

A METHOD IN SUPPLYING COMBUSTION AIR TO A COMBUSTION CHAMBER,
ARRANGEMENTS IN SAID COMBUSTION CHAMBER AS WELL AS USE OF
OXYGEN-CONTAINING EXHAUST FROM A GAS TURBINE

The invention relates to a method in supplying combustion air to a combustion chamber. Likewise, the invention relates to arrangements in a combustion chamber of the kind concerned as well as a special use of oxygen-containing exhaust from a gas turbine or another engine fuel combusting unit/equipment/apparatus.

More specifically, the invention relates to a method associated with the supply of oxygen-containing combustion air to a first engine fuel combusting unit, e.g. a combustion chamber. The arrangements in a combustion chamber according to the invention is of the kind as indicated in the preamble of claim 2. The use of oxygen-containing exhaust from e.g. a gas turbine as combustion air for e.g. a combustion chamber, is more specifically defined in claim 4.

The arrangements and devices in accordance with the invention may e.g. be used in a combustion chamber, which may be assigned a so-called "reformer" which may on its side be incorporated into a process plant, and which reformer comprises a reactor chamber for the treatment of gases. The combustion chamber, as well known, is supplied with gas or liquid engine fuel and combustion air. In the reactor chamber e.g.

methane-containing gas is treated for the achievement of a refined methane gas upon supplied heat from the combustion of engine fuel in the combustion chamber during combustion air supply. The process plant comprises at least one gas turbine which may be adapted to operate a generator for the generation of electrical current, e.g. for use within the process plant.

During the development of the present invention, one has especially attached importance to the reduction of energy consumption and exhaust discharge from the process plant, i.a. gas effluents such as CO, CO₂, NO_x and VO_x to the atmosphere and/or into water.

One has particularly, yet not exclusively, aimed at providing an offshore production plant, e.g. a methanol factory built up on an offshore installation, and which does not contaminate the surroundings any more than the very best plants on land and wherein, moreover, as previously mentioned, large energy savings and exhaust discharge reductions are achieved, also in relation to plants ashore. In offshore production the necessary energy must be provided in situ through the combustion of fossile fuel, in lieu of electrical power which often is produced ashore by means of waterpower.

Methane, CH₄, is as known the most important constituent in natural gas and appears i.a. as gas exiting from the crust of the earth. Socalled methane towers are known in the form of destillation towers for evaporating methane.

Upon the adaption of e.g. a methanol factory at an offshore production plant, substantial energy supply in the form of electrical current and heated air is required. Total need of electricity for installations of this kind could vary from 10 to 50 MW, while the need for hot air having a high temperature, e.g. 650°C, could vary from 50 to about 200 kgs/second.

Conventionally, these types of energy are provided by means of separate gas turbine operated generators for the generation of electrical current and by means of combustion chambers for the combustion of gas or liquid fuel during the supply of combustion air, and production of heated air having the required temperature (650°C), said combustion chambers being incorporated in suitable reformers which, likewise, comprise a reactor chamber which is fed with gas for treatment, the reformers being included in a process plant.

In the combustion chamber, the necessary amounts of air must be heated from ambient air temperature to the desired exhaust temperature. This means that the combustion chamber must be supplied with a substantial amount of fuel. Simultaneously, the combustion air must be allotted the necessary energy of flowing from fans or the like, for forced supply to the combustion chamber of the reformer. This energy is produced by either a gas turbine or an internal combustion engine.

This results in a low total energy efficiency, simultaneously as offshore plants suffer from larger exhaust discharges than corresponding industry ashore.

The device according to the invention enable an increase of the total efficiency of the reformer or each reformer, respectively, in case the process plant comprises more than one, by reducing the need for energy for a reformer as defined introductorily, simultaneously effecting a reduction in the discharge amount of exhaust from the same reformer's combustion chamber through the reduction of the amount of fuel supplied to the combustion chamber/chambers.

To this end, the invention distinguishes itself through the features appearing from the characterizing clause of claim 1.

According to the invention, exhaust gas from the gas turbine is supplied as combustion air to the reformer's combustion chamber. As previously known, the gas turbine operates an

electrical generator or another mechanical equipment.

As a rule, the oxygen-content in the exhaust gases from a gas turbine will be satisfactory in order to secure good combustion in the combustion chamber. However, it is within the scope of this invention possibly to supply a small amount of combustion air rich on oxygen in addition to a larger amount of gas turbine exhaust gas.

The exhaust gases from the gas turbines are blown with an overpressure of up to 0,5 bars into the combustion chambers, in which gas or liquid engine fuel supplied thereto burns in order to bring the final temperature up to the necessary value of 650°C.

This entails that electrically operated fans for forced supply of cold combustion air to the combustion chamber normally could be left out, totally resulting in quite substantial energy savings and reduced amount of exhaust gas.

Combustion gas in the form of hot turbine exhaust gas involves the greatest advantage over cold combustion air that the former is preheated to a substantial degree. Thus, a preheating up to a temperature of about 450°C can be achieved, dependent on the load on the gas turbine. This entails an energy saving in relation to prior art technique where a significant amount of energy is consumed in order to heat combustion air supplied to the combustion chamber at ambient temperature, up to said 650°C from e.g. 15°C in relation to up to said 650°C from gas turbine exhaust gas temperature of about 450°C. This very substantial preheating of the combustion gas received by the combustion chamber, also allows energy savings, which here manifest themselves in a reduction of propellant gas amount supplied per time unit to the combustion chamber which becomes significantly less power consuming as a result of the heat energy brought into the combustion chamber with the combustion gas/air.

The significant environmental improvements are achieved through temperature reduction by the combustion in the reformer, and by leaving out combustion air fan. Reduction of amount of fuel supplied to the combustion chamber per time unit has also a positive influence on the exhaust gas discharges, particularly CO₂ in the surroundings in relation to conventional installations, both plants ashore and plants offshore.

Further advantages and features of the system and arrangements according to the invention will appear from the following description, reference being made to the attached, single, diagrammatically shown drawing figure illustrating the main components of a reformer (reforming plant) for e.g. methane refining through heat treatment in a reactor chamber assigned a combustion chamber which, in its turn, is fed with gaseous or liquid fuel (natural gas) and combustion air in the form of turbine gas from a gas turbine. The reformer may be included in a process plant for the production of methanol and comprises a plurality of reformers, each including a combustion chamber to which is assigned the exhaust gas outlet from a gas turbine. The arrangement is such that the supply of exhaust gas from the gas turbine as combustion "air" (oxygen-containing gas) wholly or substantially wholly meets the combustion chamber's demand for oxygen upon the combustion of propellant gas supplied to the combustion chamber.

In the figure of the drawing, a quadrangle shown in dot-and-dash lines indicates diagrammatically a gas turbine 10 substantially positioned therewithin, said gas turbine 10 receiving fuel through a first pipeline 12 and air through a second pipeline 14. Reference numeral 16 indicates a shaft for the supply of mechanical kinetic energy to a generator 18 for the generation of electrical energy converted from twisting moment received. This known, conventional generator 18 is adjusted to the efficiency of the gas turbine 10.

The exhaust gases from the exhaust outlet (at 20) of the gas turbine 10 contain about 16 - 18 % O₂ when they leave the gas turbine with an overpressure of 0,5 bars and a temperature of 350 - 450°C.

The turbine exhaust gases which, in accordance with the invention are to be used as oxygen-containing combustion gas (combustion air) in the further heating process, are conducted in a suitable turbine exhaust/combustion gas (air) channel 22 to a reformer's 24 combustion chamber 26. Besides the combustion chamber 26, the reformer 24 comprises a reactor chamber 28.

To the reformer's 24 combustion chamber 26 leads a third pipeline 30 for the supply of gaseous or liquid fuel to be burned in the combustion chamber together with the oxygen contained in the turbine exhaust gas supplied thereto.

The exhaust gas channel 22 is assigned a bypass-loop 32 having a shutoff valve 34 which can be opened in order to couple the loop 32 into the flowing course upon starting the gas turbine 10, and which is used for adjusting the amount of exhaust gas/combusting air per time unit to the combustion chamber 26 in relation to the gaseous or liquid fuel supplied thereto.

The exhaust gases leaves the combustion chamber 26 exhibiting a temperature of up to 650°C and transfers a substantial part of its heat energy to the overlying reactor chamber 28, while possible residual heat can be recovered by means of at least one heat exchanger, not shown. In a fourth pipeline 36, e.g. water steam and methane-containing gas is supplied to the reactor chamber 28, while a fifth pipeline 40 carries synthesis gas for methanol production.

Exhaust gases from the reactor chamber 28 of the reformer 24 and possible exhaust gases passed through the bypass-loop 32, are led together out through a chimney 42, out into the atmo-

sphere which, due to previously indicated purposes, is polluted to a less degree than from a known plant having a corresponding capacity, but comprising fan-driven supply line for cold combustion air to a combustion chamber 26 consuming a larger amount of gaseous or liquid fuel per time unit than the combustion chamber in e.g. a reforming arrangement and assigned a gas turbine's exhaust gas inlet according to the invention. As known, heat may be recovered from the exhaust gases in the chimney 42.



C l a i m s

1. A method in supplying oxygen-containing combustion air to a first fuel-burning unit, e.g. a combustion chamber (26), characterized in that oxygen-containing exhaust gas from a second fuel-burning unit, e.g. a gas turbine (10), is lead to said first fuel-burning unit (26), said exhaust gas, preferably, leaving said second fuel-burning unit's (10) exhaust gas outlet at an overpressure.
2. Arrangements in a combustion chamber (26) which e.g. may be assigned to a refining unit for gases, a socalled reformer (24) which, possibly together with one or more further reformers (24), may be incorporated in a process plant, and/or one or more other units which might have a need for supplied heat energy from one or more combustion chambers (26), e.g. for the heat treatment of gases within said unit(s), which reformer (24) or each reformer, respectively, may comprise a reactor chamber (28) assigned a combustion chamber (26), possibly one combustion chamber (26) each, adapted to be supplied with gas or liquid fuel and oxygen-containing combustion air for the burning thereof, and where the heat energy produced in the combustion chamber (26) is supplied to e.g. said reactor chamber (28), in which e.g. a gas treatment is carried out, e.g. a heat treatment of methane which, in treated condition, may be taken out in the form of synthesis gas for use in e.g. methanol production, and wherein the process plant comprises at least one gas turbine (10) adapted to operate a generator (18) for the generation of electrical current, characterized in that the gas turbine's (10) exhaust gas outlet (at 20), through a channel, a pipe or a similar passage (22), directly or indirectly, is in communication with said combustion chamber's (26) combustion air inlet, so that hot turbine exhaust gas, e.g. with a temperature of 350 - 450°C, is conducted through said channel, etc., (22) to the combustion chamber (26).

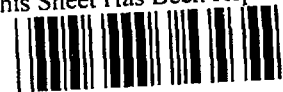




3. Arrangements as set forth in claim 2, c h a r a c -
t e r i z e d i n that said channel, etc., (22) for con-
veying turbine exhaust gas is assigned a bypass loop (32)
having a valve (34), in order to enable simple adjustment of
the amount of turbine exhaust gas which, at any given time,
is supplied to the combustion chamber (26).

4. Use of oxygen-containing exhaust gas from a first fuel-
burning unit, e.g. a gas turbine (10), as combustion air for
a second fuel-burning unit, e.g. a combustion chamber (26),
the exhaust gas leaving said first fuel-burning unit's (10)
exhaust gas discharge outlet (at 20), preferably at an over-
pressure, driving the exhaust gas to the combustion air inlet
of said second fuel-burning unit (26).

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