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The invention relates to a wind turbine rotor blade having a top side, a bottom side, a leading edge, a trailing edge, a hub fastening means and a blade tip, wherein the wind turbine rotor blade is divided into a hub region, a middle region and a blade tip region, and a root region is defined from the hub fastening means to the maximum blade depth, wherein a radially outwardly extending air-conducting channel is provided within the wind turbine rotor blade for conducting suctioned air from a suction region to a blow-out region arranged in the blade tip region, and boundary layer suctioning occurs, wherein the suctioning of the air occurs on the top side of the wind turbine rotor blade, and a boundary layer fence is provided in the hub region close to the hub fastening means in order to prevent a flow in the direction of the hub fastening means.

Various wind turbine rotor blades are known from the prior art, in which different modifications are provided in respect of the aerodynamic profile thereof and also in respect of the aerodynamic influencing by boundary layer suctioning, wherein the aim of optimizing wind turbine rotor blades is always to improve the overall power of the wind turbine.

The known prior art will be considered in greater detail below:

Document DE 10 2008 052 858 B9 describes the profile of a rotor blade of a wind turbine having a top side (suction side) and a bottom side (pressure side) with a mean line and a chord between the leading edge and the trailing edge of the profile, wherein the relative profile thickness is more than 49%, the trailing edge is blunt, the mean line has an S shape and runs beneath the chord in a section between 0% to 60% of the profile depth of the profile, and the suction side and the pressure side of the profile each have a concave contour in the rear region.

Document EP 2 182 203 B1 describes a rotor blade for a wind turbine, consisting of an original rotor blade and a blade tip extension connected thereto, characterized in that the blade tip extension comprises two glass-fibre-reinforced half-shells which are adhesively bonded to one another and to an end region of the original rotor blade.

Document EP 2 292 926 A1 discloses a rotor blade of a wind turbine, wherein the root region of the optimized rotor blade is designed to be optimized on the leading edge and/or the trailing edge, so that a continuous extension of the main region of the rotor is achieved.

Document EP 2 527 642 describes a rotor blade of a wind turbine, in which an air-conducting channel which runs approximately radially outwards is provided for conducting suctioned air from a suction region, arranged in the root region, to a blow-out region, wherein a boundary layer influencing, in particular a boundary layer suctioning, is said to take place only in the region of the trailing edge.

Document DE 10 2008 003 411 A1 describes a family of blade profiles for a wind turbine blade. Each blade profile may contain a blunt trailing edge, a substantially oval suction side and a substantially S-shaped pressure side.

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A rotor blade having a boundary layer suction system is also known from document WO 2007/035758 A1 and is defined as follows: an air inlet located in the root region of the blade, an air outlet in the blade tip region, and a flow channel which is arranged in the interior of the blade and connects the air inlet and the air outlet to one another. By means of the centrifugal force brought about by the rotational movement, the air is preferably suctioned at the air inlet and transported to the air outlet. The air is preferably compressed as it moves through the flow channel under the effect of the centrifugal force. The suctioning of the boundary layer takes place on the surface of the rotor blade, wherein the suctioning takes place substantially close to the trailing edge and/or rather in an unplanned manner.

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Document DE 10 2012 111 195 A1 describes a rotor blade arrangement for a wind turbine, wherein the rotor blade arrangement comprises: a rotor blade with outer surfaces which define a pressure side, a suction side, a leading edge and a trailing edge which each extend substantially in the span direction between a tip and a base; and a blade enlarging device comprising a first panel and a second panel located opposite the first panel, wherein both the first panel and the second panel have an inner surface and an outer surface which each extend between a proximal end and a distal end, wherein the distal end of both the first panel and the second panel in a standard operating position is spaced apart from the rotor blade substantially in the chord direction.

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Document CH 209 491 discloses a propeller in which an automatic boundary layer influencing takes place. Provided on the surface of the inner region of the propeller are one or more suction regions via slots which are connected to a blow-out region at the propeller tip by way of at least one air-conducting channel that runs within the propeller in a manner guided radially outwards. Via the rotation, the

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suctioned air is passively transported to the propeller tip under the effect of the centrifugal force and is blown out there. The influencing of the transported quantities of air via control valves and throttle flaps is also possible.

5 Document EP 1 760 310 A1 discloses a rotor blade of a wind turbine, in which the rotor blade surface area is considerably enlarged in the root region and thus the power of the overall system is increased. The rotor blade profile is long in the root region and is designed to taper smoothly, as a result of which a narrow trailing edge is formed in the root region. The total surface area of the rotor blade in the  
10 root region is increased by a multiple over conventional root regions of rotor blades.

Furthermore, document EP 2 204 577 A2 discloses a rotor blade add-on component which can be arranged on the trailing edge of the rotor blade in order to increase the efficiency in the vicinity of the root region, so that the power of the  
15 wind turbine on which the suitably designed rotor blades are arranged can be operated more efficiently, wherein the add-on component can be formed with the rotor blade in the manner of a high-lift profile.

20 With regard to the general prior art, reference is also made in particular to the details contained in the aforementioned documents regarding the fluidics of wind turbine rotor blades.

In wind turbine rotor blades, the greatest problems lie in adapting the air flow on  
25 the top side of a wind turbine rotor blade. By optimizing the air flow, the efficiency of a wind turbine can be considerably increased.

However, the wind turbine rotor blades known in the prior art are unable to provide any further increase in efficiency, so that there continues to be a need to  
30 further improve the performance of a new wind turbine or in particular also of existing wind turbines.

The object of the present invention is to improve the performance of a wind turbine rotor blade so that the flow on the top side of the wind turbine rotor blade,  
35 which in the prior art conventionally changes from a laminar into a turbulent flow, is reduced considerably or even to zero and at the same time the efficiency is improved by changing the wind turbine rotor blade geometry, wherein at least the

point of change at which the laminar flow changes into a turbulent flow can be shifted as far as possible to the trailing edge.

This object is achieved by a wind turbine rotor blade according to claim 1.

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It has been recognized that wind turbine rotor blades, after many years of use, have an individual zone of soiling on the top side thereof, which is dependent on the rotor blade geometry and is caused by environmental influences, wherein this zone first starts in a specific region. This region has been examined in greater detail and it has been found here that the flow over these wind turbine rotor blades known in the prior art, at the starting point of the soiling, exhibits a change in the flow of the air flowing over the surface of the top side. At this starting point of the soiling, the flow changes from laminar to turbulent, thereby forming eddies which deposit dirt particles on the top side of a wind turbine rotor blade.

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Proceeding from this starting position and discovery, the aforementioned object has been achieved by the following features of a wind turbine rotor blade, wherein at the same time the soiling of the top side of a wind turbine rotor blade can be reduced:

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The trailing edge in the hub region and at least in the first section of the adjoining middle region is blunt, broad and/or truncated and tapers in the direction of the blade tip region, wherein said trailing edge is continued beyond the root region in the direction of the blade tip.

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Furthermore, the suction region is arranged in the region in which a laminar air flow detaches from the top side in a manner specific to the rotor blade geometry, so that a bearing and continuation of the laminar air flow against the further surface of the top side occurs, and the suction region, starting at or close to the boundary layer fence in the hub region, extends into the middle region, wherein the suction region is continued in the middle region beyond the root region in the direction of the blade tip.

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By virtue of this design, the boundary layer suctioning thus takes place precisely at the point of detachment of the laminar flow. The detachment starts approximately in the middle of a wind turbine rotor blade, but runs differently outwards in the radial direction, wherein the flow tear-off edge in the region of 1/3 to ap-

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proximately 3/5 of the wind turbine rotor blade length runs considerably approximately to the trailing edge and into the latter.

5 When modifying an existing rotor blade, the hub region is reconstructed by way of suitable add-on components, wherein by virtue of the suctioning the laminar flow is conducted or borne against the new add-on part and, in this way, force in the hub region is used to produce energy. Significantly extending the blade depth in the hub region has been found to have a negative effect and does not lead to the desired power increases, so that it is not the enlargement of the surface area that  
10 brings about an increase in efficiency and an associated production of energy, but rather the bearing of the laminar flow as far as the leading edge or almost the leading edge. By virtue of this combination of features, a very large surface area is simulated without actually having to be constructed, but at the same time a high energy gain is achieved with increase values of up to 15% annual energy  
15 output.

Here, the profile geometry of the wind turbine rotor blade is a profile dissimilar to a Wortmann profile and is in no way a Wortmann profile or a Wortmann-like profile, since the boundary layer suctioning for example with a profile geometry described in EP 1 760 310 A1 is not efficient or advisable for technical reasons.  
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Also important is the boundary layer fence, by which a delimited profile start is formed and thus an aerodynamically advantageous blade connection to the hub of a wind turbine is made possible. Particularly when modifying existing wind turbine rotor blades to create a wind turbine rotor blade according to the invention, there  
25 is no flowing transition to the original rotor blade geometry since the boundary layer fence now forms the termination.

The wind turbine rotor blade profile to be used is configured in such a way that  
30 the region of the blunt, broad and/or truncated trailing edge extends outwards in the radial direction towards the blade tip, beyond the maximum rotor blade depth, which leads to a considerable increase in efficiency.

In contrast to EP 2 527 642 A1, the suctioning takes place at the point of detachment or change of the laminar flow and not at the trailing edge of the wind turbine rotor blade. Instead, the suctioning at the point of detachment is the critical  
35 factor for achieving the higher efficiency. There is also no need for a Wortmann

profile or Wortmann-like profile in combination with a blunt profile with the boundary layer suctioning.

5 The positioning of the boundary layer suctioning always takes place as a function of the laminar flow detachment edge, which is dependent on the rotor blade geometry, wherein this is necessary both for the field of modifying existing wind turbine rotor blades and also for the new construction of wind turbine rotor blades.

10 In contrast to DE 10 2008 003 411 A1 and to WO 2007/035758 A1, the profile design here is configured in such a way that the blunt, broad and/or truncated trailing edge is continued outwards in the radial direction beyond the point with maximum blade depth, in order to achieve a notable increase in efficiency.

15 It has been recognized that the region in which the laminar air flow changes into a turbulent air flow migrates during rotation of the rotor blade, so that to this end it may be necessary to adapt the suction line, that is to say the region in which suctioning takes place in the radial direction. This phenomenon is dependent on the inflow speed and the blade setting angle.

20 The suction region has a plurality of suction segments which can be opened and closed, and which are opened and/or closed as a function of a point of change at which a laminar air flow detaches from the top side in a manner specific to the rotor blade geometry, said point of change migrating as a result of a rotation of  
25 the rotor blade at the hub in order to adapt the work angle of the rotor blade to the wind, a variable suction line thus forming.

By virtue of this design, it is possible to implement a very precise tracking of the suctioning and thus to adapt the suction line to the work angles of the rotor blade  
30 based on a rotor blade rotation as is conventional in modern turbines. A tracking of the suctioning along the shifting point of change or line of the points of change thus takes place by opening and closing individual suction segments.

The activation of the suction regions may take place as a function of the work  
35 angle and the wind speed.

The maximum blade depth of the wind turbine rotor blade is provided in the hub region or in the first section of the middle region and the blade depth decreases from the maximum blade depth to the boundary layer fence.

- 5        The suction region is arranged in the surface section 40% of the local blade depth from the leading edge to 5% of the local blade depth from the trailing edge.

One very important aspect when positioning the radially arranged suction region on the top side of the wind turbine rotor blade is that first, beginning at the  
10       boundary layer fence, the suction region is arranged almost in the middle of the rotor blade and is gradually moved to the trailing edge in a manner specific to the rotor blade geometry only after the region of maximum blade depth, wherein this takes place as a function of the point of change of the flow, at which the laminar flow changes into a turbulent flow.

15       Of course, different suction region zones with differently dimensioned air-conducting channels may be provided, as a result of which further improvements are possible, and which ultimately leads to different suction volumes brought about by different rotational speed ranges.

20       The suction region is arranged in the hub region in the surface section 40% of the local blade depth from the leading edge to 30% of the local blade depth from the trailing edge.

25       The boundary layer fence(s) arranged or to be arranged are arranged to run particularly in the radius. Nevertheless, the design can also be such that a transverse flow in relation to the rotating rotor blade, caused by the rotation, is optimally aided, wherein the boundary layer fence is then not oriented in a manner following the radius but rather is guided transversely over the rotor blade.

30       A rotor blade known in the prior art is modified by way of add-on components.

The blade inner body of the rotor blade is used as an air-conducting channel. It is not necessary to place a special tube inside the rotor blade in order to transport  
35       the air from the hub side to the blade tip. It is sufficient to seal the hub side of the rotor blade by a bulkhead that is almost airtight, preferably completely airtight, and to provide an outlet region in the area of the blade tip. With particular preference, a suitable adaptation is made in the blade tip by means of an add-on

part having an integrated air-conducting channel, as a result of which the volume flow via the air-conducting channel into the blade tip is limited, and preferably a valve may also be provided there which regulates the suction and thus the passive boundary layer influencing.

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The add-on components are of segmented design, wherein direct installation on a wind turbine can take place.

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One important aspect is the modification of existing systems, wherein, with a segmented design, two men can fully modify a turbine in a few days, wherein all the essential components are provided in the segmented add-on parts and can then be applied by lamination simply by roughening the existing wind turbine rotor blades.

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The blade tip of a rotor blade known in the prior art is modified by way of an add-on component which does not extend the overall length of the rotor blade.

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Alternatively, the blade tip of a rotor blade known in the prior art is modified by way of an add-on component which extends the overall length of the rotor blade by 0.5 to 7 m. In particular, winglets may be attached or also extended and may be provided with suitable outlet regions.

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The segmented add-on components have at least one boundary layer fence section. With this design, the segments can be joined together very easily on site, without particular care having to be taken with regard to the positioning. Each segment has a boundary layer fence or at least a boundary layer fence section at least on one side, so that the individual segments are delimited aerodynamic surface areas.

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A valve for controlling the influencing of the boundary layer is arranged in the air-conducting channel.

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A method for controlling the power of a wind turbine having the boundary layer suctioning claimed here comprises, in a no-power range, a start-up range, a working range and a maximum power range, the features that – no boundary layer suctioning takes place in the no-power range and/or in the maximum range,

- a maximum available boundary layer suctioning takes place in the start-up range, and

– a variable boundary layer suctioning takes place in the working range, starting with maximum boundary layer suctioning at low power and ending with minimum boundary layer suctioning at high power. As a result, an additional improvement in the wind turbine efficiency is achieved in the low power range and also in the start-up range, so that more energy can be produced at lower wind strengths.

Nevertheless, early prevention of overloading can be achieved when the boundary layer suctioning is run down to a minimum. The method for controlling a wind turbine is further improved in that the boundary layer suctioning is deactivated when a maximum nominal power is reached. The reaching of a maximum nominal power takes place already at a low wind speed, so that the use of the boundary layer influencing can be stopped in good time since otherwise the generator of the wind turbine would be destroyed or at least damaged by excessive power.

Conveying means for actively influencing the boundary layer by conducting air within the air-conducting channel are provided so that the air can be transported both from the suction region to the blow-out region and also in the opposite direction.

The openings of the suction region and/or of the blow-out region are designed as holes and/or slots.

All of the improvements mentioned are designed in particular in such a way that they can be configured also as subsequent add-on components. Also claimed, therefore, are all of the add-on components which can improve a rotor blade of standard design so that a rotor blade having at least the features of the main claim is formed. To this end, a first add-on part in the root region is designed in such a way that an add-on element can be placed onto the root region, which is usually of circular shape, said add-on element having a blunt trailing edge on which a suction region is provided. A second add-on part is provided for the region of the blade tip, so that a blow-out region is formed here. A further part for subsequently improving a standard rotor blade is the air-conducting channel to be incorporated in the interior of the rotor blade. For attaching the add-on components, use may be made of standard attachment methods such as lamination, screwing, adhesive bonding, bolting or similar methods, all of which are known in the field of rotor blade technology.

Exemplary embodiments of the invention will be described in detail below with reference to the appended drawings.

In the drawings:

5

Fig. 1 shows a schematic view of one exemplary embodiment of a wind turbine rotor blade known in the prior art, with the modification according to the invention;

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Fig. 2 shows a schematic view of a second exemplary embodiment of a wind turbine rotor blade, as a new rotor blade;

Fig. 3 shows a schematic cross-section through a wind turbine rotor blade known in the prior art, illustrating the flow and the point of change;

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Fig. 4 shows a schematic cross-section through the wind turbine rotor blade according to the invention, illustrating the flow and the point of change;

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Fig. 5 shows a schematic view of a third exemplary embodiment of a wind turbine rotor blade of segmented design, in a three-dimensional view;

Fig. 6 shows a schematic view of the third exemplary embodiment of a wind turbine rotor blade of segmented design as shown in Fig. 5, in a plan view of the top side;

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Fig. 7 shows a schematic view of the wind turbine rotor blade shown in Fig. 1, with cross-sections at different locations of the wind turbine rotor blade having different blade depths;

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Figs. 8 a) to g) show cross-sections through the wind turbine rotor blade shown in Fig. 1, indicating the ratios  $r/R = \dots$ , where a) is a cross-section spaced apart from the hub by 0.03, b) 0.05, c) 0.1, d) 0.2, e) 0.25, f) 0.3 and g) 0.4/0.5;

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Fig. 9 shows a schematic view of a first exemplary embodiment of the wind turbine rotor blade according to the invention on a wind turbine;

Fig. 10 shows a schematic view of a second exemplary embodiment of the wind turbine rotor blade according to the invention on a wind turbine, and

Fig. 11 shows a schematic view of a third exemplary embodiment of the wind turbine rotor blade according to the invention on a wind turbine.

5 Fig. 1 shows a schematic view of an exemplary embodiment of a wind turbine rotor blade 1 known in the prior art, with the modification according to the invention.

The wind turbine rotor blade 1 comprises a blade tip 12, a top side 13, a bottom side 14, a trailing edge 15, a leading edge 16 and a hub fastening means 17.

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Arranged on the existing wind turbine rotor blade 1 is a suction add-on part 31 with a suction region 21 provided therein, and a blow-out add-on part 32 with an extended rotor blade tip and winglet 29. Also shown is the air-conducting channel 23 which is arranged at the suction region 21 and is guided as far as the blow-out region 22.

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The wind turbine rotor blade 1 is divided into a hub region 111, a middle region 112 and a blade tip region 113, which represent the respective wind turbine rotor blade sections.

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This diagram gives a clear view of the newly designed trailing edge 15, which has been modified by the attached suction add-on part 31. The trailing edge 15 is now designed to be blunt, broad and/or truncated starting from the new boundary layer fence 28 to the point of transition into the old trailing edge 15.

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Also clearly visible is the arrangement of the suction region 21, which is not arranged on the trailing edge 15, on the top side 13 close to the trailing edge 15 or in an undefined manner in unclear regions of the top side 13, as known in the prior art, but rather is arranged along a line of points of change at which the laminar flow of the air flowing over the wind turbine rotor blade 1 changes into a turbulent flow.

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Only by virtue of this very specific design is it possible to achieve a considerable increase in efficiency over the wind turbine rotor blades known in the prior art.

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Hereinbelow, the same references as in Fig. 1 will be used for identical elements. For the principal function thereof, reference is made to Fig. 1.

Fig. 2 shows a schematic view of a second exemplary embodiment of a wind turbine rotor blade 1, as a new rotor blade.

5 The suction region 21, the blow-out region 22 and the air-conducting channel 23 are shown.

Fig. 3 shows a schematic cross-section through a wind turbine rotor blade 1 known in the prior art, illustrating the flow and the point of change X.

10 At the point of change X, the initially laminar air flow starts to change into a turbulent air flow, which leads to an impairment of the efficiency and also to increased soiling of the top side 13 of the wind turbine rotor blade 1.

15 Fig. 4 shows a schematic cross-section through the wind turbine rotor blade 1 according to the invention, illustrating the flow and the point of change X.

By virtue of the suction provided in the suction region 21 in combination with the blunt, broad and/or truncated trailing edge 15 of the wind turbine rotor blade 1, the air flow which is still laminar at the point of change X bears against the additionally attached flat element, as a result of which the energy output of the wind turbine W as a whole is increased by approximately 15%. The turbulent flow does not form until much later and, in combination with the blunt, broad and/or truncated trailing edge 15, leads to a further increase in the energy output of the wind turbine W.

25 Fig. 5 shows a schematic view of a third exemplary embodiment of a wind turbine rotor blade 1 of segmented design, in a three-dimensional view.

30 Six segments of the suction add-on part 31 are placed onto a wind turbine rotor blade 1 that is to be modified. Each of these individual segments 31 has a boundary layer fence 28 or 28' on the left-hand side as seen in the direction of the leading edge. When assembled together, for example outdoors, good transitions from both an aerodynamic point of view and an assembly point of view can thus be achieved.

35 Fig. 6 shows a schematic view of the third exemplary embodiment of a wind turbine rotor blade 1 of segmented design as shown in Fig. 5, in a plan view of the top side 15.

Fig. 7 shows a schematic view of the wind turbine rotor blade 1 shown in Fig. 1, with cross-sections at different locations of the wind turbine rotor blade 1 having different blade depths  $S_{max}$ ,  $S_{gr}$ ,  $S_{mb}$ ,  $S_x$ .

- 5 Figs. 8 a) to g) show cross-sections through the wind turbine rotor blade shown in Fig. 1, indicating the ratios  $r/R = \dots$ , where a) is a cross-section spaced apart from the hub by 0.03, b) 0.05, c) 0.1, d) 0.2, e) 0.25, f) 0.3 and g) 0.4/0.5.

10 Here, the larger outlines of the cross-sections represent the new design and the smaller cross-sections represent the original design of a modified wind turbine rotor blade 1.

15 Figs. 9, 10 and 11 are schematic views of three exemplary embodiments of the wind turbine rotor blade 1 according to the invention on a wind turbine W.

The wind turbine W consists of a wind turbine tower T which is placed on a foundation, and a generator housing which is placed onto the wind turbine tower T and on which there is provided a hub with three wind turbine rotor blades 1 arranged thereon.

20 In order to modify existing wind turbines W, an installation device M or working platform can be lowered from the generator housing or alternatively can be raised from below on the wind turbine tower T or on the wind turbine rotor blade 1, in order to install the suction add-on part 31 and/or the segmented add-on part 31' and/or the blow-out add-on part 32 and the air-conducting channel 23 (not  
25 shown).

## List of references

	1	wind turbine rotor blade
	11	root region
5	111	hub region
	112	middle region
	113	blade tip region
	12	blade tip
	13	top side
10	14	bottom side
	15	trailing edge
	16	leading edge
	17	hub fastening means
15	21	suction region
	22	blow-out region
	23	air-conducting channel
	28, 28'	boundary layer fence
	29	winglet
20	31, 31'	suction add-on part
	32	blow-out add-on part
	M	installation device
25	S <sub>max</sub>	maximum blade depth/shoulder depth
	S <sub>gr</sub>	blade/shoulder depth in the area of the boundary layer fence
	S <sub>mb</sub>	blade/shoulder depth in the area of the middle region
	S <sub>x</sub>	local blade depth at the point on the rotor blade
	T	wind turbine tower
30	W	wind turbine
	X	point of change from laminar to turbulent flow
	→	air flow

**Patentkrav**

1. Vindturbinerotorvinge (1) med en overside (13), en underside (14), en forkant (16), en bagkant (15), et navfastgørelsesmiddel (17) og en vingspids (12), hvori
- 5 vindturbinerotorvingen (1) er opdelt i et navområde (111), et mellemområde (112) og et vingspidsområde (113), og et rodområde (11) er defineret fra navfastgørelsesmidlet (17) til den maksimale bladdybde ( $S_{max}$ ), hvori
- der inde i vindturbinerotorvingen (1) er tilvejebragt en radielt udad forløbende luftled kanal (23) til at lede indsuget luft fra et sugeområde (21) til et udblæsningsområde (22) arrangeret i vingspidsområdet (113), og hvor en grænselagsugning forekommer, hvor indsugning af luft forekommer på oversiden af vindturbinerotorvingen (1),
  - og hvor der er tilvejebragt et grænselagshegn (28) i navområdet (111) nær ved navfastgørelsesmidlet (17) for at hindre en strømning i retning af navfastgørelsesmidlet (17), hvori
  - bagkanten (15) i navområdet (111) i det mindste i det første afsnit af det tilstødende mellemområde (112) er stump, bred og/eller afskåret og aftager i retning af vingspidsområdet (113), **kendetegnet ved, at** bagkanten er videreført forbi rodområdet (11) i retning af vingspidsen (12), sugeområdet (21) er arrangeret i
  - 20 det område, hvor en laminar luftstrøm løsrives fra oversiden (13) på måde, der er specifik for rotorvingegeometrien, sådan at der forekommer kontakt og videreførelse af den laminare luftstrøm mod den yderligere overflade af oversiden (13), og
  - sugeområdet (21), begyndende ved eller nær ved grænselagshegnet (28) i navområdet (111), strækker sig ind i mellemområdet (112), hvori sugeområdet (21) fortsætter i mellemområdet (112) forbi rodområdet (11) i retning af vingspidsen (12).
2. Vindturbinerotorvinge (1) ifølge krav 1, **kendetegnet ved, at** sugeområdet (21) har en flerhed af sugesegmenter, som kan åbnes og lukkes, og som åbnes og lukkes som en funktion af et omslagspunkt (X), ved hvilket en laminar luftstrøm løsrives fra oversiden (13) på en måde, som er specifik for rotorvingegeometrien, hvilket omslagspunkt vandrer som resultat af en drejning af rotorvingen ved navet for at tilpasse vingens indfaldsvinkel til vinden, således at der dannes
- 35 en variable sugelinie.
3. Vindturbinerotorvinge (1) ifølge krav 1 eller 2, **kendetegnet ved, at** den maksimale vingedybde ( $S_{max}$ ) af vindturbinerotorvingen (1) er tilvejebragt i navom-

rådet (111) eller i den første sektion af mellemområdet (112), og vingedybden (Sgr) aftager fra den maksimale vingedybde (Smax) til grænselagshegnet (28).

5 4. Vindturbinerotorvinge (1) ifølge krav 1, 2 eller 3, **kendetegnet ved, at** sugeområdet (21) er arrangeret i overfladeafsnittet 40% af den lokale vingedybde (Sx) fra forkanten (16) til 5% af den lokale vingedybde (Sx) fra bagkanten (15).

10 5. Vindturbinerotorvinge (1) ifølge krav 4, **kendetegnet ved, at** sugeområdet (21) er arrangeret i navområdet (111) i overfladeafsnittet 40% af den lokale vingedybde (Sx) fra forkanten (16) til 30% af den lokale vingedybde (Sx) fra bagkanten (15).

15 6. Vindturbinerotorvinge (1) ifølge ethvert foregående krav, **kendetegnet ved, at** vingens (1) indre legeme anvendes som en luftledekanal.

7. Vindturbinerotorvinge (1) ifølge ethvert foregående krav, **kendetegnet ved, at** en kendt rotorvinge modificeres ved påbyggede komponenter.

20 8. Vindturbinerotorvinge (1) ifølge krav 7, **kendetegnet ved, at** de påbyggede komponenter er udformet segmenteret.

25 9. Vindturbinerotorvinge (1) ifølge ethvert foregående krav, **kendetegnet ved, at** en kendt rotorvinges vingspids (12) modificeres ved en påbygget komponent, som ikke forlænger rotorvingens samlede længde.

10. Vindturbinerotorvinge (1) ifølge ethvert foregående krav, **kendetegnet ved, at** en kendt rotorvinges vingspids (12) modificeres ved en påbygget komponent, som forlænger rotorvingens samlede længde med 0,5 til 7 m.

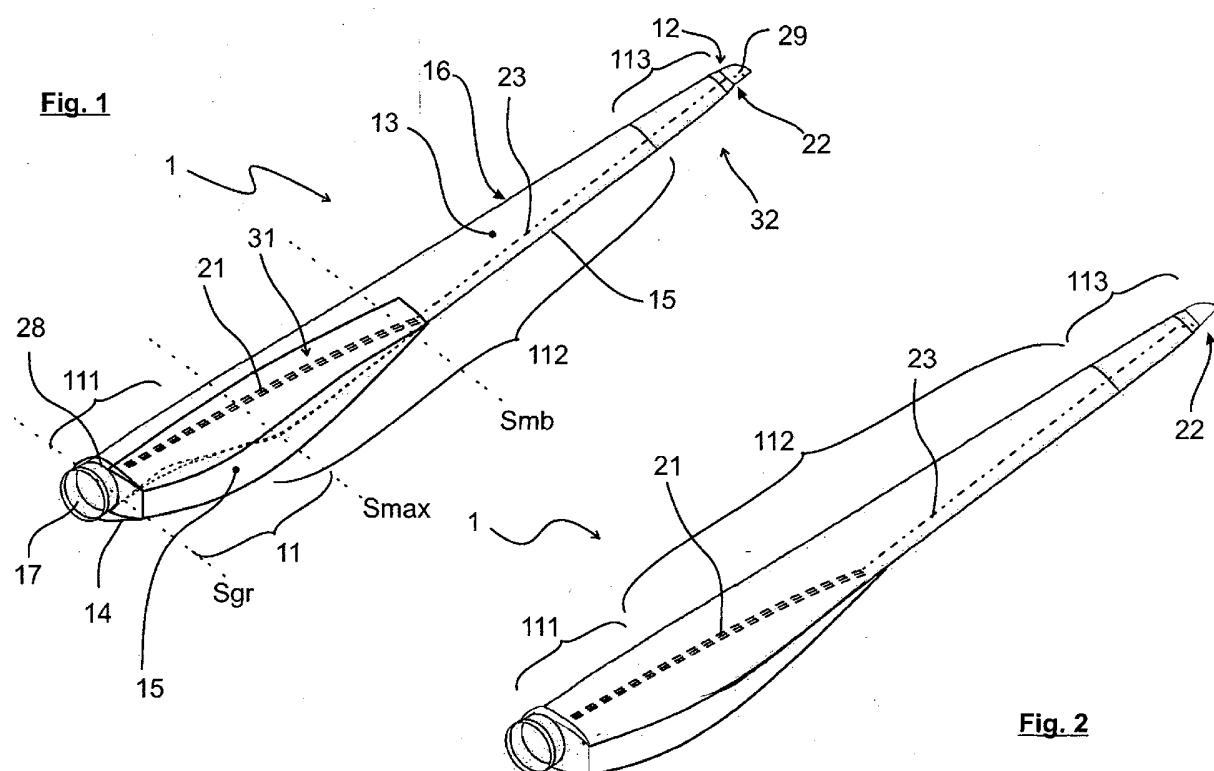
30 11. Vindturbinerotorvinge (1) ifølge ethvert af krav 8 til 10, **kendetegnet ved, at** de segmenterede påbyggede komponenter har mindst et grænselagshegnssafsnit (28, 28').

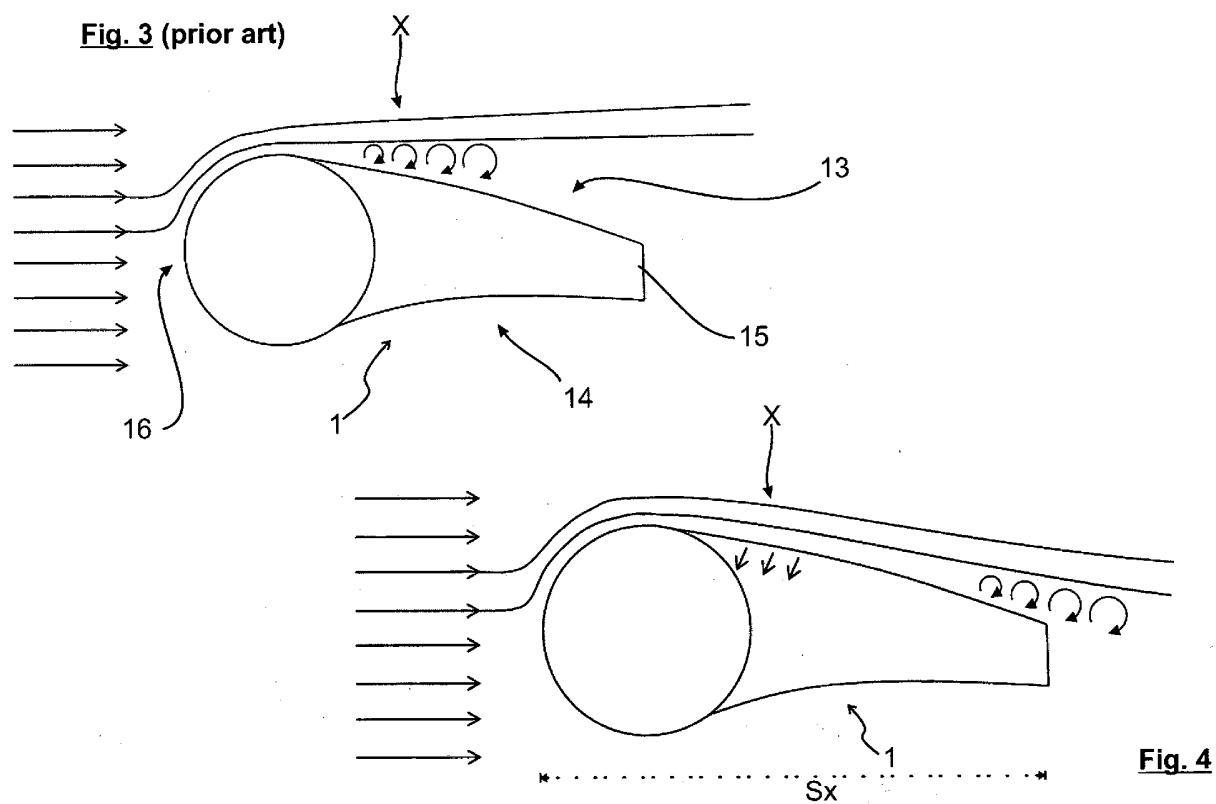
35 12. Vindturbinerotorvinge (1) ifølge ethvert foregående krav, **kendetegnet ved, at** en ventil til at styre grænselagspåvirkningen er arrangeret i luftledekanalen (23).

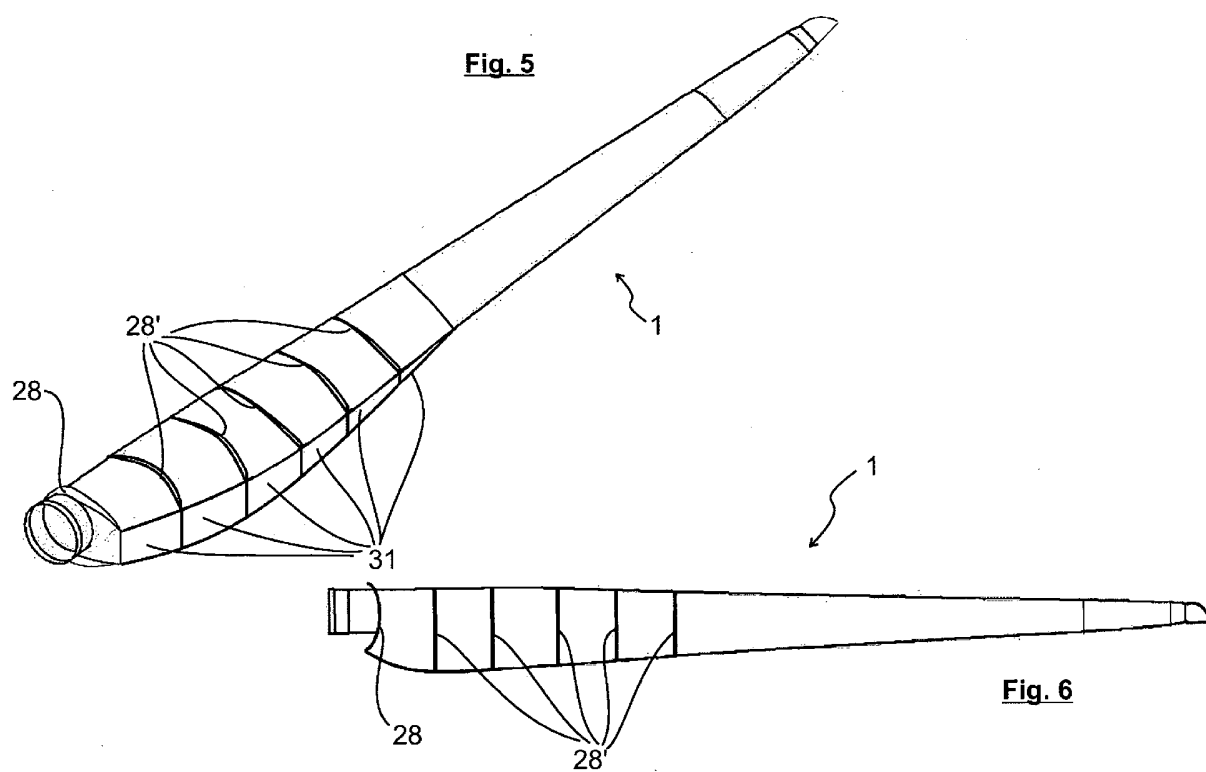
13. Vindturbinerotorvinge (1) ifølge ethvert foregående krav, **kendetegnet ved, at** transportmidler til aktiv påvirkning af grænselaget inden i luftledekanalen (23) er tilvejebragt sådan at luft kan transporteres både fra sugeområdet (21) til udblæsningsområdet (22) og i modsat retning.

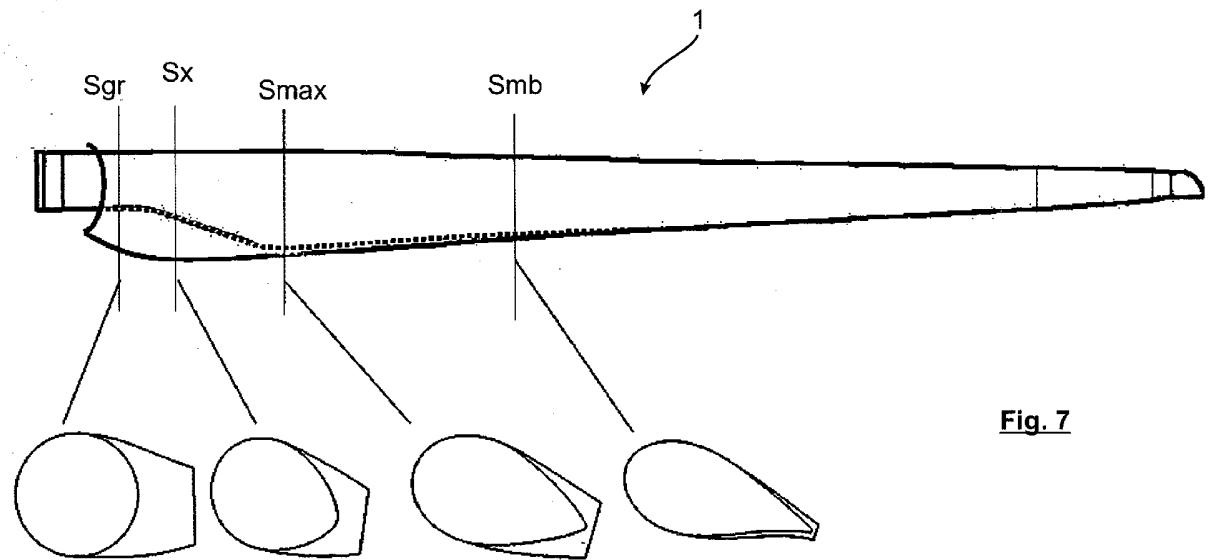
5

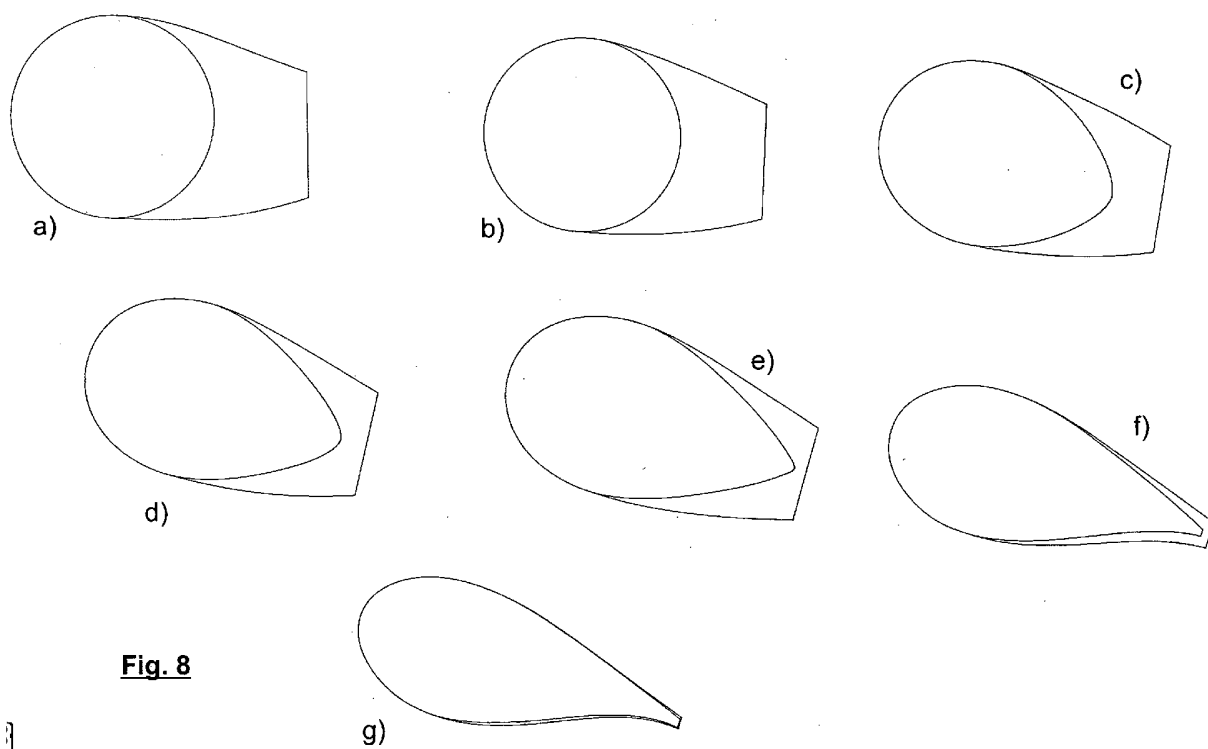
14. Vindturbinerotorvinge (1) ifølge ethvert foregående krav, **kendetegnet ved, at** sugeområdets (21) og/eller udblæsningsområdets (22) åbninger er udformet som huller og/eller spalter.







**Fig. 7**



**Fig. 8**

