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Datasheet for the decision of 19 November 2008

Case Number: T 0526/07 - 3.2.01

Application Number: 98202632.0

Publication Number: 0895929

IPC: B64C 25/42

Language of the proceedings: EN

Title of invention:
Aircraft stop-to-position autobrake control system

Patentee:
The Boeing Company

Opponent:
AIRBUS SAS, et al

Headword:
-

Relevant legal provisions:
RPBA Art. 13(1)

Relevant legal provisions (EPC 1973):
EPC Art. 54, 56

Keyword:
"Novelty - yes"
"Inventive step - no"
"Amendment to a party's case - refused (auxiliary request)"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0526/07 - 3.2.01

D E C I S I O N
of the Technical Board of Appeal 3.2.01
of 19 November 2008

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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 25 January 2007 revoking European patent No. 0895929 pursuant to Article 102(1) EPC 1973.

Composition of the Board:

Chairman:	S. Crane
Members:	J. Osborne
	G. Weiss

Summary of Facts and Submissions

I. The appeal is directed against the decision posted 25 January 2007 revoking European patent No. 0 895 929. The opposition division found that the subject-matter of the independent claims 1, 4 as granted was not new with respect to the document:

$D6_1$: S. Goldthorpe *et al.*, "Guidance and Control Requirements for High-Speed Rollout and Turnoff (ROTO)", NASA Contractor report 195026, Final report (McDonnell-Douglas Aerospace), Hampton/Virginia, January 1995, 1-6, 16, 17, 22-25, 37.

II. In addition to $D6_1$, the following state of the art played a role during the appeal:

D1: US-A-4 316 252.

III. With its statement of grounds of appeal the appellant filed amended sets of claims according to three auxiliary requests. The board summoned the parties to oral proceedings to be held on 19 November 2008 and in an annex to the summons raised objections that some of the amendments made in the claims according to the auxiliary requests found no basis in the application as originally filed. In response the appellant with a letter dated and received 17 October 2008 filed amended requests.

IV. At the oral proceedings the appellant requested that the decision under appeal be set aside and the patent maintained as granted (main request) or in the

alternative that the patent be maintained in amended form on the basis of claims 1 to 6 according to the auxiliary requests 2a, 3, 4, 4a, 4b, 5, 5a, 5b, all filed with the letter dated 17 October 2008. The auxiliary requests 1, 2 and 2b were withdrawn. The respondent requested that the appeal be dismissed.

V. Independent claims 1, 4 as granted (main request) read:

"1. A method for automatically stopping an aircraft (12) at a selected position on a runway (14), said aircraft provided with an aircraft brake system (30) which is responsive to input control signals to apply braking to the aircraft, said method comprising the steps of:
- determining the aircraft's present position;
- comparing by logic control means (32) the aircraft's actual position with a selected stopping position on a runway,
characterized in that
the desired aircraft stopping position (16) on a runway is selected by a stop position selector; and said logic control means in response to the comparison of the aircraft's actual position with the selected stopping position, predeterminedly apply a control signal to the aircraft break system (30), such that the aircraft breaks in a manner tending to stop the aircraft at the selected stopping position, using a closed-loop control of target deceleration to control the airplane's deceleration to stop at said stopping position on the runway."

"4. An aircraft automatic braking system comprising:
- an aircraft positioning system (20, 34) for

determining the aircraft’s present position;
- logic control means (32) for comparing the aircraft’s (12) actual position with a selected aircraft stopping position on a runway,
characterized in that
the system further comprises stop position input means (31) for selecting said desired aircraft stopping position (16) on a runway (14);
said logic control means in response to the comparison of the aircraft’s actual position with the selected stopping position predeterminedly decelerates said aircraft such that the aircraft tends to stop at said selected stopping position,
wherein the logic control means use a closed loop control of target deceleration to control the aircraft’s deceleration to stop at the desired stopping position on the runway.”

VI. Claims 1, 4 according to the appellant's auxiliary request 2a contain the following additional wording:

“1. … wherein, if the closed-loop control of target deceleration is unavailable, the logic control means apply a predetermined target deceleration to the aircraft brake system.”

“4. … and is arranged to apply a predetermined target deceleration to the aircraft brake system if the closed-loop control of target deceleration is unavailable.”

VII. Claims 1, 4 according to the appellant's auxiliary request 3 contain the following additional wording:

"1. … the method further comparing a touch down position against an initially estimated touch down position and, if the touch down position is outside a margin from the initially estimated touch down position, displaying an advisory message indicating that the closed-loop control of target deceleration is inoperative."

"4. … the system further comprising means for comparing a touch down position to an initially estimated touch down position and, if the touch down position is outside a margin from the initially estimated touch down position, displaying an advisory message indicating that the closed-loop control of target deceleration is inoperative."

VIII. Claims 1, 4 according to the appellant's auxiliary request 4 contain the following additional wording:

"1. … the method further comparing a touch down position against an initially estimated touch down position and, if the touch down position is outside a margin from the initially estimated touch down position, using a fixed target deceleration as the control signal."

"4. … the system further comprising means for comparing a touch down position to an initially estimated touch down position and, if the touch down position is outside a margin from the initially estimated touch down position, using a fixed target deceleration as the control signal."

The claims 1, 4 according to auxiliary requests 4a, 4b differ from those according to auxiliary request 4 by the substitution of "fixed target deceleration" by "predetermined target deceleration" and "target decoration according to a predetermined target deceleration setting" respectively.

IX. Claims 1, 4 according to the appellant's auxiliary requests 5, 5a, 5b effectively contain a combination of the features of the corresponding claims according to auxiliary requests 3 and 4, 3 and 4a, and 3 and 4b respectively.

X. The appellant essentially submitted that:

The opposition division was wrong to interpret the term "stop" in the claims as granted as encompassing a runway exit speed of 70 knots and therefore find that $D6_1$ anticipated the subject-matter of the claims. $D6_1$ relates to a special case of decelerating aircraft to leave the runway at exits having particular geometries in order to reduce runway occupancy time. The aircraft stop not on the runway but in the exit lane. By comparison, the present patent relates to braking an aircraft to stop at a particular position on the runway. Whilst in accordance with the claims the terminal speed of the aircraft on the runway might not be zero, the skilled person would understand that it is clearly not the speed at which aircraft exit the runway as disclosed in $D6_1$.

The closest state of the art for consideration of inventive step is that disclosed in D1. The subject-matter of claims 1, 4 of the present patent as granted

differs from that disclosure in that the target deceleration is continually recalculated on the basis of a comparison between the current aircraft position and the selected stop position. The technical problem solved is to improve the ability to stop the aircraft at the selected position. $D6_1$ relates to a particular combination of a braking system and airport geometry for stopping the aircraft after it has exited the runway. It contains no teaching directed towards solving the present problem but if the skilled person beginning from D1 nevertheless were to recognize any benefit to him he would adopt the whole teaching, thereby moving away from the presently claimed subject-matter. Moreover, it is not clear from $D6_1$ that the same equation of motion is used for both deceleration on the runway and stopping after the aircraft has left the runway.

As regards auxiliary request 2a the additional feature provides a safety back-up in case the closed-loop control fails. Neither D1 nor $D6_1$ addresses this problem and no solution is evident for the skilled person.

The later auxiliary requests contain amendments introduced in response to objections raised by the board in its annex to the summons and introduce no new objections.

XI. The respondent's submissions may be summarised as follows:

It is not disputed by the appellant that the claims encompass an aircraft not coming to a halt on the runway. The opposition division therefore was correct

to interpret "stop" in the claims as meaning to reduce speed to an amount sufficiently low to enable the aircraft to turn off the runway safely. Indeed, the patent specification contains equations in which the final speed is not zero but a variable. Even if it is considered that the aircraft is actually brought to a halt at the selected position, this also is disclosed in $D6_1$ since there is no essential difference between stopping on the runway and in the exit. It is evident that there is a link between the actual speed and the exit geometry and it must be recognized that the system disclosed in $D6_1$ is suitable for bringing an aircraft to a halt on the runway. It is set out in the Guidelines C-III, 4.13 that subject-matter specified in a claim as "for" a particular purpose must be understood as merely suitable for the purpose. As a result, even if the subject-matter of claim 1 as granted were found to be new, that of claim 4 is not.

As regards inventive step, if D1 is considered as the closest state of the art, the subject-matter of the granted claims differs from that of D1 by the feature of the closed-loop control which improves the accuracy of stopping at a selected position. D1 already predicts the degree of braking necessary but if that is excessive it merely warns the pilot. The skilled person therefore is motivated to seek improved control. $D6_1$ teaches how such improved accuracy may be achieved and employs the same laws of motion in its closed-loop system as does the present patent specification. Moreover, it is clearly disclosed that those same laws are used to bring the aircraft to a halt where it states that "on the ROTO exit the control law decelerates the aircraft to a stop …". Although the

disclosure of $D6_1$ does relate to both braking control and airport geometry, they are clearly separate teachings and the skilled person would recognize the elementary nature of the laws of motion and their universal applicability.

The amendments to the independent claims 1, 4 according to the auxiliary request 2a fail to add an inventive feature. The additional features relate to the provision of a back-up system in the event that the closed-loop control fails and as such solve a problem independent of that solved by the claims according to the main request. Redundancy is well known in aircraft and it would be normal to use a simpler system as a back-up facility. It was already known from D1 and, as set out in the patent specification, it was generally known in the art to provide predetermined target deceleration signals to an aircraft braking system.

Reasons for the Decision

Main request

Novelty

1. According to claim 1 the logic control means acts to control the aircraft's deceleration to "stop at said stopping position on the runway". The first matter at issue is the interpretation of the term "stop" in this context. The appellant accepts that the meaning of the term is not to be restricted to an aircraft having been brought to a halt and may include a certain residual speed. However, the question remains how high that residual speed may be. It is common that an aircraft

will not come to a halt on a runway but, depending on the geometry of the airport, either will turn off at an exit before moving onto a taxiway or will turn on the runway before taxiing back along it. In the contested decision the opposition division found that the term "stop" had the meaning of to reduce speed to an amount sufficiently low to enable the aircraft to turn off the runway safely. Whilst the board does not disagree in essence with that finding, it considers it to be incomplete because it makes no mention of the geometry of the exit.

1.1 The maximum speed at which an aircraft can leave a runway is determined by the geometry of the exit. High speed exits having a large radius are known, for allowing aircraft to exit the runway at up to 60 knots (about 110 kmh). However, the patent specification makes no mention of such special geometries. In paragraph [0009] it is merely stated that "the selected stopping position may be, for example, a runway exit position from which the pilot should be able to see the desired exit and manually guide (taxi) the airplane off the runway …". In the absence of any reference to special exit geometries the skilled person reading the patent specification would understand that it relates to runways having no special geometry.

1.2 $D6_1$ relates to a simulation of the braking of aircraft for the purpose of minimising runway occupancy time. A fundamental aspect of the simulation is the use of high-speed rollout and turnoff (ROTO) exits allowing aircraft to exit the runway at speeds of 70 knots (126 kmh). The aircraft leave the runway at what is termed the "exit speed" (page 16, fourth paragraph) and

then "stop" before reaching the taxiway (page 16, third paragraph and page 17, first full paragraph). In the board's judgement the term "stop" also in $D6_1$ does not necessarily mean that the aircraft comes to a complete halt but only that it slows to a residual speed which enables it to move safely onto the taxiway. Differing geometries of the exit at the respective transitions from the runway and onto the taxiway may result in somewhat different residual speeds according to the patent specification and $D6_1$. Nevertheless, the term "stop" in the patent specification has a meaning similar to the same term in $D6_1$ and clearly different from "exit speed". Since claim 1 specifies controlling the aircraft's deceleration to stop "on the runway" it is clearly distinguished from the teaching of $D6_1$ in which the aircraft is decelerated to an exit speed on the runway and to a stop on the exit. The subject-matter of claim 1 therefore is new with respect to $D6_1$.

2. Whereas claim 1 defines a method, claim 4 defines a braking system in part by a functional feature that the control means "control the aircraft's deceleration to stop at the desired position on the runway". This functional feature serves to establish a clear distinction between the subject-matter of claim 4 and the disclosure of $D6_1$ because, as explained above, the latter does not teach that the aircraft is brought to a stop on the runway.

2.1 The respondent argues with reference to the Guidelines C-III, 4.3 that the braking system according to $D6_1$ would be suitable for stopping the aircraft on the runway and that the subject-matter of claim 4 therefore would not be new with respect to $D6_1$. It argues that if

the appropriate parameters were input into the system the result defined by the above-mentioned functional feature would be attained. However, the referenced section of the Guidelines relates to claims to apparatus “for” a particular purpose. Claim 4 does not specify a braking system which is merely "for" stopping an aircraft at a selected position on a runway, it specifies one which does control the deceleration to stop at the desired position on the runway. By comparison, the disclosure of $D6_1$ is of a simulation of a system which is particularly adapted to decelerate the aircraft on the runway and then to bring it to a halt on the exit. That system would be provided with input data to include the positions of the ROTO exits since if the exit speed cannot be attained prior to reaching one exit without exceeding a certain deceleration the next exit is selected. Whether the system would function without such data can only be surmised since the system is not described in sufficient detail for this to be determined.

2.2 The subject-matter also of claim 4 therefore is new with respect to $D6_1$.

Inventive step

3. Before considering the disclosures of the state of the art it is necessary to interpret the meaning of the feature of "closed-loop control" in claims 1, 4. In accordance with the teaching of the patent specification the target deceleration is calculated using input data of desired stopping position, actual speed and actual position. The resulting value is subject to closed-loop control by being compared with

the actual deceleration and an error value is passed to the braking system. However, according to the description closed-loop control of target deceleration is used to stop at a precise position on a runway. It is implicit that this closed-loop control refers not to the generation of the error signal but to a continual calculation of target deceleration since only that calculation can achieve the desired accuracy of stopping position. Moreover, only that repeated calculation determines the value of the target deceleration. This interpretation is consistent with the submissions by both parties during the appeal proceedings.

4. In the board's judgement the closest state of the art for considering inventive step is disclosed by D1. Although the respondent argued that $D6_1$ formed a closer starting point this approach need not be considered further since the board anyway finds that the subject-matter of claims 1, 4 lacks an inventive step when beginning from D1.

4.1 D1 relates to an apparatus for determining the position of an aircraft with respect to a runway. It discloses an aircraft position indicator in combination with a system for automatically controlling the braking system of an aircraft such that the aircraft assumes a desired deceleration. Prior to landing the pilot inputs the position of the expected touch-down relative to the end of the runway, the glide slope angle and a profile of desired deceleration as a function of position on the runway. After the aircraft has landed a processor monitors the aircraft position and instantaneous ground speed, compares them with desired values and generates

a control signal for the braking system to correct the deceleration to the desired value as determined from the profile. The process is monitored and the pilot is alerted if the aircraft speed would be excessive at the end of the runway without additional braking. No desired stopping position on the runway is mentioned but it is implicit that it is the point at which the deceleration profile ends.

4.2 The subject-matter of claim 1 differs from the method disclosed in D1 by the feature that:

– the logic control means in response to the comparison of the aircraft's actual position with the selected stopping position, predeterminedly apply a control signal to the aircraft brake system such that the aircraft brakes in a manner tending to stop the aircraft at the selected stopping position, using a closed-loop control of target deceleration to control the airplane's deceleration to stop at the stopping position on the runway.

This feature has the effect that the value of the target deceleration is determined, on the basis of the remaining distance to the stopping point, as that necessary to stop the aircraft at the desired position. If the actual deceleration differs from the determined deceleration the value of the target deceleration subsequently will be modified in an attempt to recover the situation and achieve the stop as desired. By comparison, the system according to D1 determines the desired deceleration on the basis of the position on the runway. If the actual deceleration differs from that desired the value will not be changed in an

attempt to recover the situation but merely set to the value according to the position on the runway. The problem solved by the differentiating feature may therefore be seen as to more reliably automatically brake the aircraft to stop at a desired position.

4.3 As already set out above, $D6_1$ relates to a simulation of a system performing a method of automatically decelerating an aircraft to a given speed on the runway and further to stop on the exit. The method employs an "autobraking control law" to provide a variable target deceleration command to the autobrake system of an aircraft calculated on the basis of the desired exit speed and the measured values of ground speed and distance to the exit. In the ROTO exit the control law decelerates the aircraft to a stop. The "autobraking control law" disclosed in $D6_1$ is an equation of motion which belongs to the elementary knowledge of the skilled person and, indeed, every technical student and is identical to that used in accordance with the teaching of the patent specification. According to the teaching of $D6_1$ the calculation according to that equation is "ongoing in case the aircraft is not decelerating as expected …" and is updated at a rate of 20Hz, i.e. the target deceleration is subject to closed loop control within the meaning of the present patent. The deceleration is determined in this way both on the runway and to bring the aircraft to a stop in the exit (page 17, first full paragraph). The skilled person faced with the problem of improving the performance of the braking control in accordance with D1 would be motivated by this teaching of $D6_1$ to use it in the braking system of D1 and so arrive at a method according to present claim 1.

4.4 The appellant argues that the teaching according to $D6_1$ is of braking control together with airport geometry for the purpose of reducing runway occupancy time and that the skilled person would not separate a part of the teaching for application to D1. The board disagrees with that view because the elementary nature of the control law according to $D6_1$ would render its applicability for use at airports of conventional geometry evident to the skilled person. Moreover, the statement in $D6_1$ regarding the benefit of using the closed loop control is evidently unrelated to the geometry of the exits.

4.5 On the basis of the foregoing the board finds that the subject-matter of claim 1 does not involve an inventive step and the request fails.

Auxiliary requests

5. The first aspect to be considered is admissibility of the requests.

5.1 Claims 1, 4 according to auxiliary requests 3, 5, 5a and 5b now contain a condition relating to the display of an advisory message which has been extracted from an explanation of "indication logic" in the description. This feature was not included in claims either in the application as granted or as originally filed. The logic sequence involves nested conditions and there is doubt as to whether there was an original disclosure of the single link between the condition and result as presently claimed.

5.2 All of the requests 4 to 5b were first filed after the parties had been summoned to oral proceedings and include a feature relating to an estimated touch-down position which was not included in any claim as originally filed, as granted or as filed with the statement of grounds of appeal. The introduction of the feature raises doubts as regards its original disclosure.

5.3 Although the board recognises that some changes were occasioned by objections concerning original disclosure which it raised in an annex to the summons, the amendments made lead to new possible objections. Amendments to the appellant's case as presented in its statement of grounds of appeal may be admitted and considered only at the board's discretion (Article 13(1) RPBA). The discretion shall be exercised in view of *inter alia* the complexity of the new subject-matter submitted, the current state of the proceedings and the need for procedural economy. Since the auxiliary requests 3 to 5b introduce amendments which fail to establish a sound basis for consideration of inventive step the board exercises its discretion pursuant to Article 13(1) RPBA and does not admit those requests into the procedure.

6. The amendment to claims 1, 4 according to auxiliary request 2a successfully overcomes objections raised by the board in the annex to the summons to oral proceedings and leads to no new objection. Auxiliary request 2a therefore is admitted into the procedure.

6.1 Claims 1, 4 specify the application of a predetermined target deceleration to the aircraft brake system if the

closed-loop control is unavailable. This additional feature provides a fail-safe condition to ensure the availability of a braking control signal. The provision of a back-up for safety relevant systems in aircraft is well known to the skilled person and it typically would be required of him to make such a provision when modifying an aircraft equipped with the system according to D1. As set out above, the system according to D1 already applies a deceleration control signal to the braking system whose value depends on the position of the aircraft on the runway and therefore is predetermined. Since the system according to D1 is already available it would be an obvious measure for the skilled person when improving on that system to use it as the back-up arrangement for fail-safe operation.

6.2 The board therefore considers that also claims 1, 4 according to auxiliary request 2a do not involve an inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Vottner S. Crane