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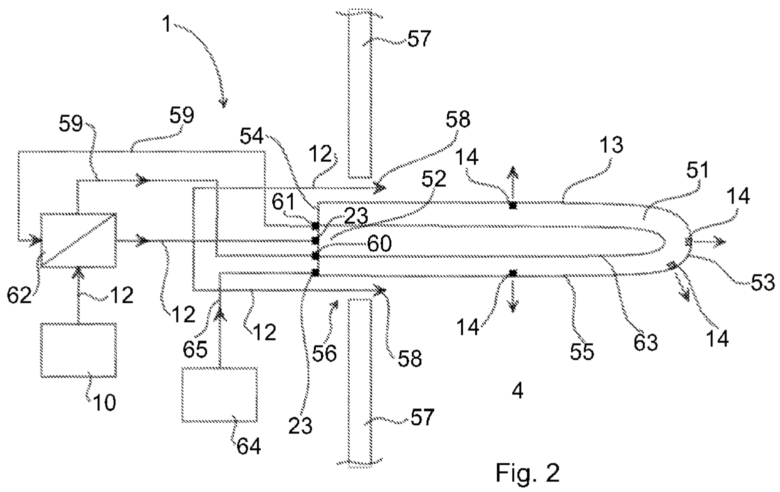

Fig. 2

(57) Abstract: The present invention relates to a device and method for conserving heat in a combustion chamber having a supply device comprising a tube and being arranged for supplying a fluid into the combustion chamber, the method comprising: providing the tube in the combustion chamber, the tube having a lateral surface, a first end with a first end surface, and at least one aperture through at least one of said surfaces, said tube, led by said first end, extending into the combustion chamber through a through hole in a wall of the combustion chamber; circulating a cooling liquid in the tube and in a coolant conduit loop outside of and connected to said tube for cooling the tube; cooling the cooling liquid with a gas flowing past the coolant conduit loop such that heat is exchanged from the coolant conduit loop to the gas; and introducing the heated gas into said combustion chamber.

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COOLING OF COMBUSTION CHAMBER SUPPLY DEVICE

TECHNICAL FIELD

The invention relates to a device and method for conserving heat in a combustion chamber.

BACKGROUND

Generally, heat generating plants, such as boilers, incinerator furnaces and technically corresponding apparatuses are designed to combust or burn different kinds of fuels. Depending on the type of fuel being combusted or burnt, different kinds of hazardous gases and/or particles may be formed or released. The amount of these hazardous gases and/or particles depends, among other things, on how well or completely the fuel is being combusted or burnt. This in turn depends on e.g. the temperature of the grate and the combustion chamber, the amount of available air and other substances that are present to be used by the combustion process and so on. In order to improve the combustion and in order to minimise the pollution/emission caused by the hazardous gases and/or particles, different kinds of supply devices for supplying fluid to an internal combustion chamber of a heat generating plant have been devised.

Supply devices for supplying fluid to an internal combustion chamber of a heat generating plant, such as a boiler, an incinerator furnace and technically corresponding apparatus are known from SE 9201747-4 publication number 502 188 and SE 9304038-4 publication number 502 283 both in the same name of ECOMB and their foreign counterparts.

These known fluid supply devices provide comparatively low emission levels and great flexibility and enable adjustments to desired emission levels to be achieved quickly and reliably. This is attained by arranging a supply device comprising at least one tube to be inserted horizontally into the combustion chamber.

Said devices also simplify de-sooting and cleaning of the tubes included in the device, a feature which also enhances the yield of the combustion and vaporisation process respectively.

The devices also enable different fluids or solids to be supplied at different points of time, through one or more of said tubes, so that a new optimal operating point can be set in relation to the prevailing operating state of the combustion chamber. A particular advantage afforded by the known supply devices is that one or more tubes can be withdrawn while still enabling the combustion or gasification process to continue with the use of the remaining tubes.

Other types of supply devices are described in DE 306 765 (Bauer) and US 5,112,216 (Tenn) for example.

A supply device must be able to operate reliably over a long period of time in a demanding environment. The tube that is inserted into the combustion chamber, according to prior art, is subjected to high stresses as a result of the high temperature and the corrosive environment that prevail. To reduce the wear of the material of the tube du to the exposure to high temperature, it is cooled by means of cooling water circulating within the tube.

SUMMARY

It is an objective of the present invention to alleviate a problem of the prior art.

According to an aspect of the present invention, there is provided a method of conserving heat in a combustion chamber, the combustion chamber being associated with a supply device comprising a tube and the supply device being arranged for supplying a fluid and/or solid particles into the combustion chamber. The combustion chamber is delimited by at least one chamber wall. The method comprises providing the tube in the combustion chamber, the tube having a central longitudinal axis, a lateral surface, a first end with a first end surface, a second end, and at least one aperture through at least one of said surfaces. The tube, led by said first end, extends into the combustion chamber through a through hole in the wall of the combustion chamber. The method also comprises supplying the fluid and/or solid particles from a supply source outside of the combustion chamber to the tube via a supply line and a connector located at the second end of the tube and connected to the supply line. The method further comprises emitting the fluid and/or solid particles from the tube through the at least one aperture into the combustion chamber. The method also comprises circulating a cooling liquid in the tube and in a coolant conduit loop outside of and connected to said tube for cooling the tube, whereby the cooling liquid is heated in the tube. Also, the method comprises cooling the heated cooling liquid with a gas flowing past the coolant conduit loop such that heat is exchanged from the coolant conduit loop to the gas, whereby the gas is heated. Further, the method comprises introducing at least some of the heated gas into said combustion chamber.

According to another aspect of the present invention, there is provided a supply device for supplying a fluid and/or solid particles to a combustion chamber, said combustion chamber being delimited by at least one chamber wall. The supply device comprises a tube, arranged in the combustion chamber, the tube having a central longitudinal axis, a lateral surface, a first end with a first end surface, a second end, and at least one aperture through at least one of said surfaces and arranged to emit fluid and/or solid particles into the combustion chamber, said tube, led by said first end, extending into the combustion chamber through a through hole in the wall of the combustion chamber. The tube also comprises a coolant duct for guiding circulating cooling liquid in the tube for cooling the tube. The device further comprises a supply line connected to a supply source and to a connector of the tube, the supply line being arranged for supplying the fluid and/or solid particles from the supply source to the tube. The device also comprises a coolant conduit loop arranged outside of the tube and connected to the tube such that the cooling liquid can circulate through the coolant duct and the coolant conduit loop. Also, the device comprises a fan arranged for providing a gas flow to pass the coolant conduit loop such that heat is exchanged from the coolant conduit loop to the gas, whereby the gas is heated and the coolant medium is cooled. Further, the device comprises a gas duct arranged for guiding at least some of the heated gas into the combustion chamber.

By introducing at least some of the heated gas into the combustion chamber, heat energy removed from the combustion chamber by the cooling liquid used for cooling the supply device tube is returned to the combustion chamber, thereby conserving energy. Preferably, all of the heated gas is provided into the combustion chamber, allowing the supply device to be substantially energy neutral in respect of its thermal effect on the combustion chamber. The gas may e.g. be secondary air or oxygen which the supply device is anyway intended to emit into the combustion chamber, which secondary air or oxygen may in accordance with the present invention be pre-heated before entering the combustion chamber. However, other gases are also contemplated for the invention. Thus, energy is recycled to the combustion chamber via an intermediary cooling medium, the cooling liquid, e.g. water. E.g. water is a much more efficient cooling medium than e.g. air (Cp of 4.2 kJ/kg, C, compared with 1.0 kJ/kg, C). Using a heated cooling liquid for pre-heating gas forwarded into the combustion chamber via liquid/gas heat exchanging may thus be an efficient way of conserving energy in the combustion chamber.

The discussions above and below in respect of any of the aspects of the invention is also in applicable parts relevant to any other aspect of the present invention.

Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the element, apparatus, component, means, step, etc." are to be interpreted openly as referring to at least one instance of the element, apparatus, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated. The use of “first”, “second” etc. for different features/components of the present disclosure are only intended to distinguish the features/components from other similar features/components and not to impart any order or hierarchy to the features/components.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is now described, by way of example, with reference to the accompanying drawings, in which:

Fig 1 is a schematic perspective view, partly in cross-section, of a combustion chamber with an embodiment of a supply device of the present invention.

Fig 2 is a schematic side view, partially in –section, of a supply device according to an embodiment of the present invention wherein a tube of the supply device is shown in longitudinal section and inserted into a combustion chamber.

Fig 3 is a schematic side view of the inside of a wall of a combustion chamber, wherein the wall has an embodiment of a supply device of the present invention provided in a through hole of the wall.

Fig 4 is a schematic side view of the inside of a wall of a combustion chamber, wherein the wall has another embodiment of a supply device of the present invention provided in a through hole of the wall.

Fig 5 is a schematic perspective view, partly in cross-section, of a supply device according to another embodiment of the present invention wherein a tube of the supply device is shown inserted into a combustion chamber.

DETAILED DESCRIPTION

The invention will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of example so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout the description.

The term “tube” is intended to denote a hollow substantially cylindrical structure being delimited by a lateral surface and first and second end surfaces. The lateral surface is substantially parallel to the central longitudinal axis of the tube, whereas the respective end surfaces are substantially not parallel to the central longitudinal axis of the tube but intersects the central longitudinal axis of the tube. The tube has a first end with the first end surface, and a second end with the second end surface. Conveniently, the first and second ends do not include any of the lateral surface. When the tube is inserted into the combustion chamber, the first end may be regarded as an inner end since it extends, is inserted, into the combustion chamber, whereas the second end may be regarded as an outer end since it extends through an outer wall of the combustion chamber, such that the second end is in or outside said outer wall. The apertures discussed herein are thus apertures through one of these surfaces. The second end surface, i.e. the surface of the second end of the tube, may, depending on the design of the tube, more or less substantially consist of an aperture. The tube may be a substantially circular tube, i.e. have a substantially circular cross-section perpendicular to the central longitudinal axis, but other shapes are also contemplated, such as a square or rectangular tube.

That something is at the first or second end of the tube, such as the at least one aperture being at the first end of the tube or the displacing device meshing with or engaging the tube at its second end, implies that it is on/in the end surface or on/in the lateral surface but in close proximity of, or adjacent to, the end surface and at least closer to that (first or second) end surface than to the other (first or second) end surface of the tube.

That an aperture is arranged for emitting the fluid and/or solid particles in a certain direction implies that a tube surface where the aperture is located, i.e. an extrapolated surface of how the surface would be had there not been an aperture there, is in a plane which is not parallel to the direction in which the aperture is arranged to emit the fluid and/or solid particles. Specifically, the plane of the aperture surface may be perpendicular to the direction in which the aperture is arranged to emit the fluid and/or solid particles. The aperture may e.g. be equipped with a nozzle for better control of the emission of the fluid and/or solid particles.

The tube may be of any size, but it may be convenient to use a tube which has a longitudinal length of less than 10 m, such as less than 5 m, in order to reduce the lateral stress on the tube, especially if the tube is inserted substantially horizontally into the combustion chamber. The diameter of the tube may also be of any size, but it may be convenient to use a tube with a diameter of less than 250 mm, such as less than 200 mm, less than 150 mm, less than 120 mm or less than 100 mm, in order to reduce the weight of the tube to make it more easy to handle and move, axially and/or rotationally around its longitudinal axis. Another advantage with using a smaller tube is that less cooling may be needed of the tube, since the tube takes up heat in relation to its surface area.

Only one tube may be used in a combustion chamber, but it may also be convenient to use a plurality of tubes, e.g. substantially parallel to each other, at different positions in the combustion chamber. The tubes may then co-operate with each other to provide optimal supply of the fluid and/or solid particles in the combustion chamber, e.g.

improved mixture of the fluid and/or solid particles with the atmosphere in the combustion chamber and/or improved coverage of the combustion chamber volume by being able to supply the fluid and/or solid particles at more different positions in the combustion chamber.

The tube may be inserted into the combustion chamber in any direction. It may be convenient to insert the tube vertically, e.g. hanging through the top wall (ceiling/roof) of the combustion chamber in order to reduce the lateral stresses on the tube and the mounting of the tube in the chamber wall, and/or on the displacing device. On the other hand it may be convenient to insert the tube horizontally, e.g. through a side wall of the combustion chamber. Depending on the design on the combustion chamber, it may be easier to reach the place within the combustion chamber where it is desired to supply the fluid and/or solid particles in the combustion chamber with a horizontal tube. A vertically inserted tube may need to be much longer and heavier in order to reach the same position in the combustion chamber as a substantially smaller horizontally inserted tube.

The apertures of the tube may be provided with nozzles adapted to be adjustable in different directions so as to emit fluid or solid particles in different directions.

The supply device may comprise a displacing device or means for displacing the tube, engaging the tube at its second end, for axially displacing the tube along its central longitudinal axis. The displacing device may be arranged so as to also permit rotation of the tube around its central axis.

The tube of the supply device comprises a coolant duct for guiding circulating cooling liquid in the tube for cooling the tube while it is subjected to heat in the combustion chamber. The coolant duct may extend along the whole longitudinal length of the tube such that the whole tube may be cooled. The coolant duct may e.g. be configured such that cooling liquid is introduced into the tube through the second end surface of the tube or at least at the second end of the tube, i.e. the end outside of the combustion chamber, or at least close to the combustion chamber wall, when the tube is fully inserted into the combustion chamber. The coolant duct may further be configured to guide the cooling liquid longitudinally along the length of the tube, e.g. close to the central longitudinal axis of the tube, to the first end of the tube, possibly all the way to contact the inside of the first end surface of the tube. The coolant duct may further be configured to guide the cooling liquid longitudinally back towards the second end of the tube, possibly contacting the inside of the lateral surface of the tube e.g. in an annular longitudinal duct formed by the lateral surface of the tube and the lateral surface of a concentrically positioned inner tubular arrangement inside the tube, allowing the cooling liquid to exit the tube at the second end, e.g. through the second end surface.

The cooling liquid may be any suitable cooling liquid, e.g. water.

The coolant conduit loop is connected to the tube such that cooling liquid exiting the tube enters the coolant conduit loop, travels through the coolant conduit loop and then re-enters the tube from the coolant conduit loop. The coolant conduit loop and the coolant duct of the tube may thus form an endless loop for circulating the cooling liquid. The coolant conduit loop may at least partly be made from a heat conducting material in order to facilitate heat exchange through the material for cooling the cooling liquid.

The fan may be arranged for blowing the gas, such as air, oxygen and/or recycled combustion gases, past the coolant conduit loop such that heat may travel from the cooling liquid in the coolant conduit loop to the gas. This may preferably be achieved by means of a liquid/gas heat exchanger where the fan act to form a flow of the gas through the liquid/gas heat exchanger.

The gas duct is arranged to guide heated gas into the combustion chamber. The gas duct may e.g. be connected to the liquid/gas heat exchanger to guide the therein heated gas to the combustion chamber. The heated gas may be introduced into the combustion chamber from the gas duct e.g. via the supply device or via other nozzles in the combustion chamber. At least some of the heated gas may e.g. be emitted into the combustion chamber as a fluid of the fluid and/or solid particles emitted by the tube of the supply device through the aperture of said tube. Additionally or alternatively, at least some of the heated gas may be introduced into the combustion chamber via slits, or other gas supply inlet, of the supply device in the through hole of the combustion chamber wall laterally or around the tube when it extends through said through hole. Such slits may be connected to the gas duct and act as inlets of the heated gas from the gas duct into the combustion chamber. The gas may e.g. be air or oxygen which is introduced into the combustion chamber as secondary air or oxygen for improved combustion of the combustion gases. Preferably, all of the heated gas is introduced into the combustion chamber.

According to one specific embodiment of the present invention, at least a part of the gas which is used for cooling the liquid coolant is also regarded as the fluid and/or solid particles to be emitted into the combustion chamber, i.e. no other fluid and/or solid particles than the heated gas is emitted into the combustion chamber by the supply device. In this embodiment, the fan for the gas may also be regarded as the supply source of the fluid and/or solid particles discussed herein and the gas duct may also be regarded as the supply line of the fluid and/or solid particles discussed herein. According to another specific embodiment of the present invention, the fluid and/or solid particles may be combined with at least a part of the heated gas prior to being supplied into the tube.

Figure 1 schematically shows an embodiment of a supply device 1 of the present invention, for optimizing flue gas parameters in a combustion plant 2. The supply device 1 comprises a number of feeding apparatuses to the plant which are arranged for minimizing disturbances caused by depositions. The combustion plant comprises a furnace for combustion of solid fuels with a grate 3 and an upper combustion chamber 4.

The fuel can be fed intermittently or continuously and combustion air in the form of primary air is blown from below and up through the grate 3.

Particles in the flue gas above the grate 3 comprises ash, slag and/or un burnt fuel. These can together form bigger particles, so called agglomerates, or be reduced to smaller, more or less clean ash particles. Slag enriched fuels often give higher concentrations of dust and slag in the flue gas.

The walls of the combustion chamber may be equipped with wall pipes 6 with an external insulation 5. The supply device 1 comprises tubes 13 having apertures or holes 14 for feeding secondary air into the combustion chamber 4 for improved combustion, as well as other desired additives such as ammonia and/or urea solution for reducing the amount of NOx in the combustion gases or a sulphur containing compound, e.g.

ammonium sulphate, for reducing the amount of corrosive chlorine compounds in the combustion gases.

Since the tubes 13 are inserted into the combustion chamber, they are subjected to high temperatures for prolonged time periods, which may wear on the material of the tubes 13. By cooling the tubes 13 by means of a cooling liquid circulating in the tubes 13, the strain put on the tubes 13 material may be reduced an the useful life span of the tubes 13 may be significantly improved.

Poor mixing conditions in the combustion chamber 4 may render the combustion plant a lower combustion efficiency. This especially occurs when steps are taken to reduce NOx when concentrations of unburned gases/particles are higher than before the adjustment. Throttling down air supply and/or flue gas recirculation reduces the temperature in the combustion zone and, further, creates reducing conditions which lead to lower NOx concentrations and higher concentrations of unburned gases and particles. The demand for efficient admixing of secondary air becomes even more important.

In the plant shown in figure 1, the supply device tubes 13 for supplying a fluid and/or solid particles, e.g. secondary air, to the combustion chamber 4 are arranged forming a curtain system comprising a number of substantially horizontal tubes 13, some of which are parallel to each other, at one or more vertical levels in the combustion chamber 4. The tubes 13 are equipped with perforations/apertures 14 shaped as nozzles alongside the mantle/lateral surface of the entire tubes, e.g. in rows.

The outlet area of the apertures 14 determines the flow of the fluid at a given pressure. The combustion gas flow over a cross section of the combustion chamber 4 may vary, whereby this may have to be compensated for when supplying/emitting the fluids to the combustion chamber.

A fluid, e.g. secondary air at high pressure, is fed via a fan 10 connected to a collecting box 11, to which flexible tubes 12 are connected, which with quick-couplings 23 are connected to the end of the tubes 13. Depending on the actual combustion process the tubes 13 may be inserted and withdrawn from the chamber 4 in an axial direction along the central longitudinal axis of the respective tube 13 at longer or shorter periods of time. In such a way the emission level of the combustion process can be maintained optimal.

The tubes 13 are displaceable in an axial direction from the combustion chamber 4 via through holes in its wall. On the outside of the chamber opposite positioned rollers 15 engage the mantle of the tubes 13. These rollers 15 are via a transmission 16 driven by a motor 17 and form a displacing device of the supply device 1. Other types of displacing devices than the rollers 15 are also contemplated, e.g. a scissor lift engaging at the second end of the tube 13.

On a frame 20 there is an arrangement of wire brushes 21, between which the tubes 13 pass when being withdrawn from and thereafter inserted into the combustion chamber 4. These brushes 21 perform an efficient cleaning of the tubes, so that they are released from dust and corrosive slag depositions. Alternatively or additionally, an automatic shaking device (striking tool or similar, not shown) or acoustic soot blower (infrasonics or ultrasonics) can be connected for continuous or intermittent slag removal, or water or blown air or steam may be used.

The supply device 1 comprises a cooling system, which will now be discussed with reference to figure 2 which schematically illustrates an embodiment of a supply device 1 of the present invention.

Figure 2 shows a tube 13 of the supply device 1 of an embodiment of the present invention. The tube 13 has a first end 51 with a first end surface 53, and a second end 52 with a second end surface 54, a lateral surface 55, and apertures 14. The tube 13 extends, led by its first end, into the combustion chamber 4 through a through hole 56 of the wall 57 delimiting the combustion chamber. A gas duct 12 is connected to the tube 13 via a connector 23 for supplying heated gas into the tube 13, which gas may then be emitted through at least one of the apertures 14, possibly in different directions, as shown by the arrows in figure 2. The gas duct 12 is also connected to slits 58 of the supply device 1, which slits are positioned in the hole 56 of the wall 57, laterally of or around the tube 13. In this specific embodiment, the heated gas is secondary air. A coolant conduit loop 59 is connected to the tube 13 via an inlet 60 arranged for allowing a cooling liquid to enter the coolant duct 63 of the tube 13 from the coolant conduit loop 59, and an outlet 61 arranged for allowing the cooling liquid to exit the coolant duct 63 of the tube 13 into the coolant conduit loop 59. A pumping means may be used to circulate the cooling liquid in the coolant duct 63 and the coolant conduit loop 59. In this embodiment, the cooling liquid is water. Both the gas duct 12 and the coolant conduit loop 59 passes, or form part of, a liquid/gas heat exchanger 62, such that heat is exchanged between cooling liquid travelling in the coolant conduit loop 59 and gas travelling in the gas duct 12, whereby the cooling liquid is cooled and the gas is heated. A fan 10 is connected to the liquid/gas heat exchanger 62 for forming a gas flow through the gas duct 12 through the heat exchanger 62 and into the combustion chamber 4. A supply source 64 of the supply device 1 contains a fluid and/or solid particles to be emitted into the combustion chamber and is connected to a supply line 65. In this specific embodiment, the fluid and/or solid particles is a urea solution for reducing the amount of nitrogen oxides (NOx) in the combustion gases. The supply line 65 is connected to the tube 13 via a connector 23, same or different from the connector 23 connected to the gas duct 12, such that the fluid and/or solid particles can be supplied to the tube 13 from the supply source 64 via the supply line 65 and be emitted into the combustion chamber 4 through at least one of the apertures 14. If the fluid and/or solid particles is emitted though an aperture 14 also emitting the heated gas, the heated gas may help carry the fluid and/or solid particles into the combustion chamber and mix with the combustion gases therein.

Figures 3 and 4 schematically illustrates different embodiments of the supply device 1 as it is positioned in a through hole 56 of the wall 57 delimiting the combustion chamber 4 while the tube 13 is completely axially withdrawn from the combustion chamber 4 and the through hole 56. The supply device 1 as inserted in the through hole 56 comprises a liner pipe 66 for allowing the tube 13 to axially slide in and out of the combustion chamber 4. Around the liner pipe 66, slits 58 are provided for emitting heated gas into the combustion chamber 4. The slits 58 are connected to the gas duct 12 as discussed above. Both the liner pipe 66 and the slits 58 are fitted in a concrete filling 67 in the through hole 56. Any wall pipes 5 of the wall 57 may be bent around the hole 56 so as not to prevent the insertion of the tube 13 or the introduction of the heated gas through the slits 58. In the embodiment of figure 3, two slits 58 are used, one above the liner pipe 66 and one below the liner pipe 66. However, any number of slits 58 may be used around the liner pipe 66, e.g. four slits 58: above, below, to the left and to the right of the liner pipe 66. In the embodiment of figure 4, a plurality of slits 58, or one substantially annular slit 58, substantially completely encircle the liner pipe 66.

Figure 5 is a schematic perspective view, partly in cross-section, of a supply device 1 according to another embodiment of the present invention wherein a tube 13 of the supply device 1 is shown inserted into a combustion chamber 4. The figure is similar to figure 2 and the same reference numerals are used. Reference is made to the discussion regarding figure 2, above. Arrows are provided in figure 5 to indicate flow directions in the different conduits and into the combustion chamber.

In one embodiment of the present invention, there is provided a supply device or method for conserving heat in a combustion chamber having a supply device comprising a tube and being arranged for supplying a fluid into the combustion chamber, the method comprising: providing the tube in the combustion chamber, the tube having a lateral surface, a first end with a first end surface, and at least one aperture through at least one of said surfaces, said tube, led by said first end, extending into the combustion chamber through a through hole in a wall of the combustion chamber; circulating a cooling liquid in the tube and in a coolant conduit loop outside of and connected to said tube for cooling the tube; cooling the cooling liquid with a gas flowing past the coolant conduit loop such that heat is exchanged from the coolant conduit loop to the gas; and introducing at least some of the heated gas into said combustion chamber.

The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

CLAIMS

1. A method of conserving energy in a combustion chamber (4) having a supply device (1) comprising a tube (13) and being arranged for supplying a fluid and/or solid particles to the combustion chamber (4), said combustion chamber being delimited by at least one chamber wall (57), the method comprising:

providing the tube (13) in the combustion chamber (4), the tube having a central longitudinal axis, a lateral surface, a first end (51) with a first end surface, a second end (52), and at least one aperture (14) through at least one of said surfaces, said tube (13), led by said first (51) end, extending into the combustion chamber (4) through a through hole (56) in the wall (57) of the combustion chamber (4);

supplying the fluid and/or solid particles from a supply source (10;64) outside of the combustion chamber (4) to the tube (13) via a supply line (12;65) and a connector (23) located at the second end (52) of the tube (13) and connected to the supply line (12;65);

emitting the fluid and/or solid particles from the tube (13) through the at least one aperture (14) into the combustion chamber (4);

circulating a cooling liquid in the tube (13) and in a coolant conduit loop (59) outside of and connected to said tube (13) for cooling the tube, whereby the cooling liquid is heated in the tube (13);

cooling the heated cooling liquid with a gas flowing past the coolant conduit loop (59) such that heat is exchanged from the coolant conduit loop (59) to the gas, whereby the gas is heated; and

introducing at least some of the heated gas into said combustion chamber (4).

2. The method of claim 1, wherein at least part of the heated gas is introduced into the combustion chamber (4) by means of the supply device (1).

3. The method of claim 1 or 2, wherein at least part of the heated gas is introduced into the combustion chamber (4) as at least part of the fluid and/or solid particles emitted from the tube (13) through the at least one aperture (14).

4. The method of any preceding claim, wherein at least part of the heated gas is introduced into the combustion chamber (4) via at least one gas supply inlet (58) of the supply device (1), which inlet is arranged for allowing the gas to pass through the through hole (56) of the chamber wall (57) and laterally of the tube (13).

5. The method of any preceding claim, wherein the gas comprises air, oxygen, nitrogen, recycled exhaust gas or a combination thereof.

6. The method of any preceding claim, wherein the cooling liquid comprises or consists of water.

7. A supply device (1) for supplying a fluid and/or solid particles to a combustion chamber (4), said combustion chamber being delimited by at least one chamber wall (57), said supply device (1) comprising:

a tube (13), arranged in the combustion chamber (4), the tube having a central longitudinal axis, a lateral surface, a first end (51) with a first end surface, a second end (52), and at least one aperture (14) through at least one of said surfaces and arranged to emit fluid and/or solid particles into the combustion chamber (4), said tube (13), led by said first end (51), extending into the combustion chamber (4) through a through hole (56) in the wall (57) of the combustion chamber (4), the tube (13) comprising a coolant duct (63)for guiding circulating cooling liquid in the tube (13) for cooling the tube;

a supply line (12;65) connected to a supply source (10;64) and to a connector (23) of the tube (13), the supply line (12;65) being arranged for supplying the fluid and/or solid particles from the supply source (10;64) to the tube (13);

a coolant conduit loop (59) arranged outside of the tube (13) and connected to the tube such that the cooling liquid can circulate through the coolant duct (63) and the coolant conduit loop (59);

a fan (10) arranged for providing a gas flow to pass the coolant conduit loop (59) such that heat is exchanged from the coolant conduit loop (59) to the gas, whereby the gas is heated and the coolant medium is cooled; and a gas duct (12) arranged for guiding at least some of the heated gas into the combustion chamber (4).

8. The supply device of claim 7, wherein the gas duct (12) is connected to the tube (13) such that at least part of the heated gas is introduced into the combustion chamber (4) as at least part of the fluid and/or solid particles emitted from the tube (13) through the at least one aperture (14).

9. The supply device of claim 7 or 8, wherein the gas duct (12) is connected to at least one gas supply inlet (58) of the supply device (1), which inlet (58) is arranged laterally of the tube (13) and for allowing the gas to pass through the through hole (56) of the chamber wall (57) and into the combustion chamber (4).

10. The supply device of any claim 7-9, wherein the tube (13) is axially displaceable along its longitudinal axis and through the through hole (56) of the chamber wall (57).

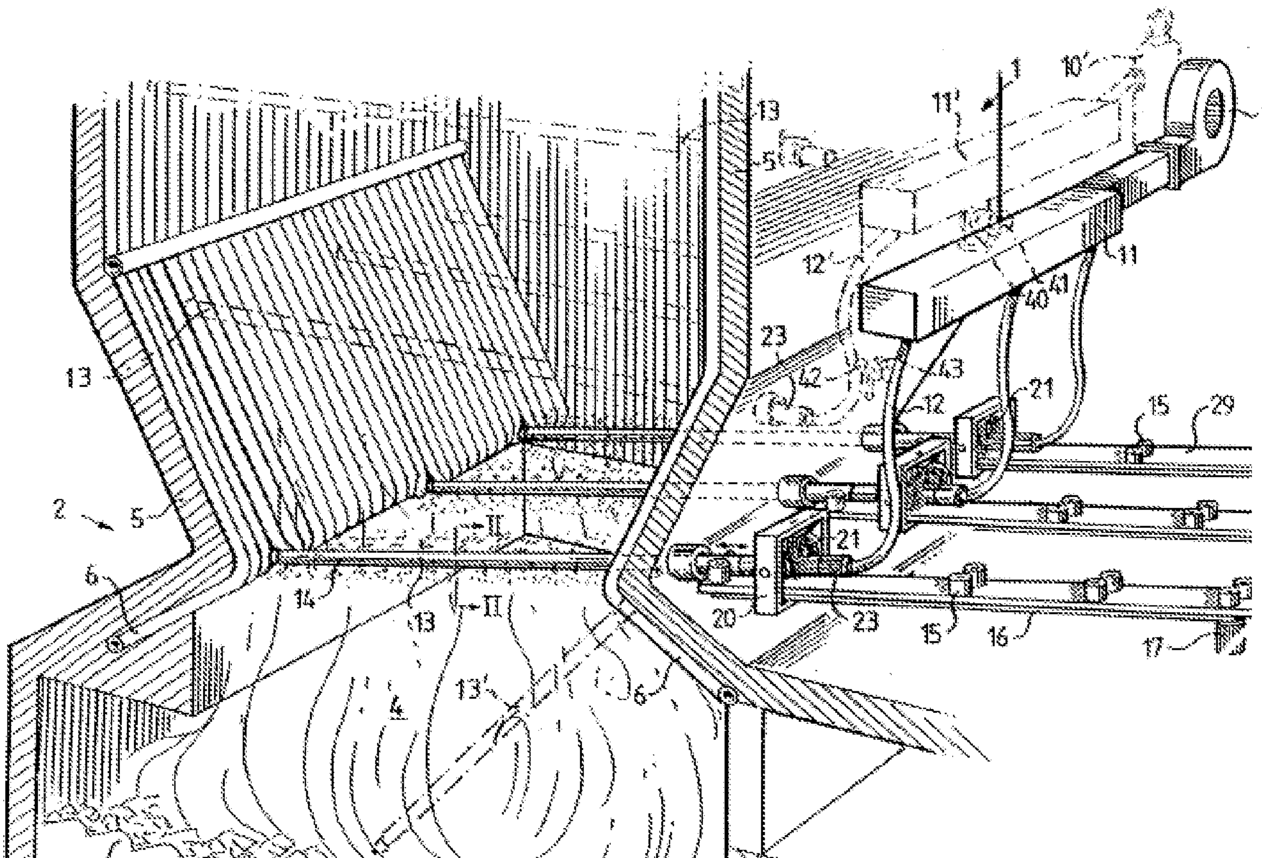

Fig. 1

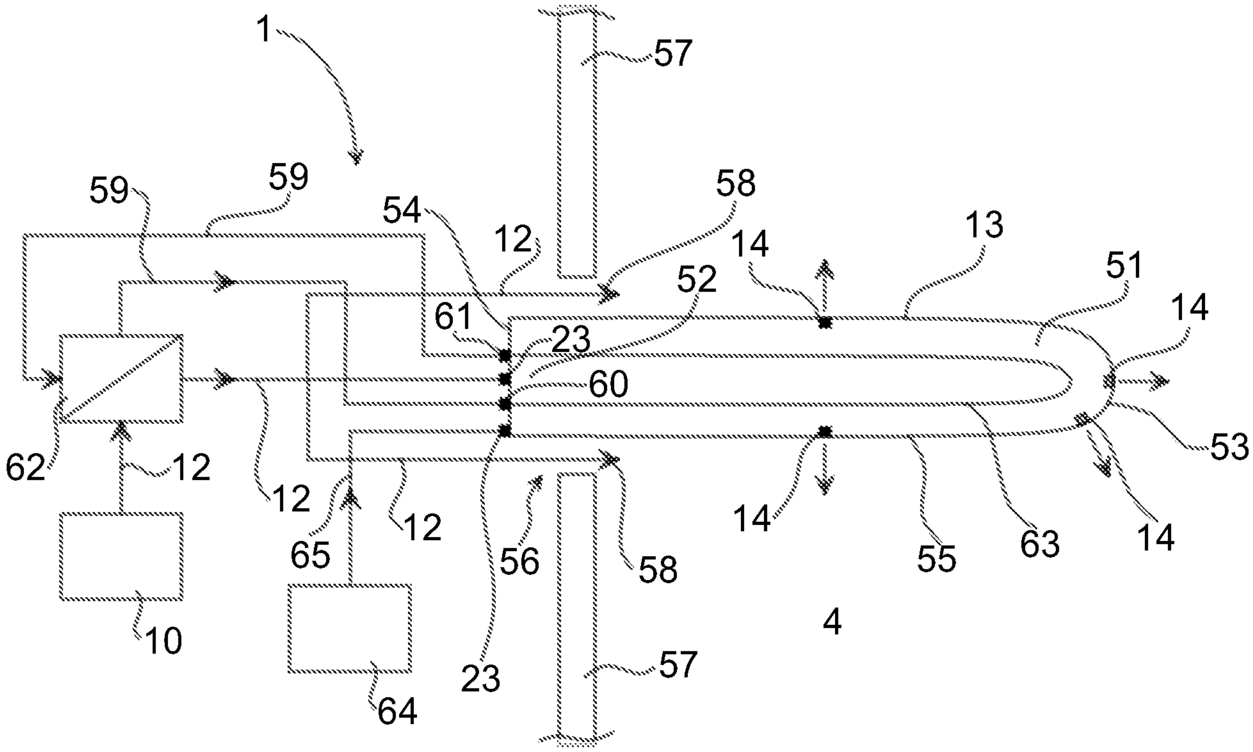

Fig. 2

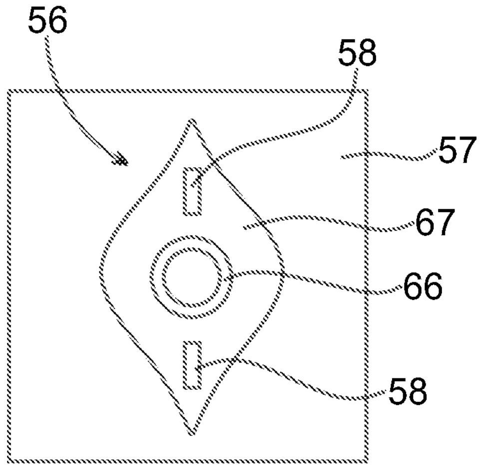

Fig. 3

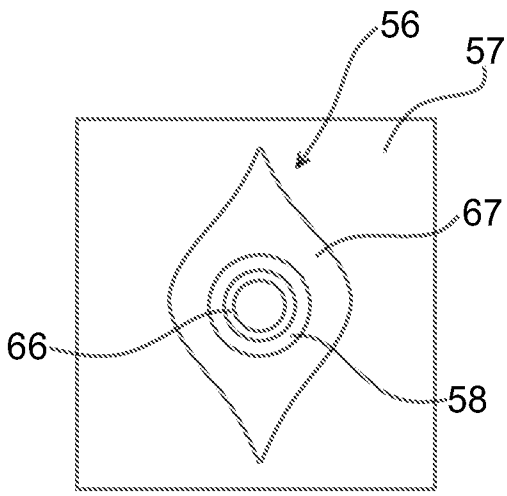

Fig. 4

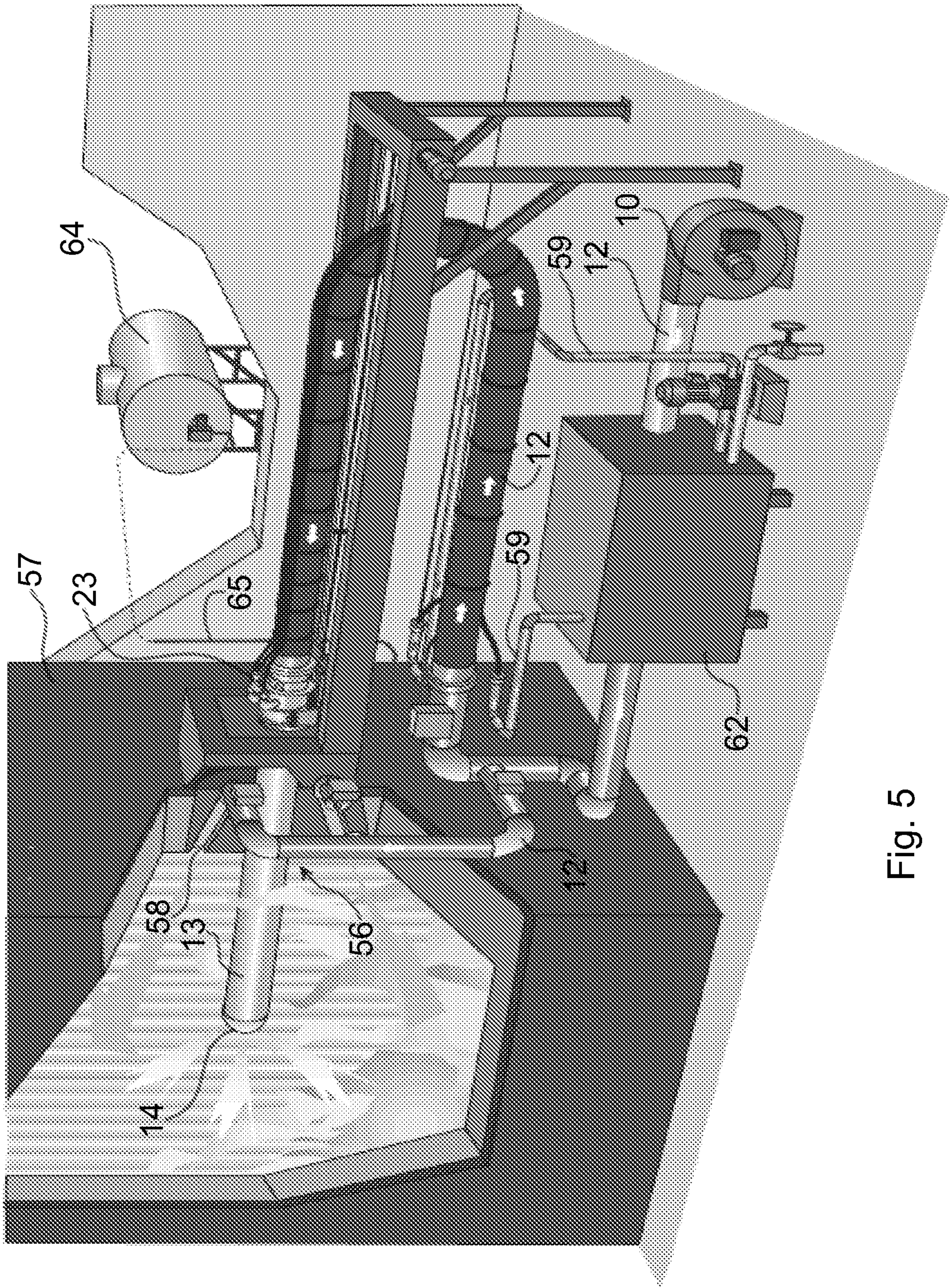

Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2012/051094

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B01D, F23G, F23J, F23L, F27D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5342592 A (PETER-HOBLYN JEREMY D ET AL), 30 August 1994 (1994-08-30); abstract; figures 1-3 --	1-10
A	US 4842834 A (BURTON ALBERT A), 27 June 1989 (1989-06-27); abstract; column 7, line 46 - line 60; figures 5-6 --	1-10
A	GB 2375160 A (CLYDE BERGEMANN LTD), 6 November 2002 (2002-11-06); abstract; figures 1,3; claim 1 --	1-10
A	EP 1312862 A2 (ECOMB AB), 21 May 2003 (2003-05-21); abstract; paragraph [0033]; figure 2 -- --------	1-10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11-02-2013	12-02-2013

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Continuation of: second sheet

International Patent Classification (IPC)

F27D 17/00 (2006.01)
F23J 15/00 (2006.01)
F23L 9/02 (2006.01)
F23L 15/00 (2006.01)

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EP	1312862 A2	21/05/2003	US	20030124477	A1	03/07/2003
			US	6712606	B2	30/03/2004