BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS | BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE | CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

A		B		C	X

File Number: T 382/91 - 3.2.1

Application No.: 81 200 792.0

Publication No.: 0 045 988

Title of invention: Extendible airfoil track assembly

Classification: B64C 13/34

D E C I S I O N
of 2 March 1993

Proprietor of the patent: The Boeing Company

Opponent: 01) British Aerospace Plc
02) Deutsche Airbus GmbH

Headword:

EPC Article 56

Keyword: "Inventive step (yes)"

Case Number : T 382/91 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 2 March 1993

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Decision under appeal :
Decision of the Opposition Division of the European Patent Office announced 19 November 1990, and issued in written form on 18 March 1991, revoking European patent No. 0 045 988 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : F. Gumbel
Members : S. Crane
W.M. Schar

Summary of Facts and Submissions

I. European patent No. 0 045 988 was granted on 19 November 1987 on the basis of European patent application No. 81 200 792.0.

II. The patent was opposed by the Respondents (Deutsche Airbus GmbH is the legal successor of Messerschmitt-Bölkow-Blohm GmbH) on the grounds that its subject-matter lacked inventive step with respect to the state of the art.

As state of the art the following documents were cited:

(D1) US-A-3 089 666
(D2) DE-C-748 146
(D3) US-A-2 298 264
(D4) DE-A-2 729 234
(D5) US-A-3 834 247
(A) DE-C-643 682
(B) US-A-1 611 326
(C) DE-B-1 051 025
(D) GB-A-463 796
(E) US-A-4 286 649
(F) GB-A-619 169
(G) DE-C-1 139 388
(H) US-A-4 158 315.

III. By its decision given at the oral proceedings on 19 November 1990, issued in written form on 18 March 1991, the Opposition Division revoked the patent.

IV. The Appellants (Proprietors of the patent) filed an appeal against this decision on 17 May 1991 and paid the appeal fee on the same day.

The Statement of Grounds of Appeal was received on 26 July 1991. With this statement the Appellants filed a Claim 1 on the basis of which they requested maintenance of the patent in amended form, this claim corresponding in essence to the claim according to the auxiliary request considered by the Opposition Division.

V. With a letter dated 12 October 1991 the first Respondents (Opponents 01) made various objections to the formal allowability of the new claim proposed by the Appellants and referred to further documents illustrating the state of the art, viz.:

(D6) GB-A-1 339 331

(D7) Maintenance Manual Trident 3B Section 27-80-01, pages 1 and 2 (October 1974) and Section 27-80-0131, 27-80-0331 and 27-80-0341

(D8) VC10-Series Illustrated Parts Catalogue, various pages

(D9) "The Principles of Aircraft Stressing", W.L. Morse, Charles Griffin & Company, London 1941, pages 1 to 5

(D10) Documentation relation to the F111/F14 fighter of General Dynamics.

VI. In a communication of the Board dated 18 September 1992 pursuant to Article 11(2) RPBA the Board made various comments with respect to the allowability of the proposed claim and referred inter alia to

(D11) US-A-1 917 428

a document that had been cited in the Search Report.

VII. In response to this communication the Appellants filed with a letter dated 1 February 1993 new documents

corresponding to a main and auxiliary request on the basis of which maintenance of the patent in amended form was requested.

The single claim of the main request is worded as follows:

"Mechanism for extending a wing leading edge slat high-lift device (2) relative to a main airfoil (15), comprising:

a carrier track (23) connected to said high-lift device, extending substantially chordwise of said main airfoil and comprising a toothed section;

guide means secured to said main airfoil and comprising upper and lower rollers (26) in contact with upper and lower surfaces of said carrier track (23) for support thereof;

a pinion gear (25) adapted to gear in meshing engagement with said toothed section for extending and retracting the high-lift device, said pinion gear (25) being located spanwise between a pair of wing ribs (18) providing a structurally straddled support for said pinion gear (25),

characterized in that

a) the carrier track (23) has a hat-shaped cross section, namely an inverted U-shaped cross section defining a downwardly facing channel along the length thereof, each of the vertical webs of the channel being formed with an outwardly extending flange at its lower edge;

b) said toothed section is formed by a single-piece gear rack (24) formed separately of said carrier track (23) and mounted within said channel with its gear teeth facing downwardly and fixed by several spaced apart fasteners (28, 28A) passing through both vertical webs of

said carrier track (23) and through said gear rack (24) above said teeth;

c) the depth of the channel is greater than the height of the gear rack (24) and the gear rack is located entirely up inside the channel so that the inner facing sides of the channel protect the gear rack teeth from dirt or material that would jam the gear meshing relationship with the pinion gear (25); and

d) said upper and lower rollers (26) are in contact respectively with the cross member of said inverted U-shaped carrier track (23) and the lower surface of both outwardly extending flanges thereof and are located spanwise between said pair of wing ribs (18), which provide a structurally straddled support for said rollers (26)."

The other documents according to the main request are as follows:

Description: Amendment A, filed with the letter dated1 February 1993, to replace column 1 of the granted patent specification;
Columns 2 and 7 of the granted patent specification amended as shown in the copies attached to the letter of 1 February 1993;
Columns 3 to 6 of the granted patent specification.

Drawings: Sheets 1 to 5 of the granted patent specification;
Sheet 6 amended as shown in the copy attached to the letter of 1 February 1993.

VIII. With a letter dated 19 February 1993 the first Respondents referred to a further prior art document, viz. US-A-3 930 533 (D12), which in their opinion was particularly

relevant to the characterising features of the new claim filed by the Appellant.

IX. Oral proceedings were held on 2 March 1993.

At the commencement of the oral proceedings the Chairman stated that the Board intended to disregard the late-filed document D12, pursuant to Article 114(2) EPC, particularly as it seemed to be of no more relevance than document E already present on the file.

X. The arguments presented by the Appellants in support of their request can be summarised as follows:

All the features of the new claim could be found in the original disclosure so that there could be no objection to the claim under Article 123(2) EPC. With respect to the statement that the carrier track extended "substantially chordwise" reference was to be made to Figure 1 which showed that the carrier track need not extend exactly in a chordwise direction but at an acute angle thereto.

At the time the invention was made wing leading edge slat high-lift devices of commercial aircraft were supported on carrier tracks which were separate from the actual extension actuator. It was known in principle from document D11, which was considered to constitute the closest state of the art, to integrate a gear rack with the carrier track, but there the drive pinion was located above the carrier track and this configuration was unsuitable for modern thin wings. The formation of the rack on the underside of the carrier track to solve this problem would mean however that the rack would be under tensile stress and therefore more liable to cracking, such cracks then propagating through the carrier track and leading to ultimate failure. Thus this arrangement was

considered unacceptable from the safety aspect. The Appellants had overcome this technical prejudice by using a separate gear rack which was attached to the carrier track in a very particular way so that stressing of the gear rack could be minimised, and that even if the gear rack did fracture the pieces would be retained in the channel in the carrier track and not endanger operation of the aircraft. Furthermore, the location of the gear rack within the channel in the carrier track reduced the overall height of the mechanism, protected the teeth from damage and allowed the carrier track to run along its whole length between upper and lower rollers which straddled the carrier track. The particular cross-sectional form of the carrier track stated in the claim ensured adequate bending and torsional strength, despite the provision of the channel for the gear rack, and provided extended surfaces to distribute the very considerable loads developed onto the rollers. It could be seen therefore that all of the features of the characterising clause of the claim combined with each other in the achievement of the object of providing an extension mechanism which was light-weight but nevertheless could meet the stringent safety requirements imposed on commercial aircraft.

The arguments put forward by the Respondents were a textbook example of an ex-post-facto attempt to call into question the merits of what was an extremely valuable and commercially successful invention. Despite their having extended their investigations to the remotest of technical fields they had still not in any case been able to show that a combination of carrier track and gear rack as specified in the characterising clause of the claim was known per se. Similarly, the attempts of the Respondents to see in the extension mechanism of Figures 41 and 42 of document D1 a structure in some way comparable to that

claimed was based purely on hindsight. Document D1 did not in any case relate to a high-lift device but to a baffle plate for deflecting the downwash from a tiltable propellor unit.

XI. The arguments presented by the Respondents in support of their requests that the appeal be set aside were essentially as follows:

In the originally filed application documents the carrier track had been exclusively referred to as extending "chordwise" so that there was no basis for the broader term "substantially chordwise" used in the claim. Similarly, the claim now referred to the rollers being "located" spanwise between a pair of wing ribs, whereas the original disclosure only used the narrower term "centred" in this respect. Lastly, the positioning of the gear rack entirely within the channel of the carrier track had been presented in the original disclosure essentially in the context of providing a raceway for the drive pinion, protection of the teeth of the gear rack being mentioned only as a subsidiary aspect. Now, however, this latter aspect had been given prominence which switched the emphasis of the original disclosure. All of these amendments infringed against Article 123(2) EPC and the new claim was therefore not allowable.

Document D11, which was very old, was not a suitable starting point for evaluating the alleged invention. Document D1 was much more appropriate in this respect. It was clear from Figures 30 to 32 and the accompanying text that the purpose of extending the baffle plate shown in Figures 41 and 42 was to increase lift at low speeds and that accordingly this baffle plate was a high-lift device within the meaning of the claim. It could be seen from Figures 41 and 42 that the extension mechanism comprised a

carrier track to which was attached a downwardly facing gear rack that meshed with a drive pinion. The carrier track ran between upper and lower rollers. In his attempt to put the schematic teaching of these Figures into effect the skilled man would have recourse to the general state of the art in the field of rack and pinion mechanisms. Of particular relevance here were documents D4 and E both of which disclosed carrier tracks with a downwardly facing channel in which a gear rack was mounted. The assembly shown in document E was substantially identical to that defined in the claim with the exception of the outwardly extending flanges at the lower edge of the channel in the carrier track. Such flanges were however shown in document D4 and it would be a trivial measure for the skilled man to strengthen a carrier track in this way if needs be. Furthermore, the carrier track shown in document E ran between straddled upper and lower rollers in the same way as proposed by the claim. Also, as witnessed by documents D6 to D8 and D10 it was commonplace in the art to arrange the carrier tracks for wing leading edge slat high-lift devices between respective pairs of wing ribs on which guide rollers are supported. Accordingly, all of the features of the characterising clause of the claim were either known from or trivial with respect to the state of the art. It was not possible to see how these features combined in any way to produce a non-obvious result.

Reasons for the Decision

1. The appeal complies with the requirements of Articles 106 to 108 and Rules 1(1) and 64 EPC. It is therefore admissible.

2. Allowability of the amendments

The present claim is based in essence on the originally filed Claim 1 complemented with various features concerning the form of the carrier track, the mounting of the gear rack within the carrier track, and the mounting of the guide rollers within the airfoil, all of which features can be readily derived from the original disclosure.

In contrast to the Respondents the Board sees no objection to the statement in the claim that the carrier track extends "substantially chordwise" as a basis for this can be found in the original Figure 1. That the inner facing sides of the channel in the carrier track protect the gear rack teeth, as required by the claim, is clearly stated in paragraph 2, page 2 of the original disclosure, so again the Board cannot follow the Respondents' objection in this respect. Lastly, the Board cannot accept the contention of the Respondents that the skilled man would have attached a special restrictive meaning to the statement in paragraph 3, page 7 of the original disclosure that the rollers are "centred spanwise" between the pair of wing ribs. Instead, the Board takes the view that the skilled man would in the circumstances understand this in the sense, as required by the present claim, that the rollers are located between the wing ribs.

The amendments made to the description do not extend beyond those necessary to adapt this to the terms of the present claim and to mention the most relevant state of the art.

Accordingly there are no objections to the amended documents under Article 123(2) EPC.

Furthermore, since all of the features of granted Claim 1 are contained in the new claim there has been no infringement of Article 123(3) EPC.

3. State of the art

3.1 In document D11 there is disclosed a mechanism for extending a wing leading edge slat comprising a curved carrier track for the slat which is provided at its upper rear end with an integral toothed section forming a rack engaged by a drive pinion situated above the carrier track. The latter has an "I"-shaped cross-section and is guided by means of, firstly, upper and lower rollers attached via trunnions to a spanwise extending rib, and secondly by means of upper and lower pairs of rollers mounted on the rear end of the carrier track and engaging arcuate plate members disposed between adjacent wing ribs.

3.2 Document D1 relates to an aircraft with pairs of tiltable propellor units mounted in fore and aft alignment on the wing so as to provide a variable thrust direction for very short or vertical landing or take-off.

As described with respect to Figures 27 to 35 the interaction with the wing of the slipstream from the forward propellor when this is tilted substantially can produce negative lift. One of the means proposed to alleviate this problem is the provision of an extension on the leading edge of the wing to deter high speed air from flowing downwards beneath the leading edge to cause a low pressure area. One suitable extensible baffle plate arrangement for this purpose is shown in Figures 41 and 42. The baffle plate is mounted on a curved rack bar which is guided by upper and lower rollers. The rack bar is not described in detail but would appear from the Figures to

comprise a gear rack member affixed to one side of a plate-like carrier member. The lower rollers engage the lower edge of the carrier member and the upper rollers the upper edge of the gear rack member. The downwardly facing teeth of the gear rack member are spaced upwardly from the lower edge of the carrier member and engaged by a drive pinion.

3.3 Document D3 relates to a wing leading edge slat extension mechanism in which the slat is supported on a pair of carrier tracks of "I"-shaped cross-section guided between respective upper and lower roller pairs. The slat is extended by a separate actuator. The carrier tracks are equipped with respective rack members in the form of lengths of roller chain attached to the vertical web of the "I"-shaped cross-section. The rack members engage respective sprockets which are drivingly interconnected by a sprocket and chain transmission with a drive ratio other than unity. The carrier tracks are therefore constrained to move different distances on extension by the actuator so that the slot formed between the slat and the main airfoil is tapered.

3.4 Documents D6, D7 and D8 disclose wing leading edge slat extension mechanisms wherein the actuator is separate from the carrier tracks. The carrier tracks have an "I"-shaped cross-section and are arranged between respective pairs of wing ribs on which are mounted guide rollers for the carrier tracks. According to document D6 the guide rollers are mounted cantilever fashion and extend into the space between the flanges of the "I"-shaped carrier track. According to documents D7 and D8 the rollers straddle the carrier track and engage the upper and lower surface thereof.

3.5 Document D10 is a technical manual the individual pages of which are changed from time to time. Page 2-20 (Figure 5) relating to the wing leading edge assembly bears a change date of 1 July 1974 so that the Board is satisfied that it belongs to the state of the art. It appears from Figure 5 that the carrier track for the leading edge slat is provided along its lower surface with a toothed section engaged by a drive pinion and is supported for movement by rollers extending cantilever fashion from the wing ribs in the manner discussed above with respect to document D6.

3.6 Document D4 relates to an adjustment mechanism for a sliding carrier in precision apparatus such as a microscope or the like. The carrier has a "hat-shaped" cross-section with outwardly extending flanges formed at the lower edges of an open U-shaped channel section, the upper and lower surfaces of these flanges being in sliding engagement with guideways on the base of the apparatus. In the channel section there is arranged a gear rack member attached to the carrier by means of fasteners at either end of the gear rack member which are screwed into the upper cross-member of the U-shaped channel section. The gear rack member is engaged by a hand-driven pinion supported on the base of the apparatus by a leaf-spring arrangement for urging the pinion against the gear rack member.

3.7 Document E is concerned with a mechanism for positioning the starter bar of continuous casting apparatus. Such a bar is curved and has a trailing end for joining to a metal strand issuing from a continuous casting mould. The bar is driven by pinch rolls in an arcuate path until the trailing end reaches a predetermined position at which the metal strand is separated from it. Document E relates in particular to means for holding the bar in this position. For this purpose the leading end of the bar is provided on

its convex side with a slot in which is mounted a gear rack secured in any suitable manner against the curved inner wall of the slot. As can be seen from the Figures the depth of the slot is greater than the height of the gear rack. The rack teeth mesh with a gear wheel connected via an overrunning clutch to a motor. After the metal strand has been separated as mentioned above the bar is held stationary until the motor is actuated enabling it to descend under gravity. The bar is guided in its movement by spaced rollers engaging all four sides thereof.

3.8 The remaining documents introduced into the proceedings are less relevant than those dealt with above and need not be discussed further. They did, in fact, not play any role during the appeal proceedings.

4. Novelty

That the mechanism defined in the claim is new follows from the above discussion of the prior art and is not in dispute. In particular it is distinguished from the state of the art according to document D11, on which the preamble of the claim is based, by the features set out in the characterising clause.

5. Inventive step

The Board shares the view of the Appellants that the most appropriate starting point for evaluating the inventive step of the claimed subject-matter is the mechanism disclosed in document D11. The Respondents dispute this and are of the opinion that document D1 is more relevant. However, although as disclosed there the extension of the baffle plate has the effect of decreasing the negative lift generated by the interaction of downwash from the propellor unit with the wing, and could therefore be said

to increase lift, the Board is satisfied that document D1 does not relate to a mechanism for extending a "wing leading edge slat high-lift device" as this would normally be understood by a man skilled in the art. As will in any case become clear from what is said below it would have no material effect on the evaluation of inventive step if document D1 were chosen as the best starting point instead of document D11.

In the light of the state of the art disclosed in document D11 the technical problem to be solved is to be seen in the provision of a mechanism for extending a wing leading edge slat high-lift device which is capable of being used in a thin wing and which despite its low weight and simplicity is capable of meeting the stringent safety standards required in modern commercial aircraft.

It would be clear to the skilled man that the arrangement disclosed in document D11, although potentially promising insofar as it integrates the actual extension mechanism into the carrier track, would need substantial development in order to bring it into conformity with current design practice. In particular, the requirement for low overall height of the mechanism, dictated by modern wing profiles, would necessitate providing the gear rack teeth on the lower, concave side of the carrier track. Furthermore, it would clearly be preferable to replace the somewhat complex arrangement for guiding the inboard end of the carrier track disclosed in document D11, in which the carrier track itself is provided with support rollers engaging curved plates extending between adjacent wing ribs, by an arrangement known per se from for example document D7, in which the carrier track runs between upper and lower rollers straddling the track. Since in the latter arrangement it would no longer be practical for the gear rack teeth to be formed along the bottom edge of the

carrier track the skilled man would therefore be led to an arrangement in which the teeth are set back from this edge, as is shown in document D1. Furthermore, having regard to basic engineering considerations concerning the different mechanical properties required for the gear rack teeth and the carrier track, and facilitating the machining of the teeth, the skilled man could also recognise the advantages of forming the teeth in a separate gear rack member which is then fixed to the carrier track in a suitable manner. In this respect it is to be noted that such a separate gear rack member is apparently shown in Figures 41 and 42 of document D1, even if not specifically described as such, and is also clearly described in the slat extension mechanism of document D3.

In the view of the Board all of the above measures are ones which the skilled man concerned with the development of the mechanism disclosed in document D11 could be reasonable expected to make on the basis of his general and specialist technical knowledge without the application of inventive ingenuity. However, it is evident that the application of the above technical considerations would not lead to the arrangement specified in the present claim in particular having regard to the cross-sectional form of the carrier track, the location of the gear rack with respect to the carrier track and the means by which the gear rack is fastened to the carrier track. In the latter respect the Appellants have argued, and the Board accepts, that the provision of bores in the gear rack above the teeth thereof for receiving fasteners is a measure which the skilled man would normally try to avoid, since it would lead to a combination of stress concentration factors. The Appellants have however turned this apparent disadvantage to a good end insofar as it is now ensured that if the gear rack does fracture it does so at a controlled position, i.e. through a bore for a fastener,

the fastener nevertheless acting to retain the fractured segment of the gear rack in the channel in the carrier track. It is therefore clear, contrary to what has been alleged by the Respondents, that this feature makes a contribution to the solution of the technical problem stated above.

In their attempt to show that the arrangement of carrier track and gear rack specified in the present claim was known per se and would be arrived at by the skilled man as the result of applying his general knowledge in the field of rack and pinion mechanisms or by reference to relevant state of the art documents in this field the Respondents have referred in particular to documents D4 and E. It is however to be noted in the first place that these documents stem from remote fields (precision instruments and continuous casting machines) which the skilled man in the present case, i.e. an aeronautical engineer, would have no cause to consult in his search for a solution to the technical problem indicated above. Furthermore, it is in any case apparent from the discussion of these documents in points 3.6 and 3.7 above that neither of them disclose a gear rack secured in a channel of a carrier track by several spaced apart fasteners passing through the vertical webs of the carrier track and the gear rack above the teeth thereof, as required by the present claim. The Respondents have argued that this arrangement of fasteners would be one that would readily occur to the skilled person but for the reasons given in the preceding paragraph the Board cannot accept that as being an accurate statement of the technical realities involved.

Having regard to the above it is apparent that the skilled man would not have been led to adopt, in combination, the features (a) to (d) specified in the characterising clause of the claim in order to arrive at a solution to the technical problem with which he was faced.

The Board therefore comes to the conclusion that the subject-matter of the claim according to the main request cannot be derived in an obvious manner from the state of the art and accordingly involves an inventive step (Article 56 EPC). This claim together with the revised description and drawings therefore forms a suitable basis for maintenance of the patent in amended form.

Since the main request was acceptable there is no need to discuss the auxiliary request.

Order

For these reasons, it is decided that:

1. The contested decision is set aside.

2. The case is remitted to the first instance with the order to maintain the patent in amended form on the basis of the documents according to the main request specified in section VII above.

The Registrar: **The Chairman:**

S. Fabiani F. Gumbel

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