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**Datasheet for the decision  
of 11 April 2018**

**Case Number:** T 0212/15 - 3.2.08

**Application Number:** 07872223.8

**Publication Number:** 2024660

**IPC:** F16F15/22, B64C27/00

**Language of the proceedings:** EN

**Title of invention:**

ROTARY WING AIRCRAFT ROTATING MACHINERY VIBRATION CONTROL  
SYSTEM

**Patent Proprietor:**

LORD Corporation

**Opponent:**

HUTCHINSON

**Headword:**

**Relevant legal provisions:**

EPC Art. 54, 56  
RPBA Art. 12(4), 13(1)

**Keyword:**

Late-filed evidence - admitted (yes)

Novelty - (yes)

Inventive step - (yes)

**Decisions cited:**

**Catchword:**



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Case Number: T 0212/15 - 3.2.08

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.08**  
**of 11 April 2018**

**Appellant:** HUTCHINSON  
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**Decision under appeal:** **Decision of the Opposition Division of the  
European Patent Office posted on 4 December 2014  
rejecting the opposition filed against European  
patent No. 2024660 pursuant to Article 101(2)  
EPC.**

**Composition of the Board:**

**Chairwoman** P. Acton  
**Members:** M. Foulger  
Y. Podbielski

## Summary of Facts and Submissions

- I. With the decision posted on 4 December 2014, the opposition division rejected the opposition formed against European patent No. 2 024 660.
- II. The appellant (opponent) filed an appeal against this decision. The appeal was filed in due form and within the given time limits.
- III. Oral proceedings were held before the Board on 11 April 2018.
- IV. The appellant requested that the decision under appeal be set aside and the patent be revoked. They furthermore requested that documents D7 to D10 be admitted into the proceedings.

The respondent (patent proprietor) requested that the appeal be dismissed or, in the alternative, that the patent be maintained on the basis of the claims of one of auxiliary requests 1 or 2, filed on 23 October 2015 with the reply to the statement setting out the grounds of appeal. They furthermore requested that documents D7 to D10 not be admitted into the proceedings.

- V. Claim 1 of the patent (main request) reads:

"**(i)** A rotary wing aircraft (20), **(ii)** having an aircraft body interior cabin space (22) **(iii)** supported in flight through an exterior air space **(iv)** by a rotary wing system (24) rotating with an operational rotating frequency, **(v)** said rotary wing aircraft (20) having a persistent operational rotating frequency vibration, said rotary wing aircraft (20) including:

**(vi)** an operational rotating frequency reference sensor (32), **(vii)** said operational rotating frequency reference sensor (32) outputting a rotating frequency signal indicative of the rotary wing system operational rotating frequency,

**(viii)** a first imbalance rotor (60) having a first mass concentration (61), **(ix)** said first imbalance rotor (60) driven at a first rotational clockwise rotational direction **(x)** to rotate with a first controllable phase ( $\phi_{1_1}$ ),

**(xi)** a second imbalance rotor (62) having a second mass concentration (63), **(xii)** said second imbalance rotor (62) driven at a second rotational clockwise rotational direction **(xiii)** to rotate with a second controllable phase ( $\phi_{1_2}$ ),

**(xiv)** a third imbalance rotor (64) having a third mass concentration, **(xv)** said third imbalance rotor driven at a third rotational counter clockwise rotational direction **(xvi)** to rotate with a third controllable phase ( $\phi_{1_3}$ ),

**(xvii)** a fourth imbalance rotor having a fourth mass concentration (65), **(xviii)** said fourth imbalance rotor (64) driven at a fourth rotational counter clockwise rotational direction **(xix)** to rotate with a fourth controllable phase ( $\phi_{1_4}$ ),

**(xx)** a plurality of vibration sensors (34) for monitoring said vibration and outputting vibration signals,

**(xxi)** a controller (36), **(xxii)** said controller receiving said outputted rotating frequency signal,

**(xxiii)** said controller also receiving said vibration sensor signals **(xxiv)** wherein said controller independently controls said first imbalance rotor first controllable phase ( $\phi_{1_2}$ ), said second imbalance rotor second controllable phase ( $\phi_{1_2}$ ), said third imbalance rotor third controllable phase ( $\phi_{1_3}$ ), and said fourth

imbalance rotor fourth controllable phase ( $\phi_{1\_4}$ ), **(xxv)** relative to said rotating frequency reference signal **(xxvi)** to produce a first biaxial force and a moment which reduces the vibration signals outputted from said vibration sensors (34) **(xxvii)** having an aircraft body structure (23) between said body interior cabin space (22), said exterior space and said rotary wing system (24) rotating with said operational rotating frequency, **(xxviii)** said first imbalance rotor (60), said second imbalance rotor (62), said third imbalance rotor (64), and said fourth imbalance rotor (60) are mounted to said aircraft body structure (23) **(xxix)** wherein said first biaxial force and said moment are inputted into said rotary wing aircraft (20) through said aircraft body structure (23), **(xxx)** said first biaxial force oriented in a first plane."

(Feature numbering added by the Board in bold.)

Claim 3 of the patent as granted reads:

"A rotating aircraft control system as claimed in claim 2, said system including a ninth imbalance rotor having a ninth mass concentration, said ninth imbalance rotor driven to rotate with a ninth controllable phase ( $\phi_{3\_1}$ ), a tenth imbalance rotor having a tenth mass concentration, said tenth imbalance rotor driven to rotate with a tenth controllable phase ( $\phi_{3\_2}$ ), an eleventh imbalance rotor having a eleventh mass concentration, said eleventh imbalance rotor driven to rotate with a eleventh controllable phase ( $\phi_{3\_3}$ ), a twelfth imbalance rotor having a twelfth mass concentration, said twelfth imbalance rotor driven to rotate with a twelfth controllable phase ( $\phi_{3\_4}$ ),

wherein said ninth controllable rotation phase, said tenth controllable rotation phase, said eleventh controllable rotation phase, and said twelfth controllable rotation phase are controlled to produce a third biaxial force which reduces the vehicle vibration monitored by said at least one vibration sensor."

The auxiliary requests are not relevant for this decision.

VI. The following documents are referred to in this decision:

D2: US 5,903,077 A

D4: EP 0 409 462 A1

D7: US 6,467,723 B1

D8: Blunt, "Synchronous Averaging of Helicopter Tail Rotor Gearbox Vibration: Phase reference Considerations", 1998

D9: US 3,617,020 A

D10: Abramowitz and Stegun, "Handbook of Mathematical Functions With Formulas, Graphs and Mathematical Tables", National Bureau of Standards Applied Mathematics Series 55, December 1972.

VII. The appellant argued essentially the following:

i) Admissibility of documents D7-D10

D7 and D8 had been filed to address the finding in the decision under appeal that a rotating frequency reference signal was not known from the cited prior art. In this respect, D8 reflected the common general knowledge of the skilled person.

D9 had been found in the course of preparing an

opposition against a divisional application of the present patent and had been filed as soon as possible.

D10 was a handbook which showed the common general knowledge of the skilled person.

D7-D10 should therefore be admitted into the proceedings.

ii) Novelty

D9 disclosed a rotary wing aircraft (see fig. 1). Features i - v were therefore known. Moreover, the aircraft had an operational rotating frequency sensor 126 corresponding to features vi and vii of the claim. The aircraft also had four rotors - two rotating clockwise and two anti-clockwise (31, 32, 33, 34) so features viii - xix were also known from D9.

The controller was the combination of the clockwise automatic control system and the counter-clockwise automatic control system. This formed a "black box" which had inputs from the speed reference generator 128 (feature xxii) and the vertical and lateral accelerometers 100, 101 (feature xxiii). Moreover, it had four independently controllable outputs (see fig. 5B) to the four rotors (features xxiv, xxv). The rotors produced a biaxial force to reduce the vibrations (feature xxvi). The rotors were attached to the helicopter body and so features xxvii - xxx were also known from D9.

Hence, the subject-matter of claim 1 was not new with respect to D9.



iii) Inventive step

D7 disclosed a rotary wing aircraft with all features of claim 1 except that the controller independently controlled each rotor.

The problem to be solved was to reduce vibrations.

To solve this problem, the skilled person would have referred to D4 which was also concerned with further reducing vibrations. D4 disclosed a force generating device with four rotors which according to col. 5, l. 33 were independently controlled. The skilled person would therefore apply this teaching to the aircraft of D7 in order to solve the above problem. The skilled person would have thereby arrived at the subject-matter of claim 1 without the exercise of inventive activity.

Similarly, D2 disclosed a rotary wing aircraft with all features of claim 1 except that the controller independently controlled each rotor (feature xxiv). As set out above, the skilled person would have referred to D4 in order to solve the problem of reducing vibrations. The skilled person would have thereby arrived at the subject-matter of claim 1 without the exercise of inventive activity, when starting from D2 as closest prior art.

Should the Board consider that features vi, vii and xxiii relating to the operational rotating frequency reference sensor were not known from D2, these features were obvious for the skilled person. They solved the problem of obtaining a more accurate reference signal. Since there was no synergy between these features and the other distinguishing features identified above the partial problem approach could be used. It was part of

the common general knowledge of the skilled person (as shown by D8) that an operational rotating frequency reference sensor was necessary in a rotary wing aircraft. As this frequency was important for vibration reduction, it would have been obvious for the skilled person to apply features vi, vii and xxiii to the rotary wing aircraft of D2 in order to solve this partial problem. As the solutions of both partial problems were obvious, the subject-matter of claim 1 lacked an inventive step.

iv) Claim 3

Although claim 3 referred back to claim 2, it concerned a rotating aircraft control system rather than a rotary wing aircraft. Moreover, paragraph [0019] demonstrated that it was indeed intended to be an independent claim. Thus, it did not contain all the features of claim 2 and its subject-matter was consequently to be analysed with respect to novelty and inventive step.

VIII. The respondent argued essentially the following:

i) Admission of D7-D10 into the proceedings

These documents were late filed and not prima facie relevant. D8 was not suitable to demonstrate the knowledge of the skilled person because it was a test report. D9 could have been filed earlier because it was known to the appellant for several months before being filed.

These documents should not therefore be admitted into the proceedings.

ii) Novelty

D9 did not disclose a controller but rather two controllers. This difference was reflected in the upstream input to the controllers which meant that the vibration signals from the sensors were not fed directly into the controller as claimed. In D9 they were rather processed into a composite signal which was then fed into the clockwise and counter-clockwise controllers. Thus, this composite signal could not be regarded as being the vibration sensor signal.

Hence, D9 disclosed neither a (single) controller nor did it disclose that the controller received the vibration sensor signals. Consequently, the subject-matter of claim 1 was new with respect to D9.

iii) Inventive step

With regard to the combination of the teachings of D7 and D4, this combination would not have led to the subject-matter of claim 1.

D4 did not disclose that the rotors were independently controllable. D4, col. 5, l. 32-36 merely disclosed that the offset angles of the two pairs could be independently controlled. Thus, only a control of the offset angle of two rotors was disclosed. An independent control in the sense of the claim was not disclosed.

With regard to the combination of the teachings of D2 and D4, D2 did not disclose features vi, vii, xxiii and xxiv. All these features contributed to solving the problem of reducing vibrations in the aircraft thus there was synergy between them. D2, col. 2, l. 3-12 taught away from using a cluster of nested rotors as

was shown in D4. Furthermore, as discussed above, D4 did not disclose independently controllable rotors. Therefore, the combination of the teachings of D2 and D4 was neither obvious nor did not lead to the subject-matter of claim 1.

Moreover, if the common general knowledge as shown by D8 was also combined with the teachings of D2 and D4, the skilled person would not have arrived at the subject-matter of claim 1 because feature xxiv would still be lacking.

The subject-matter of claim therefore involved an inventive step.

iv) Claim 3

This claim included ninth, tenth, eleventh, and twelfth imbalance rotors. This required first through to eighth imbalance rotors which were defined in claims 1 and 2. Paragraph [0019] referred to a vehicular vibration control system, i.e. yet another object. The only way to interpret this was to read claim 3 as a dependent claim incorporating all the features of claim 2.

## **Reasons for the Decision**

1. Admission of documents D7-D10 into the proceedings

D7 and D8 were filed with the statement setting out the grounds of appeal. Their admission is therefore determined by Article 12(4) RPBA. These documents were filed to overcome the finding of the opposition division that feature xxii was not shown in either of documents D2 or D4. They are thus a reaction to the

decision under appeal and filed at the earliest possible moment in the appeal proceedings. The Board therefore admits these documents into the proceedings.

D9 and D10 were filed at a later date and their admission is determined by Article 13(1) RPBA. According to Article 13(1) RPBA the Board shall exercise its discretion 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. As D9 was submitted well before the parties were invited to oral proceedings and the document appeared *prima facie* relevant the Board exercises its discretion and admits the document into the proceedings. D10 is a handbook and thus demonstrates the common general knowledge of the skilled person. Hence, it is also admitted into the proceedings.

2. Novelty - independent claim 1

2.1 It is common ground that D9 discloses a helicopter with a vibration control system (features i - v of claim 1). Moreover, D9 discloses four imbalance rotors 31 - 34 (features viii - xix of claim 1), a plurality of vibration sensors 100, 101 (feature xx of claim 1) and an operational rotating frequency reference sensor (features vi and vii of claim 1).

2.2 It is however disputed whether D9 discloses a controller as defined in claim 1. Claim 1 requires a controller (feature xxi) which receives the outputted rotating frequency signal (feature xxii) as well as the vibration sensor signals (feature xxiii) and which independently controls the phases of the four rotors

(feature xxiv).

2.3 The combined clockwise and counter-clockwise automatic control systems shown in figs. 5A and B have as inputs the clockwise signal 210 and the counter-clockwise signal 211. These signals are derived from the outputs from the vertical and lateral accelerometers 102, 101 and have been processed by the phase adjusters 107, 200, as well as the amplifier and coordinate converters 110A and 110B. The phase adjuster shifts the phase of the signal to compensate for the phase lag between the accelerometer and the equivalent external force required to be created by the force balancer (col. 6, l. 6 - 11). The outputs from the phase adjusters are then fed into the amplifier and coordinate converters 110B and 110A which mix these signals to produce the clockwise signal 210 and the counter-clockwise signal 211. Thus, it is not the vibration sensor signal as such which is input into the controller as required by feature xxiii but rather a modified and mixed signal.

2.4 The feature xxiii is therefore not known from D9 and consequently the subject-matter of claim 1 is new.

3. Inventive step - claim 1

3.1 D7 as closest prior art

3.1.1 D7 discloses a rotary wing aircraft. It is common ground that D7 does not disclose a controller which independently controls the first imbalance rotor first controllable phase, the second imbalance rotor second controllable phase, the third imbalance rotor third controllable phase, and the fourth imbalance rotor fourth controllable phase.

3.1.2 The problem to be solved is to reduce vibrations in the aircraft.

3.1.3 The disclosure of D4 relates to the field of vibration control and in particular an inertial force generating device which comprises two pairs of rotors 12,14 and 16,18. This device is for cancelling vibrations developed by aircraft engines (col. 1, l. 4-9).

3.1.4 The passage of D4 (col. 5, l. 32 - 34) relied upon by both parties discloses simply that the offset angles of the two rotor pairs could be independently controlled. Thus, the direction and magnitude of the resultant vector is determined by the difference in phase between the rotors in each pair. This also follows from the passage col. 5, l. 28-31 whereby "by varying the offset angle  $\theta$  between the center of mass radii, the magnitude of the inertial force generated by the paired rotors can be controlled". It does not disclose that the phases of all four rotors are independently controlled as required by the claim (feature xxiv). Thus, even if the skilled person had tried to apply the teaching of D4 to the aircraft of D7 then this would not have led to the claimed solution.

3.1.5 Hence, the subject-matter of claim 1 involves an inventive step with regard to the combination of the teachings of D7 and D4.

3.2 D2 as closest prior art

3.2.1 It is not disputed that D2 also does not disclose independently controllable rotors because the rotor pairs have external teeth that are in constant engagement with one another (see fig. 6).

- 3.2.2 The problem to be solved is to reduce vibrations in the aircraft.
- 3.2.3 The skilled person would be dissuaded from referring to D4 to solve this problem because D2, col. 2, l. 3-12 teaches against the use of such a cluster of eccentric rotors. Even if the skilled person had referred to D4 then, as discussed above, this would not have led to the subject-matter of claim 1 because D4 does not disclose independently controllable rotors.
- 3.2.4 The parties dispute whether the features vi and xii relating to the operational rotating frequency are known from D2. However, as feature xxiv is not rendered obvious by the cited prior art and the claim is allowable for this reason alone, it is not necessary to examine whether features vi and xii are known from D2 or made obvious by D8.
- 3.2.5 The subject-matter of claim 1 therefore involves an inventive step.

#### 4. Claim 3

- 4.1 Claim 3 concerns a "rotating aircraft control system as claimed in claim 2". Claim 2 does not however concern a control system but rather a rotary wing aircraft. There are thus doubts whether claim 3 includes all the features of claim 2 and, hence, whether it is truly a dependent claim.
- 4.2 The Board considers that this claim can only be read as a dependent claim. The claim itself requires a ninth, tenth, eleventh and twelfth rotor and thus implies first through to eighth rotors which are defined in claims 1 and 2. The argument that paragraph [0019]



shows that claim 3 is indeed independent is not persuasive because this paragraph relates to a "vehicular vibration control system" which is yet another object.

4.3 As claim 3 is to be read as being a claim dependent on claim 2, which in turn depends on claim 1, its subject-matter is also new and inventive.

### **Order**

#### **For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairwoman:



C. Moser

P. Acton

Decision electronically authenticated