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Datasheet for the decision of 14 February 2008

Case Number: T 0651/07 - 3.2.04

Application Number: 01303781.7

Publication Number: 1149998

IPC: F02C 3/30

Language of the proceedings: EN

Title of invention:
Water injection for reducing gas turbine engine emissions

Applicant:
GENERAL ELECTRIC COMPANY

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 52(1), 54

Relevant legal provisions (EPC 1973):
-

Keyword:
"Novelty (no)"

Decisions cited:
-

Catchword:
-

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Case Number: T 0651/07 - 3.2.04

D E C I S I O N
of the Technical Board of Appeal 3.2.04
of 14 February 2008

Appellant: GENERAL ELECTRIC COMPANY
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 2 November 2006 refusing European application No. 01303781.7 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: M. Ceyte
Members: A. de Vries
C. Heath

Summary of Facts and Submissions

I. The Appellant lodged an appeal, received 14 December 2006, against the decision of the Examining Division on the state of the file posted 2 November 2006, refusing the European patent application No. 01 303 781.7 and simultaneously paid the required fee. The grounds of appeal were received 9 March 2007.

In the communications referred to in the decision the Examining Division inter alia held that the application did not meet the requirements of Articles 52(1) and 54 EPC for lack of novelty having regard in particular to the following documents

D1: EP-A-0 051 487

D2: WO-A-00/08326

II. Oral proceedings, auxiliarily requested by the Appellant, were scheduled for 17 January 2008.

In the annex to the summons to the oral proceedings pursuant to Article 11(1) RPBA and dated 6 September 2007 the Board made observations concerning in particular lack of novelty (Articles 52(1), 54 EPC) of the subject-matter of claims 1 and 3 vis-à-vis D2.

With letter of 14 November 2007, the Appellant withdrew the request for oral proceedings and requested that a written decision be made in accordance with the current state of the file.

The oral proceedings were subsequently cancelled.

III. The Appellant requests that the decision under appeal be set aside and that a patent be granted on the basis of the following documents

Claims:
No. 1 to 5 as filed with letter of 9 January 2006
Description:
Pages 2-9 as originally filed
Pages 1, 1a, 10 as filed with letter of 9 March 2007
Drawings:
Sheets 1/3 to 3/3 as originally filed

IV. The wording of the independent claims 1 and 3 is as follows :

1. "A method for reducing an amount of emissions from a gas turbine engine combustor (16) using a water injection assembly (206), a gas turbine engine (200) including two rotor assemblies (230, 210) respectively including a high pressure compressor (204) and a low pressure compressor (202), said method comprising the steps of:

operating the gas turbine engine (10) with a combustor fuel/air mixture equivalence ratio less than one;

supplying water into the gas turbine engine (10) with a water delivery system (270) including a first plurality of spray nozzles (288) and a second plurality of spray nozzles (300) upstream from the first plurality of spray nozzles such that water enters the gas turbine engine upstream of the low pressure compressor (230) through the second plurality of spray nozzles (300) while simultaneously supplying water through the first plurality of spray nozzles (288)

upstream of the low pressure compressor; and, wherein the water injection assembly (206) further includes an air delivery system (272) connected between the water delivery system (270) and the gas turbine engine (10) with a plurality of piping (314), said step of supplying water characterized by:

atomizing the water injection assembly with the air delivery system to supply atomized water into said high pressure and low pressure compressors; wherein the water delivery system (270) further includes a metering valve (274) and at least two water manifolds (284,292), the metering valve and manifolds being connected to respective spray nozzles (288, 300), and,

said step of supplying water further comprising the step of metering the water being injected into the gas turbine engine (10) to control a size and amount of water droplets being sprayed into the gas turbine engine."

3. "A gas turbine engine (10) comprising:

first and second rotor assemblies (230, 210);

a combustor (16) disposed downstream from said first rotor and coaxial with said first rotor assembly (230), said combustor configured to operate with a fuel/air mixture equivalence ratio less than one;

a water injection assembly (206) mounted to said gas turbine engine, said water injection assembly comprising a water delivery system (270) comprising a plurality of first spray nozzles (288) and a plurality of second spray nozzles (300) connected to the gas turbine engine, said first spray nozzles (288) being configured to inject water upstream from said first rotor assembly (230), said second plurality of spray nozzles (300) being configured to inject water upstream

from said first plurality of spray nozzles while said plurality of first spray nozzles (288) being configured to simultaneously inject water upstream of the second rotor assembly (210); and, characterized by:

an air delivery system (272) comprising a plurality of piping connected between said water delivery system and the gas turbine engine whereby the water injection assembly (206) is atomized by the air delivery system (272); and,

a metering valve (274) and a pair of manifolds (284, 292), said metering valve being connected to each of said manifolds to said first and second plurality of spray nozzles."

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 99 EPC and is therefore admissible.

2. *Background of the Invention*

The application concerns a method for reducing emissions from a gas turbine engine, and the gas turbine engine itself, in which atomized water is injected into the inlets of the engine's low and high pressure compressors. Atomization is by way of an air delivery system, which in the sole embodiment feeds high pressure air back from a bleed at the high pressure compressor to the nozzles of the water injection system. The atomized water spray or mist cools the air within and exiting the compressor so that when it enters the combustor it reduces flame temperature and thus nitrous oxide emissions.

3. *Lack of Novelty*

3.1 As stated in the annex to the summons to oral proceedings pursuant to Article 11(1) RPBA it is undisputed that the features of the preamble of claim 1 are known. D2, see in particular figure 8, and page 14, line 16, to page 15, line 17, discloses a method of injecting water into a gas turbine engine 250 (a LM6000 engine of General Electrics, as in the present application, see description, page 5, final paragraph) into the inlets of both its high and low pressure compressors 254 and 258 respectively, via correspondingly located respective sets of nozzles 266 and 276 of a water delivery system 260. Water is injected continuously to achieve the desired steady state effects as may be inferred from the discussion on page 3, which for injection at both locations (as opposed to the alternative of injection at either one of the two locations) may be taken to mean simultaneous injection at both sites.

The use of an LM6000 engine as in the present application moreover implies operation with a combustor fuel/air mixture equivalence ratio less than one.

The water injection system also includes an air delivery system comprising a plurality of piping in the form of eight stage bleed 272, connector 270, pipe 274 and air manifold 262 connected between said water delivery system, at nozzles 266 or 276, and the gas turbine engine, at bleed 272.

3.2 The characterizing features of claim 1 are also derivable from D2.

3.2.1 Thus, the air delivery system uses high pressure air from the bleed 272 at high pressure compressor 254 to atomize the water injected into the compressor inlets, just as in the similar embodiment of figure 6, as explained on page 11, lines 19 to 28 of D2. This is confirmed by the droplet size of 20 microns mentioned on page 22, first paragraph in connection with the embodiment of figure 8, which is identical to that mentioned in the present application, see description page 9, lines 1 and 2. It also follows from the final, general statement in D2 on page 26, lines 20 to 24, focussing on the overall effects of "injecting atomized water", read in conjunction with the preceding paragraph, comparing the two alternative methods of atomization, namely using air (as in figure 8) or pressure.

3.2.2 Figures l3A to l3B, in conjunction with page 17, lines 1 to 20 of D2, provide further detail of the water/air supply system in figure 8 (page 5, lines 3 and 4). In this passage "frame water injection" and "inlet water injection" refer to injection at both inlets as mentioned above and located (see figure) at "front frame 256" and "inlet 252" (using the terminology of D2 at page 14, lines 17,18). This injection scheme includes metering or control valves 380 and 384 and manifolds connected to respective nozzles as schematically shown in figures 133 and 13C (manifolds and nozzles correspond to those mentioned in the paragraph bridging pages 14 and 15). Further valves are shown in figure 13A between gear pump 352 and flow

meter 358 in the main water delivery line serving both injection supply lines (marked A and D) and described on page 17, lines 5 to 7. These valves control supply of water to the nozzles as indicated on page 17, lines 17 to 20, in dependence of the droplet size desired as explained on page 22, 1st paragraph (in particular lines 4 to 6).

3.2.3 D2 does not explicitly mention emission reduction. As discussed in the present application, description page 2, 2nd paragraph, (nitrous oxide) emissions are reduced as a result of the lower temperature of the high pressure compressor exit air flow due to the fine mist. This effect is thus directly linked to water spray injection into the compressor. Even if the Appellant had been the first to recognize this additional effect of water spraying - this is not so, as is clear from further Dl, see page 8, lines 7 to 16 - nevertheless this effect is necessarily already present in the method of water spray injection as practised in the engine of figure 8 of D2.

3.3 Further independent claim 3 is directed at a gas turbine which includes all of the structural features mentioned or implicit in claim 1, as well as further constructional turbine engine features implicit in any gas turbine engine (in particular a LM6000) such as coaxial rotors and a combustor. Claim 3 further specifies that said metering valve is connected to each of the pair of manifolds. This valve may be identified with either of the two valves shown in figure 13A between gear pump 352 and flow meter 358 mentioned above.

3.4 The Appellant has not replied in substance to the observations made in the annex as set out above. The Board therefore sees no reason to depart from its preliminary opinion as expressed in the annex.

3.5 The Board concludes that, as all the features of independent claims 1 and 3 are derivable from D2, the subject-matter of both claims lacks novelty and the application fails to meet the requirements of Article 52(1) in combination with Article 54 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar The Chairman

G. Magouliotis M. Ceyte