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File Number: T 232/91 - 3.5.1

Application No.: 83 900 211.0

Publication No.: 0 120 855

Title of invention: TOTAL ENERGY BASED FLIGHT CONTROL SYSTEM

Classification: B64C 19/00

D E C I S I O N
of 29 August 1991

Proprietor of the patent: The Boeing Company

Opponent: Deutsche Airbus GmbH Hamburg

Headword:

EPC Articles 54, 56

Keyword: "Novelty (confirmed)" - "Inventive step (confirmed)"

Headnote



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Boards of Appeal

Chambres de recours

Case Number : T 232/91 - 3.5.1

D E C I S I O N
of the Technical Board of Appeal 3.5.1
of 29 August 1991

Appellant :
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Decision under appeal : Decision of Opposition Division of the European
Patent Office dated 31 January 1991 rejecting the
opposition filed against European patent
No. 0 120 855 pursuant to Article 102(2) EPC.

Composition of the Board :

Chairman : P.K.J. van den Berg
Members : W.B. Oettinger
E.M.C. Holtz

Summary of Facts and Submissions

I. The appeal lies from the decision of the Opposition Division, dated 31 January 1991, to reject the opposition filed against European patent No. 120 855 granted on the basis of international patent application PCT/US 82/01388 (European application No. 83 900 211.0) having a filing date of 30 September 1982.

II. Claim 1 of that patent reads as follows:

"An aircraft longitudinal flight control system for automatically controlling the aircraft's flight path and speed, using engine thrust and elevator control surface position, characterised by

means (22) for developing an incremental net thrust command signal ΔT_C which is a linear combination of a signal representative of the aircraft's total energy error with respect to the flight path and speed command targets and a signal representative of the rate of change of the aircraft's total energy;

thrust control means (24) for automatically controlling the incremental net thrust of the engines to said incremental net thrust command signal ΔT_C , such that said total energy error is reduced to zero;

means (26) for developing an incremental elevator (position) command signal $\Delta \delta e_C$ which is a linear combination of a signal representative of the aircraft's total energy distribution error with respect to the flight path and speed targets and a signal representative of the rate of change of the total energy distribution, and;

elevator position control means (24) for automatically controlling the (incremental) elevator position to said incremental elevator command signal $\Delta\delta e_c$ such that said aircraft's total energy distribution error is reduced to zero, the aircraft's total energy E being defined by

$$E = W \cdot h + \frac{1}{2} \frac{W \cdot V^2}{g}$$

and the rate of change of the aircraft's total energy distribution being defined by

$$\dot{E} = -\dot{\gamma} + \frac{\dot{V}}{g}$$

where

g = acceleration due to gravity

h = aircraft altitude

V = aircraft longitudinal velocity

W = aircraft weight

$\gamma = \dot{h}/V =$ flight path angle."

Claims 2 to 35 by referring back either directly or indirectly to Claim 1 are all dependent upon that claim.

III. In the notice of opposition, it was contended that the subject-matter of Claim 1 was not novel over the following prior art documents:

D1: DE-A-2 513 901

D2: DE-A-2 250 219

D3: GB-C-(meaning -A-) 1 435 202

D4: GB-C-(meaning -A-) 1 435 203

D5: GB-C-(meaning -A-) 1 541 520.

Particular reference was made to D1 and D2 but the lack of novelty objection was more specifically explained only with reference to D1.

A similar but sweeping statement was made in respect of all dependent claims.

- IV. In the decision under appeal, the Opposition Division held that D1 did not take the novelty of Claim 1 and the same would be true for the other prior art citations.

Moreover, the Opposition Division, having carried out, on its own motion, an inventive step examination concluded that the subject-matter of that claim does involve an inventive step over the cited prior art.

- V. The appeal was lodged by the Opponent, and the respective fee paid, on 18 March 1991 with a request that the appealed decision be set aside and the patent revoked.

In a statement of grounds, filed on 8 April 1991, the Appellant maintained his contention that Claim 1 is not novel, and he cited several passages of D1 for support which he submitted were disregarded by the Opposition Division.

- VI. The Respondent (Proprietor of the patent) in a reply requests that the appeal be dismissed because even the cited passages of D1 did not disclose the claimed system.

As an auxiliary request, he requests that oral proceedings be held.

Reasons for the Decision

1. The appeal is admissible (Articles 106 to 108 and Rule 64 EPC).
2. The first and main issue arising out of the appeal is whether the Opposition Division's rejection of the Opponent's lack of novelty objection based on D1 was correct.

In this respect, the Board concludes as follows:

- 2.1 The gist of the claimed invention as it is defined by the characterising features in Claim 1 (cf. paragraph II), is to be seen, in a system according to the preamble of that claim, in (a) the use of thrust (only) to control the total (kinetic + potential) energy of the aircraft and (b) the use of elevator position (only) to control the energy distribution between longitudinal acceleration (representing a change of kinetic energy) and vertical flight path angle (representing a change in potential energy) (cf. description column 2, lines 1-3 and lines 41-48; column 3, lines 19-26; column 4, lines 38-54 and 55-63; column 4, line 65 to column 5, line 11).
- 2.2 Simplified in this way, it could appear that the claimed features do not represent more than physical laws which are always fulfilled, i.e. features of prior art systems as well as of the claimed invention.

As stated in column 5, lines 9-11, thrust is "ultimately" the source of energy and the application of the elevator results "mostly" in redistribution of energy, and this is inevitably the case. For instance, the fact that thrust controls the total energy follows directly from the law of preservation of energy. And the fact that the elevator

changes the distribution (ratio) between kinetic and potential energy follows directly from the change in altitude due to the non-horizontal flight path. In column 1, lines 64-65, this use of basic principles of physics has been admitted.

- 2.3 Nevertheless, it must be considered that Claim 1 defines four kinds of specific "means" (22, 24, 26) which may or may not be prior art.

The issue to be decided boils down to the question whether they are prior art or not.

- 2.4 The first (22) of these means (first characterising feature) has in fact the following function:

Given a particular vertical flight path target and a particular speed target, respective command signals are, by computation, converted into a total energy error signal representing the difference between actual and target total energy.

- 2.5 Another (26) of said means (third characterising feature) has the following function:

Given the aforementioned targets, respective command signals are, by computation, converted into a total energy distribution error signal representing the difference between actual and target distribution (ratio) between kinetic and potential energy.

- 2.6 Further means (24) (second and fourth characterising features) have, respectively, the following functions:

The total energy error signal controls thrust so that the error is reduced to zero.

The energy distribution error signal controls the elevator position so that the error is reduced to zero.

- 2.7 These functions must be understood as exclusive ones in the sense that the energy error signal controls only thrust and the distribution error signal controls only the elevator.

This follows from the objects and objectives mentioned in the description, for instance where it refers to the avoidance (column 1, lines 51-53) of undesirable flight path and speed control coupling (lines 28-29), i.e. the provision of a "decoupled" control (column 1, line 58), which is more efficient (column 5, line 8).

- 2.8 The aforementioned functions have been summarised by the Opposition Division in a very clear way in numbered paragraph 1 of the reasons for the decision under appeal and it would appear that the Appellant does not dispute that this summary is correct.

- 2.9 The Opposition Division has furthermore, in their paragraph 2.1, dealt with D1, particularly with those passages to which the Opponent drew attention (pages 2-4 and 9-12).

It concluded, in the end, that there is nothing anywhere in D1 which would indicate or suggest controlling the (incremental) thrust with a signal dependent on the total energy error of the aircraft (helicopter) and rate of change of energy.

- 2.10 Effectively, in response, the Appellant in the statement of grounds now cites the following passages of D1:

- page 12 from the last but nine lines to page 13, bottom (particularly lines 6 and 7),
- Figure 4 (particularly thrust servo 12', inclination servo 13' and flight path indicator 15 with selector 15a), and
- page 20, second paragraph to page 21, line 3.

With particular reference to the "useful error signals ECOL and ECYC" controlling the thrust and flight path angle computer (or rather: servo), the Appellant submits that thus ("somit") the total energy error and energy distribution error are used for controlling the aircraft.

- 2.11 However, not only are the aircraft's total energy and total energy distribution mentioned nowhere in D1, in the opinion of the Board, it would not, moreover, be correct to equate the thrust control signal (E_{COL}) and the flight path angle control signal (E_{CYC}) with a "total energy error" and an "energy distribution error" signal respectively.

It is, of course, true and follows from the functions of means 12 and 13, 12' and 13', that E_{COL} represents a thrust ("Vorschub") control signal and E_{CYC} represents a flight path angle ("Längsneigung") control signal. However, the former is derived in accordance with equation 15 and the latter in accordance with equation 16 from a number of parameters none of which is the total energy error or total energy distribution error (cf. page 13).

Disregarding the difference in thrust and flight path angle control between helicopters and "normal" aircraft:

It would be true to say that some of the parameters on the right side of error equation 16 (computed acceleration, commanded acceleration, computed velocity and attenuation)

are related to kinetic energy and that some of the parameters on the right side of error equation 15 (commanded flight path angle, actual flight path angle and attenuation) are related to potential energy change. But this does not mean that the error signals in equations 15 and 16 are expressed in terms of total energy and of total energy distribution, respectively. More particularly, this is not the case because in equation 16 only terms related to kinetic (but not to potential) energy and in equation 15 only terms related to potential energy change (but not to kinetic energy) are contained and, therefore, no parameter representing total energy distribution appears.

- 2.12 The Appellant relies solely on the aforementioned submission in support of his contention that Claim 1 lacks novelty.

Since, for the above reasons, the submission is not convincing, the lack of novelty objection must fail.

3. The Appellant has never submitted that if novelty is given, Claim 1 would nevertheless be unallowable for the reason that its subject-matter does not involve an inventive step.

Such a submission would have appeared logical from the point of view that if the Opposition Division, or the Board, comes to the conclusion that there are differences between the claimed system and the prior art, these differences might appear to relate only to obvious modifications of the known system.

It was apparently for this reason that the Opposition Division carried out, on its own motion, an obviousness or inventive step examination. It has come to the conclusion

that the system of Claim 1 is not obvious, i.e. involves an inventive step (paragraph 2.3 of the appealed decision).

The Board agrees with this finding. It cannot see any incentive in D1 to deviate from its teaching to compute, in the computers 12 and 13, the error signals as indicated for instance by the equations 15 and 16. In particular, no reason to use instead the total energy error and total energy distribution error can be derived from D1.

Nor is such a modification of the system of D1 rendered obvious by any of the other prior art documents cited summarily in the opposition, D2 to D5.

4. The subject-matter of Claim 1 being, for these reasons, novel and inventive, the same applies to that of the dependent claims.
5. These conclusions have been drawn solely on the basis of direct reference to the patent in suit, to prior art document D1, and to the Appellant's submissions without the Board having to refer to the Respondent's reply dated 19 June 1991.

The condition for an immediate decision, taking into account Article 113(1) EPC, is therefore met.

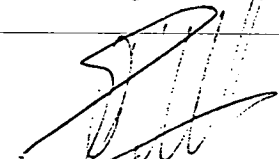
6. The Respondent's main request being therefore allowable, his auxiliary request is not relevant.

Order

For these reasons, it is decided that:

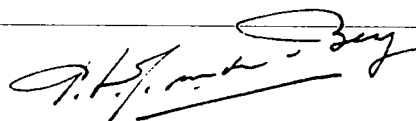
The appeal is dismissed.

The Registrar:



M. Kiehl

The Chairman:



P.K.J. van den Berg