(19) DANMARK

(10) DK/EP 2631467 T3

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: *F 03 D 1/06 (2006.01)*

(45) Oversættelsen bekendtgjort den: **2016-01-18**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2015-10-14**

(86) Europæisk ansøgning nr.: **12156864.6**

(86) Europæisk indleveringsdag: **2012-02-24**

(87) Den europæiske ansøgnings publiceringsdag: **2013-08-28**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **Anordning til reduktion af støj, der genereres af en vindmøllevinge**

(56) Fremdragne publikationer:
WO-A2-01/46582
US-A1- 2010 143 143
US-A1- 2011 142 637

DESCRIPTION

[0001] The invention relates to an arrangement to reduce aerodynamic noise, which is originated by a wind turbine blade.

[0002] EP 1 314 885 discloses a flexible serrated trailing edge of a wind turbine. A serrated panel is connected at the trailing edge of the blade to optimize the aerodynamic characteristics of the wind turbine blade. This results in an increased electrical output power of the wind turbine for example.

[0003] The shape of the trailing edge even influences the noise or the aerodynamic noise, which is originated by the wind turbine blade.

[0004] Thus the dimension and the shape of a panel, which is attached to the trailing edge, even contribute to the aerodynamic noise of the turning wind turbine blade. Thus a compromise needs to be found between the location and the dimension of the panel for an improved blade-characteristic on the one hand and a reduced aerodynamic noise on the other hand.

[0005] FIG 4 shows a blade 1 of a wind turbine. A number of panels 2 are arranged at and along the trailing edge TE of the blade 1. The panels 2 show a number of serrations SE. the size and the shape of the panels are optimized in a way that a lift-drag-ratio of the blade is increased. Thus the aerodynamic characteristics of the blade 1 are improved.

[0006] The panels 2 might connected by a glue with the trailing edge TE. Thus retrofitting of existing blades in dependency of specific conditions of the site of the wind turbine is quite easy.

[0007] The panels 2 may be made in smaller sections and may be attached side by side as illustrated. Thus an entire flap, arranged at the trailing edge TE of the blade, is established or constituted.

[0008] FIG 5 shows a specific detail of FIG 4, which is indicated by a circle there.

[0009] The flap FP as shown here in detail comprises several panels 2. This allows a flexible movement of the serrated panels 2 when the wind turbine is in operational mode. Due to the flexing of the serrated panels the blade characteristics are improved.

[0010] There is a little gap GP between two adjacent panels 2. The gap GP is needed for the flexing movement of the panels 2.

[0011] Additionally the panels 2 are connected with the trailing edge TE by a band or strip or connection-area FX. This connection-area FX is preferably used for a glue-connection.

[0012] Another band or strip OL is arranged between the connection area FX and the serrations SE, thus a kind of "overhang" or projection OL is created.

[0013] The little gap GP between the panels 2 generates a whistletone as aerodynamic noise. The whistle-tone is even influenced by the dimension of the strip OL or overhang OL.

[0014] The whistle tone is originated by the wind V, which is slipping through the gap GP. This is schematically shown in FIG 6.

[0015] FIG 7 refers to the FIG 5 and shows a well known prior art solution to reduce this whistle-tone.

[0016] The gap GP between the panels 2 is filled with a flexible filler material 3.

[0017] However the filler material 3 deteriorates over time and becomes stiff and inflexible. Thus the filler material 3 finally might fall off.

[0018] The usage of the filler material even results in time extensive work thus this solution is expensive.

[0019] Document US 2011/0142637 shows another configuration to reduce noise according to the preamble of claim 1.

[0020] It is therefore the aim of the invention to provide an improved arrangement to reduce or even avoid noise, which is originated by a wind turbine blade.

[0021] This aim is solved by the features of claim 1.

[0022] Preferred configurations are addressed by the dependent claims.

[0023] According to the invention an arrangement is provided to reduce aerodynamic noise, which is originated by a wind turbine blade. The blade comprises a first panel and a second panel. The first and the second panel are arranged at the trailing edge of the blade, while the first panel is adjacent to the second panel. The first panel comprises a first transition zone and the second panel comprises a second transition zone. The first transition zone and the second transition zone are engaged in a way that the origination of whistle tones by a gap, which is between the first panel and the adjacent second panel, is reduced or even avoided.

[0024] In the invention the first and/or the second transition zone comprises a lip. The lip is used for an engaged connection of the transition zones. Thus the gap is narrowed and reduced in a way that the slipping of wind through the gap is hindered or avoided.

[0025] According to the invention the first and the second transition zone comprise a lip each. The lips are overlapped and are preferably engaged in a form-fitted manner. Thus the gap is narrowed or even closed or reduced in a way that the slipping of wind through the gap is hindered or avoided.

[0026] In a preferred configuration the first transition zone is engaged with the second transition zone by a groove-and-tongue connection. Thus the gap is narrowed or even closed or reduced in a way that the slipping of wind through the gap is hindered or avoided.

[0027] In a preferred configuration the panels are arranged and shaped in a way that the aerodynamic characteristic of the blade is improved.

[0028] In a preferred configuration the panels are arranged and prepared for a flexing movement of the panels. Thus the aerodynamic characteristic of the blade is improved.

[0029] In a preferred configuration the engaged transition zones are prepared to support the flexing movement of the panels. Thus the aerodynamic characteristic of the blade is improved, too.

[0030] In a preferred configuration the panels comprise a number of serrations (SE), which are arranged and shaped in a way that the aerodynamic characteristic of the blade is improved.

[0031] In a preferred configuration the panels are connected with the trailing edge by a glued connection. Thus retrofitting of existing blades with panels is enabled.

[0032] The arrangement invented allows a trade-off between optimized aerodynamic characteristics of the blade on the one hand and an optimized noise-reduction on the other hand.

[0033] The invention results in a long-term and quite stable arrangement avoiding unreliable and weak parts, which were used before - like filler material for example.

[0034] The invention allows the reduction of working time and thus the reduction of costs.

[0035] The invention even allows the compensation of tolerances, which might be introduced by two spaced adjacent panels. Variances or tolerances are met and compensated by the specific overlapping portion as claimed.

[0036] The invention can be used for each shaped panel. It does not matter if the panel is serrated or not. Thus a wide range of panels can be used optimize the blade.

[0037] Even an optimized retrofitting of existing blades by panels is supported by the arrangement invented.

[0038] The invention is shown in more detail by help of figures.

FIG 1
shows a blade with panels as starting point for the arrangement invented,
FIG 2

shows the engagement of the panels according to the invention,

FIG 3

shows a detail of the connection, which is shown in FIG 2, and

FIG 4

to FIG 7 show the prior art discussed in the introduction of this description.

[0039] FIG 1 shows a blade 11 with panels 21 as starting point for the arrangement invented.

[0040] A number of panels 21 are arranged at and along the trailing edge TE1 of the blade 11. The panels 21 show a number of serrations SE1.

[0041] The size and the shape of the panels 21 are optimized in a way that a lift-drag-ratio of the blade 11 is increased. Thus the aerodynamic characteristics of the blade 11 are improved.

[0042] The panels 21 might be connected by glue with the trailing edge TE1. Thus retrofitting of existing blades 11 in dependency of specific conditions of the site of the wind turbine is quite easy.

[0043] The panels 21 may be made in smaller sections and may be attached side by side as illustrated. Thus an entire flap, arranged at the trailing edge TE1 of the blade 11, is established or constituted.

[0044] FIG 2 shows the engagement of the panels 21 according to the invention. Reference is made to FIG 1 and to the circle shown there.

[0045] The panels 21 are arranged in adjacent manner as shown in FIG 1.

[0046] A first panel 21A comprises a first transition zone TZ1. A second panel 21B comprises a second transition zone TZ2.

[0047] The first transition zone TZ1 and even the second transition zone TZ2 comprises a lip each.

[0048] The lips overlap each other thus the lips are engaged when the panels 21 are positioned at the trailing edge TE1 of the blade 11.

[0049] The gap GP1, which is arranged between the panels 21A and 21B, is reduced in its dimension thus the origination of whistle tones by the gap GP1 is reduced or even avoided.

[0050] The overlap allows the flexible movement of the panels 21 in relation to each other. Thus the flexibility of the construction is maintained.

[0051] FIG 3 shows the engaged lips LIP and thus even the engaged transition zones TZ1, TZ2 referring to FIG 2 and FIG 1.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP1314885A [0002]
- US20110142637A [0019]

Patentkrav

1. Anordning til reduktion af støj, der genereres af en vindmøllevinge (11),
- hvor vindmøllevingen (11) omfatter en første plade (21A) og en anden plade (21B),
- hvor den første plade (21A) og den anden plade (21B) er anbragt på vindmøllevingens bagkant (TE1),
- hvor den første plade (21A) er ved siden af den anden plade (21B)
- hvor den første plade (21A) omfatter en første overgangszone (TZ1), og hvor den anden plade (21B) omfatter en anden overgangszone (TZ2), **kendetegnet ved, at**
- den første overgangszone (TZ1) og den anden overgangszone (TZ2) hver især omfatter en læbe (LIP), og
- hvor læberne (LIP) overlapper hinanden;
- således at et mellemrum mellem den første plade (21A) og den anden plade (21B) gøres smallere, således at generering af fløjtelyde ved mellemrummet reduceres eller endda undgås.

2. Anordning ifølge krav 1, hvor den første overgangszone (TZ1) er i indgreb med den anden overgangszone (TZ2) ved hjælp af en rille-og-tunge-forbindelse.

3. Anordning ifølge et af kravene 1 eller 2, hvor pladerne (21, 21A, 21B) er indrettet og fremstillet til en bøjebevægelse af pladerne (21, 21A, 21B).

4. Anordning ifølge krav 3, hvor overgangszonerne (TZ1, TZ2), der er i indgreb med hinanden, er fremstillet til at understøtte bøjebevægelsen af pladerne (21, 21A, 21B).

5. Anordning ifølge krav 3, hvor pladerne (21, 21A, 21B) er indrettet og formet på en sådan måde, at vindmøllevingens (11) aerodynamiske egenskab forbedres.

6. Anordning ifølge et af kravene 1 til 5, hvor pladerne (21, 21A, 21B) omfatter et antal takker (SE1), der er indrettet og formet på en sådan måde, at

vindmøllevingens (11) aerodynamiske egenskab forbedres.

7. Anordning ifølge et af kravene 1 til 5, hvor pladerne (21, 21A, 21B) er forbundet med bagkanten (TE1) ved hjælp af en limforbindelse.

DRAWINGS

FIG 1

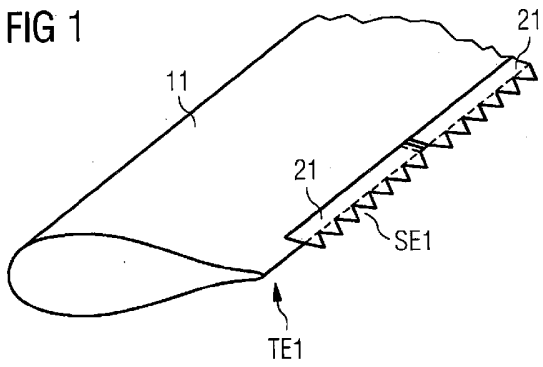

FIG 2

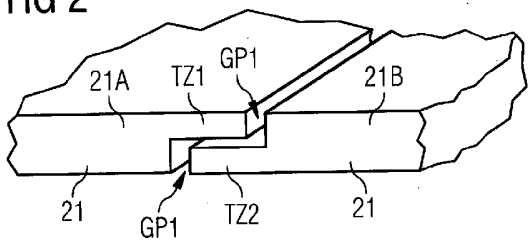

FIG 3

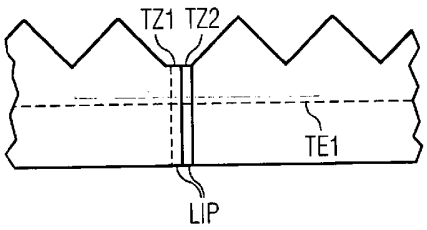

FIG 4

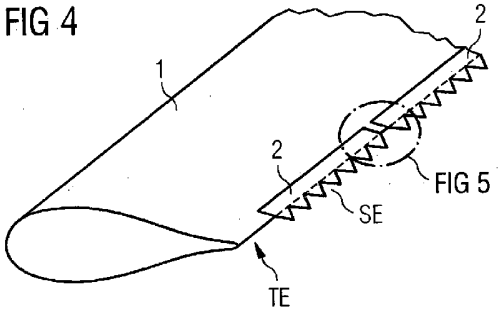

FIG 5

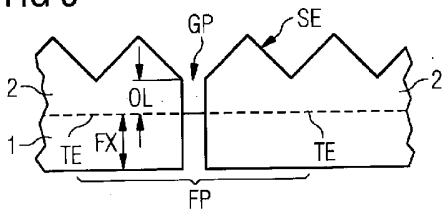

FIG 6

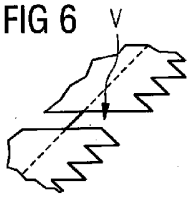

FIG 7