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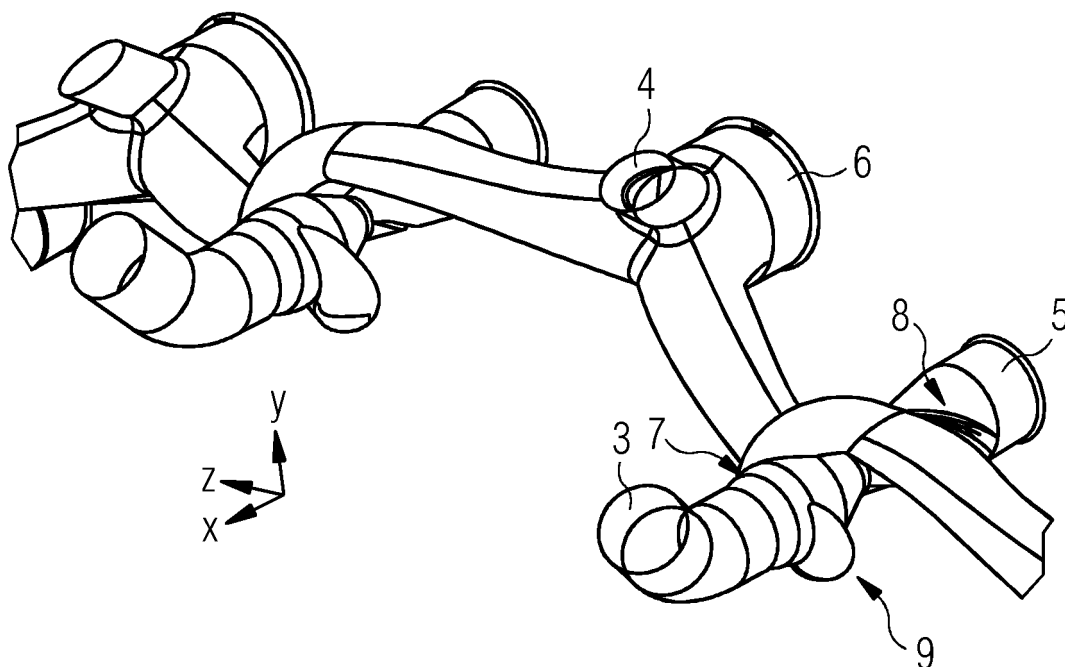
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(54) **Pilot burner with axial swirlers for a gas turbine**

(57) It is described a pilot burner (1) for a gas turbine (12), comprising an annular base body (2) with a fuel inlet pipe (5), an air inlet pipe (6) and a mixture outlet pipe (3) connected at a connection section (7). Said fuel inlet pipe (5) and said air inlet pipe (6) comprise separate means (8, 9) for axially swirling of the transported media, e.g.

embodied as helical grooves and/or fins (8) in the inlet pipes (5, 6) or embodied as a helically shaped part (9) of said inlet pipes (5, 6). Furthermore, a gas turbine (12) comprising a compressor (13), a combustion chamber (14), a turbine (15) and a pilot burner (1) of the kind above is disclosed.

FIG 6



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Description

Field of invention

[0001] The present invention relates to a pilot burner for a gas turbine, comprising an annular base body with a fuel inlet pipe, an air inlet pipe and a mixture outlet pipe connected at a connection section. Furthermore, the present invention relates to a gas turbine comprising a compressor, a turbine, a combustion chamber and a pilot burner of the kind above.

Art Background

[0002] A pilot burner and a gas turbine as presented above are generally known. Air and fuel are mixed to form a flammable mixture, which is ignited and forms a pilot flame for a burner in the combustion chamber. It is not just about generating a flame, but also strict environmental rules have to be taken care of. For this reason, air and fuel shall be mixed well what sometimes is done by radial swirlers or not at all. However, known solutions suffer of rather poor pre-mixing of fuel and air, comparably high material temperatures in the burner body going hand in hand with a short life time and risk of flashback, where fuel is injected into the combustion systems.

[0003] Accordingly, there is a need to provide a pilot burner, which overcomes the drawbacks mentioned above.

Summary of the Invention

[0004] This need may be met by the subject matter according to the independent claims. Advantageous embodiments of the present invention are described by the dependent claims.

[0005] According to a first aspect of the invention, there is provided a pilot burner as disclosed in the opening paragraph, wherein said fuel inlet pipe and said air inlet pipe comprise separate means for axially swirling of the transported media.

[0006] Moreover, there is provided a gas turbine comprising a compressor, a turbine, a combustion chamber and a pilot burner of the kind above.

[0007] These aspects of the invention are based on the idea that axially swirling provides for a comparably long mixing distance. In this way the drawbacks mentioned above may be avoided. In particular, fuel and air is mixed very well what leads to comparably low nitrogen oxide emissions (NO_x-emissions). Furthermore, temperatures in the burner body are reduced which leads to longer life time of the components. Finally, problems with flashback, where fuel is injected into the combustion systems, are reduced as well.

[0008] According to a further embodiment of the invention, said swirling means are embodied as helical grooves and/or fins. In this way, a straight pipe may be used for swirling. However, more or less any other shape

of the pipe is applicable as well, as swirling is done by the helical grooves and/or fins.

[0009] According to yet another embodiment of the invention, said swirling means are embodied as a helically shaped part of said fuel inlet pipe and/or said air inlet pipe. In this way, a pipe with a smooth inner surface may be used as swirling is done by the course of the pipe.

[0010] According to a further embodiment of the invention, rotational directions of the swirling means of said fuel inlet pipe and said air inlet pipe are unidirectional. In this way, a quite long interphase transfer area improves the mixing of the fluids, i.e. air and fuel.

[0011] According to yet another embodiment of the invention, rotational directions of the swirling means of said fuel inlet pipe and said air inlet pipe are counter-directional. In this way, quite intense turbulences improve the mixing of the fluids, i.e. air and fuel.

[0012] In a further embodiment the pilot burner comprises a cooling chamber respectively cooling grid connected to the air inlet pipe and to cooling air outlets in the region of the mixture outlet pipes. In this way, the pilot burner can be cooled. In particular, air is tapped before mixing with fuel, goes through the entire burner tip and later is released into the combustion chamber. The taken measures keep most of the tip at the same temperature as the incoming air by the insulation effect of the air in the grid.

[0013] It has to be noted that embodiments of the invention have been described with reference to different subject matters. However, a person skilled in the art will gather from the above and the following description that, unless other notified, in addition to any combination of features belonging to one type of subject matter also any combination between features relating to different subject matters is considered as to be disclosed with this document.

[0014] The aspects defined above and further aspects of the present invention are apparent from the examples of embodiment to be described hereinafter and are explained with reference to the examples of embodiment. The invention will be described in more detail hereinafter with reference to examples of embodiment but to which the invention is not limited.

Brief Description of the Drawing

[0015]

Figure 1 shows a schematic oblique view of an exemplary pilot burner from the front side;

Figure 2 shows a front view of the pilot burner of Fig. 1;

Figure 3 shows a back view of the pilot burner of Fig. 1;

Figure 4 shows a side view of the pilot burner of Fig.

1;

Figure 5 shows an oblique view of the fuel inlet pipes, the air inlet pipes and the mixture outlet pipes of the pilot burner of Fig. 1 shown separately from its annular base body from the front side;

Figure 6 shows a detail view of the arrangement shown in Fig. 5;

Figure 7 shows a detail view of the arrangement shown in Fig. 5 from the back side;

Figure 8 shows a cross section of the pilot burner of Fig. 1 in the connection section respectively mixing section;

Figure 9 shows a cross section of the pilot burner of Fig. 1 in cooling air tapping section and

Figure 10 shows a schematic view of an exemplary gas turbine, in which the pilot burner may be used.

Detailed Description

[0016] The illustration in the drawing is schematically. It is noted that in different figures, similar or identical elements or features are provided with the same reference signs or with reference signs, which are different from the corresponding reference signs only within the first digit. In order to avoid unnecessary repetitions elements or features which have already been elucidated with respect to a previously described embodiment are not elucidated again at a later position of the description.

[0017] Fig. 1 shows a schematic oblique view of an exemplary pilot burner 1 from the front side. In particular, Fig. 1 shows an annular base body 2 of the pilot burner 1 with mixture outlet pipes 3 and cooling air outlets 4. It can be seen that preferably the mixture outlet pipes 3 for fuel and the cooling air outlets 4 may be arranged such that they end at a conical section of the annular base body 2. Particularly outlet holes of the mixture outlet pipes 3 may be distributed over the circumference of the conical section. Particularly outlet holes of the cooling air outlets 4 may be distributed over the circumference of the conical section. Furthermore the mixture outlet pipes 3 and the cooling air outlets 4 may be arranged alternately.

[0018] Fig. 2 furthermore shows a front view of the pilot burner of Fig. 1 also showing the mixture outlet pipes 3 and cooling air outlets 4.

[0019] Fig. 3 shows a back view of the pilot burner of Fig. 1, in particular fuel inlet pipes 5 and air inlet pipes 6. The fuel inlet pipes 5 and the air inlet pipes 6 may be arranged alternately over the circumference.

[0020] Furthermore, Fig. 4 shows a side view of the pilot burner of Fig. 1. In particular, the mixture outlet pipes 3 and cooling air outlets 4 are shown again.

[0021] Fig. 5 now shows an oblique view of the mixture

outlet pipes 3, the cooling air outlets 4, the fuel inlet pipes 5 and the air inlet pipes 6 of the pilot burner 1 of Fig. 1 shown separately from its annular base body 2 from the front side. That means that Fig. 5 is just a "virtual" view through the material of the annular base body 2, meaning that the hollow pipes are shown as concrete objects. The annular base body 2 is not shown directly. As it can be seen the mixture outlet pipes 3, the cooling air outlets 4, the fuel inlet pipes 5 and the air inlet pipes 6 of the pilot burner 1 are substantially passages through the annular base body 2.

[0022] Fig. 6 shows a detail view of the arrangement shown in Fig. 5 from the front side and Fig. 7 shows a detail view of the arrangement shown in Fig. 5 from the back side.

[0023] In particular, Figs. 5 to 7 disclose a connection section 7 connecting a fuel inlet pipe 5, an air inlet pipe 6 and a mixture outlet pipe 3. Furthermore, helical fins 8 of the fuel inlet pipe 5 and a helically shaped part 9 of the air inlet pipe 6 is shown.

[0024] Accordingly, Figs. 1 to 7 disclose a pilot burner 1 for a gas turbine, comprising an annular base body 2 with a fuel inlet pipe 5, an air inlet pipe 6 and a mixture outlet pipe 3 connected at a connection section 7. The fuel inlet pipe 5 and the air inlet pipe 6 comprise separate means 8, 9 for axially swirling of the transported media.

[0025] Concretely, said swirling means of the fuel inlet pipe 5 are embodied as helical fins 8. However, helical grooves may be applicable instead or in addition as well. In this way, a straight pipe may be used for swirling. However, more or less any other shape of the pipe is applicable as well, as swirling is done by the helical grooves and/or fins 8.

[0026] Thus the means 8 (i.e. the helical grooves and/or fins 8) provide individually a swirl to the fuel.

[0027] Moreover, the swirling means of the air inlet pipe 6 are embodied as a helically shaped part 9 of said air inlet pipe 6. In this way, a pipe with a smooth inner surface may be used as swirling is done by the course of the pipe.

[0028] Thus the means 9 (i.e. the helically shaped part 9) provide individually a swirl to the air.

[0029] One skilled in the art will easily perceive an embodiment, in which the swirling means of the air inlet pipe 6 are embodied as helical grooves and/or fins 8 and the swirling means of the fuel inlet pipe 5 are embodied as a helically shaped part 9 of the same.

[0030] Recent research activities have shown that axially swirling provides for a comparably long mixing distance. In this way the following advantages may be obtained:

- fuel and air are mixed very well what leads to comparably low NO_x-emissions,
- temperatures in the burner body 2 are reduced which leads to longer life time of the components,
- problems with flashback where fuel is injected into the combustion systems are reduced.

[0031] In the example shown in Figs 1 to 7 rotational directions of the swirling means 8, 9 of said fuel inlet pipe 5 and said air inlet pipe 6 are unidirectional. In this way, a quite long interphase transfer area improves the mixing of the fluids, i.e. air and fuel.

[0032] However, the rotational directions of the swirling means 8, 9 of said fuel inlet pipe 5 and said air inlet pipe 6 may also be counter-directional. In this way, quite intense turbulences improve the mixing of the fluids, i.e. air and fuel.

[0033] Fig. 8 now shows a cross section of the pilot burner 1 of the Figs. 1 to 7 in the connection section 7 respectively mixing section. Furthermore, a cooling chamber 10 respectively cooling grid is shown in the annular base body 2. That means that the connection section 7 (or mixing section) and the cooling chamber 10 (or cooling grid) may also each be passages within the annular base body 2.

[0034] Fig. 9 furthermore shows a cross section of the pilot burner 1 of Fig. 1 in a cooling air tapping section 11, by which a part of the air entering the air inlet pipe 6 is guided through the cooling chamber 10 and finally through cooling air outlets 4. In this way, the pilot burner 1 can be cooled.

[0035] The taken measures keep most of the burner 1 at the same temperature by the insulation effect of the air in the cooling chamber 10. Thus, the cooling chamber 10 may cool the material of the annular base body 2, particularly cooling internal surfaces of the annular base body 2. Furthermore cooling air can also exit via cooling air outlets 4 allowing to cool an external front surface of the annular base body 2.

[0036] Fig. 10 finally shows a schematic view of an exemplary gas turbine 12. The gas turbine 12 (also called gas turbine engine) comprises a compressor 13, a combustion chamber 14 and a turbine 15 as it is known per se. In this gas turbine 12 the pilot burner 1 of the kind presented above may be used, being arranged in the region of the combustion chamber 14.

[0037] The pilot burner 1 is particularly present to provide pilot fuel for start-up or transient mode of operations to stabilize the flame and/or combustion. The pilot fuel may be gaseous fuel. In another embodiment pilot fuel may be liquid fuel.

[0038] Generally, the shape of the channels can keep the fluid at a speed over the flame speed at all times. In this way, no combustion can take place inside the burner which prevents flashback. Advantageously, there are no stagnation areas of the flow, where a mix of fuel and an oxidizer has a possibility to react and cause a flashback. Moreover, a higher velocity of the jet out of the pilot tip may keep the pilot flame further away from the tip and therefore also make the metal less hot.

[0039] The complex structures within the annular base body 2 as disclosed in this text may be produced by 3D printing or additive manufacturing, e.g. via selective laser sintering, selective laser melting and similar methods.

[0040] Finally, it should be noted that the term "com-

prising" does not exclude other elements or steps and the use of articles "a" or "an" does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

Claims

1. Pilot burner (1) for a gas turbine (12), comprising an annular base body (2) with a fuel inlet pipe (5), an air inlet pipe (6) and a mixture outlet pipe (3) connected at a connection section (7),
wherein
said fuel inlet pipe (5) and said air inlet pipe (6) comprise separate means (8, 9) for axially swirling of the transported media.
2. Pilot burner (1) as claimed in claim 1, wherein said swirling means are embodied as helical grooves and/or fins (8).
3. Pilot burner (1) as claimed in claim 1 or 2, wherein said swirling means are embodied as a helically shaped part (9) of said fuel inlet pipe (5) and/or said air inlet pipe (6).
4. Pilot burner (1) as claimed in any one of the claims 1 to 3, wherein rotational directions of the swirling means (8, 9) of said fuel inlet pipe (5) and said air inlet pipe (6) are unidirectional.
5. Pilot burner (1) as claimed in any one of the claims 1 to 3, wherein rotational directions of the swirling means (8, 9) of said fuel inlet pipe (5) and said air inlet pipe (6) are counter-directional.
6. Pilot burner (1) as claimed in any one of the claims 1 to 5, comprising a cooling chamber (10) respectively cooling grid connected to the air inlet pipe (6) and to cooling air outlets (4) in the region of the mixture outlet pipes (3).
7. Gas turbine (12) comprising a compressor (13), a combustion chamber (14), a turbine (15) and a pilot burner (1) as claimed in claims 1 to 6.

FIG 1

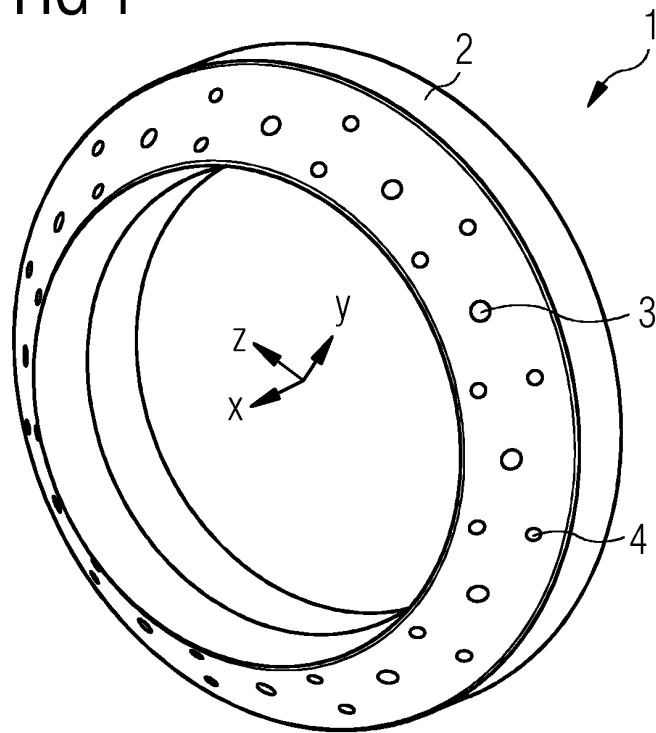


FIG 2

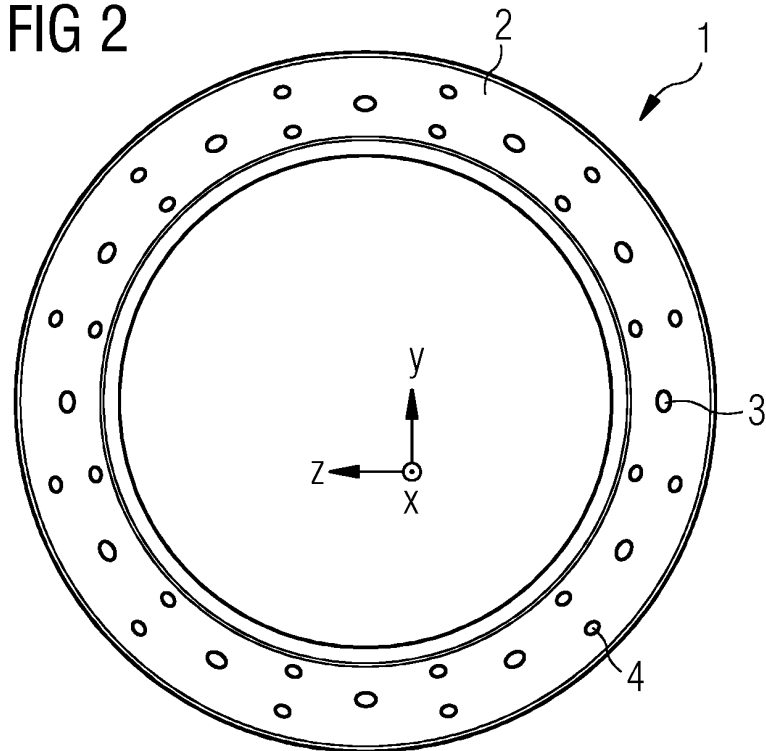


FIG 3

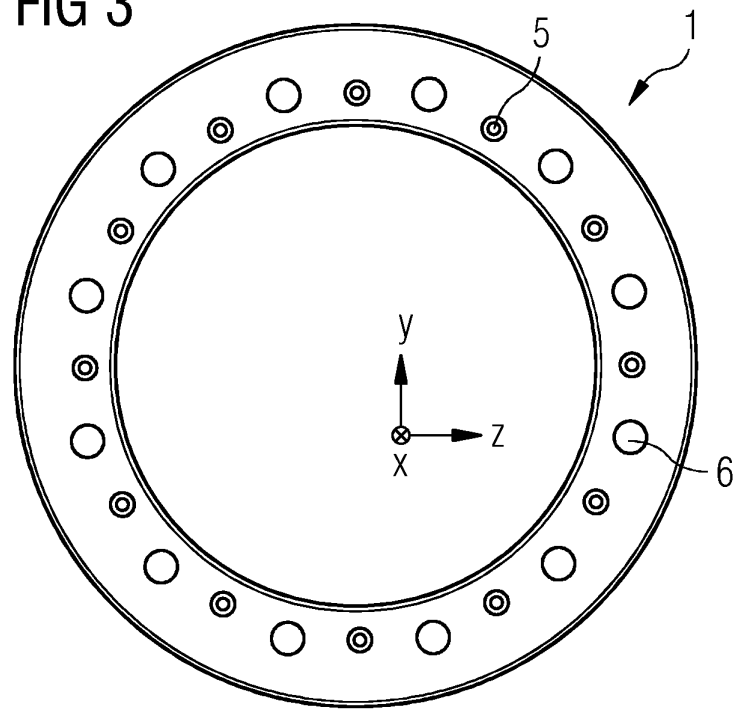


FIG 4

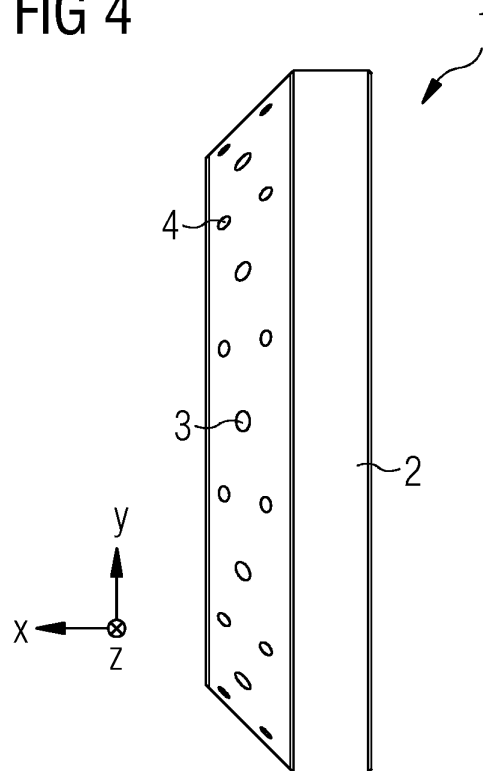


FIG 5

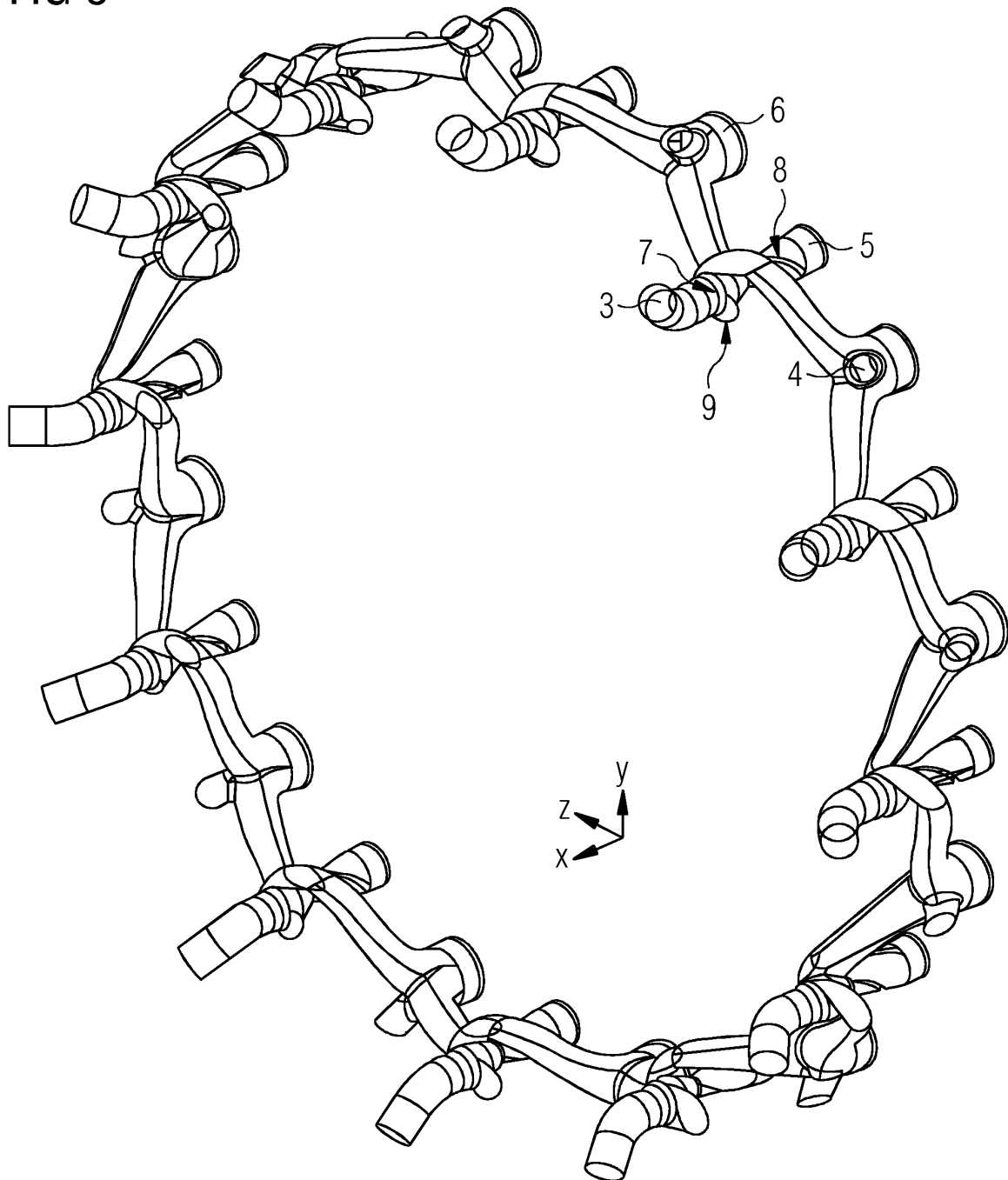


FIG 6

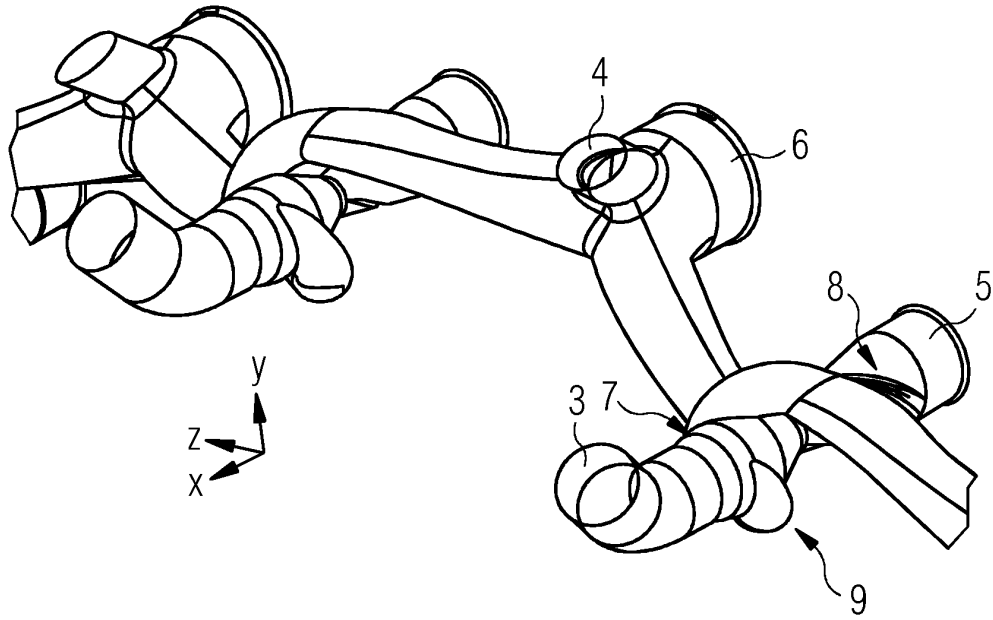


FIG 7

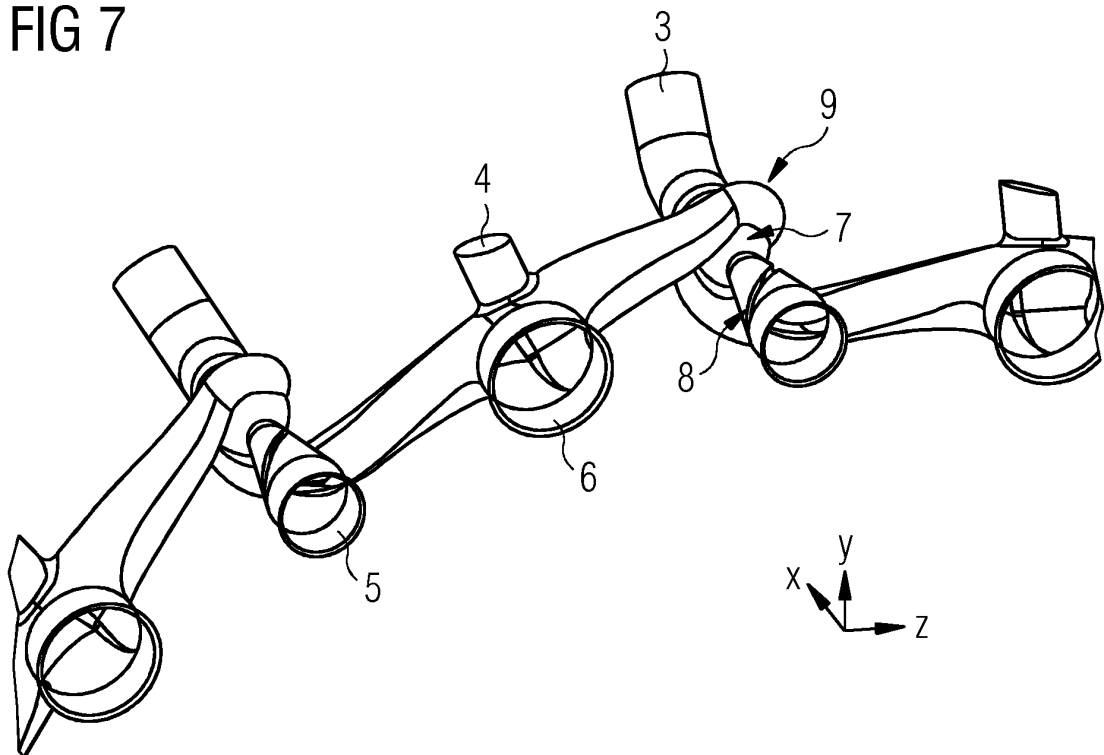


FIG 8

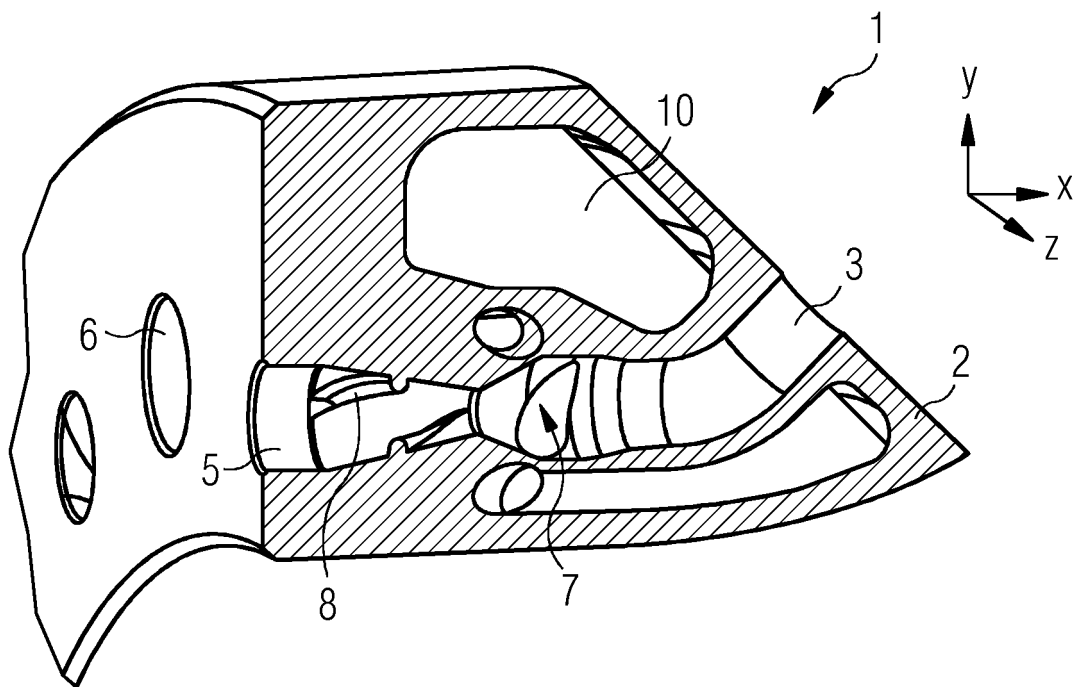


FIG 9

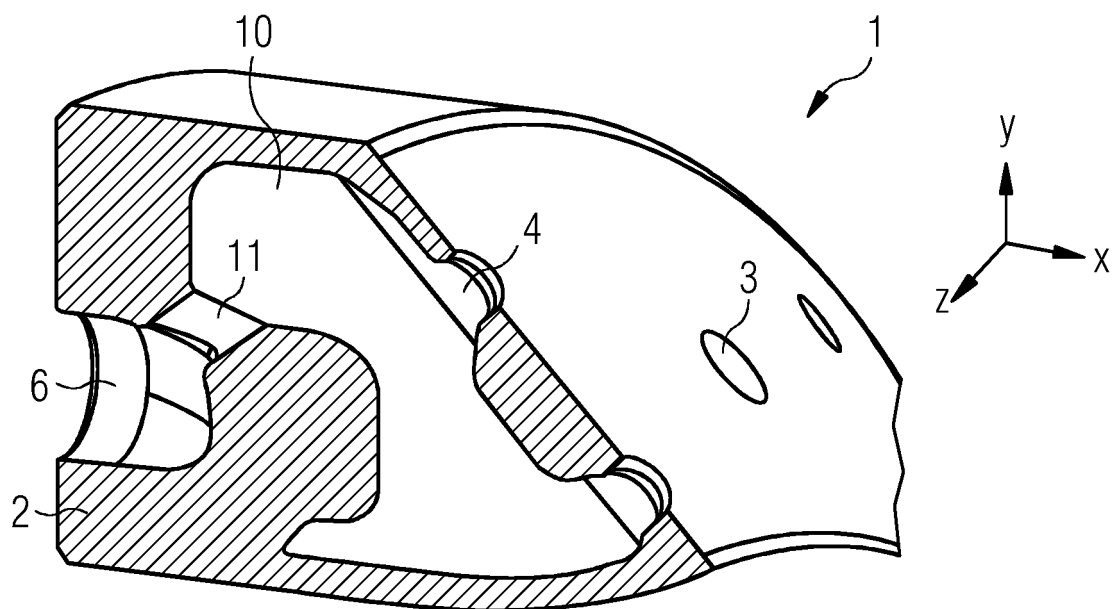
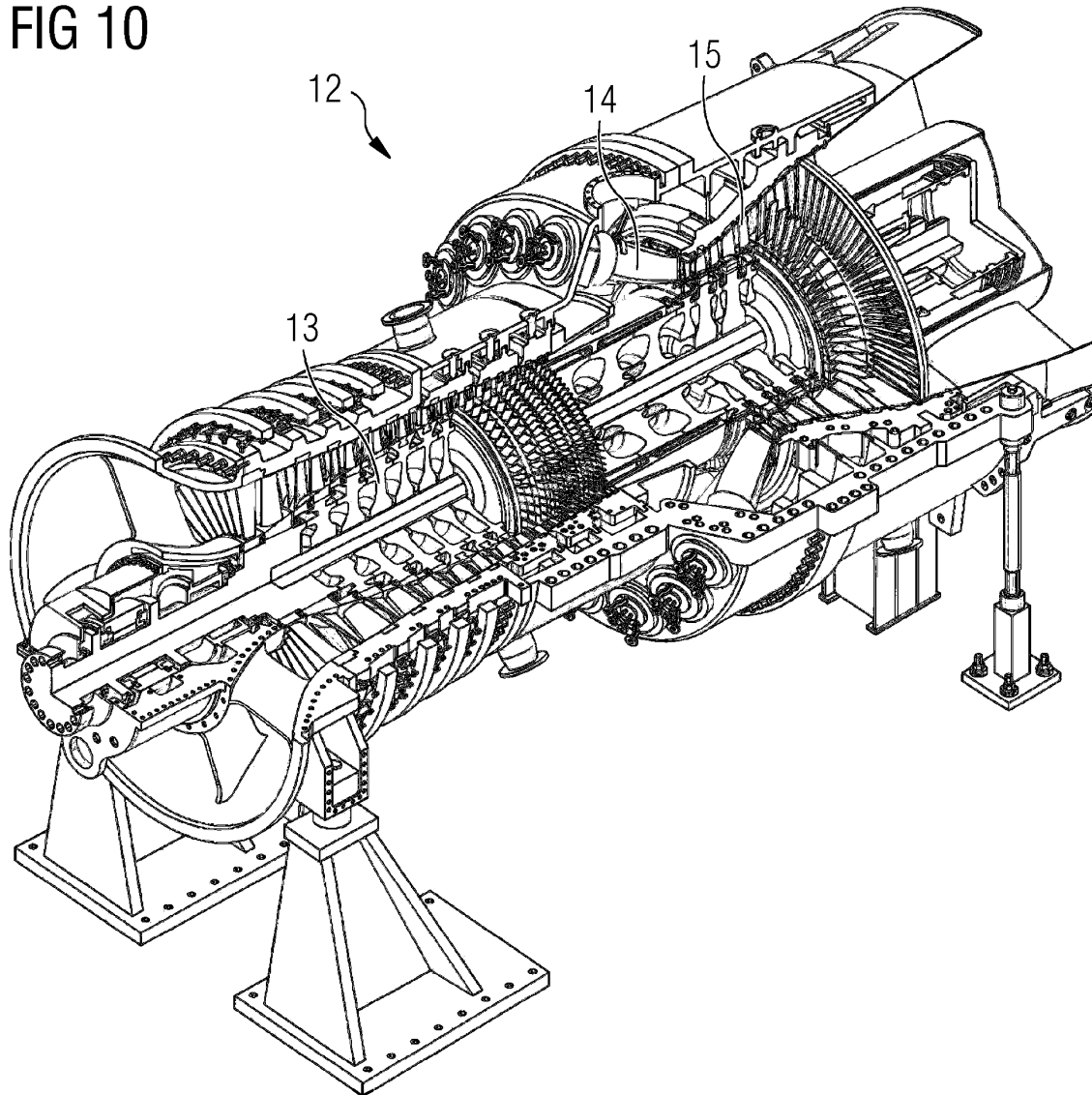


FIG 10





EUROPEAN SEARCH REPORT

Application Number
EP 14 15 4321

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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