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Case Number: T 1859/15 - 3.2.01

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Title of invention:
Aerospace vehicle yaw generating systems and associated methods

Patent Proprietor:
The Boeing Company

Opponent:
AIRBUS SAS(FR)/ AIRBUS OPÉRATIONS SAS(FR)/ AIRBUS OPERATIONS LTD (GB)/ AIRBUS OPERATIONS GMBH (DE)/ AIRBUS OPERATIONS S.L. (ES)

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Catchword:

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Case Number: T 1859/15 - 3.2.01

D E C I S I O N
of Technical Board of Appeal 3.2.01
of 13 April 2018

Appellant: (Patent Proprietor)	The Boeing Company 100 North Riverside Plaza Chicago, IL 60606-1596 (US)
Representative:	Bartelds, Erik Arnold & Siedsma Bezuidenhoutseweg 57 2594 AC The Hague (NL)
Respondent: (Opponent)	AIRBUS SAS(FR)/ AIRBUS OPÉRATIONS SAS(FR)/ AIRBUS OPERATIONS LTD (GB)/ AIRBUS OPERATIONS GMBH (DE)/ AIRBUS OPERATIONS S.L. (ES) 1 Rond-Point Maurice Bellonte/ 316 route de Bayonne/New Filton House Filton/Kreetslag 10/Avenida de John Lennon s/n F-31707 Blagnac/F-31060 Toulouse Bristol BS99 7AR/D-21129 Hamburg/ ES-Madrid (FR)
Representative:	Bird & Bird LLP Großer Grasbrook 9 20457 Hamburg (DE)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 23 July 2015 revoking European patent No. 2128020 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	G. Pricolo
Members:	C. Narcisi
	S. Fernández de Córdoba

Summary of Facts and Submissions

I. European patent No. 2 128 020 was revoked by the decision of the Opposition Division posted on 23 July 2015. Against the decision an appeal was lodged by the Patentee on 21 September 2015 and the appeal fee was paid. The statement of grounds of appeal was filed by the Patentee on 2 December 2015.

II. Oral proceedings were held on 13 April 2018. The Appellant (Patentee) requested that the appealed decision be set aside and that the patent be maintained in amended form according to the main request (filed on 2 December 2015) or, in the alternative, according to auxiliary request I-A, II, II-A, III, III-A, III-B, IV, IV-A, V, VI, VI-A (filed on 2 December 2015), or according to "any one of the auxiliary requests refused by the Opposition Division".

III. Claim 1 (main request) reads as follows:

"An aerospace vehicle (101; 801) having a fuselage (110; 810) with a first portion (112; 812) and a second portion (114; 814); and a yaw generating system (100; 800), said yaw generating system (100; 800) comprising: a movable control surface (142; 842) coupled to the fuselage (110; 810) and, when retracted, extending generally in a horizontal plane, the control surface (142; 842) being movable to a deflected position in which the control surface (142; 842) is positioned to create a flow pattern proximate to the fuselage (110; 810) when the aerospace vehicle (101; 801) is located in a flow field (F), the flow pattern being positioned to create a pressure differential (P1) between the first portion (112; 812) of the fuselage (110; 810) and

the second portion (114; 814) of the fuselage (110; 810),
the first and second portions (112, 114; 812, 814) being located so that the pressure differential (P1) produces a yawing moment (Ym1) on the aerospace vehicle (101;801),
characterized in that:
-the control surface (142; 842) includes a first control surface (142a; 842a), and
-the system further comprises a second movable control surface (142b; 842b) coupled to the fuselage (110; 810) and, when retracted, extending generally in a horizontal plane, the first and second control surfaces (142a, 142b; 842a, 842b) being at least approximately symmetrically located with respect to the fuselage (110; 810), the second control surface (142b; 842b) being positionable to a selected position when the first control surface (142a; 842a) is placed in the deflected position,
-a first wing section (120a; 820) is coupled to the fuselage (110; 810), the first control surface (142a; 842a) being coupled to the first wing section (120a; 820) and being located within a first third of a wing span running from the fuselage (110; 810) to a tip of the first wing section (120a; 820),
-a second wing section (120b; 820) is coupled to the fuselage (110; 810) generally opposite the first wing section (120a, 820), the second control surface (142b; 842b) being coupled to the second wing section (120b; 820) and being located within a first third of a wing span running from the fuselage (110; 810) to a tip of the second wing section (120b; 820), and
-in the deflected position of the first control surface (142a; 842a) and in the selected position of the second control surface (142b; 842b) the first control surface (142a; 842a) is positioned to accelerate portions of

the fluid flow in some areas, thereby increasing dynamic pressure and decreasing local or static pressure, and to decelerate other portions of the flow, reducing dynamic pressure and increasing local or static pressure so as to create the flow pattern that creates the pressure differential (P1),
wherein the first movable control surface (142a; 842a) includes a first spoiler surface and the second movable control surface (142b; 842b) includes a second spoiler surface, the first spoiler surface being coupled to the first wing section (120a; 820a) and the second spoiler surface being coupled to the second wing section (120b; 820b).”

Claim 1 of auxiliary request II differs from claim 1 of the main request in that the wording “and being located within a first third of a wing span running from the fuselage (110; 810) to a tip of the first wing section (120a; 820)” is deleted, the wording “being coupled to the second wing section (120b;820) and being located within a first third of a wing span running from the fuselage (110; 810) to a tip of the second wing section (120b; 820), and” is replaced by “being coupled to the second wing section (120b; 820),”, and the wording “wherein the first movable control surface (142a; 842a) includes a first spoiler surface and the second movable control surface includes a second spoiler surface, the first spoiler surface being coupled to the first wing section (120a; 820a) and the second spoiler surface being coupled to the second wing section (120b; 820b)” is replaced by “wherein:
-the first control surface (142a;842a) is located proximate to a first side (111;811) of the fuselage (110;810) opposite a second side (113;813) of the fuselage (110;810) and the second control surface

(142b;842b) is located proximate the second side (113;813) of the fuselage (110;810),and
-the pressure differential (P1) between the first portion (112;812) of the fuselage (110;810) and the second portion (114;814) of the fuselage creates a side force (S1) that produces the yawing moment (Ym1), the side force (S1) having a direction extending outwardly from the fuselage (110;810) and away from the second side (113;813) of the fuselage (110;810),and
the first control surface (142a;842a) in the deflected position is positioned to create a flow pattern proximate to the fuselage (110;810) to create the pressure differential (P1) between the first portion (112;812) of the fuselage (110;810) and the second portion (114;814)of the fuselage (110;810) while creating an at least approximately balanced net rolling moment (Rmnet) on the aerospace vehicle (101;801) when the vehicle (101; 801) is located in the flow field (F) at one or more selected operating conditions,
wherein when the first control surface (142a) is in the deflected position a first amount of lift (L1) created by the first wing section (120a) is less than a second amount of lift (L2) created by the second wing section (120b), thus creating a lift rolling moment (RMl),
while side force (S1) is positioned above a c.g. of the aerospace vehicle (101), thus creating a first rolling moment (Rm1) which is generally opposite the lift rolling moment (Rml), resulting in the net rolling moment (Rmnet) that is at least approximately balanced."

Claim 1 of auxiliary request III differs from claim 1 of the main request in that the wording "and being located within a first third of a wing span running from the fuselage (110;810) to a tip of the first wing section (120a;820)" is deleted, the wording "being

coupled to the second wing section (120b;820) and being located within a first third of a wing span running from the fuselage (110; 810) to a tip of the second wing section (120b; 820), and" is replaced by "being coupled to the second wing section (120b; 820),", and the wording "wherein the first movable control surface (142a; 842a) includes a first spoiler surface and the second movable control surface (142b; 842b) includes a second spoiler surface, the first spoiler surface being coupled to the first wing section (120a; 820a) and the second spoiler surface being coupled to the second wing section (120b; 820b)" is replaced by
"the first movable control surface (142a; 842a) includes a first spoiler surface and the second movable control surface (142b; 842b) includes a second spoiler surface, the first spoiler surface being coupled to the first wing section (120a; 820a) and the second spoiler surface being coupled to the second wing section (120b; 820b),
-the first control surface (142a;842a) is located proximate to a first side (111;811) of the fuselage (110;810) opposite a second side (113;813) of the fuselage (110;810) and the second control surface (142b;842b) is located proximate the second side (113;813) of the fuselage (110;810), and
-the pressure differential (P1) between the first portion (112;812) of the fuselage (110;810) and the second portion (114;814) of the fuselage creates a side force (S1) that produces the yawing moment (Ym1), the side force (S1) having a direction extending outwardly from the fuselage (110;810) and away from the second side (113;813) of the fuselage (110;810),
-the aerospace vehicle (101;801) further being characterized by:
-at least one of a mechanical flight control system and an electronic flight control system operatively coupled

to the first and second control surfaces (142a;142b; 842a;842b) to move the first control surface (142a; 842a) to the deflected position and the second control surface (142b;842b) to the selected position when an asymmetric thrust condition creates a thrust yawing moment (Ymt) on the aerospace vehicle (101;801) at one or more selected operating conditions, the first yawing moment (Ym1) being at east approximately opposite the thrust yawing moment (Ymt); and
-a vertical stabilizer (102;802) coupled to the fuselage (110;810) the vertical stabilizer (102;802) having a rudder surface (141) that is movable to produce a rudder yawing moment (Ymr) at least approximately opposite the thrust yawing moment (Ymt).”

IV. The Appellant’s arguments may be summarized as follows:

The subject-matter of claim 1 in conjunction with the patent specification (hereinafter designated as EP-B) discloses the invention sufficiently clearly and completely such that the skilled person would be able to carry it out. From the disclosure of EP-B it is clear that the control surface 142 at each side of the fuselage includes only a spoiler (see e.g. figures 1, 4, 5; description, paragraphs [0012], [0017]). Consequently, the term “the (first/second) movable control surface includes a (first/second) spoiler surface” should be interpreted as an exhaustive list. In addition, it is clearly stated in claim 1 and in the disclosure of EP-B that the spoiler is located within the first third of the wing span (EP-B, paragraph [0017]) and that the control surface “is positioned to create a flow pattern proximate to the fuselage” (see

e.g. EP-B, [0017]). Also, the functional features in claim 1 (relating to the velocity of the fluid flow, the dynamic pressure of the fluid and the static pressure of the fluid flow) constitute functional technical features which distinguish the invention from the prior art, for they clearly imply a technical effect. Moreover, these functional features require a specific structural arrangement of the first and second control surface, e.g. the angle of deflection has to be chosen such that the pressure differential according to the claims is created.

The skilled person would understand that the present invention clearly excludes various flow types that would not produce the pulling force as taught by the patent. Thus, it does not teach detaching flow (as opposed to the cited prior art) since according to the invention the flow stays attached when the flow lowers the static pressure on the opposite side of the fuselage. Likewise, it also excludes that the flow will not hit anything when the spoiler is deflected. If for example the wing is too high, the flow will not attach to anything and not hit anything even the tail. If the wing is too low, it will not be able to go over the fuselage. If the fuselage is not long enough, there will not be enough runway to cross-over and the flow will not hit anything. Also, the flow could start to cross over the fuselage and not make it over before running out of runway (effectively splitting the flow between port and starboard sides), thus it would not provide lowering of static pressure that produces a side force because the forces would balance each other out, for the lowering of static pressure would be on top of the fuselage and not on the sides or the lowering of static pressure would be equal on both sides of the fuselage (see Appellant’s letter dated 13 February 2018).

The skilled person would have no difficulty in following the above mentioned functional features representing constraints (or instructions) in conjunction with the aforementioned structural features in the claim and in the figures, and would be able to put the invention into effect. No computational efforts going beyond those ordinarily required by the customary practice of the skilled person would be involved. In particular, the skilled person would understand that the present invention provides an additional yawing moment acting on the fuselage in order to compensate and balance out the yawing moment caused by a loss of thrust in one of the engines, in the event that the yawing moment generated by the vertical stabilizing surface or by the rudder would not be sufficient to provide such compensation (see also claim 1 of auxiliary request 3). The location of the force S1 (above the centre of gravity of the aircraft) generating said yawing moment is specified in claim 1 of auxiliary requests III. Claim 1 of auxiliary request II includes corresponding details as to how the net rolling moment is approximately balanced.

V. The Respondent's arguments may be summarized as follows:

The subject-matter of claim 1 in conjunction with the patent specification (EP-B) does not disclose the invention in a manner sufficiently clear and complete for it to be put into effect by the skilled person. First, contrary to the Appellant's view, the control surfaces do not include only spoilers but other control surfaces too, such as e.g. flaps (EP-B, [0038]). Also, the spoiler is not necessarily positioned within the first third of the wing span, for it can have other

locations where the same physical effects are created (EP-B, [0018]).

Second, the Appellant itself states (see letter dated 13 February 2018) that the claimed functional features relating to the pressure differential (between the first and second portion of the fuselage) is only created if the correct angle of deflection is chosen for the control surfaces. However, claim 2 of EP-B clearly suggests that any differential deflection of the first and second control surface generates the claimed pressure differential.

Moreover, the Appellant alleges that deflected spoilers cause various types of flow. Apparently all known inboard spoilers, i.e. spoilers located in the claimed position, would destroy lift by detaching flow. For some spoilers the flow would come back into contact with the fuselage, for others the flow would only come into contact with the tail and for even other inboard spoilers the flow would never come back into contact with the fuselage. Appellant further contends that for the present invention to work flow must not detach from the fuselage at all. This requirement is nowhere disclosed in the opposed patent. It is also not disclosed how the skilled person could design such a spoiler, if all commonly known inboard spoilers detach flow from the fuselage.

Finally, the Appellant also alleges that the "height" of the wing on the fuselage (and therefore the height of the spoilers) is also crucial for performing the invention. This is nowhere disclosed in the opposed patent and appears to contradict the various embodiments disclosed in EP-B, all allegedly generating the claimed pressure differential but having very different "heights" of the control surfaces on the fuselage. The Appellant likewise asserts that the length of the fuselage is critical for putting the

invention into practice. However, no disclosure whatsoever is to be found in EP-B that specific length requirements have to be met.
For all these reasons the invention is not clearly and sufficiently disclosed in EP-B.

Reasons for the Decision

1. The appeal is admissible.

2. The subject-matter of claim 1 of the main request in conjunction with the patent specification does not disclose the invention in a manner sufficiently clear and complete for the skilled person to carry it out (Article 83 EPC).
The Board considers that it would not be possible for the skilled person to put the invention into practice, for the teaching of claim 1 in conjunction with EP-B's disclosure is far too broad and general and does not allow to derive specific indications and guidance which are sufficiently clear and complete.

Starting from the first embodiment in EP-B (see e.g. figures 1, 4 and 5; EP-B, paragraphs [0012]-[0018]) it is noted that the claimed feature reading "the first movable control surface (142a; 842a) includes a first spoiler surface and the second movable control surface includes a second spoiler surface" (hereinafter designated as feature (i)) does not provide a clear teaching, for the description definitely and explicitly states that in other embodiments "other arrangements of control surfaces 142" (see EP-B, [0016]; see also [0038]) can be included, such as flaps or aileron surfaces (see also EP-B, figures 4, 5).

In addition, it is stated in paragraph [0018] of EP-B that "as discussed above, in figure 1 the first control surface 142a is located within the first third of the wing span, however, it is understood that the first control surface 142a can have other locations where the deflected position can create the first pressure differential on the fuselage". In other words, the skilled person is presented here with the information and teaching that any possible and reasonable location of the spoiler on the wing is in principle contemplated by the invention, as far as and to the extent that the claimed physical effect according to the claimed functional feature (i.e. "in the deflected position of the first control surface (142a; 842a) and in the selected position of the second control surface (142b; 842b) the first control surface (142a; 842a) is positioned to accelerate portions of the fluid flow in some areas, thereby increasing dynamic pressure and decreasing local or static pressure, and to decelerate other portions of the flow, reducing dynamic pressure and increasing local or static pressure so as to create the flow pattern that creates the pressure differential (P1)", hereinafter designated as feature (iii)) is made possible and is obtained. This is clearly in disagreement with the further claimed feature reading "the first/second control surface being coupled to the first/second wing section and being located within a first third of a wing span running from the fuselage to a tip of the first/second wing section" (hereinafter designated as feature (ii)). Obviously, the control surfaces can also include ailerons or flaps (EP-B, [0016]), provided that they produce the physical effect according to said functional feature (iii) (relating to differential pressure) (see also EP-B, e.g. [0038]).

The further claimed feature reciting "positioned to create a flow pattern proximate to the fuselage" similarly does not provide any clear indication to the skilled person (the term "proximate" being not defined in EP-B or in the art) and moreover may apply to any one of the control surfaces discussed hereinbefore (i.e. spoilers, flaps, ailerons). In conclusion, the skilled person would have to look for control surfaces leading to the mentioned functional feature (iii), these control surfaces being selected among spoilers, ailerons and flaps and being located in principle at any position "proximate the fuselage" such as to produce the physical effects implied by feature (iii).

As to the aforesaid functional feature (iii) it is noted that it merely represents and states a fundamental physical law (Bernoulli's principle) implying that the sum of the static pressure p and the dynamic pressure $(1/2)\rho v^2$ (with fluid flow velocity v and fluid density ρ) is constant. Thus, at locations where deflection of the control surface leads to a lower flow velocity v (or lower dynamic pressure) local static pressure is increased, and vice versa. Hence feature (iii) solely expresses a general physical law and (contrary to the Appellant's view) does not provide the skilled person with any specific guidance or instructions as to the specific configuration of the flow field and the pressure differential affecting specific (first and second) portions of the fuselage in order to produce the intended yawing moment Ym1. The illustration of the flow field in figure 4 (or 5) of EP-B (and the related parts of the description) does not give the skilled person any more information about the nature and configuration of the flow field than is already provided by feature (iii) (see EP-B, [0034]), given that figure 4 is purely schematic.

The Board further notes, as observed the Respondent, that several arguments of the Appellant confirm in many respects that relevant information enabling the skilled person to carry out the invention is missing in EP-B. In particular, the Appellant contends that said functional limitations require a specific structural arrangement (see letter dated 13 February 2018, page 5), that the angle of deflection has to be properly chosen (see cited letter, page 5), that the inboard spoiler should not be implemented in the general known way to detach flow (which by contrast according to the invention remains attached to the fuselage) (see cited letter, page 10) and that the aircraft's specific dimensions such as "height" of the wing and length of the fuselage are important (see cited letter, page 10). Any clear and unambiguous indications reflecting these and the former aspects discussed above cannot be found in EP-B, and given the multitude of parameters and structural features involved (and related missing indications in EP-B) the Board cannot share the Appellant's view that the skilled person would have no difficulty in providing the corresponding missing structural arrangements and instructions.

The further embodiments as disclosed in EP-B (for instance in paragraphs [0019]-[0023], [0024]-[0025], [0026]-[027], [0028]-[0031]; these embodiments representing together with the first embodiment in paragraphs [0013]-[0018] the main embodiments of the invention in EP-B) likewise fall within the scope of claim 1 of the main request. These embodiments are also considered to contravene Article 83 EPC since, as discussed above in relation to the first embodiment, they similarly do not imply a clear, unambiguous and sufficient teaching concerning the nature of the

control surfaces, their specific location on the wing, the configuration of the flow field, specific angles of deflection of the control surfaces and critical aircraft's dimensions such as fuselage length and "height" of the wings on the fuselage.
In addition, these further embodiments (such as the embodiments disclosed in paragraphs [0019]-[0023] and [0028]-[0031], corresponding to claim 1 of auxiliary request III; or the embodiments of paragraphs [0026]-[0027], corresponding to claim 1 of auxiliary request II) entail further difficulties, given that they all require the generation of a second yawing moment Ym2 and related side force S2, produced by a second pressure differential P2 acting between a first and second portion of the aircraft's body, this second pressure differential being produced by a second flow pattern (see e.g. EP-B, [0019]), [0023], [0026]). However, the skilled person would not be able to derive from the disclosure of EP-B how this second flow pattern is created (just as it would not be able to derive it for the first flow pattern), and moreover it would not be able to deduce which control surfaces and related control methods lead to the generation of a first flow pattern and first yawing moment Ym1, as opposed to control surfaces and related control methods leading to the generation of a second flow pattern and a second yawing moment Ym2. Therefore, the subject-matter of claim 1 of auxiliary requests II and III (in conjunction with the patent specification (EP-B)), similarly to claim 1 of the main request, does not involve a sufficiently clear and complete technical teaching.

The same applies to all other auxiliary requests, as respective claim 1 of any of these requests includes the above mentioned features (i), (ii) and (iii) (or

equivalent and corresponding features relating to the (nature of the) control surfaces and their location on or coupling to the aircraft's fuselage or wing section; or corresponding functional features (see feature (iii)), as the relevant parameters and structural features are missing (see reasons given above in relation to claim 1 of the main request) and as any of these claims is based on a respective of the aforementioned paragraphs of EP-B (see above), each lacking a sufficiently clear and complete disclosure (see above).
In fact, the Appellant did not contest, at the oral proceedings, that if the main request would fail the other requests (apart from auxiliary requests II and III discussed above) would also fail.

For the above mentioned reasons the invention is not disclosed in a sufficiently clear and complete manner, such that the skilled person would be able to carry it out (Article 83 EPC).

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

A. Vottner G. Pricolo

Decision electronically authenticated