamber 2 have the chance to cool at least partially before they pass through flue gas extractor 11. The temperature of the flue gas extractor will hereby not exceed a predetermined maximum operating temperature of the flue gas extractor. This cooling of the flue gases is further enhanced in the embodiment of figure 1 by the concentric pipe 5 which ensures that the heat of the flue gases is exchanged with the supplied combustion air, whereby the temperature of the flue gases in flue gas outlet 3 falls sharply. Flue gas extractor 11 is further set to control the combustion process in combustion chamber 2 in accordance with optimal excess air. An optimal excess air is defined here as an excess of air which is greater than 1 and which is minimal. The combustion of the fuel is hereby complete because the excess air is greater than 1, and the total quantity of flue gases is minimal because the excess air is minimal. As a result of the minimal quantity of flue gases the energy from combustion chamber 2 carried by the flue gases to flue gas outlet 3 is also minimal, whereby the temperature at the location of flue gas extractor 11 remains within predetermined limits.

[0028] The advantage of using a flue gas extractor 11 which is placed in flue gas outlet 3 is that the flue gas

extractor draws the air out of combustion chamber 2 and pushes it to the chimney (not shown; the location where the flue gases are blown into the ambient air). Because flue gas extractor 11 draws air out of the combustion chamber, an underpressure will be created in the combustion chamber. It is noted in this context that it will never be possible to manufacture 100% airtight combustion chambers 2 and associated connections of flue gas outlet 3 and combustion air inlet 4. Because combustion chamber 2, and hereby also the flue gas outlet and combustion air inlet connected thereto, are subjected to an underpressure by flue gas extractor 11, flue gases cannot leak to the surrounding area. A considerable safety advantage is hereby achieved.

[0029] Shown in figure 1 is how flue gas outlet 3 and combustion air inlet 4 are connected to a CLV 14. A CLV is a collective feed of air and discharge of combustion gases which is typically applied in buildings with multiple residential units in order to allow a plurality of combustion devices to be connected to one chimney. CLV 14 comprises an inner pipe 15 and an outer pipe 16. Inner pipe 15 is provided for the purpose of upward discharge of flue gases 12. The inner pipe is open for this purpose at the top of the CLV. Inner pipe 15 preferably extends higher at the top than outer pipe 16 in order to prevent flue gases 12 blown out of the inner pipe being drawn in by the outer pipe as combustion air 13. Inner pipe 15 is provided at the bottom with a water outlet 19. A water outlet 19 is optionally provided with a pH neutralizer 20. Water outlet 19 is provided so as to be connected to sewer 21, optionally with a pH neutralizer 20 between outlet 19 and sewer 21. Inner pipe 15 is closed off from air at the bottom such that flue gases 12 cannot leave the inner pipe at the bottom. The skilled person will be familiar with different principles for closing a pipe off from air such that water can however be discharged, such principles being generally applied in water outlets for washbasins and toilets.

[0030] CLV 14 further comprises an outer pipe 16 which is closed 17 at the bottom. Because outer pipe 16 is closed 17 at the bottom, air cannot flow directly from outer pipe 16 to inner pipe 15. CLV 14 as shown in figure 1 will hereby not display any natural draught when the combustion devices connected thereto are not in operation.

[0031] A moisture guide 18 is placed at the position of the connection of flue gas outlet 3 to inner pipe 15 of CLV 14. Moisture guide 18 is provided so as to guide moisture droplets from flue gas outlet 3 to the inner side of inner pipe 15. In a first embodiment moisture guide 18 has for this purpose a convex surface on which extends between the wall of flue gas outlet 3 and the inner side of inner pipe 15 of the CLV. Because of the convex surface moisture will not have the chance to drip off and drop downward in inner pipe 15 of the CLV. Downward falling droplets would cause an unacceptable noise nuisance in the building in which CLV 14 is placed. Having the droplets roll downward along the inner side of inner wall 15 pre-

vents this noise nuisance. The skilled person will appreciate that different moisture guides 18 can be designed to prevent droplets forming and dropping downward in inner pipe 15. According to a further embodiment a moisture guide 18 can thus be formed by a succession of surfaces having an obtuse angle relative to each other so that droplets can roll from the one surface to the other without dripping off the edge between the surfaces. On the basis of the described effect, i.e. guiding moisture droplets from flue gas outlet 3 to the inner wall of inner pipe 15, it will be apparent to the skilled person which connections will suffice here and which will not. This result can also be tested in simple manner by introducing a minimal flow of water into the flue gas outlet and then testing whether the minimal flow of water drips in inner pipe 15 or runs off against the inner side. The minimal flow of water is selected here such that it is representative of the amount of condensed water present in the flue gases from the stove at maximum energy output.

[0032] In order to optimize discharge of condensate out of flue gas outlet 3 the flue gas outlet 3 is preferably placed in draining manner. This means that the horizontal distance between stove 1 and CLV 14 spanned by flue gas outlet 3 is placed in draining manner. Flue gas outlet 3 will specifically have to have a gradient of at least 1% over at least 70% of the horizontal distance between stove 1 and CLV 14. The skilled person will appreciate how flue gas outlet 3 can be formed in draining manner in order to guide condensate occurring in flue gas outlet 3 away from stove 1 and to inner pipe 15 of the CLV.

[0033] Figure 2 shows a possible embodiment of flue gas extractor 11. Figure 2 shows here how flue gas outlet 3, which is the inner pipe of concentric pipe 5, is separated at the position of flue gas outlet 11 from the combustion air inlet 4 formed by the outer pipe. This allows a module to be placed in the flue gas outlet which comprises a fan 22 and a valve 23, preferably a throttle valve 23. Valve 23 preferably has a closed position and a plurality of open positions. The closed position is preferably used when the stove is not in operation such that flue gases which are present in inner pipe 15 of the CLV, and which come for instance from other stoves connected to CLV 14, cannot be blown through the flue gas outlet to combustion chamber 2 of the non-operational stove. The valve with closed position hereby allows a plurality of stoves to be connected to one CLV. The plurality of open positions of valve 23, in co-action with the active fan 22, will result in a plurality of corresponding flow rates of flue gases flowing through the flue gas extractor. The flow rate of the flue gases can be controlled by adjusting the open position of valve 23. The skilled person will be familiar with the general principle of controlling and adjusting airflows by means of a combination of a fan and a valve. This will not therefore be explained in further detail in this description.

[0034] Valve 23 and fan 22 placed in flue gas outlet 3 together form flue gas extractor 11. Fan 22 and valve 23 are preferably connected operatively to a controller of

stove 1. Fan 22 and valve 23 are placed in a position on the basis of input parameters of stove 1 or on the basis of measurement data from sensors in or on stove 1. A lambda probe can for instance be used to control flue gas extractor 11. It will be apparent to the skilled person that this control of valve 23 and fan 24 by the controller (not shown) can be implemented in different ways, for instance on the basis of a table wherein respective positions of valve 23 are related to corresponding settings or input parameters or sensor values of stove 1. Valve 23 can alternatively be controlled on the basis of an algorithm in which one or more of the following values serve as basis for calculating the valve position: input parameters of the valve position, measurement values of sensors in the stove.

[0035] Shown in figure 1 is a simple mechanism for indirect measurement of an excess of air in combustion chamber 2. The excess air is determined on the basis of temperature measurement performed by a temperature sensor 24 on gas injector 10. This measurement principle is based on the insight that the temperature of gas injector 10 is related to the excess air. Tests and studies have shown that this is the result of the substantially fixed ratio of primary air 6 and secondary air 8. This operation of the temperature sensor will be elucidated on the basis of several examples. The airflow through stove 1 can be optimized on the basis of the temperature sensor. This is possible by means of controlling a flue gas extractor 11 in the embodiment of stove 1 of figure 1. This is also possible however in other embodiments of stoves wherein the airflows through stove 1 are controlled in other ways. There are therefore stoves which have a blower at the position of the air inlet to blow air through the stove, which blower can be controlled on the basis of temperature sensor 24. Stoves also exist which influence a passive airflow, for instance on the basis of natural draught of the chimney, by opening and closing a valve, which valve can then be controlled on the basis of temperature sensor 24.

[0036] In a first example illustrating the operation of temperature sensor 24 a lean gas on the one hand and a rich gas on the other are introduced into combustion chamber 2 as fuel. A lean gas has considerably fewer hydrocarbons than a rich gas, whereby the lean gas also requires less air 6, 8 for combustion compared to the rich gas. When a first predetermined quantity of air is introduced into combustion chamber 2 for combustion of the lean gas, a first gas mixture will result from mixing the lean gas with the first quantity of primary air 6. This first gas mixture will have a ratio of hydrocarbons - oxygen lying very close to the ignitable ratio because relatively few hydrocarbons are present in the lean gas. As a result the first gas mixture will ignite very closely to injectors 10 in combustion chamber 2, whereby the injectors become warmer because the flame comes close to the injectors. When a rich gas is mixed with the same quantity of primary air 6 a second gas mixture will result from mixing the first quantity of primary air 6 and the rich gas. This

second gas mixture will however have a ratio of hydrocarbons - oxygen which is still some way from the ignitable ratio because a relatively large amount of hydrocarbons are present in the rich gas. A considerable amount of secondary air 8 will hereby have to be added to the second gas mixture in order to combust the mixture. As a result the second gas mixture will only ignite at an appreciable distance from the injectors, whereby the injectors become less warm.

[0037] By adjusting the flue gas extractor in the case of the lean gas to a lower setting, at which fewer flue gases are discharged, less air will be supplied and, because the ratio of primary air 6 and secondary air 8 is substantially constant, less primary air 6 will therefore be added to the lean gas upon injection 10 thereof. Because less primary air 6 is added, the first gas mixture will be further from the ignitable ratio of hydrocarbons - oxygen, whereby the mixture ignites higher in combustion chamber 2. The temperature of injector 10 will hereby fall because the flames occur further away from injector 10. This first example shows how the airflow through combustion chamber 2 can be controlled on the basis of temperature sensor 24 in order to optimize the excess air in accordance with the type of gas introduced into the combustion chamber as fuel.

[0038] A further example shows how the airflow through combustion chamber 2 can be controlled on the basis of temperature sensor 24 in order to compensate external effects on the airflow. The maximum airflow will thus depend in the case of a self-drawing chimney on weather conditions and other factors. A resistance in flue gas outlet 12 will also occur in the case of a CLV system when multiple devices are operating simultaneously, whereby a flue gas extractor 11 will have to overcome a higher pressure on the side of CLV 14. Use is made in this second example of a flue gas extractor 11 which is in a first position and wherein the chimney draught is such that the airflow through combustion chamber 2 is relatively large. In a similar situation the same flue gas extractor 11 is placed in the same position but flue gas extractor 11 is connected to a CLV 14 to which other stoves are connected and are in operation such that the pressure in the inner pipe of the CLV is also high. A relatively low quantity of air will hereby flow through combustion chamber 2.

[0039] In the case of the self-drawing chimney the relatively high quantity of air will flow through combustion chamber 2, whereby a relatively large quantity of primary air 6 is also mixed with the gas. Because a relatively large quantity of primary air 6 is mixed with the gas, the ratio of hydrocarbons - oxygen in the mixture lies close to the ignitable range. The mixture will hereby ignite close to the injector and the temperature measured by temperature sensor 24 will be high. Flue gas extractor 11 can hereby be set to a lower position whereby less air will flow through combustion chamber 2.

[0040] In the case of the CLV with high pressure in the inner pipe relatively little air will flow through combustion

chamber 2 and less primary air 6 will also be mixed with the gas. The mixture of primary air and gas will hereby have a ratio of hydrocarbons - oxygen which is still some way from the ignitable ratio. As a result a further considerable quantity of secondary air 8 will have to be mixed with the mixture before the mixture can ignite or combust. The mixture will hereby ignite higher in the combustion chamber, whereby the temperature measured by temperature sensor 24 will be relatively low. In such a case the flue gas extractor 11 can be adjusted to a higher setting in order to draw more air through combustion chamber 2, whereby the resistance in inner pipe 15 is compensated.

[0041] Both examples are based on a gas stove. It will however be apparent to the skilled person that other types of stove, such as wood stoves and pellet stoves, also facilitate a combustion process wherein a ratio of hydrocarbons and oxygen must come within an ignitable range before flames are formed. The quantity of primary air and the energy density of the fuel will also influence this ratio in other types of stove. It will therefore also be possible to control an excess of air on the basis of a temperature sensor placed in a lowest zone of another type of stove. The use of temperature sensor 24 to determine the excess air is therefore not limited to gas stoves.

[0042] The above described examples show that a good indication can be obtained of an excess of air in combustion chamber 2 on the basis of a temperature sensor 24 in a lowest zone of combustion chamber 2. The excess air may then be influenced here by the operation of the chimney and/or flue gas outlet and/or combustion air inlet, or the excess air can be influenced by the energy properties of the fuel, and a good control of the excess air can always be obtained on the basis of temperature sensor 24. It is noted here that a temperature sensor can be provided easily and inexpensively in stove 1.

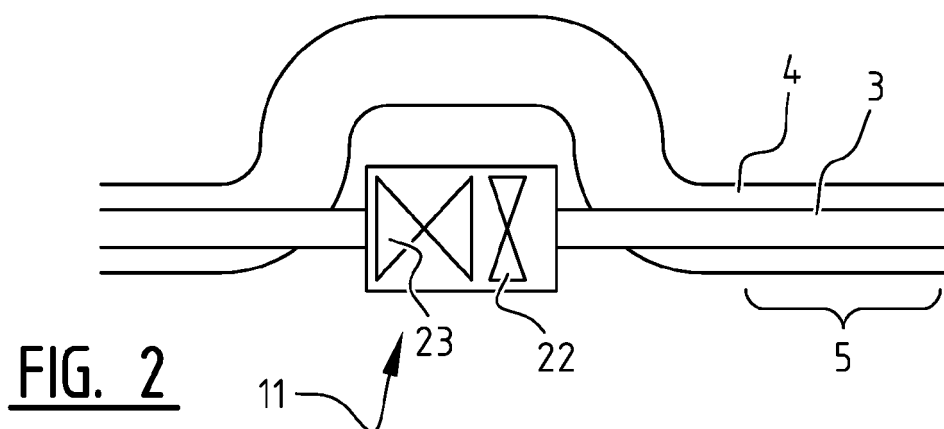
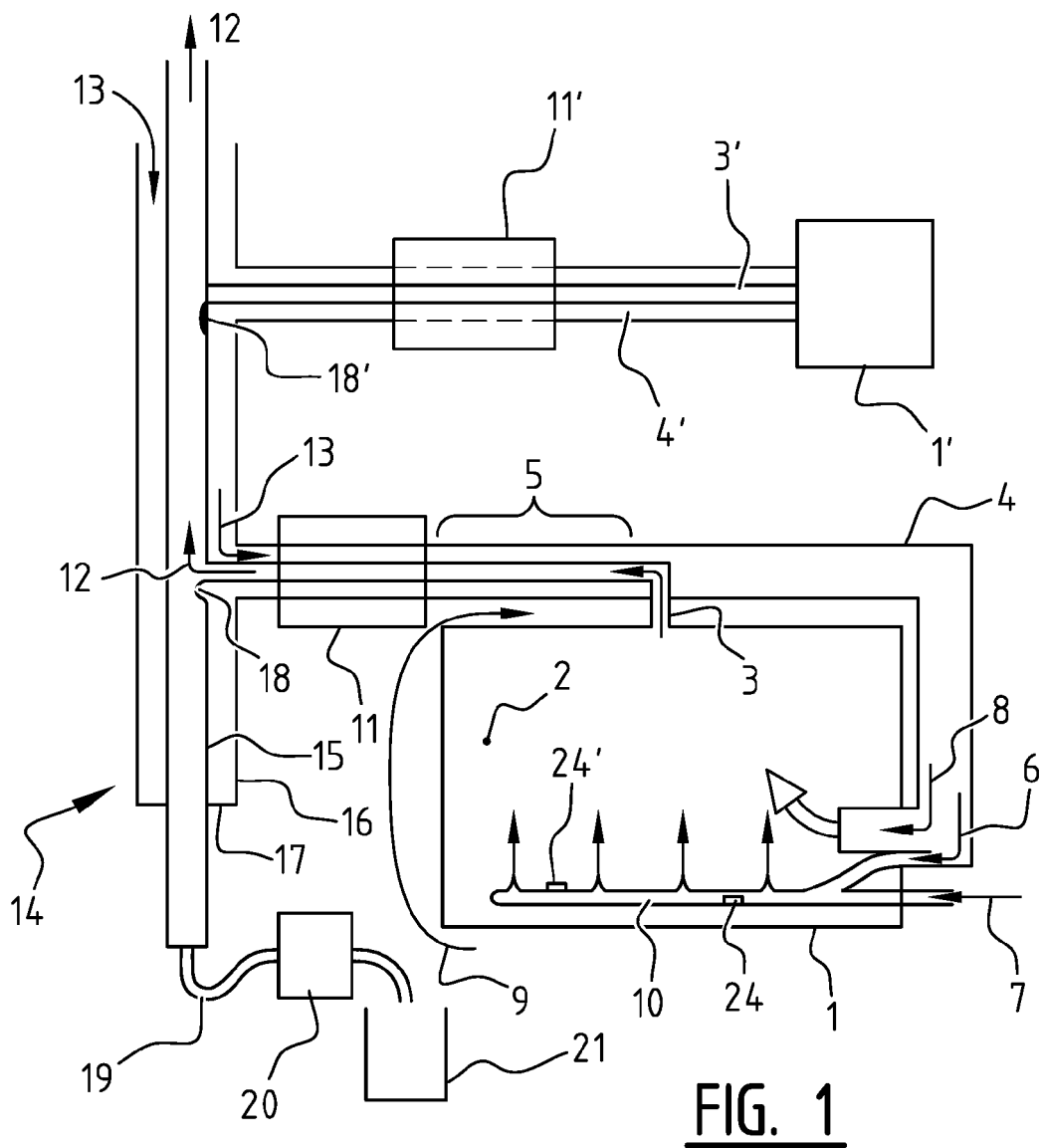
[0043] Figure 1 shows two embodiments of temperature sensors 24. A first temperature sensor 24 is shown on an underside of injector 10. A second embodiment of the temperature sensor is indicated with reference numeral 24' and is placed on an upper side of injector 10. The controller (not shown) is preferably connected to temperature sensor 24 and/or 24' and provided with a control mechanism for controlling the airflow through combustion chamber 2 to a lower flow rate when the temperature of temperature sensor 24 rises above a predetermined value or above a predetermined temperature range. The controller is also provided with a control mechanism for controlling the airflow through combustion chamber 2 to a higher flow rate when temperature sensor 24 measures a temperature lying below a predetermined value or below a predetermined temperature range. The temperature value and/or the temperature range will preferably be determined here by the manufacturer of the stove, for instance on the basis of tests, taking into account the exact position of the temperature sensor or

temperature sensors 24, taking account of the structural properties of stove 1 and taking account of the type of fuel for which the stove is designed.

[0044] The description and the figures serve only to illustrate the principles of the invention. It will therefore be appreciated that a skilled person can deviate from the different setups which may or may not have been explicitly shown and described above and which comprise the principles of the invention. All examples described herein are further intended solely for the purpose of illustrating the invention and aiding the reader in properly understanding the principles of the invention. The examples will not be limitative here to the scope of protection. All statements describing principles, aspects and embodiments of the invention and specific examples thereof are here also understood to comprise equivalents thereof. The scope of protection of the present invention will therefore be defined solely by the following claims.

Claims

1. Stove with a combustion chamber for burning a fuel, wherein the stove has an inlet for combustion air and an outlet for flue gases, which outlet for flue gases is provided with a flue gas extractor for active discharge of flue gases, which flue gas extractor is controllable by a controller to at least two extraction positions in order to optimize an excess of air during burning of the fuel, wherein the flue gas extractor is placed at a distance of at least 1 metre from the combustion chamber.
2. Stove as claimed in claim 1, wherein the flue gas extractor comprises a fan and a valve, wherein the valve has a closed position and at least two open positions, which at least two open positions respectively determine the at least two extraction positions.
3. Stove as claimed in any of the foregoing claims, wherein the flue gas extractor has at least five extraction positions.
4. Stove as claimed in any of the foregoing claims, wherein the flue gas extractor is placed at a distance of at least 3 metres from the combustion chamber, preferably at a distance of at least 4 metres from the combustion chamber and more preferably at a distance of at least 5 metres from the combustion chamber.
5. Stove as claimed in any of the foregoing claims, wherein the stove has infeed means for introducing a predetermined quantity of fuel into the combustion chamber.
6. Stove as claimed in claim 5, wherein the fuel is chosen from gas or pellets.
7. Stove as claimed in any of the foregoing claims, wherein the controller controls the flue gas extractor on the basis of an input value.
8. Stove as claimed in claim 7 and claim 5 or 6, wherein the input value is related to the predetermined quantity of fuel introduced into the combustion chamber by the infeed means.
9. Stove as claimed in any of the foregoing claims, wherein the stove is a gas stove for burning gas, wherein the stove has at least one injector for injecting the gas into a combustion chamber, and wherein the injector is provided with a temperature sensor which is operatively connected to the controller.
10. Stove as claimed in claim 5, wherein the controller is provided so as to set the flue gas extractor to a higher extraction position when the temperature sensor measures a temperature which is below a predetermined temperature.
11. Stove as claimed in claim 5 or 6, wherein the controller is provided so as to set the flue gas extractor to a lower extraction position when the temperature sensor measures a temperature which is above a further predetermined temperature.
12. Stove as claimed in any of the foregoing claims, wherein the stove has a user interface which allows a user to set an energy output of the stove.
13. Stove as claimed in any of the foregoing claims, wherein optimization of the excess air during combustion of the fuel is defined as setting the excess air to a value greater than 1, wherein the value is minimal.
14. Stove as claimed in claim 13, wherein the value is preferably greater than 1.05, more preferably greater than 1.1, most preferably greater than 1.2, and wherein the value is preferably smaller than 1.9, more preferably smaller than 1.7 and most preferably smaller than 1.5.





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Application Number
EP 16 15 1212

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