The gas flow in this case can be directed towards the axis of rotation as well as away from the axis of rotation.

The combustion device (1) with rotary combustion chamber (4). Specific measures are taken to provide ignition of a combustible mixture. It is proposed that a hollow tube be provided coaxially with the axis of rotation (6), so that a small part of the mixture is guided into the combustion chamber. At the position of said axis of rotation (6) the mixture is ignited (8), and said ignition extends to the combustion chamber (4). For stabilization of the flame in the combustion chamber flame stabilization means (17, 27, 37, 47, 57, 67) are used. The flame stabilization means can comprise heat distribution means, (37, 47, 57) such as spokes, ribs, scales and the like. It is also possible to supply external heat (17). Another option is to provide a radiator (67). In order to promote the combustion, it is also possible to arrange for the combustion chamber to extend radially relative to the axis of rotation. The combustion gas flow in this case can be directed towards the axis of rotation as well as away from the axis of rotation.
Rotary combustion device

The present invention relates to a rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation and is connected to said annular combustion chamber, and a turbine/outlet/nozzle which is provided near the outer circumference of said combustion chamber.

Such a rotary combustion device is disclosed in WO 2004/076853 A1 in the name of Micro Turbine Technologie B.V. This publication describes a combustion device in the form of a reaction turbine which can be of an extremely compact design and can be used, for example, in combination with heating appliances and/or as an independent generator in mobile applications such as ships, lorries and trains. This reaction turbine is characterized by a combustion chamber rotating at high speeds of rotation.

For certain applications, such as the abovementioned use with heating appliances, it is necessary to switch the reaction turbine on and off regularly. In other words, if the reaction turbine is driven by exhaust gases from combustion in its combustion chamber, regular ignition of a combustible mixture in the combustion chamber is necessary.

It must be understood that the rotary combustion device described here can likewise be in the form of a turbine for performing a Rankine cycle, for example an organic Rankine cycle with condensation and evaporation.

In view of the high speed of rotation of the reaction turbine, it has been found that ignition of a gas mixture in a rapidly rotating chamber is not easy.

In addition, there is the problem that once the mixture has been ignited the combustion must be maintained.

It is the object of the present invention to provide a rotary combustion device with flame stabilization, so that it can always be ensured that the mixture which is supplied to the combustion chamber is ignited and optimum combustion constantly occurs.

This object is achieved in a combustion device of the type described above in that combustion stabilization means are provided in said combustion chamber, said combustion stabilization means comprising a part of said combustion chamber extending substantially radially relative to said axis of rotation, provided in such a way
relative to said inlet and outlet that the end of said part of said combustion chamber connected to the inlet lies at a shorter or greater distance from said axis of rotation than the part of said combustion chamber connected to the outlet. The flow of the gas here can be directed towards the axis of rotation as well as away from it. In particular, it is preferable for the flow to move towards the axis because the flame can be stabilized better in this way. According to a specific embodiment of the present invention, the rotary combustion device is in the form of a reaction turbine with a turbine wheel provided so that it can rotate about the axis of rotation, which turbine wheel contains an inlet provided near said axis of rotation, a compressor extending from said inlet in the direction of the circumference of the turbine wheel, a rotary combustion chamber connecting to said compressor, and a turbine/outlet/nozzle provided so that it connects to the combustion chamber near the circumference of said turbine wheel.

It will be understood that the abovementioned problems of unstable combustion, in particular at high speeds of rotation of the combustion chamber, are due to various physical circumstances. In this context are mentioned coriolis effects, centrifugal forces and cooling effects. It should be understood that further effects are present and that whether or not theories relating to these effects are correct does not affect the scope of protection of the invention.

According to a further embodiment of the invention, separate combustion stabilization means are provided. Since the construction described above is such that it inherently provides a more stable combustion. The individual combustion stabilization means to be described below are aids for stabilizing the combustion. They can comprise ignition means which are provided outside the combustion chamber.

According to this variant of the invention, the ignition means are provided outside the combustion chamber. This leads to a certain delay occurring in the start of the combustion in the turbine relative to the moment when the ignition is initiated in the combustion chamber.

According to a specific variant of the invention, it is possible to provide the ignition means in the compressor part lying upstream of the combustion chamber. This means that the free radicals which at a later stage lead to the reaction of the gas with oxygen (air) under optimum conditions in the combustion chamber are already generated in the compressor.

According to a further advantageous embodiment of the invention, the initiation
of the ignition at a distance from the combustion chamber is achieved in that a small part of the mixture, such as, for example, approximately 5 volume %, is ignited at a distance, and this mixture is fed to the combustion chamber. The composition of the mixture fed through the separate line can deviate from the composition of the mixture present in the combustion chamber (for example 95 volume %).

According to a further variant, such a line through which combustible mixture is fed at least partially to the combustion chamber is provided so as to be at least partially coaxial with the axis of rotation. In this coaxial part ignition can be achieved in a particularly simple manner.

According to a further advantageous embodiment, it is possible to produce the ignition mechanism between the inside wall and outside wall of the combustion chamber. Ignition is achieved by generating a spark between said two conducting parts. The static electricity required for this can be generated by means of the rotation of the turbine.

The ignition means can comprise a spark plug and corresponding electric circuit. Igniting in a simple manner can also be important in situations in which the combustion is not stable and fails. However, in such situations it is preferable to provide combustion-stabilizing means. Depending on the fuel used and other circumstances, problems can be expected, in particular at high speeds of rotation of a rotary combustion chamber. These problems can be complete failure of the combustion or the occurrence of pulses, flame backfire and the like.

According to a further aspect of the present invention, it is proposed to provide a reaction turbine with rotary combustion chamber in which the combustion chamber is provided with combustion-stabilizing means. It has been found that, inter alia, combustion fails primarily in the part of the combustion chamber which is furthest away from the axis of rotation of the combustion chamber. According to a first approach to the present invention, the combustion in the combustion chamber is stabilized by heating the part concerned. This results in the temperature gradient in the combustion chamber being reduced. This heating can be achieved by supplying external heat to, for example, the combustion chamber, for example by making use of the warm exhaust gases. The external supply can also come from a stationary heat source. Another option is to distribute the heat over the combustion chamber or displace heat from the centre of rotation to the outer circumference of the combustion
chamber. Heat-conducting elements, such as ribs, scales, spokes and the like, can be present in the combustion chamber, which heat-conducting elements transport heat from the part of the combustion chamber closest to the axis of rotation to the part furthest from the axis of rotation and in addition provide for turbulence, so that the flame can stabilize.

Another possibility is to provide a radiating body in the region of the axis of rotation. This body radiates a second body, which is situated in the region of the fuel inlet of the combustion chamber. In this way a stable ignition source is created.

Other possibilities are to provide a coating either in the combustion chamber or in the compressor situated upstream of the combustion chamber, such as thermal barrier coatings. It is also possible to provide a porous object, such as a porous ceramic material part, metal foam or interwoven metal fibres, in the combustion chamber. It has been found that such a porous material part, on the one hand, distributes heat and, on the other hand, prevents disappearance of ignition-promoting radicals.

Another approach is to prevent flame backfire. This can be achieved by providing material at the beginning of the combustion chamber. Examples are a porous, readily permeable material such as foam ceramic, metal foam, or gauze mats of thin metal fibres. Through the use of such materials, a more homogeneous flame can be obtained. Coriolis effects are also avoided. Such a material is preferably positioned at the transition between the compressor channel and the combustion chamber. The combustion chamber can also be filled with this material, in which case the combustion occurs in the material.

It should be understood that these measures for stabilizing the combustion in the combustion chamber and/or preventing flame backfire are separate from the measures described above for optimizing the ignition. Of course, these measures may be combined if desired. For instance, it is possible to achieve the ignition in another way. Examples are to heat the external wall or to heat in another way, so that the self-ignition temperature of the fuel is achieved. Another possibility is a spark ignition in the combustion chamber and finally a flame can be drawn by the compressor.

It will be understood that the individual measures described above to stabilize the combustion or to prevent flame backfire can be used in addition to or independently of the invention described in the preamble, the combustion-stabilizing means comprising the positioning of at least a part of the combustion chamber substantially perpendicular
to the axis of rotation of the rotary combustion device. It should be understood that
express protection is being requested for the different variants individually without
combination with a combustion chamber designed in this way.

The invention will be explained in greater detail below with reference to an
exemplary embodiment shown in the drawing, in which:

Fig. 1 shows diagrammatically an example of an ignition mechanism according to
the present invention;

Fig. 2 shows diagrammatically a first embodiment of combustion stabilization
means;

Fig. 3 shows a second embodiment of combustion stabilization means;

Figs 4a-b show a third embodiment of combustion stabilization means;

Fig. 5 shows a fourth embodiment of combustion stabilization means;

Figs 6a-b show a further embodiment of combustion stabilization means;

Fig. 7 shows a further embodiment of combustion stabilization means;

Fig. 8 shows yet a further embodiment of combustion stabilization means;

Figs 9a, b show special embodiments of the combustion chamber;

Fig. 10 shows a variant of the combustion chamber of Fig. 9;

Figs 11a-c show diagrammatic variants of the combustion chamber shown in Fig. 9;

Fig. 12 shows a further variant of the combustion chamber;

Fig. 13 shows a variant with a central combustion chamber;

Fig. 14 shows a variant according to Claim 12 with special fuel supply; and

Fig. 15 shows a variant of the construction according to Fig. 13 with modified
compressor.

The various figures show very diagrammatically a reaction turbine. It will be
understood that in the case of the embodiment used in practice numerous adaptations and
further construction details can be present.

In general, such a combustion turbine, such as is shown, for example, in Fig. 1 and
indicated in its entirety by 1, consists of an inlet 2, a compressor part 3, a combustion
chamber 4 and an outlet 5. Only "half" of a reaction turbine is shown in the figures, and
the reaction turbine rotates about an axis 6. It will be understood that the compressor part
can be designed in any conceivable way. It can be segmented or otherwise and can consist
of channels extending to and from. The same applies to the combustion chamber 4.

The term outlet should be understood as meaning both the turbine part and the
nozzles and the like. For further details reference is made to the abovementioned PCT application WO 2004/076835. It should be understood, however, that other embodiments of the reaction turbine are also possible.

In the embodiment according to Fig. 1 the aim is to start off the ignition in the combustion chamber in as simple a manner as possible.

For this purpose, the combustion chamber 4 is connected not only to the compressor 3, but also to a line 7. The line 7 extends partially coaxially with the axis of rotation 6. The line 7 has an igniter, such as a spark plug 8, provided in it. It will be understood that if the reaction turbine, and more particularly the combustion chamber, is rotating at high speed such a speed is much lower or even zero at the igniter 8.

In this way a spark can be generated in an operationally reliable and simple manner.

According to the present invention, for the ignition a mixture of the gas and air (oxygen) for combustion is then passed through the line. The composition of this mixture is such that the radicals produced by the igniter during the ignition are maintained as much as possible or even increase in order to be able to initiate the ignition in combustion chamber 4.

Once the ignition has occurred, it is important for it to be maintained. In particular, at very high speeds at which extreme turbulence occurs and the flame speed has to be greater than 0.5 m/s, it is necessary to take measures to stabilize the flame.

Figures 2—7 show different proposals which can possibly be used in combination with each other, in combination with the construction shown in Fig. 1 or otherwise, for ignition of the mixture and flame stabilization.

The reaction turbine shown in Fig. 2 is indicated in its entirety by 11. The reaction turbine is provided with an inlet 12, a compressor 13, a combustion chamber 14, and an outlet 15, and the entire unit rotates about axis 16.

In this variant an external burner 17 is present. Said burner can be provided so as to be stationary, and the external surface of the combustion chamber 14 is heated by the radiation indicated by the arrows from burner 17. Through this heating it is easier to maintain the combustion near the outer circumference. Said burner 17 can also be used to initiate the combustion and/or to maintain the combustion in the turbine solely with said burner, or to operate the turbine on external combustion alone.

Fig. 3 shows an embodiment of the reaction turbine wheel which is indicated in its entirety by 21. The inlet is indicated by 22 here, the compressor by 23, combustion
chamber by 24 and outlet by 25. The rotation occurs about axis 26. The wall of the combustion chamber 24 lying near the axis of rotation 26 is indicated by 27 and is of a substantially flat design, and is preferably provided with a coating for generating free radicals. The coating 27 is preferably level with the outlet of the compressor, i.e. is not staggered in the direction towards the axis, which further promotes the stabilization.

Figs 4a-b show a reaction turbine 31 with inlet 32, compressor 33, combustion chamber 34 and outlet 35. The axis of rotation is indicated by 36. It is apparent that spokes or ribs 37 are present in the combustion chamber, which spokes or ribs extend radially from the wall of the combustion chamber 34 closest to the axis of rotation 36 to the external wall of the chamber 34. As is clear from a comparison of Figs 4a-b, the spokes or ribs are in the form of round or rectangular ribs which cover only a part of the surface and along/between which the mixture can move. Of course, the spokes or ribs can also be directed differently. This applies, for example, if external heat is supplied.

In the variant shown in Fig. 5 the reaction turbine is indicated in its entirety by 41 and has an inlet 42, a compressor 43, a combustion chamber 44 and an outlet 45. In this specific embodiment the internal wall of the combustion chamber 44, i.e. the part which lies closest to the axis of rotation 46, is provided with elevations or scales.

Figs 6a, 6b show a variant of the reaction turbine which is indicated in its entirety by 51 and is provided with an inlet 52, a compressor 53, a combustion chamber 54 and an outlet 55. The axis of rotation is indicated by 56. An annular porous structure 57, details of which are apparent from Fig. 6b, is provided in the combustion chamber 54. The structure is preferably a ceramic material or metal foam provided with a ceramic coating which, on the one hand, provides for heat distribution and, on the other hand, by the provision of, for example, catalytic material, facilitates the generation or maintenance of radicals.

A further variant is shown in Fig. 7. The reaction turbine is indicated by 61 and provided with inlet 62, compressor 63, combustion chamber 64 and outlet 65, all rotating about axis 66. The combustion chamber contains a radiation body 67 and a receptor 68 which is heated under the influence of the radiation and thereby provides for stabilization of the combustion. Of course, the receptor and the radiation body can be some part of the combustion chamber.

Fig. 8 shows yet a further variant of the combustion chamber means. This variant is indicated in its entirety by 141 and partially corresponds to the construction described with reference to Figs 1 - 7, i.e. with an inlet 142 and a compressor 143. The combustion
chamber is indicated by 144, and between the combustion chamber 144 and the compressor is a block of ceramic foam material 147 which serves to prevent backfire of the flame as much as possible and is indicated by 145. In addition, a blocking ring 146 is present, which ring, like the combustion chamber 144, extends in annular form around the axis of rotation 147. Reference numeral 148 indicates a flame-stabilizing coating. The gas coming out of the combustion chamber 144 goes into the nozzle 149, which is situated in a heat shield or shroud 150. There the gas is conveyed back. The dividing wall is provided with an insulating material 151.

Figs 9 - 12 show other ways of stabilizing the combustion in the combustion chamber. Here the combustion chamber and combustion direction are designed to be radial, or partially radial.

For instance, in the embodiment according to Fig. 9a, the reaction turbine is indicated by 71 and has an inlet 72 and a compressor 73 lying at a radial distance from it, with a combustion chamber 74 then lying at a radial distance from said compressor, to which combustion chamber a turbine 75 including nozzle connects radially. Reference numeral 78 shows a flame backfire block 78, preferably made of ceramic material, and more particularly ceramic or metal foam material. Reference numeral 80 indicates a bearing, and 79 indicates a generator. It will be understood that the reaction turbines described above can be connected to any further construction, such as generators.

Fig. 9b shows only a part of a variant of Fig. 9a. This reaction turbine is indicated by 171 and is in the form of a disc turbine. Reference numeral 173 indicates the compressor channel, and 174 indicates the combustion chamber. The flame backfire block is indicated by 178, and the nozzle or outlet by 179.

Fig. 10 shows a reaction turbine 81 with inlet 82. A compressor is indicated by 83. A return flow channel 87 is connected to the compressor, followed by a combustion chamber 84 extending radially away from the axis 76. The outlet part, consisting of turbine and nozzles 85, is situated radially on the end of the combustion chamber.

Fig. 11a shows a construction which is based on the principle according to Figs 9 and 10, and the turbine wheel is indicated by 91 here. The latter is provided with an inlet 92, a radial compressor 93, and a combustion chamber 94. Unlike the earlier example, the direction of flow of the gas, as can be seen from the direction of the arrow, is towards the axis 96. An outlet 95 with turbine and nozzles is connected to the combustion chamber 94. Figures 11b and 11c are specific embodiments, in which the combustion occurs as far as
possible on the outside of the rotary device, where the pressure is highest. In Figure lib there is radial outflow of the hot gases at the nozzles, while in Figure Hc there is tangential outflow of the hot gases at the nozzles.

Fig. 12 shows a variant in which the turbine wheel is indicated by 101 and is provided with an inlet 102, a compressor 103 and a combustion chamber 104. As in the case of the embodiment according to Fig. 11, the direction of movement of the gas is towards the axis 106. The outlet part is shown by 105.

Fig. 13 illustrates a variant in which the turbine wheel is indicated by 111. The inlet 112 is situated on the outer circumference of the turbine wheel. The combustion chamber is indicated by 114 and is very centrally situated. It has been found that the more the combustion chamber is taken towards the centre 116 of the turbine wheel, the fewer problems with the irregular or interrupted combustion occur. The outlet is indicated by 115.

The variant shown in Fig. 14, which is indicated in its entirety by 121, air is likewise introduced near the circumference 122 into combustion chamber 124, which comprises the axis 126. Fuel is supplied fully or partially by way of a separate line 129 in the direction of the axis 126. The outlet is indicated by 125.

Finally, Fig. 15 shows a variant in which the inlet 132 of the device 131 is situated near the axis 136. Following it, a compressor 133 is present, after which the combustion chamber 134 and outlet 135 follow in the manner described above.

It will be understood that in the variants according to Figs 13 - 15 it is possible to arrange for only a part of the combustion chamber to comprise the axis of rotation.

It is clear from the above that the various inventive ideas mentioned here can be embodied in a large number of ways. After reading about the above embodiments, further variants, which lie within the scope of the claims, will immediately spring to mind in the case of the person skilled in the art.

In addition, rights are expressly requested for embodiments which are described in the subclaims independently of the main claim. This applies in particular to the combustion-stabilizing means and the radial design of the combustion chamber.
Claims

1. Rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation and is connected to said annular combustion chamber, and a turbine/outlet/nozzle which is provided near the outer circumference of said combustion chamber, characterized in that combustion stabilization means (17, 27, 37, 47, 57, 67) are provided in said combustion chamber (14, 24, 34, 44, 54, 64), said combustion stabilization means comprising a part of said combustion chamber (74, 84, 94, 104) extending substantially radially relative to said axis of rotation (6), provided in such a way relative to said inlet (2) and outlet that the end of said part of said combustion chamber connected to the inlet lies at a shorter or greater distance from said axis of rotation than the part of said combustion chamber connected to the outlet.

2. Rotary combustion device according to Claim 1, comprising a reaction turbine (1) with a turbine wheel provided so that it can rotate about said axis of rotation (6), which turbine wheel contains an inlet (2) provided near said axis of rotation, a compressor (3) extending from said inlet in the direction of the circumference of the turbine wheel, a rotary combustion chamber (4) connecting to said compressor, and a turbine/outlet/nozzle provided so that it connects to the combustion chamber near the circumference of said turbine wheel.

3. Rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation and is connected to said annular combustion chamber, and a turbine/outlet/nozzle which is provided near the outer circumference of said combustion chamber, characterized in that combustion stabilization means (17, 27, 37, 47, 57, 67), comprising heat distribution means (37, 47, 57), are provided in said combustion chamber (14, 24, 34, 44, 54, 64).

4. Rotary combustion device according to Claim 3, in which said heat distribution means comprise heating means (17), which are designed to heat the part of said combustion chamber lying nearest to the circumference.

5. Rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation and is connected to said annular combustion chamber, and a turbine/outlet nozzle
which is provided near the outer circumference of said combustion chamber, characterized in that combustion stabilization means (17, 27, 37, 47, 57, 67) are provided in said combustion chamber (14, 24, 34, 44, 54, 64), said combustion stabilization means comprising a coating (27) on the wall of said combustion chamber.

6. Rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation and is connected to said annular combustion chamber, and a turbine/outlet/nozzle which is provided near the outer circumference of said combustion chamber, characterized in that combustion stabilization means (17, 27, 37, 47, 57, 67) are provided in said combustion chamber (14, 24, 34, 44, 54, 64), said heat distribution means comprising bodies (37, 47) extending radially relative to said axis of rotation (36, 46).

7. Rotary combustion device according to Claim 6, in which said bodies (47) extend from the wall closest to the axis of rotation (46) of the combustion chamber up to a distance from the wall of the combustion chamber (44) nearest to the circumference.

8. Rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation and is connected to said annular combustion chamber, and a turbine/outlet/nozzle which is provided near the outer circumference of said combustion chamber, characterized in that combustion stabilization means (17, 27, 37, 47, 57, 67) are provided in said combustion chamber (14, 24, 34, 44, 54, 64), said heat distribution means comprising a radiator (67) provided in the combustion chamber.

9. Rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation and is connected to said annular combustion chamber, and a turbine/outlet/nozzle which is provided near the outer circumference of said combustion chamber, characterized in that combustion stabilization means (17, 27, 37, 47, 57, 67) are provided in said combustion chamber (14, 24, 34, 44, 54, 64), said heat distribution means comprising porous gas-permeable material (57).

10. Rotary combustion device according to Claim 9, in which said part (57) is annular.

11. Rotary combustion device comprising an annular combustion chamber which is rotatable about an axis of rotation, an inlet which is provided near said axis of rotation
and is connected to said annular combustion chamber, and a turbine/outlet/nozzle which is provided near the outer circumference of said combustion chamber, characterized in that combustion stabilization means (17, 27, 37, 47, 57, 67) are provided in said combustion chamber (14, 24, 34, 44, 54, 64), the cross sectional surface area of said part of said combustion chamber increasing in the direction away from said axis of rotation perpendicular to the radius on the axis of rotation.

12. Rotary combustion device according to one of the preceding claims, in which said outlet is connected to said inlet.

13. Rotary combustion device according to one of the preceding claims, in which ignition means (8) are present for igniting the gas present in the combustion chamber, characterized in that said ignition means (8) are provided outside said combustion chamber (4).

14. Rotary combustion device according to Claim 13, in which said ignition means comprise a supply line (7) connected to the combustion chamber and also an igniter (8) provided in said line (J).

15. Rotary combustion device according to 14, in which said line extends coaxially with said axis of rotation (6).

16. Rotary combustion device according to one of Claims 13 - 15, in which the ignition means are formed by the shroud and impeller of the turbine, between which a spark is generated by means of static electricity, said static electricity being generated by means of the rotation of the reaction turbine.

17. Method for combusting an air/fuel mixture, in which during said combustion said air/fuel mixture is rotated as a ring of gas about an axis, said air is moved from said axis by centrifugal force to said ring, and the combusted air/fuel mixture is discharged relative to said axis at a position on or outside said ring and provides propulsion, characterized in that the partially combusted air/fuel mixture is moved substantially radially relative to said axis.

18. Method according to Claim 17, in which said partially combusted air/fuel mixture is moved away from said axis.

19. Method according to Claim 17, in which said partially combusted air/fuel mixture is moved substantially radially towards said axis.
Fig 11c

Fig 12
**INTERNATIONAL SEARCH REPORT**

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<td>WO 2004/076835 A (MICRO TURBINE TECHNOLOGY)</td>
<td>1-7,12, 13,16-19</td>
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<td></td>
<td>B.V; WITTEVEEN, GUSTAAF, JAN</td>
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**X** Further documents are listed in the continuation of Box C

**X** 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

'EM' earlier document but published on or after the international filing date

'L' document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

'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

**IT** 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

**8** document member of the same patent family

Date of the actual completion of the international search: 20 March 2007

Date of mailing of the international search report: 03/04/2007

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Fax (+31-70) 340-3016

Authorized officer: 0'Shea, Gearóid
### DOCUMENTS CONSIDERED TO BE RELEVANT

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**Box II** Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. [ ] Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [x] Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box III** Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet.

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [x] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

**Remark on Protest**

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1,2,12-19

   Rotary combustion device having combustion stabilisation means provided in said combustion chamber and comprising a part of said combustion chamber.

2. claims: 3,4,12-19

   Rotary combustion device having combustion stabilisation means provided in said combustion chamber and comprising heat distribution means.

3. claims: 5,12-19

   Rotary combustion device having combustion stabilisation means provided in said combustion chamber and comprising a coating on the wall thereof.

4. claims: 6,7,12-19

   Rotary combustion device having combustion stabilisation means provided in said combustion chamber and comprising heat distribution means in the form of bodies.

5. claims: 8,12-19

   Rotary combustion device having combustion stabilisation means provided in said combustion chamber and comprising a radiator.

6. claims: 9,10,12-19

   Rotary combustion device having combustion stabilisation means provided in said combustion chamber and comprising a porous gas-permeable material.

7. claims: 11-19

   Rotary combustion device having combustion stabilisation means provided in said combustion chamber, the cross-sectional area increasing in the direction away from the axis of rotation.
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