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**Datasheet for the decision  
of 22 June 2021**

**Case Number:** T 2492/17 - 3.2.04

**Application Number:** 07861906.1

**Publication Number:** 2217806

**IPC:** F03D7/02

**Language of the proceedings:** EN

**Title of invention:**

ELECTRO-HYDRAULIC ACTUATOR FOR CONTROLLING THE PITCH OF A  
BLADE OF A WIND TURBINE

**Patent Proprietor:**

Moog Inc.

**Opponents:**

Parker Hannifin GmbH  
Bosch Rexroth AG

**Headword:**

**Relevant legal provisions:**

EPC Art. 54, 56, 123(2)  
RPBA Art. 13

**Keyword:**

Novelty - main request (no)

Inventive step - auxiliary request (no)

Amendments - intermediate generalisation

Late-filed request - justification for late filing (no)

**Decisions cited:**

**Catchword:**



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Case Number: T 2492/17 - 3.2.04

**D E C I S I O N**  
**of Technical Board of Appeal 3.2.04**  
**of 22 June 2021**

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**Decision under appeal:** **Interlocutory decision of the Opposition  
Division of the European Patent Office posted on  
14 September 2017 concerning maintenance of the  
European Patent No. 2217806 in amended form.**

**Composition of the Board:**

**Chairman**            T. Bokor  
**Members:**            S. Oechsner de Coninck  
                              G. Martin Gonzalez

## **Summary of Facts and Submissions**

- I. The opponents 1 and 2 and the patentee all appeal against the Opposition Division's decision concerning maintenance of the European Patent No. 2217806 in amended form.
- II. The opposition was based on the grounds of Articles 100(b) and 100(a) EPC, the latter in combination with lack of novelty and inventive step. In its written decision the Opposition Division held that the patent as amended according to auxiliary request 2 complied with the requirements of the EPC, having regard in particular to the following documents that also play a role in the present proceedings:  
D1: US 6 767 187 B1  
D3: DE 101 46 968 A1  
D28: DE 602 16 700 T2 (& FR 2 801 225 A1)
- III. Oral proceedings were held on 22 June 2021 in the form of a videoconference in the absence of the opponent 1 and the proprietor. Opponent 1 had declared with letter of 2 June 2021, and the proprietor with letter of 17 June 2021 that they would not participate.
- IV. The appellant proprietor requests in writing that the decision under appeal be set aside and the patent maintained according to a New Main Request filed on 9 March 2020, in the alternative according to the Main Request or one of Auxiliary Requests 1-3, all filed with the grounds of appeal dated 15 January 2018, as a 4th auxiliary request: dismissal of opponents' appeal and maintenance of the patent as upheld, or further auxiliary maintenance of the patent according to Auxiliary Request 5 filed on 9 March 2020.

V. The appellant opponents 1 and 2 request that the decision be set aside and the patent be revoked.

VI. The wording of claim 1 of the requests is as follows:

*New main request (granted claim 1):*

"A wind turbine (20) having a plurality of variable-pitch blades (24) mounted on a hub (23) for rotation relative to a nacelle (22), the wind turbine comprising:

an electro-hydraulic actuator (25) for controlling the pitch of one of said blades, said actuator including: a motor (26) adapted to be supplied with a current; a pump (27) driven by said motor and arranged to provide a hydraulic output as a function of the current supplied to said motor;

and

a hydraulic actuator (28) operatively arranged to selectively vary the pitch of the associated blade as a function of the hydraulic output of said pump; and characterised in that said motor, pump and actuator are physically arranged within the hub of said wind turbine."

*Main request (amendments vis-a-vis granted claim 1 are struck through and underlined):*

"A wind turbine (20) having a plurality of variable-pitch blades (24) mounted on a hub (23) for rotation relative to a nacelle (22), the wind turbine comprising:

an electro-hydraulic actuator (25) for controlling the pitch of one of said blades, said actuator including: a motor (26) adapted to be supplied with a current; a pump (27) driven by said motor and arranged to provide a hydraulic output as a function of the current supplied to said motor; and

a hydraulic actuator (28) operatively arranged to selectively vary the pitch of the associated blade as a function of the hydraulic output of said pump; and ~~characterised in that~~ wherein said motor, pump and hydraulic actuator are physically arranged within the hub of said wind turbine."

*Auxiliary request 1 adds to claim 1 of the main request the following final feature:*

"...wherein the wind turbine comprises a motor controller (66A, 66B, 66C) and a power stage (67 A, 67B, 67C), and wherein said motor controller (66A, 66B, 66C) and said power stage are also physically arranged within the hub of said turbine."

*Auxiliary request 2 adds to claim 1 of the auxiliary request 1 the following final feature:*

"...wherein the motor controller (66A, 66B, 66C) is adapted to supply a signal to the power stage (67 A, 67B, 67C), and wherein the power stage (67 A, 67B, 67C) is adapted to supply a current of appropriate magnitude and polarity to said electro-hydraulic actuator."

*Auxiliary request 3 adds to claim 1 of the auxiliary request 2 the following feature:*

"...wherein one of said electro-hydraulic actuators (25) is provided for each of said blades so that the pitch of the various blades can be controlled independently of one another,..."

*Auxiliary request 4 adds to claim 1 of the auxiliary request 3 the following feature:*

"...wherein one of said motor controllers (66A, 66B, 66C) and one of said power stages (67 A, 67B, 67C) is provided for each of said electro-hydraulic actuators and..."

*Auxiliary request 5*

"A wind turbine (20) having a plurality of variable-pitch blades (24) mounted on a hub (23) for rotation relative to a nacelle (22), the wind turbine comprising:

an electro-hydraulic actuator (25) for controlling the pitch of one of said blades, said actuator including: a motor (26) adapted to be supplied with a current; a pump (27) driven by said motor and arranged to provide a hydraulic output as a function of the current supplied to said motor; and

a hydraulic actuator (28) operatively arranged to selectively vary the pitch of the associated blade as a function of the hydraulic output of said pump; and wherein said motor, pump and hydraulic actuator are physically arranged within the hub of said wind turbine and wherein one of said electro-hydraulic actuators (25) is provided for each of said blades so that the pitch of the various blades can be controlled independently of one another and

wherein the wind turbine further comprises motor controllers (66A, 66B, 66C), and power stages (67A, 67B, 67C), and LVDTs (68A, 68B, 68C), and wherein said motor controllers and said power stages are also physically arranged within the hub (23) of said turbine and wherein one of said motor controllers (66A, 66B, 66C), and one of said power stages (67A, 67B, 67C) and one of said LVDTs (68A, 68B, 68C) is provided for each of said electro-hydraulic actuators and

wherein each motor controller (66A, 66B, 66C) is adapted to supply a signal to a respective power stage (67A, 67B, 67C), and wherein each power stage (67A, 67B, 67C) is adapted to supply a current of appropriate magnitude and polarity to said electro-hydraulic actuator, and wherein each LVDT (68A, 68B, 68C) is



adapted to monitor a position of a respective hydraulic actuator rod and feed back a position signal to a respective motor controller (66A, 66B, 66C)."

VII. The Appellant-Proprietor argues as follows:

- Claim 1 according to the new main request and main request is novel with respect to D1.
- The skilled person would not obviously have arrived at a wind turbine according to claim 1 of auxiliary request 1 when starting from D3 and applying its common general knowledge.
- The amendments added to claim 1 of the auxiliary request 2 are derived from paragraph 047 of the published application and do not extend beyond the content of the application as filed.
- Admission of auxiliary request 5 into the proceedings is requested, the request being a reaction to the opinion of the Board.

VIII. The Appellant-Opponents 1 and 2 argue as follows:

- D1 disclose a wind turbine having all the features of claim 1 according to the new main request and main request.
- The skilled person would obviously provide the motor controller and power stage of the electric motor of D3 also in the hub, drawing on its own technical knowledge as illustrated in D36 or D39.
- The amendments added to claim 1 of the auxiliary request 2 are isolated from the specific context of paragraph 047 of the published application and result in an intermediate generalisation that extends beyond the content of the application as filed.
- Non-admission of auxiliary request 5 into the proceedings is requested.

## **Reasons for the Decision**

1. All the appeals meet the requirements of Article 108 and Rule 99(2) EPC 2000, and are therefore admissible.
2. Background of the invention
  - 2.1 The patent concerns an improvement of an electro-hydraulic actuator for varying the pitch of the rotor blades provided on a wind turbine. It is sought to avoid prior art drawbacks related to the location of the pitch-controlling mechanism in the nacelle and the resulting need for a slip ring and hoses through the central bull gear, the arrangement being subjected to wear (paragraph 004).
  - 2.2 According to claim 1 this is done by physically arranging all organs of the electro-hydraulic actuator: motor, pump and actuator within the hub of said wind turbine.
3. New and previous main request - novelty
  - 3.1 Claim 1 according to this request is identical with claim 1 as granted.
  - 3.2 Irrespectively of the question of the admission into the proceedings of this new main request filed on 9 March 2020, the Board states that the location of the actuator - already understood to be of the hydraulic type - in claim 1 according to this request is the same as in claim 1 according to the previous main request. Therefore the Board holds that the subject-matter of either claim 1 according to the new main request or the previous main request lacks novelty over D1.

- 3.3 D1 (as well as D28 of the same family) discloses an electro-hydraulic device for varying the pitch of the blades of a machine rotor, where column 1, lines 10-11 specifies that wind generators constitute such machine rotors. As explained in column 2, line 49 to column 3 line 8, a plurality of variable-pitch blades are mounted on a hub 12 for rotation relative to a nacelle 18, where the electro-hydraulic actuator for controlling the pitch of the blades includes an electric motor 36 and a pump 32 driven by the motor and arranged to provide a hydraulic output feeding a hydraulic actuator.
- 3.4 The appellant-proprietor does not contest the presence of any of the above features of claim 1 in D1 but submits further arguments that a wind generator is not synonymous with a wind turbine but rather implies a different device, such as an industrial fan. Furthermore, the physical requirements between wind turbines and turbomachines are markedly different and cannot be seen as applicable to both types of devices.
- 3.5 In the Board's understanding the term "wind generator" is a contracted form of a wind turbine generator and thus both terms relate to the same family of wind-powered electrical generators that uses a wind turbine to produce electric energy. This understanding is further confirmed by the disclosure of D28 which is the German translation of the patent EP 1 306 558 B1, originally filed in French and bearing the French patent number FR 2 831 225 A1. D28 explicitly refers to "Windkraftanlagen" (paragraph 001) as well as the text of the French publication of the same patent "éolienne" (page 1, line 4). In both languages D1 and D28 explicitly discloses wind turbine generators as

devices receiving the same blade pitch actuator exemplified with the embodiment in a turbomachine. As concerns the alleged different operating conditions of turbo-machines and wind turbines and their associated physical requirements, the Board considers the same configuration of motor, pump and actuator as disclosed in D1 to be fully adapted to be fitted into a hub of a small or medium-sized wind turbine without any further modification, apart from purely minor dimensional changes, such as the number of rotating blades and the amplitude of the angular movement.

3.6 From the above it follows that D1 anticipates all the features defined in claim 1 of either new or previous main requests. Thus the Board confirms the Opposition Division's finding that the subject-matter of claim 1 of the main request lacks novelty, Articles 52(1) and 54 EPC.

4. Auxiliary request 1 - inventive step

4.1 Claim 1 according to this request further adds the features of granted claim 15 that adds a motor controller and a power stage, these also being physically arranged within the hub of said turbine.

4.2 It is common ground that D3 is a suitable starting point for assessing inventive step. D3 discloses a wind turbine with variable pitch blades. A first embodiment uses rotary motion of the rotor to drive the hydraulic pump (paragraph 008). In a second relevant embodiment of figure 4, the electro-hydraulic system for actuating these blades includes a hydraulic pump set ("Hydraulikaggregat") 40 comprising a hydraulic pump ("Hydropumpe") 22 and its pump drive ("Pumpenantrieb") 42 receiving electric current over slip rings

("Schleifringe") 44, and located in each blade (paragraph 42, lines 24-30). Thus the pump drive that receives electric current is an electric motor 42. The hydraulic actuator ("Hydrozylinder") 34 fed by the hydraulic pump is provided in the hub (last sentence of paragraph 043).

4.3 The Board furthermore concurs with the opponent 2 that when a change in pitch setting of the rotor blades is required, the electric motor at least needs to receive power on and off electric signals to drive the hydraulic pump for a certain period of time. Such an operation of the electric motor that drives the hydraulic pump for a certain time to obtain a required amplitude of pitch setting in a given direction thus corresponds to a definite hydraulic output in terms of volume and time. The required volume over a certain time effectively depends on a determined law of electric power applied to the motor as a function of time - even if most basic such as power on and off- and therefore is a function of the current supplied to electric motor as required by claim 1. Contrary to the proprietor's view, the nature of this function is defined in an unspecific manner in claim 1 and has to be interpreted broadly. Any function, such as the power with a constant output suggested by the proprietor, in one direction and for a certain time falls under this broad scope, and in particular is not limited to any proportionality law, special modulation of the current supplied to the motor 42 or "torque on demand" realisation.

4.4 To further implement this power function of the electric motor to adjust blade pitch as of D3, it also requires controlled operation of the electric motor 42 in the hydraulic pump 22. This is also directly

derivable from D3 that explains the provision of control elements ("Steuerelemente") possibly in the form of a control unit ("Steuerblock"), however without further explanation whether these are separate for the electric part feeding the motor 42 and hydraulic pump set 40 or if they are housed within the same control housing close to the pump. These control elements of D3 correspond clearly to the motor controller of claim 1 that furthermore require transmission of a power driving current. Indeed for such a controller to be able to operate the electric motor 42, an associated power stage is needed that supplies an electric power current to the windings of the electric motor as a function of control signals from the controller. Thus both components needed to control the electric motor 42 form part of the implicit disclosure of D3, given that their presence is directly and unambiguously derivable by the skilled person.

4.5 The proprietor does not dispute that the subject-matter of claim 1 differs from the embodiment in figure 4 of D3 by the motor and pump being physically arranged within a hub, as well as a motor controller and a power stage also being within the hub (page 5, last four lines of the proprietor letter of 9 March 2020).

4.6 Whereas the arrangement of the pump and motor within the hub provides an alternative more compact arrangement, the provision of a motor controller and power stage within the same hub is considered as a suitable way of controlling the motor to provide the required hydraulic output.

From the above it is apparent that the two differing group of features are different in nature and in effect. They are thus unrelated and can be treated separately for the examination of inventive step.

- 4.7 Hence the objective technical problem can be expressed as two unrelated partial problems, one being the provision of an alternative arrangement for the hydraulic system, the other being the provision of a suitable control system for the electric motor.
- 4.8 Concerning the first partial problem, the proprietor disagrees that the first embodiment of D3 would hint at providing the motor in the hub, because that embodiment uses rotation of the rotor shaft as driving force. The Board disagrees, as the first embodiment explicitly discloses the arrangement of the hydraulic motor in the hub (paragraph [0011] of D3). The particular realisation of the drive using mechanical power of the rotor shaft would not detract the skilled person from considering the implementation according to the second embodiment with electric power instead. Using mechanical power from the shaft requires speed adaptation by gears to drive the hydraulic motor at a suitable speed with associated components such as lubrication and housing. Such an arrangement for a mechanical drive is commensurate in size if not more complex than the electric motor foreseen for the second embodiment. This is especially so as the compactness of the realisation of the pitch setting system in the second embodiment mentioned in paragraph 044 makes it very suitable to be installed on the central console ("Drehkonsole") 24 receiving the hydraulic pump in the first embodiment (paragraph 035, first sentence). Thus the skilled person seeking an alternative to the location of the motor and pump in the root of the blade

according to the second embodiment would obviously consider an integration in the hub as an applicable alternative to the second embodiment of figure 4.

4.9 As concerns the solution of the second partial problem, that is the provision of the motor controller and power stage in the hub, the proprietor submits that D3 teaches instead to provide them in the nacelle at a remote position.

4.10 The Board finds otherwise. The passage relied upon by the proprietor in the last sentence of paragraph 042, merely explains that the current supplied to the motor 42 is made through slip rings 44 between the nacelle in the vicinity of the rotor. In the Board's view, this applies to the electric power supply necessary to drive the electric motor 42. The disclosure of D3 leaves open whether this power current is fed from a power stage controlled by the controller in the nacelle or whether this is supplied to the controller electronics of each motor. Therefore this unspecific disclosure on the location of the electronic controller for each engine does not prevent the skilled person from considering both alternatives. Here, in order to achieve an individual pitch control for each of the three blades of D3 by an individual pitching system, the preferable solution of positioning the control electronics as close as possible to the end user appears a straightforward option.

The generation of heat by these electronic circuits mentioned as a drawback by the proprietor is not regarded as a disincentive because D3 already considers cooling of the hydraulic circuit through cooling ribs ("Kühlrippen") on the low pressure tank (paragraph 035) or convection cooler ("Konvektionskühler") 38 in the



same area in the hub on the console 24 where the hydraulic circuit is already provided (paragraph 038). Hence the solution to the second partial problem would also be obvious for the skilled person, resorting to routine implementation measures for providing a suitable control system for the electric motor.

4.11 Thus the Board concludes that the subject-matter of claim 1 of to the auxiliary request 1 lacks an inventive step, on the basis of D3 and the common general knowledge of the skilled person, Articles 100(a), 52 and 56 EPC.

5. Auxiliary requests 2 to 4 - Added subject-matter

5.1 Claim 1 of auxiliary request 2 adds to claim 1 of auxiliary request 1 features derived from paragraph 47 of the application as filed, as follows: "the motor controller is adapted to supply a signal to the power stage, and wherein the power stage is adapted to supply a current of the appropriate magnitude and polarity to said electro-hydraulic actuator." The Board holds that this amendment, focusing on the relationship between the motor controller and power stage, is taken from the third sentence of paragraph 047 in isolation.

5.2 According to established jurisprudence, an intermediate generalisation is justified only in the absence of any clearly recognisable functional or structural relationship among the features of the specific combination or if the extracted features are not inextricably linked with the other features, cf. Case Law of the Boards of Appeal, 9th edition, 2019 (CLBA) II.E.1.7.

- 5.3 Paragraph 047 of the published application appears in the specific context of explaining the whole control system in relation to figure 6, showing a block diagram of the corresponding circuit for independently controlling the pitch of each blade. The totality of the features disclosed of this paragraph represent the particular way envisaged by the application as filed for realising the pitch control. A signal from a three phase slip ring is supplied to the motor controllers, that in turn supply a signal to the power stage, which again supplies the current of the appropriate magnitude and polarity to electro-hydraulic actuators. The position of each actuator rod 32 is monitored via an LVDT (Linear Variable Differential Transformer). The position signals are then fed back to their associated motor controllers and a rotating optical ring for data transmission also provides an input signal to each motor controller.
- 5.4 Rather than teaching individual control operations between each components of the overall control system as submitted by the proprietor, the various components controller, power stage, hydraulic actuator and LVDT are all functionally related to provide the required control signals, appropriate electric current and position feedback by structural electrical connection between these various components to provide the disclosed controlled way of rotating each blade in a precise manner. The last but two sentences of this paragraph strengthen this structural and functional relationship by indicating that in the previously disclosed manner the system is able to control each blade independently.

- 5.5 The Board cannot concur with the proprietor's further argument that the skilled person might consider the provision of LVDT with associated feedback as non-essential and independent of the basic operation of the motor controller and motor stage. The question of added subject-matter is essentially a question of original disclosure. The proprietor's argument instead is rather based on the consideration of whether the skilled person might have obviously considered another embodiment than the original one but without LVDT. In the present case, as explained above, no embodiment without LVDT was disclosed in the original application, nor is there any clear indication in paragraph 047 that some components or their contribution to the control system may be purely optional.
- 5.6 Thus the signal and current supplied by the controller to the power stage cannot be isolated from the other features disclosed in the context of the same paragraph 047 because the position sensors are functionally related within the context of paragraph 47 in order to provide the required feedback loop for the pitch control system. Therefore, claim 1 according to this auxiliary request 2 results in an unallowable intermediate generalisation.
- 5.7 Claim 1 according to auxiliary requests 3 and 4 also retain the same amendment as in claim 1 according to auxiliary request 2, isolated from the context of paragraph 047 and therefore suffer from the same unallowable intermediate generalisation.
- 5.8 From the above the Board concludes that claim 1 of auxiliary requests 2 to 4 contains subject matter extending beyond the application as filed and therefore do not meet the requirements of Article 123(2) EPC.

6. Auxiliary request 5 - Admission

6.1 This request was filed on 9 March 2020 after dispatch of the first summons for oral proceedings on 26 September 2019 and after the preliminary opinion of the Board on 11 February 2020 under Article 15(1) of the Rules of Procedure of the boards of Appeal (RPBA) 2020.

6.2 The revised version of the Rules of Procedure of the Boards of Appeal (RPBA 2020) entered into force on 1. January 2020, Article 24(1) RPBA 2020, i.e. after notification of the summons to oral proceedings. Therefore, Article 13 of the Rules of Procedure of the Boards of Appeal in the version valid until the date of the entry into force of the revised version (RPBA 2007) continues to apply, Article 25(3) RPBA 2020. The approach consistently adopted by the Boards when exercising their discretion in admitting an amendment filed at a very late stage consists in identifying whether good reasons exist for filing the amendment at the given stage of the proceedings - for example if it is occasioned by developments in the proceedings. Unless such a justification exists, amendment to a party's case will be admitted only if it does not extend the scope or framework of discussion as determined by the decision under appeal and the statement of the grounds of appeal, and is moreover clearly allowable, see Case Law of the boards of Appeal, 9th edition, 2019 (CLBA) V.A.4.5.1 b) and the case law cited therein.

- 6.3 The amendments concern the additional definition of LVDTs in the last three paragraphs of claim 1, whereby in the last feature the LVDT is further defined as adapted to monitor the position of the actuator rod.
- 6.4 These amendments are also derived from the same paragraph 047, and represent the proprietor's late attempt to overcome the objection under Article 123(2) EPC already discussed during opposition (point 25 of the decision) and raised in the opponents' grounds of appeal (Item I of the opponent's 1 grounds and item 3.3 of the opponent's 2 grounds). The fact that the Board in its preliminary opinion expressed the need to discuss this issue cannot be seen as unexpected development of the proceedings, and does not justify the filing of auxiliary request 5 at this late stage.
- 6.5 As concerns the allowability at first sight of this amendments, the Board observes that the amendments proposed still fail to define the slip ring and rotating optical rings required to transmit the signals. Thus the objection of intermediate generalisation does not appear to be clearly overcome by the proposed amendments.
- 6.6 For these reasons the Board decides not to admit the auxiliary request 5 into the proceedings under its discretion pursuant to Article 13(1) RPBA 2020.
7. As no allowable requests remains, the Board must set aside the decision and must revoke the patent.

**Order**

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

1.     **The decision under appeal is set aside.**
2.     **The patent is revoked.**

The Registrar:

The Chairman:



G. Magouliotis

T. Bokor

Decision electronically authenticated