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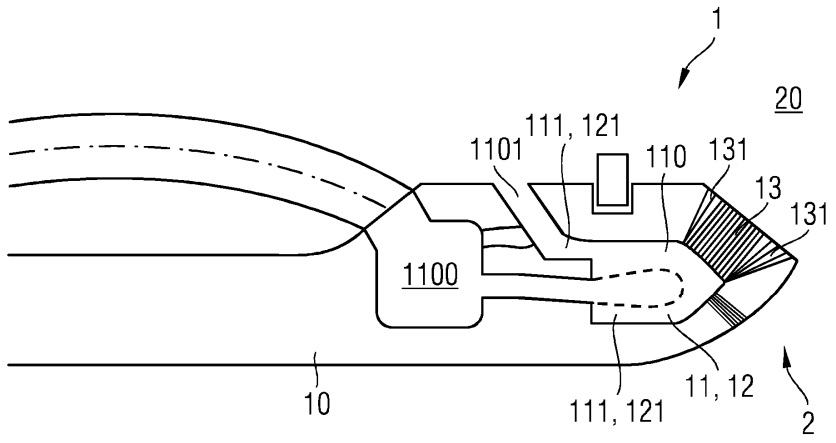
(54) **Burner for a combustion system with a premixing element and cooling element, combustion system with the burner and use of the combustion system**

(57) A burner for combustion a combustion mixture is provided. The burner comprises at least one burner body with at least one cooling element for cooling the burner body and at least one premixing element for mixing a fluidic combustion component and at least one additional fluidic combustion component for providing the combustion mixture, wherein the cooling element and the premixing element are integrated in the burner body and the cooling of the burner body can be carried out by the fluidic combustion component and/or by the additional fluidic combustion component. The premixing element is developed for cooling the burner body. Thereby fuel and/or air (combustion reactants) can be used for the cooling of the burner body. In order to ensure a high thermal conductivity between cooling element and the burner body the cooling element is integrated into the burner body. Preferably the mixing element and the cooling element comprise open pores. In addition, a combustion system with at least one such burner is provided as well as use of the combustion system for producing electricity by combusting a combustion mixture. Exhaust gas of the combustion process drives a turbine with which the electricity is produced. The combustion system is preferably included into a gas turbine.

FIG 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates to a burner for a combustion system, a combustion system with the burner and a use of the combustion system.

2. Description of the Related Art

[0002] For instance, the combustion system could be incorporated into a gas turbine which is used to produce electricity by combusting a combustion mixture of gaseous fuel and air (combustion process). Exhaust gas of the combustion process drives a turbine with which electricity is produced. Usually, the gaseous fuel is natural gas.

[0003] The combustion system comprises a compressor for providing compressed air. The compressed air is mixed with the fuel by a premixing element, which is integrated into a burner body of a burner of the combustion turbine resulting in the combustion mixture. The combustion mixture is injected into a combustion chamber of the burner where the combustion process takes place.

[0004] While operating the burner body is exposed to high temperatures leading to a decreasing of the life time of the burner body. Additionally high temperatures of the burner body could lead to the so called flashback problem: The combustion mixture can be combusted uncontrolled in the burner body.

[0005] So, on the one hand, it is desirable to reduce the operating temperatures of the burner body. But, the lower the operating temperatures of the burner body and consequently the lower the operating temperatures of the combustion process the lower efficiency of the overall process. So, on the other hand the operating temperature should be as high as possible.

SUMMARY OF THE INVENTION

[0006] It is an object of the invention to provide a burner for a combustion system with which a process temperature of the combustion process can be influenced.

[0007] Other objects of the invention are the providing of a combustion system with the burner and a use of the combustion system.

[0008] These objects are achieved by the invention specified by the claims.

[0009] Thereby a burner for combusting a combustion mixture is provided. The burner comprises at least one burner body with at least one cooling element for cooling the burner body and at least one premixing element for mixing a fluidic combustion component and at least one additional fluidic combustion component for providing the combustion mixture, wherein the cooling element and the premixing element are integrated into the burner body and the cooling of the burner body can be carried out by the fluidic combustion component and/or by the additional fluidic combustion component.

[0010] The fluidic combustion component and the fluidic additional combustion component are reactants of the combusting (combustion process). Preferably the fluidic combustion component and/or the additional fluidic combustion component are selected from the group consisting of fuel and air. Alternative reactants are possible, too.

[0011] The cooling element and the premixing element form an integrated part of the burner body. Preferably these elements and the burner body are made out of the same material or made out of similar materials. In addition, there is no fixing element between these elements and the burner body. The elements and the burner body form a monolithic body.

[0012] The cooling element can be driven with the aid of the fluidic combustion component and/or with the aid of the additional fluidic combustion component.

[0013] In a preferred embodiment the cooling element comprises the premixing element. Besides a mixing function the premixing element comprises additionally a cooling function. The premixing element is developed for cooling the burner body. Thereby fuel and/or air (fluidic combustion components, fluidic combustion reactants) can be used for the cooling of the burner body. In order to ensure a high thermal conductivity between cooling element and the burner body the cooling element is integrated into the burner body.

[0014] Additionally a combustion system with at least one such burner is provided as well as use of the combustion system for producing electricity by combusting a combustion mixture. Exhaust gas of the combustion process drives a turbine with which the electricity is produced.

[0015] In principle, various fluidic reactive or non reactive components or mixtures of these components can be used. In a preferred embodiment a fluidic combustion component and/or an additional fluidic combustion component with a fluid is used, which is selected from the group consisting of natural gas and hydrogen gas. Preferably mixtures of natural gas and hydrogen gas are possible. Thereby hydrogen rich gas can be used (see below).

[0016] The fuel is a liquid or gaseous. An efficient cooling is possible by the use of a liquid fuel (via evaporation heat). This is advantageous for the case that the cooling element and the mixing element are separated from each other.

[0017] For a combination or a separation of the cooling element and premixing element a use of a gaseous fuel is possible. This has the advantage that the fuel can be compressed. By the compression of the air (see introduction) and by the compression of the fuel the temperature of the burner body can be set variably in a relatively wide temperature range.

[0018] In a preferred embodiment the burner body

comprises at least one combustion mixture injection element for injecting of the combustion mixture into a combustion chamber of a combustion system. Preferably, besides the cooling element and/or the premixing element the combustion mixture injection element form an integral part of the burner body, too. The combustion mixture injection element is integrated into the burner body.

[0019] In view of an efficient cooling process it is advantageous to provide a cooling element with a large cooling surface. A large cooling surface is possible with a cooling element with a plurality of micro channels. Micro channels can be formed by open pores. Moreover, a plurality of open pores through which the fluidic combustion component can be led, is advantageous for an efficient mixing process.

[0020] In view of an efficient injection of the combustion mixture into the combustion chamber, it is advantageous to provide a combustion mixture injection element with micro channels through which the combustion mixture can be led and injected into the combustion chamber. These micro channels are integrated into a burner wall of the burner body which is adjacent to the combustion chamber. The burner wall of the burner body is fine structured. A burner with such a burner body is called "soft walled" burner.

[0021] Besides the cooling possibility of the combustion mixture injection element and an additional cooling possibility of the burner body such a micro structured burner wall has following additional advantage: The micro structure can be arbitrary designed with a structure close to or smaller than a quenching distance of a chosen combustion mixture. This inhibits an undesired ignition and burning of the combustion mixture inside the burner body. The possibility for the occurrence of a flashback is reduced. This is especially critical for combustion mixtures with hydrogen or hydrogen rich fuels. Hydrogen rich fuels comprise hydrogen with an amount of more than 5 vol.%. The amount of hydrogen gas on the fuel exceeds 5 vol.%. Preferably, the amount of hydrogen gas is more than 10 vol.

[0022] Like in the case of the premixing element, it is referable form the micro channels by open pores. Therefore, in a preferred embodiment, the combustion mixture injection element comprises a plurality of open injection element pores for the injection of the combustion mixture into the combustion chamber. Through these pores the combustion mixture is led and injected into the combustion chamber.

[0023] In order to reach an efficient mixing of the reactants of the combustion process, an efficient cooling of the burner body and/or an efficient inhibiting of flashback, the open premixing element pores and/or the open injection element pores comprise an average diameter which is selected from the range between 20 μm to 1000 μm. Preferably, the pore diameter is selected from the range between 30 μm and 300 μm and more preferable from 50 μm and 200 μm. For instance, an average pore diameter is about 100 μm.

[0024] The premixing element and the combustion mixture injection element, especially the micro structures of the premixing element can be formed by various materials. Preferably these materials are compatible with the material of the burner body. The thermal expansion coefficients should equal or nearly equal. Preferably the burner body, the cooling element, the premixing element and the combustion mixture injection element are made out of the same material. Different temperature expansion coefficients don't play any role. Such a material can be an appropriate alloy.

[0025] The premixing element and/or the combustion injection element can comprise ceramic. One or both elements comprise a ceramic. Ceramic can be made porous. It withstands high temperatures and can have a relatively high thermal conductivity (for an efficient cooling). The ceramic should have a temperature expansion coefficient as the material of the burner body.

[0026] Following advantageous are connected to the invention:

- An efficient premixing of fuel and air is possible.
- The burner body can be efficiently cooled.
- With the invention a controlling and adjusting of the temperature of the combustion mixture can be additionally carried out. Thereby, the combustion process can be optimized (for instance by preheating the combustion mixture).
- No combustion can take place inside the burner body which prevents flashback.
- A fuel injection velocity can be arbitrary set.
- Cooling is automatically increased at high power, when the heat load is also increasing, due to increased flow of fuel at a low temperature inside the burner body.
- The burner can be especially used for hydrogen rich fuels.

BIEF DESCRIPTION OF THE DRAWINGS

[0027] Further features and advantages of the invention are produced from the description of exemplary embodiments with reference to the drawings. The drawings are schematically.

Figure 1 shows a cross section of a first embodiment of the burner of the combustion system.

Figure 2 shows a cross section of a second embodiment of the burner of the combustion system.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Subject matter is a burner 1 of a combustion system 2 for combusting a combustion mixture 110. The combustion system 2 is a part of a gas turbine. The combustion mixture comprises a fluidic combustion component with fuel 1100 and an additional fluidic combustion component with air 1101.

[0029] The burner 1 comprises a burner body 10 with a cooling element 11 for cooling the burner body 10 and a premixing element 12 for mixing fuel 1100 and air 1101 for providing the combustion mixture 110

[0030] The cooling element 11 is the premixing element 12. The cooling of the burner body 10 can be carried out by the fuel 1100 and/or by the air 1101.

[0031] The premixing element 12 comprises a plurality of open premixing pores 121.

[0032] Additionally the burner body 10 comprises a combustion mixture injection element 13 for injecting of the combustion mixture 110 into a combustion chamber 20 of a combustion system 2.

[0033] The combustion injection element 13 comprises a plurality of open injection element pores 131 for the injection of the combustion mixture into the combustion chamber 20.

[0034] The burner body 10, the cooling element 11, the premixing element 12 and the combustion injection element 13 form a monolithic body. The cooling element 11, the premixing element 12 and the combustion injection element 13 are integral parts of the burner body. There is no fixing element for fixing these elements to the burner body. This is possible for instance by manufacturing the burner body and the elements out of the same starting material.

[0035] An average diameter of the pores of the elements 11, 12 and 13 is about 100 μm.

[0036] Concerning the first embodiment (figure 1) the fuel 1100 and the air 1101 are commonly led through the porous mixture element 12 and porous cooling element 12, respectively. Open cooling pores are the open premixing pores 121. The mixing takes place in the porous structure.

[0037] In contrast to the first embodiment, concerning the second embodiment the mixing of fuel 1100 and air 1101 to the combustion mixture 110 takes place downstream of the porous cooling element 12. Again, open cooling pores 111 of the cooling element 11 act as open premixing pores 121 of the premixing element 12. Fuel 1100 and air 1010 are led trough the pores 111 and 121 and mixed together after that.

[0038] The combustion system 2 is used for producing electricity by combusting the combustion mixture 110. Exhaust gas of the combustion process drives a (not shown) turbine with which the electricity is produced. The fuel is a hydrogen rich mixture of natural gas and gaseous hydrogen.

Claims

1. Burner (1) for combusting a combustion mixture (110); the burner (1) comprises at least one burner body (10) with

   - at least one cooling element (11) for cooling the burner body (1) and
   - at least one premixing element (12) for mixing a fluidic combustion component (1100) and at least one additional fluidic combustion component (1101) for providing the combustion mixture (110),

   wherein

   - the cooling element (11) and the premixing element (12) are integrated into the burner body (10) and
   - the cooling of the burner body (10) can be carried out by the fluidic combustion component (1100) and/or by the additional fluidic combustion component (1101).

2. Burner according to claim 1, wherein the fluidic combustion component and/or the additional fluidic combustion component are selected from the group consisting of fuel and air.

3. Burner according to one of the claims 1 or 2, wherein the cooling element (11) comprises the premixing element (12).

4. Burner according one of the claims 1 to 3, wherein the burner body (10) comprises at least one combustion mixture injection element (13) for injecting of the combustion mixture (110) into a combustion chamber (20) of a combustion system (2).

5. Burner according to according to one of the claims 1 to 4, wherein the cooling element (11), the premixing element (12) and/or the combustion mixture injection element (13) comprise a plurality of open element pores (121, 131).

6. Burner according to one of the claims 1 to 5, wherein the open element pores (121) comprise an average diameter which is selected from the range between 20 μm to 1000 μm, preferably selected from the range between 30 μm and 300 μm and more preferably selected from the range between 50 μm and 200 μm.

7. Combustion system (2) with at least one burner (1) according to one of the claims 1 to 6.

8. Use of the combustion system (2) according to claim 7 for producing electricity by combusting a combustion mixture (110).

9. Use according to claim 8, wherein a fluidic combustion component with a fuel is used, which is selected from the group consisting of natural gas and hydrogen gas.

10. Use according to claim 9, wherein a hydrogen rich fuel is used with an amount of hydrogen gas on the fuel of more than 5 vol.% and preferably more than 10 vol.%.

FIG 1

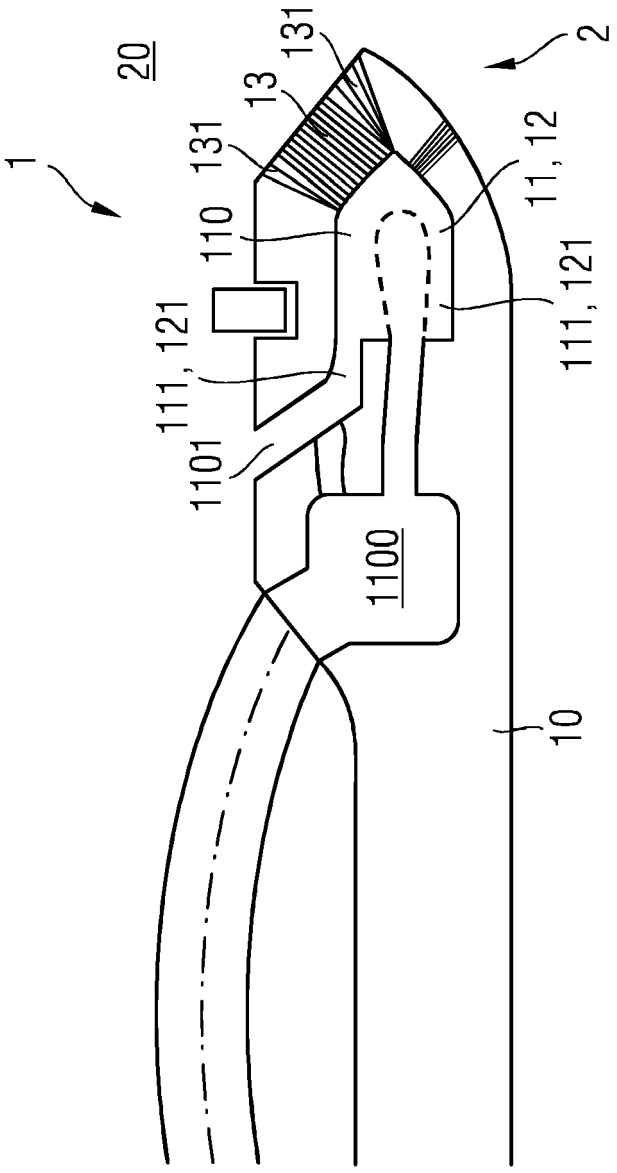
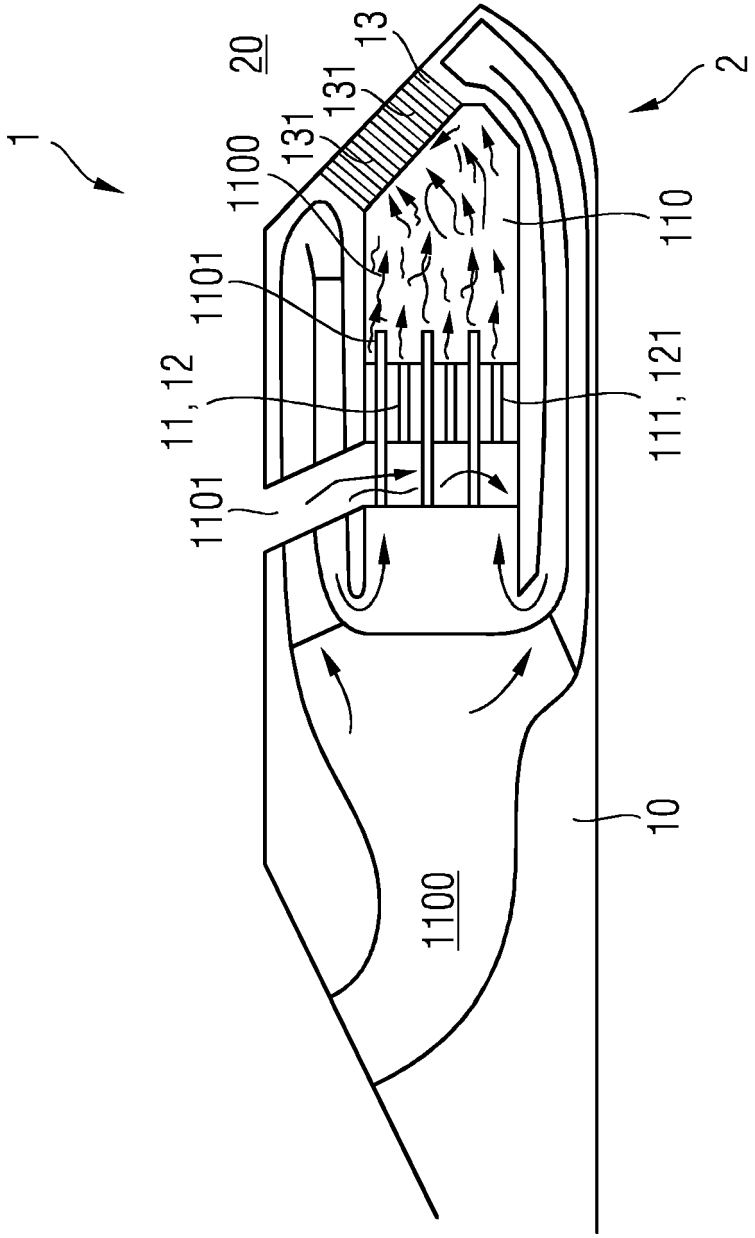


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 6160

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F23R
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	13 February 2014	Munteh, Louis

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 18 6160

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