(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 078 914 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.10.2016 Bulletin 2016/41

(51) Int Cl.:
F23R 3/60 *(2006.01)* ***F23R 3/00*** *(2006.01)*

(21) Application number: **15162999.5**

(22) Date of filing: **09.04.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA

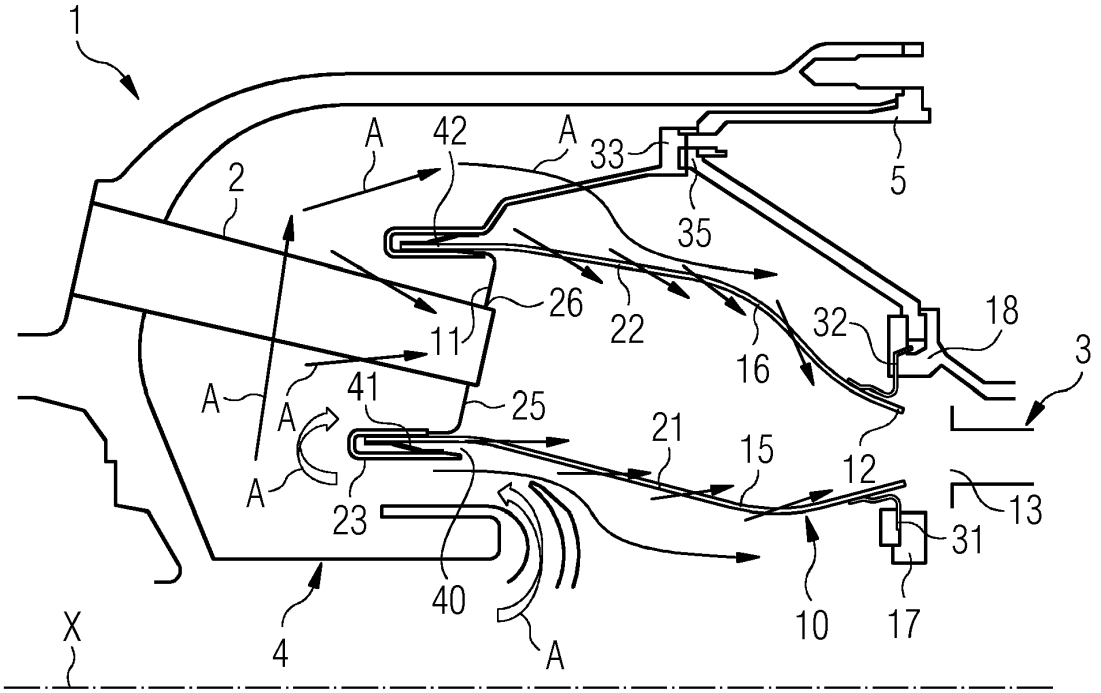
(71) Applicant: **Siemens Aktiengesellschaft**
80333 München (DE)

(72) Inventor: **Rasmusson, Patrik**
60246 Norrköping (SE)

(54) **ANNULAR COMBUSTOR FOR A GAS TURBINE ENGINE**

(57) An annular combustor (10) for a gas turbine engine (1), axially extending between a first axial burner end (11) and a second axial outlet end (12) and radially extending between an annular inner liner (15) and an annular outer liner (16), wherein the annular combustor (10) is at least an assembly of:
- a first part (21) including the annular inner liner (15) and a first connection element (31) for connecting the first part (21) to the gas turbine engine (1),
- a second part (22) including the annular outer liner (16) and a second connection element (32) for connecting the second part (22) to the gas turbine engine (1),
- at least one of the first connection element (31) and of the second connection element (32) being adjacent to the outlet end (12) of the combustor (10).

FIG 1



EP 3 078 914 A1

Description

Field of invention

[0001] The present invention relates to an annular combustor for a gas turbine engine and to a gas turbine engine including such a combustor.

Art Background

[0002] Annular combustors are well known in the field of gas turbine engines.

[0003] An annular combustor is normally included in a gas turbine engine 1 comprising, arranged in flow series: a compressor section, a burner, the annular combustor and a gas turbine section. In operation of the gas turbine engine, air is compressed by the compressor section and delivered to the combustion section, including the burner and the annular combustor. The compressed air exiting from the compressor enters the burner, where is mixed with a gaseous or liquid fuel. The air/fuel mixture is then burned and the combustion gas from the combustion is channelled through the combustor to the gas turbine section, for transforming the energy from the operative gas into working power.

[0004] The annular combustor for the above described application normally extends axially between a first axial burner end, close to the burner and a second axial outlet end, adjacent to the inlet of the gas turbine section. Further the annular combustor radially extends between an annular inner liner and an annular outer liner. At first axial burner end, the annular combustor comprises an annular backwall for connecting the annular inner liner and the annular outer liner. The backwall comprises at least a hole for coupling at least a respective burner to the annular combustor.

[0005] According to a known possible prior art solution, the annular combustor described above is normally manufactured in one piece including at least the annular inner liner, the annular outer liner and the backwall. Such unitary piece is then attached to the gas turbine engine by means of one or more connections provided between the combustor and a casing of the gas turbine engine. Such a connection is typically remote from the interface between the outlet of the combustor and the inlet of the gas turbine, therefore a gap is necessary between the combustor and the gas turbine for allowing thermal expansions.

[0006] Such an annular combustor and attachment determines a plurality of inconveniences:

- the gap in the interface between the combustor and the inlet of the turbine section cannot be reduced below a lower limit. This leads to damages to the components, due to hot gas ingestion, i.e. the hot gas exiting the second axial outlet end of the combustor and leaking through the gap between combustor and gas turbine section;
- when a reparation is required, repairing an annular combustor like the one described above, i.e. a combustor manufactured in a unitary piece attached to the casing of the gas turbine engine, is expensive.

[0007] Prior art solutions to above inconveniences may be, respectively:

- purging air has in the cavity between the combustor and the gas turbine section;
- cutting the combustor into several pieces, that, after reparation, have nevertheless to be welded back together.

[0008] The above solutions are not yet considered optimal and therefore it is still desirable to provide a new annular combustor design for efficiently overcoming the above described drawbacks.

Summary of the Invention

[0009] It may be an object of the present invention to provide an annular combustor for a gas turbine engine permitting to reduce at the minimum or eliminating the gap between the combustor and the inlet of the turbine section, in such a way that the phenomenon of hot gas ingestion is avoided or limited to a minimum.

[0010] It may be a further object of the present invention to provide an annular combustor for a gas turbine engine, whose maintenance is easier and less expensive, with respect to the prior art.

[0011] It may be an additional object of the present invention to provide a gas turbine engine including an annular combustor having a reduced gap between the combustor and the inlet of the turbine section and whose maintenance is easier and less expensive, with respect to the prior art.

[0012] In order to achieve the objects defined above, an annular combustor for a gas turbine is provided in accordance with the independent claim. The dependent claims describe advantageous developments and modifications of the invention.

[0013] According to a first aspect of the present invention, an annular combustor for a gas turbine engine, the annular combustor axially extending between a first axial burner end and a second axial outlet end, the annular combustor radially extending between an annular inner liner and an annular outer liner, the annular combustor being at least an assembly of:

- a first part including the annular inner liner and a first connection element for connecting the first part to the gas turbine engine,
- a second part including the annular outer liner and a second connection element for connecting the second part to the gas turbine engine,
- at least one of the first connection element and of the second connection element being adjacent to

the outlet end of the combustor.

[0014] The segmentation of the annular combustor allows reducing at the minimum or eliminating the gap between the outlet of the combustor and the inlet of the gas turbine. As a result, hot gas ingestion is eliminated or effectively reduced, thus producing a much more robust design, which would be also easier and therefore cheaper to repair. In particular, with the design of the present invention, it is also possible to replace only a certain part of the combustor (for example only the inner liner or only the outer liner) on site, because no cutting and welding would be needed.

[0015] Further, reducing the slot between the combustor and the turbine makes it possible to improve the flow path aerodynamics of the transition between combustor and turbine.

[0016] According to an exemplary embodiment of the present invention, the first or the second part further includes a backwall for connecting the annular inner liner and the annular outer liner at the first axial burner end, the backwall comprising at least an hole for coupling a burner to the annular combustor.

[0017] According to another exemplary embodiment of the present invention, the annular combustor is an assembly of the first part, the second part, and at least a third part including:

- a backwall for connecting the annular inner liner and the annular outer liner at the first axial burner end, the backwall providing at least an hole for letting a gas including fuel and air inside the annular combustor,
- a third connection element for connecting the third part to a casing of the gas turbine engine.

[0018] According to the last two described embodiments, it is either possible that the annular combustor of the present invention is made part of two parts, one including the backwall, or is made of three parts, respectively including inner liner, outer liner and backwall. Advantageously, these variants give the possibility to adapt the combustor design of the present invention to the design of different gas turbine engines, for example gas turbine engines having different overall dimensions.

[0019] According to a further embodiment of the present invention, between the backwall and at least one of the inner liner and the annular outer liner a sealing is provided.

[0020] More particularly, the sealing may comprise at least a finger seal.

[0021] The sealing avoids leakages through the contacts between first, second and third part of the annular combustor at the backwall, i.e. where the first, second and third part contact each other.

[0022] According to another exemplary embodiment of the present invention, the annular inner liner and/or the annular outer liner comprise a plurality of effusion holes for letting compressed air to enter the combustor through the annular inner liner and /or the outer liner, in order to cool the annular inner liner and /or the outer liner, respectively.

[0023] According to yet another exemplary embodiment of the present invention, the annular inner liner and/or the annular outer liner comprises at least a cooling passage inside the liner. The cooling passage may be provided between two panels of the annular inner liner and/or of the annular outer liner, bonded together.

[0024] The effusion holes or the cooling passages provide the necessary cooling to the walls of the inner and outer liners.

[0025] According to a second aspect of the present invention, a gas turbine engine comprises a burner, a gas turbine and an annular combustor as above described, between the burner and the gas turbine.

[0026] According to a third aspect of the present invention, a gas turbine comprises an inlet section and at least one connection element adjacent to the inlet section for coupling with an annular combustor as above described.

Brief Description of the Drawings

[0027] 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.

Fig. 1 is a partial schematic view, sectioned along a longitudinal direction, of a gas turbine engine including a first embodiment of an annular combustor according to the present invention,

Fig. 2 is a partial schematic view, sectioned along a longitudinal direction, of a gas turbine engine including a second embodiment of an annular combustor according to the present invention,

Fig. 3 is a partial schematic view, sectioned along a longitudinal direction, of a gas turbine engine including a third embodiment of an annular combustor according to the present invention,

Fig. 4 is a partial schematic view, sectioned along a longitudinal direction, of a gas turbine engine including a fourth embodiment of an annular combustor according to the present invention,

Fig. 5 shows a magnified view of the detail V of figure 4.

Detailed Description

[0028] Hereinafter, above-mentioned and other fea-

tures of the present invention are described in details. Various embodiments are described with reference to the drawings, wherein the same reference numerals are used to refer to the same elements throughout. The illustrated embodiments are intended to explain, and not to limit the invention.

[0029] Figure 1 shows an example of a gas turbine engine 1 in a partial schematic sectional view.

[0030] The gas turbine engine 1 (not shown as a whole) comprises, in flow series, a compressor section 4 (not shown as a whole), a plurality of burners 2 (only one burner 2 shown in each of the section figures 1 to 4) an annular combustor 10 and a gas turbine 3, which are generally arranged in flow series within a casing 5.

[0031] The gas turbine engine 1 is generally arranged about a rotational axis X, which is the rotational axis for rotating components, in particular the compressor section 4 and the gas turbine 3. The rotational axis X is also coincident with the axis of symmetry of the annular combustor 10, when the annular combustor 10 is assembled to the gas turbine engine 1.

[0032] In operation of the gas turbine engine 1, air is compressed by the compressor section 4 and delivered to the combustion section, including the burner 2 and the annular combustor 10. The compressed air exiting from the compressor 4 and flowing towards the combustion section is schematically represented in the attached figures by arrows A. The compressed air enters the burner 2 where is mixed with a gaseous or liquid fuel. The air/fuel mixture is then burned and the combustion gas from the combustion is channelled through the combustion chamber 10 to the gas turbine section 1, for transforming the energy from the operative gas into working power. The combustion gas flows along the combustion chamber 10 along a main direction oriented from the burner 2 to the gas turbine 3. The combustion section 4 and the burner 2 are not a specific object of the present invention and, therefore, in the following, they will not be described in further detail.

[0033] In the following the terms radial, circumferential and axial are with respect to the rotational and symmetry axis X.

[0034] The annular combustor 10 extends axially between a first axial burner end 11 and a second axial outlet end 12 and radially between an annular inner liner 15 and an annular outer liner 16.

[0035] The annular combustor 10 further includes:

- a first part 21 including the annular inner liner 15 and a first connection element 31 for connecting the first part 21 to the gas turbine engine 1,
- a second part 22, distinct from first part 21, including the annular outer liner 16 and a second connection element 32 for connecting the second part 22 to the gas turbine engine 1,
- a backwall 25 for connecting the annular inner liner 15 and the annular outer liner 16 at the first axial burner end 11. The backwall 25 comprises a plurality of holes 26, distributed about the axis X, for coupling a plurality of respective burners 2 to the annular combustor 10.

[0036] According with the different embodiments of the present invention, at least one of the first connection element 31 and of the second connection element 32 is adjacent to the outlet end 12 of the combustor 10 and is connectable to a respective gas turbine connection element 17, 18 on the gas turbine 3, respectively radially inner and outer. The connection elements 17, 18 are adjacent to the inlet section 13 of the gas turbine 3.

[0037] Optionally, the annular combustor 10 further comprises a third part 23, distinct from first part 21 and from the second part 22. The third part 23 includes the backwall 25 and a third connection element 33 for connecting the third part 22 to the casing 5 of the gas turbine engine 1.

[0038] With reference to the embodiment of figure 1, the annular combustor 10 is an assembly of:

- the first part 21, with the first connection element 31 connecting the first part 21 to the inner connection element 17 of the gas turbine 3,
- the second part 22, with the second connection element 32 connecting the second part 22 to the outer connection element 18 of the gas turbine 3,
- the third part 23, with the third connection element 33 connecting the third part 23 to a casing connection element 35 on the casing 5.

[0039] The coupling between the first, second and third part 21, 22, 23 and the gas turbine 3 and the casing 5, respectively, is circumferentially distributed about the axis X. According to the different embodiments of the present invention, this may be obtained with circumferential elongated connection elements 31, 32, 33, 17, 18, 35. As an alternative each of the first part 21, second part 22 and third part 23 comprises a respective plurality of connection elements 31, 32, 33 to be coupled to a respective plurality of connection elements 17, 18 on the gas turbine 3 and of connection elements 35 on the casing 5.

[0040] With reference to the embodiment of figures 2 and 3, the third part 23 is not present and the backwall 25 is comprised in the first part 21 and in the second part 22, respectively. The annular combustor 10 of figure 2 is therefore an assembly of:

- the first part 21, including the annular inner liner 15 and the backwall 25, with the first connection element 31 connecting the first part 21 to the casing connection element 35,
- the second part 22, with the second connection element 32 connecting the second part 22 to the outer connection element 18 of the gas turbine 3.

[0041] The coupling between the first and the second

part 21, 22 and the casing and 5 the gas turbine 3, respectively, is circumferentially distributed about the axis X. According to the different embodiments of the present invention, this may be obtained with circumferential elongated connection elements 31, 32, 18, 35. As an alternative each of the first part 21 and second part 22 comprises a respective plurality of connection elements 31, 32 to be coupled to a respective plurality of casing connection elements 35 and of outer connection elements 18 on the gas turbine 3.

[0042] The annular combustor 10 of figure 3 is instead an assembly of:

- the first part 21, with the first connection element 31 connecting the first part 21 to the inner connection element 17 of the gas turbine 3,
- the second part 22, including the annular outer liner 16 and the backwall 25, with the second connection element 32 connecting the second part 22 to the casing connection element 35.

[0043] The coupling between the first and the second part 21, 22 and the gas turbine 3 and the casing 5, respectively, is circumferentially distributed about the axis X. According to the different embodiments of the present invention, this may be obtained with circumferential elongated connection elements 31, 32, 17, 35. As an alternative each of the first part 21 and second part 22 comprises a respective plurality of connection elements 31, 32 to be coupled to a respective plurality of inner connection elements 17 on the gas turbine 3 and of casing connection elements 35.

[0044] In all the embodiments above described, the couplings between the first, second and third part 21, 22, 23 and the gas turbine 3 and/or the casing 5 are detachable and may performed by means of screw (or other threaded connection) and/or bolts. This allows connecting and disconnecting each part 21, 22, 23 of the annular combustor 10 independently from the others.

[0045] In all embodiments, the mounting of the first, second and third part 21, 22, 23 in the gas turbine engine is made in such a way that the outlet end 12 of the annular combustor 10 is mounted adjacent to the inlet section 13 of the gas turbine 3. This avoids or limits hot gas leakages when hot gases from the annular combustor 10 enter the gas turbine 3.

[0046] The first, second and third part 21, 22, 23 contact each other along the edges of the backwall 25. To avoid leakages through the contacts between first, second and third part 21, 22, 23, a sealing 40 is provided between the backwall 25 and at least one of the inner liner 15 and the annular outer liner 16.

[0047] In the embodiments of the attached figures 1 to 4, the sealing 40 comprises an inner finger seal 41 between the backwall 25 and the inner liner 15 and/or an outer finger seal 42 between the backwall 25 and the outer liner 16.

[0048] In the embodiment of figures 1 and 4, where the first, second and third part 21, 22, 23 are present, both the inner and outer finger seals 41, 42 are present.

[0049] In the embodiment of figure 2, where the backwall 25 is integrated in the first part 21 of the annular combustor 10, only the outer finger seal 42 is present.

[0050] In the embodiment of figure 3, where the backwall 25 is integrated in the second part 22 of the annular combustor 10, only the inner finger seal 41 is present.

[0051] According to other embodiments of the present invention, other sealing devices may be used between the parts 21, 22, 23 of the annular combustor 10, in order to avoid hot gas leakages between the backwall 25 and the inner liner 15 and/or between the backwall 25 and the outer liner 16.

[0052] In the embodiment of figures 1 to 3, the annular inner liner 15 and the annular outer liner 16 comprise a plurality of effusion holes 50 for letting compressed air (represented by arrows A) to enter the combustor 1) through the walls of the annular inner liner 15 and the outer liner 16, in order to cool the annular liners 15 and 16, respectively.

[0053] The embodiment of figure 4 is similar to the embodiment of figure 1, i.e it comprises the first, second and third parts 21, 22, 23 of the annular combustor independently attached to the gas turbine 3 and to the casing 5. The embodiment of figure 4 is different from the embodiment of figure 1 for the fact that the annular inner liner 15 and the annular outer liner 16 comprises one or more cooling passages 60 inside the respective liner 15, 16, for providing cooling by letting a flow of compressed air A enter the annular combustor 10 through the cooling passages 60. Each cooling passage 60 is obtained inside the walls of the annular inner liner 15 and the annular outer liner 16 by means of at least two panels 61, 62, respectively internal (i.e. facing the inner volume of the combustor 10, where hot gasses flow) and external (i.e. facing a volume external to the combustor 10, where compressed air A from the compressor 4 flows). Each cooling passage 60 comprises an inlet 63, through which compressed air A enters the passage 60, and an outlet 64, through which compressed air A exits the passage 60 to enter the annular combustor 10.

[0054] According to other embodiments (not shown) of the present invention, mixed solutions are possible:

- the annular liners 15, 16 comprise both effusion holes 50 and cooling passages 60, for example on different zones of the annular liners 15, 16,
- one of the annular liners 15, 16 comprises effusion holes 50, while the other comprises cooling passages 60.

Claims

1. An annular combustor (10) for a gas turbine engine (1), the annular combustor (10) axially extending between a first axial burner end (11) and a second axial

outlet end (12), the annular combustor (10) radially extending between an annular inner liner (15) and an annular outer liner (16), the annular combustor (10) being at least an assembly of:

- a first part (21) including the annular inner liner (15) and a first connection element (31) for connecting the first part (21) to the gas turbine engine (1),
- a second part (22) including the annular outer liner (16) and a second connection element (32) for connecting the second part (22) to the gas turbine engine (1),
- at least one of the first connection element (31) and of the second connection element (32) being adjacent to the outlet end (12) of the combustor (10).

2. The annular combustor (10) according to claim 1, wherein the first (21) or the second part (22) further includes a backwall (25) for connecting the annular inner liner (15) and the annular outer liner (16) at the first axial burner end (11), the backwall (25) comprising at least an hole (26) for coupling a burner to the annular combustor (10).

3. The annular combustor (10) according to claim 1, wherein the annular combustor (10) is an assembly of the first part (21), the second part (22), and at least a third part (23) including:

- a backwall (25) for connecting the annular inner liner (15) and the annular outer liner (16) at the first axial burner end (11), the backwall (25) providing at least an hole (26) for letting a gas including fuel and air inside the annular combustor (10),
- a third connection element (33) for connecting the third part (22) to a casing of the gas turbine engine (1).

4. The annular combustor (10) according to claim 2 or 3, wherein between the backwall (25) and at least one of the inner liner (15) and the annular outer liner (16) a sealing (40) is provided.

5. The annular combustor (10) according to claim 4, wherein the sealing comprises at least a finger seal (41, 42).

6. The annular combustor (10) according to any of the claims 2 to 5, the annular inner liner (15) and/or the annular outer liner (16) comprise a plurality of effusion holes (50) for letting compressed air to enter the combustor (10) through the annular inner liner (15) and /or the outer liner (16), in order to cool the annular inner liner (15) and /or the outer liner (16), respectively.

7. The annular combustor (10) according to any of the claims 2 to 5, the annular inner liner (15) and/or the annular outer liner (16) comprises at least a cooling passage (60) inside the liner.

8. The annular combustor (10) according to claim 7, wherein the cooling passage (60) is provided between two panels (61, 62) of the annular inner liner (15) and/or of the annular outer liner (16), bonded together.

9. A gas turbine engine (1) comprising a compressor (4), a gas turbine (3), a burner (2), and an annular combustor (10) according to any of the previous claims, between the burner (2) and the gas turbine (3).

10. A gas turbine engine (1) according to claim 9, wherein the gas turbine (3) comprises an inlet section (13) and at least one connection element (17, 18) adjacent to the inlet section (13) for coupling with at least one of the first connection element (31) and the second connection element (32) of the annular combustor (10).

11. A gas turbine engine (1) according to claim 9 or 10, further including a casing (5) with a further connection element (35) for coupling with one of the first or second or the third connection element (31, 32, 33) of the annular combustor (10).

12. A gas turbine engine (1) according to claim 10 or 11, wherein at least one of said couplings of the first, second or third connection element (31, 32, 33) is of the threaded type.

13. A gas turbine engine (1) according to any of the claims 9 to 12, wherein the outlet end (12) of the annular combustor (10) is mounted adjacent to the inlet section (13) for avoiding or limiting leakages of hot gases when hot gases from the annular combustor (10) enters the gas turbine (3).

14. A gas turbine (3) for a gas turbine engine (1) comprising an inlet section (13) and at least one connection element (17, 18) adjacent to the inlet section (13) for coupling with at least one of the first connection element (31) and the second connection element (32) of an annular combustor (10) according to any of the claims 1 to 8.

FIG 1

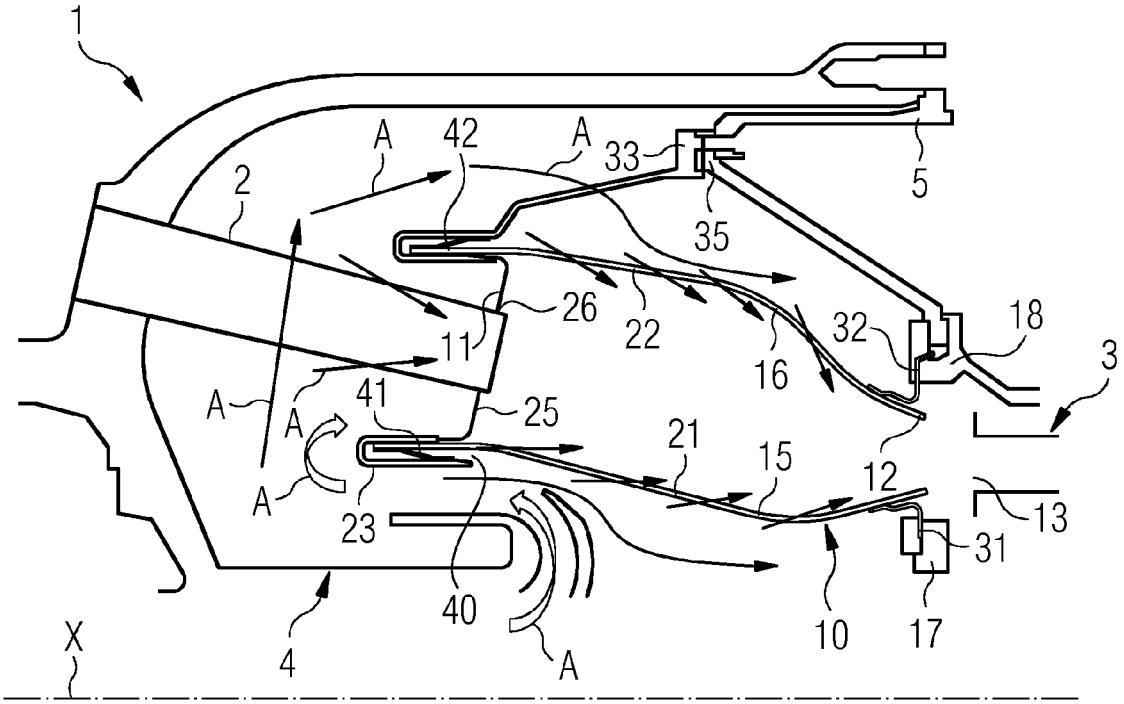

1
A
42
A
33
5
2
35
26
22
18
32
11
16
3
A
41
25
21
15
12
A
A
23
13
31
40
10
17
X
4
A

FIG 2

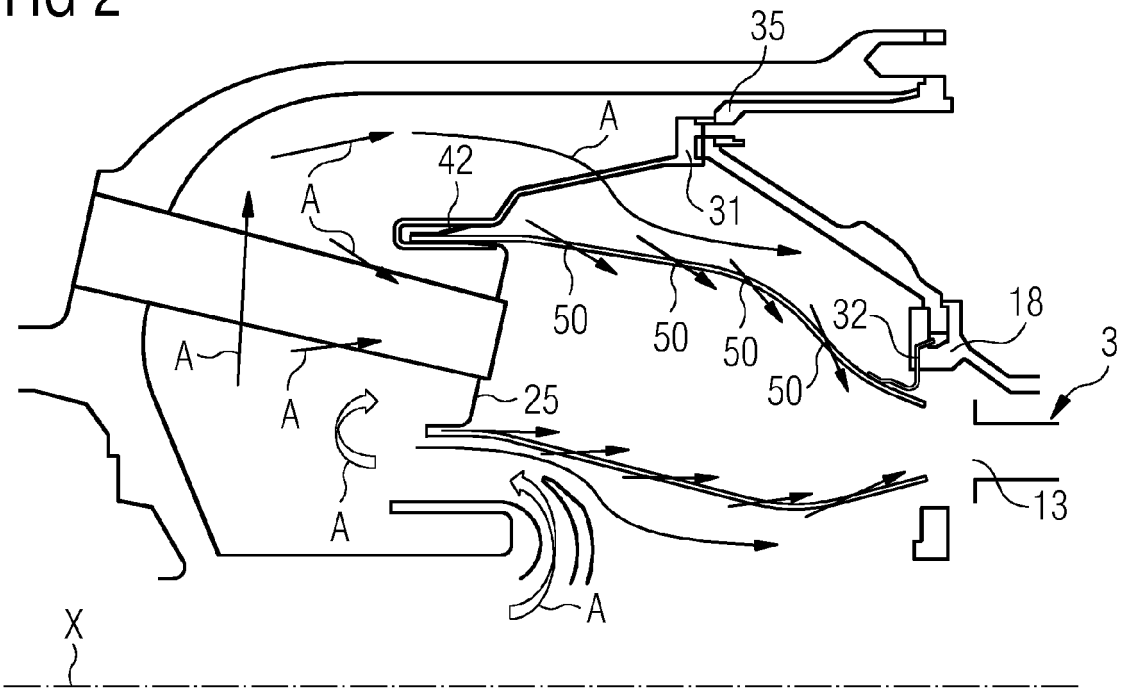

35
A
42
A
31
50
50
50
50
32
18
3
A
A
25
A
13
X
A

FIG 3

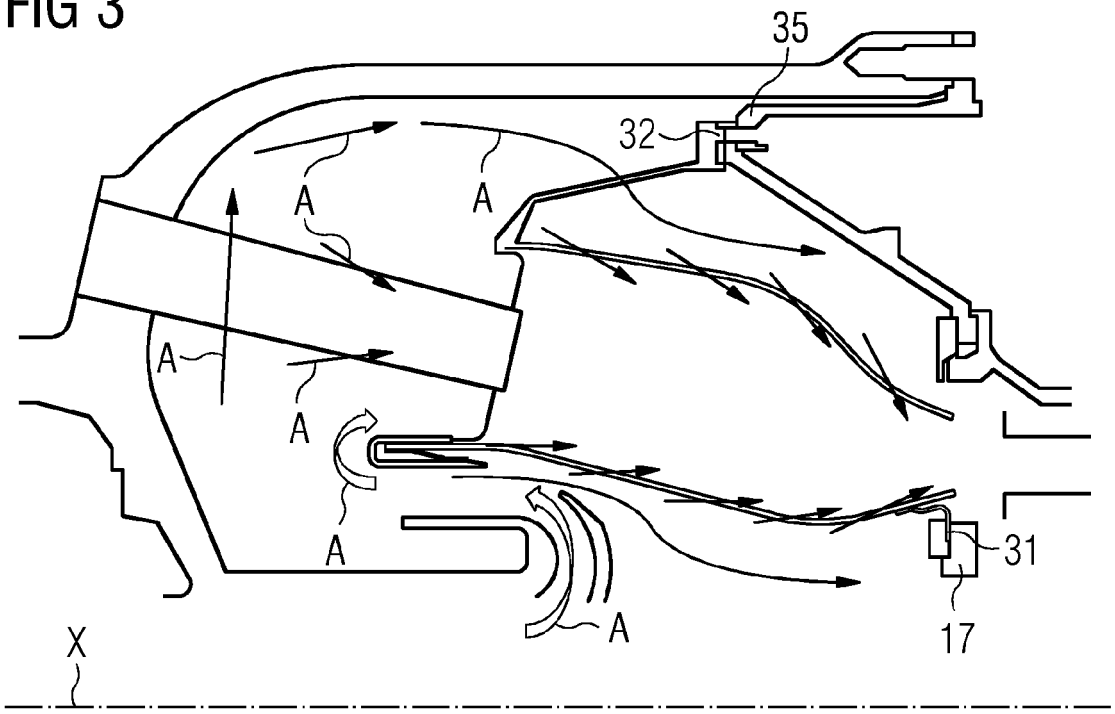


FIG 4

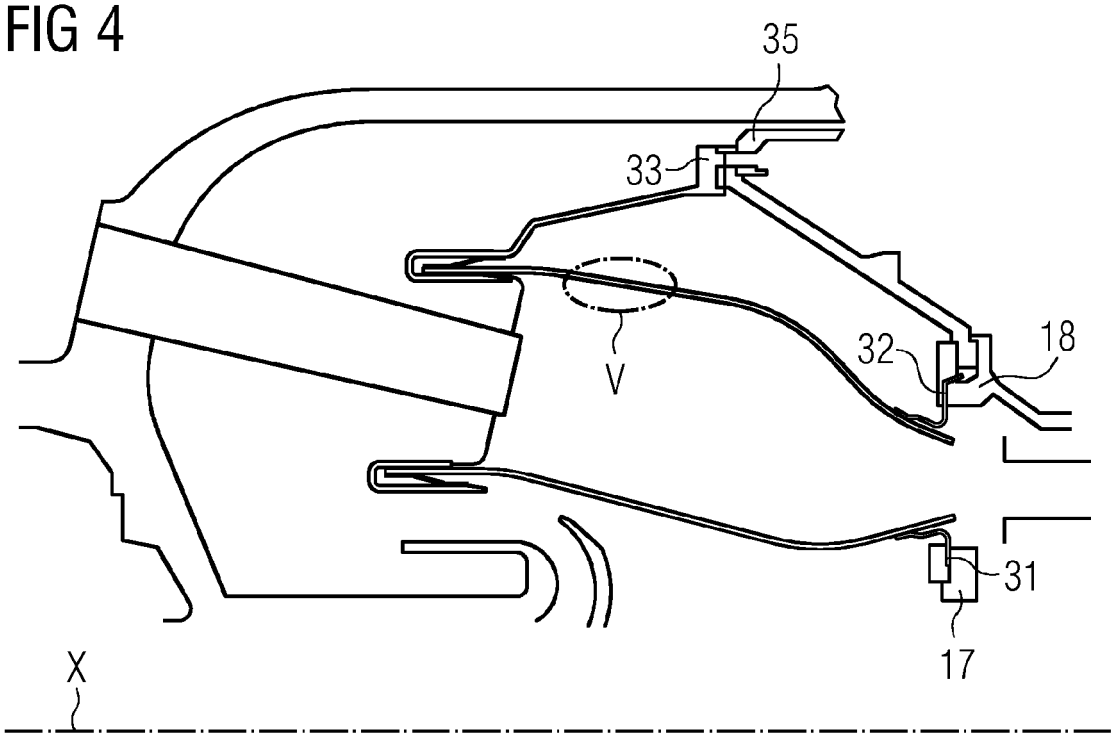
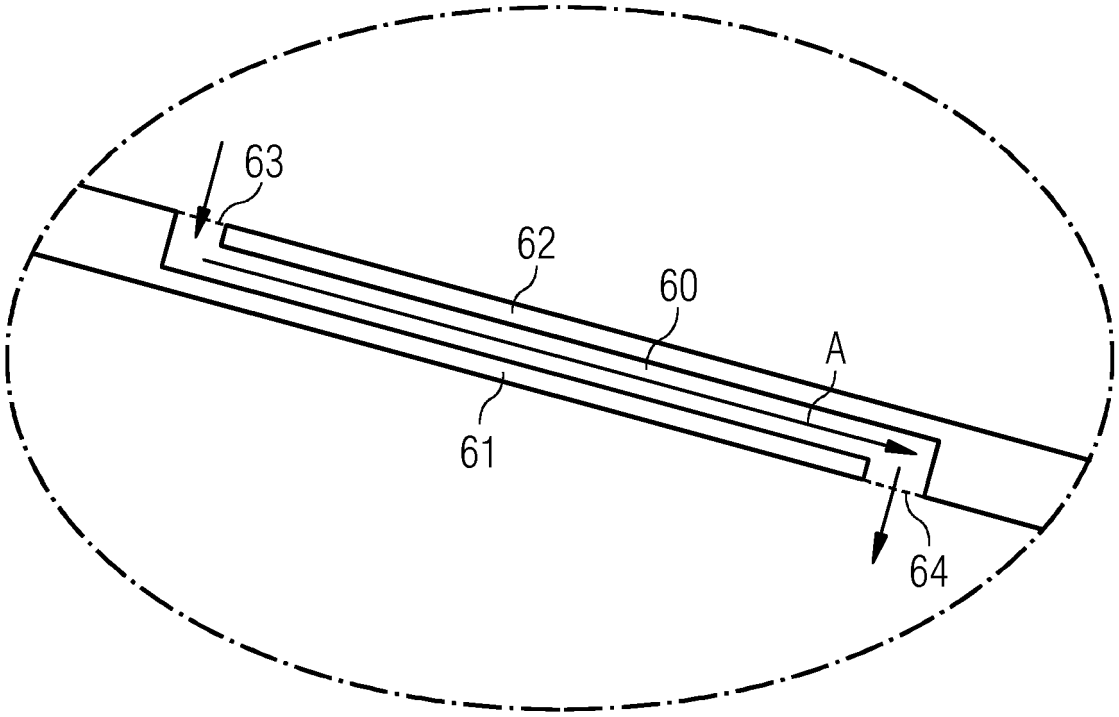


FIG 5



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 16 2999

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	GB 1 578 474 A (GEN ELECTRIC) 5 November 1980 (1980-11-05) * page 2, line 25 - page 3, line 70; figures 1-3 * -----	1,2,9-14 3	INV. F23R3/60 F23R3/00

TECHNICAL FIELDS SEARCHED (IPC)

F23R

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

Place of search	Date of completion of the search	Examiner
Munich	11 September 2015	Theis, Gilbert

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application Number
EP 15 16 2999

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

"see additional sheet(s)"

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

Europäisches Patentamt
European Patent Office
Office européen des brevets

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 15 16 2999

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3, 9-14

   An annular combustor is an assembly of the first part, the second part, and at least a third part including a backwall and a third connection element for connecting the third part to a casing of the gas turbine engine.

   ---

2. claims: 4, 5

   An annular combustor wherein between the backwall and at least one of the inner liner and the annular outer liner a sealing is provided.

   ---

3. claim: 6

   An annular combustor wherein the annular inner liner and/or the annular outer liner comprise a plurality of effusion holes for letting compressed air to enter the combustor through the annular inner liner and /or the outer liner, in order to cool the annular inner liner and /or the outer liner.

   ---

4. claims: 7, 8

   An annular combustor wherein the annular inner liner and/or the annular outer liner comprises at least a cooling passage inside the liner.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 16 2999

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-09-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1578474 A	05-11-1980	DE 2711564 A1	29-12-1977
		FR 2356000 A1	20-01-1978
		GB 1578474 A	05-11-1980
		JP S52156213 A	26-12-1977

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82