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D E C I S I O N
of 9 February 2004

Case Number: T 0961/02 - 3.2.4

Application Number: 95931524.3

Publication Number: 0777820

IPC: F01K 21/04

Language of the proceedings: EN

Title of invention:

Method and apparatus for regulating and augmenting the power output of a gas turbine

Patentee:

Siemens Westinghouse Power Corporation

Opponent:

ALSTOM (Switzerland) Ltd

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

EPC R. 71(2)

Keyword:

"Novelty - yes"

"Inventive step - yes"

Decisions cited:

-

Catchword:

-



Case Number: T 0961/02 - 3.2.4

D E C I S I O N
of the Technical Board of Appeal 3.2.4
of 9 February 2004

Appellant: ALSTOM (Switzerland) Ltd
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CH-5401 Baden (CH)

Representative: Liebe, Rainer
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Respondent: Siemens Westinghouse Power Corporation
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Representative: Berg, Peter, Dipl.-Ing.
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Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 12 July 2002
rejecting the opposition filed against European
patent No. 0777820 pursuant to Article 102(2)
EPC.

Composition of the Board:

Chairman: C. Andries
Members: T. Kriner
M. B. Tardo-Dino

Summary of Facts and Submissions

I. The appellant (opponent) lodged an appeal, received at the EPO on 18 September 2002, against the decision of the opposition division, posted on 12 July 2002, on the rejection of the opposition against the European patent No. 0 777 820. The appeal fee was paid simultaneously and the statement setting out the grounds of appeal was filed on 7 October 2002.

II. The opposition was filed against the patent as a whole and based on Article 100(a) EPC in conjunction with Articles 52(1), 54 and 56 EPC.

In its decision the opposition division held that the ground for opposition did not prejudice the maintenance of the patent unamended and that therefore the opposition was to be rejected.

III. Oral proceedings took place on 9 February 2004.

Although duly summoned, the respondent (patent proprietor) was not represented at the oral proceedings. In accordance with the provisions of Rule 71(2) EPC the proceedings were continued without him.

The appellant requested that the decision under appeal be set aside and the European patent No. 0 777 820 be revoked.

The respondent requested in his written submissions that the appeal be dismissed and the patent be maintained unamended.

IV. The appellant's argumentation during the oral proceedings was based exclusively on the following document:

E5: US-A-5 329 758.

V. Claim 1 as granted reads as follows:

"A method of regulating shaft power in a gas turbine power plant, comprising the steps of compressing air in a compressor (26) heating said compressed air (28) in a combustor by burning a fuel (30) therein, thereby producing a flow of hot gas directing a flow of feed water (38) into an evaporator (18) thereby generating a flow of steam at a steam generation rate said method comprising

- a) regulating said steam generation rate by varying the pressure of said feed water in said evaporator;
- b) introducing said generated steam into said flow of hot gas, thereby producing a mixture (32) of hot gas and generated steam flowing at a flow rate, said flow rate of said mixture being proportional to said steam generation rate;
- c) directing said mixture of hot gas and generated steam to a turbine (4) having a rotating shaft (3) for expansion therein, thereby producing power in said shaft proportional to said flow rate of said mixture of hot gas and generated steam, whereby said shaft power is regulated by varying said pressure of said feed water in said evaporator;
and

d) exhausting said mixture of hot gas and generated steam from said turbine after said expansion and directing said exhausted mixture (34) to flow over said evaporator, thereby transferring heat from said exhausted mixture to said feed water flowing in said evaporator, whereby said heat transfer generates said steam."

VI. In support of his request the appellant relied essentially on the following submissions:

The upper portion of Figure 1 of E5 showed essentially the same gas turbine power plant as Figure 1 of the patent in suit. Therefore the shaft power in this power plant inevitably had to be regulated in the same way as defined in claim 1 of the patent in suit. The valve (5) or the valve of the regulator (5') shown in Figure 1 of E5 corresponded to the valve (24) shown in Figure 1 of the patent in suit. It was obvious that a variation of the sectional area of flow of one of these valves resulted in a variation of the pressure in the evaporator (8). Since the steam generation rate was dependent on this pressure, the steam generation rate of the evaporator was regulated by varying the pressure of the feed water in the evaporator as suggested in feature a) of claim 1. Moreover, since the flow of air through the compressor (1, 3) and the temperature in the compressor were constant, the flow rate of the mixture of the hot gas produced in the combustor (4) and the steam generated in the evaporator (8) was proportional to the steam generation rate, the power produced in the shaft of the turbine (7) was proportional to the flow rate of the mixture of hot gas and steam, and the shaft power was regulated by varying

the pressure of the feed water in the evaporator (8), as suggested in features b) and c) of claim 1. Consequently the subject-matter of claim 1 of the patent in suit lacked novelty.

If the subject-matter of this claim nevertheless should be considered as novel, it was at least not based on an inventive step. Although E5 did not explicitly mention that the pressure of the feed water in the evaporator (8) was regulated by any of the valves (5 or 5'), it was at least obvious for the skilled person that a variation of the sectional area of flow of one of these valves resulted in a variation of the pressure of the feed water in the evaporator, and that therefore the steam generation rate could be regulated by varying the pressure of the feed water, if that was intended.

VII. The argumentation of the respondent filed with the letter of 7 April 2003 can be summarized as follows:

There was no document which suggested a regulation of the steam generation rate of an evaporator by varying the pressure of the feed water. Therefore, the subject-matter of claim 1 as granted was new and involved an inventive step.

Reasons for the Decision

1. The appeal is admissible.
2. *Novelty*
 - 2.1 E5 discloses a method of regulating shaft power in a gas turbine power plant, comprising the steps of compressing air in a compressor (1, 3), heating said compressed air in a combustor (4) by burning a fuel therein, thereby producing a flow of hot gas, directing a flow of feed water into an evaporator (8) thereby generating a flow of steam at a steam generation rate, said method comprising the steps of
 - (b₁) introducing said generated steam into said flow of hot gas, thereby producing a mixture of hot gas and generated steam flowing at a flow rate;
 - (c₁) directing said mixture of hot gas and generated steam to a turbine (7) having a rotating shaft for expansion therein (see column 5, lines 35 to 40), thereby producing power in said shaft proportional to said flow rate of said mixture of hot gas and generated steam; and
 - (d) exhausting said mixture of hot gas and generated steam from said turbine (7) after said expansion and directing said exhausted mixture to flow over said evaporator (8), thereby transferring heat from said exhausted mixture to said feed water flowing in said evaporator (8), whereby said heat transfer generates said steam.

However, the method according to E5 does not comprise the following steps:

- (a) regulating the steam generation rate by varying the pressure of the feed water in the evaporator;
- (b₂) producing a mixture of hot gas and generated steam flowing at a flow rate which is proportional to said steam generation rate; and
- (c₂) regulating said shaft power by varying the pressure of the feed water in said evaporator.

2.2 The appellant's argumentation that these steps are also disclosed in E5 is not convincing for the following reasons:

The steam generated in the evaporator (8) is directed via a first valve (5) and a regulator (5') to a combustion chamber (4) and via a second valve (27) to a control condenser (15). The regulator (5') regulates amongst other things in a predetermined manner the amount of steam introduced into the combustion chamber to ensure operation of the gas turbine at a predetermined point (see column 5, lines 29 to 35). The amount of compressed air fed to the combustion chamber is kept essentially constant (see for example column 3, lines 42 to 46), and the temperature at the inlet of the turbine is also kept at a constant level TIT (see for example column 8, lines 28 to 32). Hence it is correct that the power produced in the shaft of the turbine (7) is proportional to the flow rate of the mixture of hot gas and steam fed to the combustion chamber (cf. feature c₁). However, the generated steam

which is not used for the combustion chamber is fed via the second valve (27) to the control condenser (15), where the superfluous steam is evacuated during normal operation of the gas turbine power plant. During emergency shutdowns the condenser is used to quickly condense and purge the steam from the system (see column 6, lines 18 to 21). This means in other words that only a predetermined portion of the amount of steam generated in the evaporator (8) is introduced via the first valve (5 or the valve of regulator 5') into the combustion chamber (4), and that the remaining steam is fed to the control condenser (15).

Consequently it is not correct that the upper portion of Figure 1 of E5 shows essentially the same gas turbine power plant as Figure 1 of the patent in suit, and that the shaft power of the gas turbine has to be regulated in the same way as defined in claim 1 of the patent in suit. Even if the first valve (5 or the valve of regulator 5') shown in E5 is considered as corresponding to the valve (24) of the patent in suit, a variation of the sectional area of this valve could not be used for regulating the steam generation rate in the evaporator. Although it is true that the working position of this valve can have an influence on the pressure of the feed water in the evaporator, it is not the only valve influencing this pressure. At least the second valve (27), which regulates the connection between the evaporator and the control condenser (15), in combination with that control condenser (15) can have an additional influence on the pressure of the feed water. Their influence on the feed water pressure is however unknown, so that no clear teaching can therefore be deduced from that specific arrangement.

Moreover, with respect to the extremely broad range of steam flows demanded by the power plant according to E5, the evaporator (8) has to be designed in a particular way in which the flow of feed water may be increased by a factor of about 2.5 (see column 7, lines 55 to 60). This demand requires an evaporator as for example shown in Figure 2 of E5. This evaporator comprises amongst other things a further valve (87) which regulates the amount of feed water fed to a desuperheater arranged at the outlet of the evaporator. It is obvious that this valve also influences the amount of steam generated by the evaporator and the pressure of the feed water.

Consequently it is neither intended nor unequivocally possible to regulate the pressure of the feed water of the evaporator and therefore inevitably also the steam generation rate of the evaporator (8) solely by varying the sectional area of flow of the valve (5) or the valve of the regulator (5'), as stated by the appellant.

2.3 With respect to the above assessment, the Board comes to the conclusion, that the subject-matter of claim 1 is novel.

3. *Inventive step*

3.1 Starting from the state of the art disclosed in E5, the object to be achieved by the patent in suit may be regarded as to provide a simplified method of regulating shaft power in a gas turbine power plant by

varying the amount of steam introduced into the gas turbine (see column 2, lines 10 to 15).

The board has no doubt that this object is achieved by the provision of the steps (a), (b₂) and (c₂) (see section 2.1 above), since these steps allow that the evaporator generates only that amount of steam which is fed to the combustor so that the shaft power may be regulated solely by varying the pressure of the feed water, and that therefore no means (such as a control condenser) for evacuating superfluous steam is necessary.

- 3.2 The appellant's submissions according to which the provision of these steps in the method of regulating shaft power in a gas turbine power plant disclosed in E5 was obvious for the skilled person, is not convincing.

In accordance with E5 the generation of steam is not adapted to the amount of steam consumed by the combustion chamber (4). Only that portion which is momentarily required is fed in an (amount) controlled manner via the regulator (5') to the combustion chamber (4), while the remaining portion of the steam is evacuated by the control condenser (15). Since the amount of compressed air fed to the combustion chamber and the temperature at the inlet of the turbine both are kept at a constant level, the shaft power of the power turbine (7) is exclusively regulated by controlling **the amount of steam fed to the combustion chamber** (4). This finding is additionally supported by Figure 10 of E5 which shows that the amount of high pressure steam fed to the high pressure combustor (4'a)

is controlled depending on the signal of a flow sensor in the high pressure steam line. Although Figure 10 refers to a flow control scheme for the gas turbine power plant shown in Figure 3, it is obvious from the whole disclosure of E5 that this kind of regulation applies also to the gas turbine power plant shown in Figure 1.

With respect to the patent in suit, the shaft power of the turbine (4) is regulated by controlling **the pressure of the feed water.**

With respect to the above assessment, the regulation of the shaft power according to E5 on one hand and according to the patent in suit on the other hand are based on different principles. A modification of the regulation of the method of regulating the shaft power according to E5 so that it is identical with the method according to claim 1 of the patent in suit would therefore be in contradiction to the teaching of E5. Furthermore there is no suggestion available which could lead the skilled person in the direction of the method according to claim 1 of the patent in suit.

3.3 Therefore the Board comes to the conclusion that the subject-matter of claim 1 of the patent in suit as granted cannot be derived in an obvious manner from E5 and accordingly involves an inventive step (Article 56 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

G. Magouliotis

C. Andries