

(19)



(11)

**EP 4 826 255 A2**

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:

**21.10.2026 Bulletin 2026/43**

(51) International Patent Classification (IPC):

**F04D 29/70** <sup>(2006.01)</sup>

(21) Application number: **26169601.7**

(52) Cooperative Patent Classification (CPC):

**F04D 29/703; F04D 29/384;** F05D 2240/304;

(22) Date of filing: **09.04.2025**

F05D 2240/307

(84) Designated Contracting States:

**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 ME MK MT NL  
NO PL PT RO RS SE SI SK SM TR**

Designated Extension States:

**BA**

Designated Validation States:

**GE KH LA MA MD TN**

(72) Inventors:

- **WIRKUS, Jeremy Marc**  
**5406 TE Uden (NL)**
- **ROSEILLIER, Alexis Laurent Sebastien**  
**5406 TE Uden (NL)**

(74) Representative: **Patent Business B.V.**

**Lange Amerikaweg 81**  
**7332 BP Apeldoorn (NL)**

(30) Priority: **09.04.2024 NL 2037418**

(62) Document number(s) of the earlier application(s) in  
accordance with Art. 76 EPC:

**25718461.4 / 4 705 645**

(71) Applicant: **Duux Holding B.V.**

**5406 TE Uden (NL)**

### Remarks:

This application was filed on 31.03.2026 as a  
divisional application to the application mentioned  
under INID code 62.

(54) **OPTIMIZED FAN**

(57) The present invention is in the field of a fan  
with rotating blades in a substantially open casing, typi-  
cally a fan for relatively small spaces at work or at

home, such as rooms, and offices. The fan is improved  
in terms of production of noise, improved air flow, re-  
duced power consumption, and improved pitch.

**EP 4 826 255 A2**

## Description

### FIELD OF THE INVENTION

**[0001]** The present invention is in the field of a fan with rotating blades in a substantially open casing, typically a fan for relatively small spaces at work or at home, such as rooms, and offices. The fan is improved in terms of production of noise, improved air flow, reduced power consumption, and improved pitch.

### RELATED APPLICATIONS

**[0002]** The present application claims the benefit of priority from Dutch Patent Application NL2037418, filed on April 9, 2024, in the name of DUUX Holding B.V., The Netherlands.

**[0003]** The entire contents of the above-referenced applications and of all priority documents referenced in the Application Data Sheet filed herewith are hereby incorporated by reference for all purposes.

### BACKGROUND OF THE INVENTION

**[0004]** The present invention is in the field of a fan. A fan is a powered machine used to create flow of air. The fan comprises a rotating arrangement of blades (which may also be referred to as vanes), which act on the air and thereby provide airflow. The rotating assembly of blades and hub is known as a rotor. The rotor may be contained within some form of housing, or case. This casing may direct the airflow, or may increase safety by preventing objects from contacting the fan blades. Most fans are powered by electric motors.

**[0005]** A fan is a turbo machine that causes air or a gas to be set in motion. A fan can be used to supply a room with fresh air or to cool something by letting air flow over it. Usually, the rotor of a fan is driven by a condenser motor. Typically, the air sucked in is moved instantaneously.

**[0006]** A problem with fans is that they produce noise. Noise may be produced by the rotor, and the rotating blades. Noise of the rotating blades may well be above 70 dB, which is unwanted, especially if fans are provided in a sleeping room or in an office environment.

**[0007]** A further problem with fans is that the air flow is not very laminar, causing the above noise, as well as a limited air flow, and a diverging air flow. The power of a fan is thereby not efficiently used.

**[0008]** Incidentally WO 2019/065679 A1 recites a fan with an axial flow fan which blows wind; a front guard provided on the downstream side of the axial flow fan; an inner ring which partitions the front guard into an inner circumferential-side ventilation part and an outer circumferential-side ventilation part; and an outer ring formed outside the inner ring.

**[0009]** The present invention therefore relates to an improved fan, which solves one or more of the above problems and drawbacks of the prior art, providing reliable results, without jeopardizing functionality and advantages.

### SUMMARY OF THE INVENTION

**[0010]** It is an object of the invention to overcome one or more limitations of the fans of the prior art and to improve these. For a new generation of standing fans, such as for consumer use (domestic appliance), Duux has developed a fan that significantly enhances the airflow through the product (see e.g. fig. 1c). As the airflow is guided better through the fan, allowing more air to come in and encountering less resistance from the housing parts, this is found to directly results in a higher rate of airflow (airflow volume), a lower energy consumption, and lower noise levels than prior art designs. The effectiveness of the present fan is a direct result of the amount of air that can flow through the fan, and how much resistance this flow encounters while being sucked in and blown out of the fan. The key parts considered responsible for this are the fan blade, the inlet grill (mostly seen as the back of the fan), and the outlet grill (seen as the front of the product). Using advanced CAD modelling, computer simulation and prototype testing, inventors have developed geometries that result in a remarkably high performance of the fan: high volume of air throughput, low power consumption, and low noise levels (particularly at frequencies for which the human ear is most sensitive). Part of these results is considered due to a series of particular details of the geometry of the fan components. In an embodiment, inventors thereto provide a design of the fan blade, where the tips of the blade have a curve at the end (a 'wing tip') that guide the flow of air at the edges of the blade better (see e.g. fig. 2b). This geometry is found to increase the airflow volume, while reducing the turbulence (size of vortices) at the end of the blade. In a further embodiment design of the fan blade, the trailing edge of the blade (this is where the airflow leaves the blade after being scooped up) has a series of small cuts to reduce turbulence (vortices) at this end of the blade (see e.g. fig. 2c). This is found to reduce noise generated by the turbulence, while keeping the airflow performance. Even further, in an embodiment, a wing shaped ring to the inlet grill is provided, that is placed under an angle between the slats near the outer edge of the inlet grill (see e.g. fig. 3a-b). This ring is found to aid the airflow into the grill, increasing the airflow volume and reducing the noise on the inlet side. In a further embodiment a modification to the shape of the slats in the outlet grill is provided, on the inside of the fan (so the side of the slats that face the fan blade). By 'cutting off' one corner of the slats, the airflow around the slat is optimized, resulting in a higher airflow volume and improved airflow speed out of the fan (see

figs. 4a-4b). Therewith the separation of air is limited, the flow rate is increased, the reach is longer, and the flow filed at the hub is more converged. In yet a further embodiment a geometry on the outlet grill where the slats do not directly connect to the centre disc, but instead end at an extra ring around this centre disc. This creates an extra opening around the centre disc for the air to pass through, which helps the airflow around the hub of the fan blade to exit the fan more easily, thus creating improved airflow volume in the centre of the fan. Even further, a fork shape (Y-shape) for the slat is provided that make up the inlet and outlet grille of the fan (see figs. 3b and 2c). This particular shape creates optimal open surface area for air to pass through the fan (improving airflow and reducing noise) while at the same time providing enough stiffness and spacing to pass the required 'finger test' safety regulations. Thereto the present fan (10) comprises a substantially open casing (2), the casing comprising a grill shaped front-side (2a), the grill shaped front-side (2a) comprising a substantially closed central part (2d), a grill shaped back-side (2b), and a substantially cylindrically shaped side section (2c) in between said front-side and back-side, inside said casing a rotor (3), the rotor comprising at least three blades (4), characterized in that the side section comprises an open side grill section part (2g), typically provided at/adjacent to the back-side, and a closed side section part (2h), typically provided at/adjacent to the front-side, or vice-versa, and wherein the grill shaped front-side (2a) comprises a multitude of radial extensions (5), each extension (5) for connecting the side section (2c) with the central part (2d). The closed side section part (2h) typically extends over 20-80% of the side section, in particular 30-70% thereof, such as 40-60%, and the open side grill section part (2g) the remaining part, taken in a direction parallel to a central axis of the fan. Therewith an improved air flow is provided, with substantially laminar flow, which air flow does not diverges very much and extends far from the fan, noise is reduced to acceptable levels, and energy consumption is reduced. Compared to an earlier otherwise similar fan design, rotating at the same 800 rpm, the efficiency has increased about 18% relative, the airflow yield increased by some 20% relative, and the noise by - 3dB. Put different, for a similar air flow the energy consumption is reduced significantly at an increased air flow, as is detailed above. Further the absolute noise level is reduced to typically below 70 dB, and most often to below 46 dB.

**[0011]** Advantages of the present description are detailed throughout the description.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0012]** In an exemplary embodiment of the present fan the at least three blades are attached substantially perpendicular to a rotational axis of the rotor.

**[0013]** In an exemplary embodiment of the present

fan each blade individually comprises a wing tip (8), in particular wherein the wing tip is substantially parallel to the side section (2d).

**[0014]** In an exemplary embodiment of the present fan the wing tip further comprises a wing tip recess (8a), in particular a wing tip recess (8b) at a trail section of the blade.

**[0015]** In an exemplary embodiment of the present fan the wing tip (8) comprises a curved section (8b), in particular a curved section with a curvature of 80-100 degrees (measured from the central part of the blade towards the wing tip), more in particular wherein the wing tip extends towards the front side of the fan.

**[0016]** In an exemplary embodiment of the present fan each blade individually comprises at a trailing edge thereof a multitude of blade trail extensions (9), in particular 5-40 blade trail extensions, more in particular 10-30 blade trail extensions, even more in particular 20-25 blade trail extensions.

**[0017]** In an exemplary embodiment of the present fan in between two adjacent blade trail extensions an open space (9a) is provided, in particular wherein said open space has a surface area of 50-150% of that of the blade trail extension.

**[0018]** In an exemplary embodiment of the present fan each individual blade trail extension has a blade trail extension width, a blade trail extension length, and a blade trail extension thickness, wherein the blade trail extension thickness is substantially equal to that of the blade, and/or wherein the blade trail extension length is 1-20% of a blade width, in particular 5-10% of said blade width, and/or wherein the blade trail extension width is 15-60% of the blade trail extension length, in particular 20-35% of said blade trail extension length.

**[0019]** In an exemplary embodiment of the present fan an outer blade trail extension has a width that increase from an extension tip towards the blade.

**[0020]** In an exemplary embodiment of the present fan an outer blade trail extension comprises a recess (9b) at a peripheral side thereof.

**[0021]** In an exemplary embodiment of the present fan each blade trail extension comprises a rounded tip (9c).

**[0022]** In an exemplary embodiment of the present fan the grill shaped back-side (2b) comprises a wing shaped back side grill ring (2i), in particular wherein said back side grill ring (2i) is provided at an intersection of the back-side (2b) and the side section (2c), in particular wherein the ring has a ring thickness, and a ring height, wherein the ring thickness is substantially equal to that of the radial extensions (5).

**[0023]** In an exemplary embodiment of the present fan the ring height is 1-3 times as large as the ring thickness, and/or wherein the ring thickness increase from an inner part of the ring towards an outer part of the ring, in particular wherein the ring thickness increases 20-70% with respect to its smallest thickness.

**[0024]** In an exemplary embodiment of the present

fan each radial extension comprises an inner radial extension (5a), which inner radial extension splits into at least two outer radial extensions (5b), in particular each radial extension of at least one of the front-side grill and the back-side grill.

**[0025]** In an exemplary embodiment of the present fan each radial extension comprises a cross-section that is substantially rectangular, wherein the radial extension comprises a leading edge cut (5d) such that the rectangular cross-section comprises 5 corners, in particular wherein the substantially rectangular cross-section comprises rounded corners and/or a central thickness of 5-10% larger than a peripheral thickness, more in particular wherein at least one of the grill shaped front-side (2a) and the grill shaped back side (2b) comprise radial extensions with said cross section.

**[0026]** In an exemplary embodiment of the present fan the grill shaped front-side (2a) comprise a central part (2d) in connection with the radial extensions (5), in particular in connection with the radial extensions through an intermediate sub-ring (2j), more in particular wherein in between said sub-ring (2j) and said central part at least one central opening (2k) is provided.

**[0027]** In an exemplary embodiment of the present fan the fan is an axial ventilator, in particular selected from a domestic fan, a domestic air circulator, and a window air circulator, more in particular a standing fan.

**[0028]** In an exemplary embodiment of the present fan the front-side (2b) comprises a central part (2d), which central part is substantially closed, and which central part has a radius of <25% of the radius of the front-side, preferably <20% thereof, such as <15% thereof, and/or which central part (2d) has a surface area of >2% of the surface area of the front side, preferably >6.25% thereof, more preferably > 9% thereof. By having a closed central part a better, an increased, and more efficient air flow is created.

**[0029]** In an exemplary embodiment of the present fan each radial extension individually has a height h of 1-5 mm, preferably 2-4 mm, such 3 mm, preferably wherein each radial extension individually has a thickness of 1-3 mm. It is found that having sufficient height of the extensions contributes to a better, an increased, and more efficient air flow.

**[0030]** In an exemplary embodiment of the present fan a maximum spacing between two adjacent radial extensions is <10 mm, preferably < 9mm, such as < 8.6 mm. As such the blades are protected.

**[0031]** In an exemplary embodiment of the present fan each blade individually has a cross-sectional wing profile (air foil) with a leading edge (4a) and a trail edge (4b), wherein the front edge is 1.2-4 times as thick as the trail edge, preferably 1.5-3 times as thick, more preferably 1.8-2.5 times as thick, such as 2-2.2 times as thick. Such a cross-sectional shape is found to contribute to a better, an increased, and more efficient air flow.

**[0032]** In an exemplary embodiment of the present

fan each blade has a cross-sectional wing profile (air foil) which at a rotor side is at least 50% larger than at a side section (2c) side.

**[0033]** In an exemplary embodiment of the present fan each blade is attached at a pitch angle  $\alpha$  to the rotor, wherein the pitch angle is  $\alpha$  is 10-35 degrees with respect to a central axis of the rotor, preferably 15-30 degrees with respect to said central axis, such as 20-25 degrees, wherein the leading edge (4a) is further away from the front side (2a) than the trailing edge (4b).

**[0034]** In an exemplary embodiment of the present fan each blade individually is curved over a cross-section A-A' providing a concave curvature at a front side of the blade and a convex curvature at a back side of the blade.

**[0035]** In an exemplary embodiment of the present fan each blade individually is torqued backwards over an angle  $\beta$  of 10-35 degrees, preferably 20-30 degrees.

**[0036]** In an exemplary embodiment of the present fan each blade individually is substantially straight at a trail edge, or slightly curved, such as with a curve substantially following a circumference of the side section (2c).

**[0037]** In an exemplary embodiment of the present fan each blade individually is curved at a leading edge.

**[0038]** In an exemplary embodiment of the present fan each blade individually has an average thickness of 1-3.5 mm, such as 1.5-2.5 mm.

**[0039]** In an exemplary embodiment of the present fan a width of each blade individually is smaller at a side near rotor than at a periphery, preferably 10-60% smaller, such as 30-50% smaller.

**[0040]** In an exemplary embodiment of the present fan a width of each blade individually gradually increases from the side at the rotor to a periphery.

**[0041]** In an exemplary embodiment of the present fan a combined surface area of the blades projected in a plan perpendicular to the central axis is 30-70% of an area of the front-side, preferably 40-60% of said area, more preferably 45-55% of said area, such as 47-53% thereof. The design of the blades is found to contribute to a better, an increased, and more efficient air flow.

**[0042]** In an exemplary embodiment the present fan comprises a fan support (7), wherein the fan support is attached to a back side of the fan, wherein the fan-support comprising at least one electrical wire, wherein the fan support extends towards a front side of the fan, such that a centre of mass of the fan substantially coincides with a foot of the fan support. Other than most fans the present support contributes to a better stability of the fan.

**[0043]** In an exemplary embodiment of the present fan an open surface area at a front side of the fan is from 40-90% of a total front side surface area, preferably 60-80% thereof, such as 70-75% thereof.

**[0044]** In an exemplary embodiment of the present fan an open surface area at a back side of the fan is from 40-95% of a total back side surface area, prefer-

ably 60-90% thereof, such as 75-85% thereof.

**[0045]** In an exemplary embodiment of the present fan the side section forms a ring-shaped section of a sphere, such as 2-12% of said sphere, preferably 3-10% thereof, such as 4-6% thereof.

**[0046]** In an exemplary embodiment of the present fan blades extend 70-99 % in a direction perpendicular to a central axis of the rotor towards the side section of the fan, preferably extend 85-98%, such as 92-95%.

**[0047]** In an exemplary embodiment the present fan comprises 4-12 blades, in particular 5-11 blades, more in particular 7-9 blades, preferably an odd number of blades.

**[0048]** In an exemplary embodiment of the present fan the blade is obtained by forced extrusion, by 3d-printing, or by moulding.

**[0049]** In an exemplary embodiment of the present fan the blades are made from a lightweight material with a density of  $<1.2 \text{ g/cm}^3$ , preferably  $<1.1 \text{ g/cm}^3$ . It is preferred to use a lightweight material, as efficiency is improved thereby.

**[0050]** In an exemplary embodiment of the present fan the blades are made from a material with a tensile strength (ISO 527-1:2019) of  $> 25 \text{ MPa}$ , such as  $> 35 \text{ MPa}$ . It is preferred to use rather stiff materials, in order to prevent deformation of the blades during rotation. The deformation is found to reduce efficiency, to contribute to noise, to reduce air flow, and to reduce life time.

**[0051]** In an exemplary embodiment of the present fan the blades are made from a material with a shear stress (ASTM D732) of  $> 35 \text{ MPa}$ , such as  $> 50 \text{ MPa}$ . It is preferred to use rather stiff materials, in order to prevent deformation of the blades during rotation. The deformation is found to reduce efficiency, to contribute to noise, to reduce air flow, and to reduce life time.

**[0052]** In an exemplary embodiment of the present fan the blades are made from a material with a surface roughness  $R_a$  (ISO 4287:2000) of  $< 5 \mu\text{m}$ , preferably  $< 2 \mu\text{m}$ , more preferably  $< 1 \mu\text{m}$ , such as  $< 0.8 \mu\text{m}$ . It is preferred to very smooth surface materials, in order to prevent delamination of air flow of the blades during rotation. The smooth surface is found to increase efficiency, to reduce noise, to increase air flow, and to increase life time.

**[0053]** In an exemplary embodiment of the present fan at least a part of the blades, the front-side, the back-side, the rotor, and the side section are made from a polymer material, such as ABS (CAS 9003-56-9), PE or PP.

**[0054]** In an exemplary embodiment of the present fan at least a part of the rotor is made of a metal, such as stainless steel, or aluminium.

**[0055]** In an exemplary embodiment of the present fan the fan has an air flow of  $> 0.1 \text{ m}^3/\text{minute}$ , and/or wherein the fan has an air flow of  $< 50 \text{ m}^3/\text{minute}$ , and/or wherein a diameter of the fan is from 15-80 cm, preferably from 20-70 cm, such as from 25-60cm, and/or wherein a depth of the fan is from 5-20 cm, prefer-

ably from 7-15 cm, such as from 10-12cm, and/or wherein the fan in operation produces  $< 70 \text{ dB}$  noise, preferably  $< 60 \text{ dB}$ , more preferably  $< 50 \text{ dB}$ , such as  $< 46 \text{ dB}$ , and/or wherein the fan in operation produces a substantially linear air-flow, and/or wherein the fan in operation produces an air-flow which diverges  $< 20$  degrees from a central axis, preferably  $< 10$  degrees, such as  $< 6$  degrees, and/or wherein the fan in operation produces an air-flow over a distance  $> 5$  times a diameter of the fan, preferably  $> 10$  times said distance. A typical air flow is some  $1500 \text{ m}^3/\text{hour}$ , and can easily reach  $2000 \text{ m}^3/\text{hour}$  or even  $2500 \text{ m}^3/\text{hour}$  in more recent embodiments, depending on rotation speed and size of the fan. Very low noise values are obtained with the present fan.

**[0056]** The invention will hereafter be further elucidated through the following examples which are exemplary and explanatory of nature and are not intended to be considered limiting of the invention. To the person skilled in the art it may be clear that many variants, being obvious or not, may be conceivable falling within the scope of protection, defined by the present claims.

## SUMMARY OF THE FIGURES

### [0057]

Figure 1a shows an example of the present fan. Fig. 1b shows a side view including support 7. Fig. 1c shows another side view with forked radial extensions

Figs. 2a-c show details of the present rotor and blade design.

Figs. 3a-b show details of the present casing.

Figs. 4a-c show details of the present grill.

Figs. 5a-5f show details of the present rotor.

Figs. 6a-c show an air flow of a prior art fan, fig. 6b of a slightly improved fan, and fig. 6c of the present fan.

## DETAILED DESCRIPTION OF FIGURES

### [0058] In the figures:

- 10 Fan
- 2 open casing
- 2a grill shaped front-side, typically for air outlet
- 2b grill shaped back-side, typically for air inlet
- 2c cylindrically shaped side section
- 2d central part
- 2e front-side support
- 2f back-side support
- 2g open side section part
- 2h closed side section part
- 2i wing shaped back side grill ring
- 2j intermediate sub ring
- 2k open space between central part 2d and ring 2i
- 3 rotor

|          |                                                                        |
|----------|------------------------------------------------------------------------|
| 4        | blade                                                                  |
| 4a       | leading edge                                                           |
| 4b       | trail edge                                                             |
| 5        | radial extension                                                       |
| 5a       | inner radial extension                                                 |
| 5b       | outer radial extension                                                 |
| 5c       | fork                                                                   |
| 5d       | leading edge cut, e.g. 10-50 degrees w.r.t. top, such as 25-40 degrees |
| 7        | fan support                                                            |
| 8        | wing tip                                                               |
| 8a       | wing tip recess                                                        |
| 8b       | blade/wing tip curved section                                          |
| 9        | blade trail extension                                                  |
| 9a       | open space                                                             |
| 9b       | recess                                                                 |
| 9c       | round tip                                                              |
| $\alpha$ | pitch angle                                                            |
| $\beta$  | backward angle                                                         |
| h        | step height                                                            |
| s        | extension spacing                                                      |
| t        | thickness of radial extension                                          |

**[0059]** Figure 1a shows an exemplary fan with a partly closed and partly open casing, also referred to as hood. Therein a grill shaped front-side 2a, typically for air outlet, a grill shaped back-side 2b, typically for air inlet, a cylindrically shaped side section 2c, a central part 2d, a front-side support 2e, and a back-side support 2f are visible. Also a rotor 3, having blades 4, radial extensions 5, also referred to as slats or lamella, support 7, are visible. Fig. 1b shows a side view of said fan. A horizontal axis of central mass is shown. Fig. 1c shows a side view of a further exemplary fan, wherein the side section comprises an open side grill section part (2g) and a closed side section part (2h),

**[0060]** Fig. 2a shows details of a blade design, with wing tips 8, wing tip recesses 8a, and blade tip curved sections 8b. Fig. 2b shows a full view of a rotator with blades and direction of rotation. Fig. 2c shows yet a further example of the present blades, with blade trail extensions 9, also referred to as serration, open spaces 9a, recesses 9b, and round tips 9c.

**[0061]** Figs. 3a-b show details of the present casing, with wing shaped back side grill ring 2i.

**[0062]** Fig. 4a shows details of the present forked extensions, with inner radial extensions 5a, outer radial extensions 5b, forks 5c, and in fig. 4b a cross section showing a leading edge cut (left top), e.g. 10-50 degrees w.r.t. top, such as 25-40 degrees. Radial extensions have a thickness t and a height h and spacings s are provided in between. Fig. 4c then shows intermediate sub ring 2j, and open space 2k between central part 2d and ring 2i.

**[0063]** Figs. 5a-f show design details of the present blade, indicating pitch angle  $\alpha$ , backward angle  $\beta$ , blades 4 with leading edges 4a and with trail edges 4b.

**[0064]** Figs. 6a-c show an air flow of a prior art fan,

fig. 6b of a slightly improved fan, and fig. 6c of the present fan. At a left side the fan is provided. The air flow speed is provided in colour, from 0-3.0 m/s, the darker, the higher the speed.

**[0065]** The below relates to the claims as filed in WO 2025/216632 A1 Application:

#### 1. A fan (10) comprising

a substantially open casing (2), the casing comprising a grill shaped front-side (2a), the grill shaped front-side (2a) comprising a substantially closed central part (2d), a grill shaped back-side (2b), and a substantially cylindrically shaped side section (2c) in between said front-side and back-side, inside said casing a rotor (3), the rotor comprising at least three blades (4), characterized in that the side section comprises an open side grill section part (2g) and a closed side section part (2h), and wherein the grill shaped front-side (2a) comprises a multitude of radial extensions (5), each extension (5) for connecting the side section (2c) with the central part (2d).

2. The Fan according to claim 1, wherein the at least three blades are attached substantially perpendicular to a rotational axis of the rotor, and/or Wherein each blade individually comprises a wing tip (8), in particular wherein the wing tip is substantially parallel to the side section (2d).

3. The Fan according to claim 2, wherein the wing tip further comprises a wing tip recess (8a), in particular a wing tip recess (8b) at a trail section of the blade.

4. The Fan according to claim 2 or 3, wherein the wing tip (8) comprises a curved section (8b), in particular a curved section with a curvature of 80-100 degrees (measured from the central part of the blade towards the wing tip), more in particular wherein the wing tip extends towards the front side of the fan.

5. The Fan according to any of claims 1-4, wherein each blade individually comprises at a trailing edge thereof a multitude of blade trail extensions (9), in particular 5-40 blade trail extensions, more in particular 10-30 blade trail extensions, even more in particular 20-25 blade trail extensions.

6. The Fan according to claim 5, wherein in between two adjacent blade trail extensions an open space (9a) is provided, in particular wherein said open space has a surface area of 50-150% of that of the blade trail extension, and/or

wherein each individual blade trail extension has a blade trail extension width, a blade trail

extension length, and a blade trail extension thickness, wherein the blade trail extension thickness is substantially equal to that of the blade, and/or wherein the blade trail extension length is 1-20% of a blade width, in particular 5-10% of said blade width, and/or wherein the blade trail extension width is 15-60% of the blade trail extension length, in particular 20-35% of said blade trail extension length, and/or

wherein an outer blade trail extension has a width that increase from an extension tip towards the blade, and/or

wherein an outer blade trail extension comprises a recess (9b) at a peripheral side thereof, and/or

wherein each blade trail extension comprises a rounded tip (9c).

7. The Fan according to any of claims 1-6, wherein the grill shaped back-side (2b) comprises a wing shaped back side grill ring (2i), in particular wherein said back side grill ring (2i) is provided at an intersection of the back-side (2b) and the side section (2c), in particular wherein the ring has a ring thickness, and a ring height, wherein the ring thickness is substantially equal to that of the radial extensions (5), and/or wherein the ring height is 1-3 times as large as the ring thickness, and/or wherein the ring thickness increase from an inner part of the ring towards an outer part of the ring, in particular wherein the ring thickness increases 20-70% with respect to its smallest thickness.

8. The Fan according to any of claims 1-7, wherein each radial extension comprises an inner radial extension (5a), which inner radial extension splits into at least two outer radial extensions (5b), in particular each radial extension of at least one of the front-side grill and the back-side grill.

9. The Fan according to any of claims 1-8, wherein each radial extension comprises a cross-section that is substantially rectangular, wherein the radial extension comprises a leading edge cut (5d) such that the rectangular cross-section comprises 5 corners, in particular wherein the substantially rectangular cross-section comprises rounded corners and/or a central thickness of 5-10% larger than a peripheral thickness, more in particular wherein at least one of the grill shaped front-side (2a) and the grill shaped back side (2b) comprise radial extensions with said cross section.

10. The Fan according to any of claims 1-9, wherein the grill shaped front-side (2a) comprise a central part (2d) in connection with the radial extensions (5), in particular in connection with the radial extensions through an intermediate sub-ring (2j), more in particular wherein in between said sub-ring (2j) and said central part at least one central open-

ing (2k) is provided.

11. The Fan according to any of claims 1-10, wherein the fan is an axial ventilator, in particular selected from a domestic fan, a domestic air circulator, and a window air circulator, more in particular a standing fan.

12. The Fan according to any of claims 1-11, wherein the front-side (2b) comprises a central part (2d), which central part is substantially closed, and which central part has a radius of <25% of the radius of the front-side, preferably <20% thereof, such as <15% thereof, and/or which central part (2d) has a surface area of >2% of the surface area of the front side, preferably >6.25% thereof, more preferably >9% thereof.

13. The Fan according to any of claims 1-12, wherein each radial extension individually has a height h of 1-5 mm, preferably 2-4 mm, such as 3 mm, preferably wherein each radial extension individually has a thickness of 1-3 mm, and/or wherein a maximum spacing between two adjacent radial extensions is <10 mm, preferably <9 mm, such as <8.6 mm.

14. The Fan according to claim 13, wherein each blade individually has a cross-sectional wing profile (air foil) with a leading edge (4a) and a trail edge (4b), wherein the front edge is 1.2-4 times as thick as the trail edge, preferably 1.5-3 times as thick, more preferably 1.8-2.5 times as thick, such as 2-2.2 times as thick, and/or wherein each blade has a cross-sectional wing profile (air foil) which at a rotor side is at least 50% larger than at a side section (2c) side.

15. The Fan according to any of claims 1-14, wherein each blade is attached at a pitch angle  $\alpha$  to the rotor, wherein the pitch angle is  $\alpha$  is 10-35 degrees with respect to a central axis of the rotor, preferably 15-30 degrees with respect to said central axis, such as 20-25 degrees, wherein the leading edge (4a) is further away from the front side (2a) than the trailing edge (4b).

16. The Fan according to any of claims 1-15, wherein each blade individually is curved over a cross-section A-A' providing a concave curvature at a front side of the blade and a convex curvature at a back side of the blade, and/or

wherein each blade individually is torqued backwards over an angle  $\beta$  of 10-35 degrees, preferably 20-30 degrees, and/or

wherein each blade individually is substantially straight at a trail edge, or slightly curved, such as with a curve substantially following a circumference of the side section (2c), and/or

wherein each blade individually is curved at a leading edge, and/or wherein each blade individually has an average thickness of 1-3.5 mm, such as 1.5-2.5 mm, and/or

wherein a width of each blade individually is smaller at a side near rotor than at a periphery, preferably 10-60% smaller, such as 30-50% smaller, and/or

wherein a width of each blade individually gradually increases from the side at the rotor to a periphery, and/or

wherein a combined surface area of the blades projected in a plan perpendicular to the central axis is 30-70% of an area of the front-side, preferably 40-60% of said area, more preferably 45-55% of said area, such as 47-53% thereof.

17. The Fan according to any of claims 1-16, comprising

a fan support (7), wherein the fan support is attached to a back side of the fan, wherein the fan-support comprising at least one electrical wire, wherein the fan support extends towards a front side of the fan, such that a centre of mass of the fan substantially coincides with a foot of the fan support.

18. The Fan according to any of claims 1-17, wherein an open surface area at a front side of the fan is from 40-90% of a total front side surface area, preferably 60-80% thereof, such as 70-75% thereof, and/or

wherein an open surface area at a back side of the fan is from 40-95% of a total back side surface area, preferably 60-90% thereof, such as 75-85% thereof, and/or

wherein the side section forms a ring-shaped section of a sphere, such as 2-12% of said sphere, preferably 3-10% thereof, such as 4-6% thereof.

19. The Fan according to any of claims 1-18,

wherein blades extend 70-99 % in a direction perpendicular to a central axis of the rotor towards the side section of the fan, preferably extend 85-98%, such as 92-95%, and/or comprising 4-12 blades, in particular 5-11 blades, more in particular 7-9 blades, preferably an odd number of blades, and/or wherein the blade is obtained by forced extrusion, by 3d-printing, or by moulding, and/or

wherein the blades are made from a light-weight material with a density of <1.2 g/cm<sup>3</sup>, preferably <1.1 g/cm<sup>3</sup>, and/or

wherein the blades are made from a material with a tensile strength (ISO 527-1:2019) of > 25 MPa, such as > 35 MPa, and/or

wherein the blades are made from a material with a shear stress (ASTM D732) of > 35 MPa,

such as > 50 MPa, and/or

wherein the blades are made from a material with a surface roughness Ra (ISO 4287:2000) of < 5µm, preferably < 2µm, more preferably < 1µm, such as < 0.8µm, and/or

wherein at least a part of the blades, the front-side, the back-side, the rotor, and the side section are made from a polymer material, such as ABS (CAS 9003-56-9), PE or PP, and/or

wherein at least a part of the rotor is made of a metal, such as stainless steel, or aluminium.

20. The Fan according to any of claims 1-19,

wherein the fan has an air flow of > 0.1 m<sup>3</sup>/minute, and/or

wherein the fan has an air flow of < 50 m<sup>3</sup>/minute, and/or

wherein a diameter of the fan is from 15-80 cm, preferably from 20-70 cm, such as from 25-60cm, and/or

wherein a depth of the fan is from 5-20 cm, preferably from 7-15 cm, such as from 10-12cm, and/or

wherein the fan in operation produces < 70 dB noise, preferably <60 dB, more preferably <50 dB, such as < 46 dB, and/or

wherein the fan in operation produces a substantially linear air-flow, and/or

wherein the fan in operation produces an air-flow which diverges <20 degrees from a central axis, preferably < 10 degrees, such as < 6 degrees, and/or

wherein the fan in operation produces an air-flow over a distance >5 times a diameter of the fan, preferably >10 times said distance.

## Claims

1. A fan (10) comprising

a substantially open casing (2), the casing comprising a grill shaped front-side (2a), the grill shaped front-side (2a) comprising a substantially closed central part (2d), a grill shaped back-side (2b), and a substantially cylindrically shaped side section (2c) in between said front-side and back-side,

inside said casing a rotor (3), the rotor comprising at least three blades (4),

**characterized in that**

the side section comprises an open side grill section part (2g) and a closed side section part (2h),

wherein the grill shaped front-side (2a) comprises a multitude of radial extensions (5), each extension (5) for connecting the side sec-

tion (2c) with the central part (2d), and Wherein each blade individually comprises at a trailing edge thereof a multitude of blade trail extensions (9), and/or a wing tip (8).

2. The Fan according to claim 1, wherein the at least three blades are attached substantially perpendicular to a rotational axis of the rotor, and/or wherein the wing tip is substantially parallel to the side section (2d), in particular wherein the wing tip further comprises a wing tip recess (8a), in particular a wing tip recess (8b) at a trail section of the blade. 5
3. The Fan according to claim 1 or 2, wherein the wing tip (8) comprises a curved section (8b), in particular a curved section with a curvature of 80-100 degrees which is measured from the central part of the blade towards the wing tip, more in particular wherein the wing tip extends towards the front side of the fan. 10
4. The Fan according to any of claims 1-3,, wherein each blade individually comprises at a trailing edge thereof 5-40 blade trail extensions, in particular 10-30 blade trail extensions, more in particular 20-25 blade trail extensions. 15
5. The Fan according to any of claims 1-4, wherein between two adjacent blade trail extensions an open space (9a) is provided, in particular wherein said open space has a surface area of 50-150% of that of the blade trail extension. 20
6. The Fan according to any of claims 1-5 wherein each individual blade trail extension has a blade trail extension width, a blade trail extension length, and a blade trail extension thickness, wherein the blade trail extension thickness is substantially equal to that of the blade, and/or wherein the blade trail extension length is 1-20% of a blade width, in particular 5-10% of said blade width, and/or wherein the blade trail extension width is 15-60% of the blade trail extension length, in particular 20-35% of said blade trail extension length. 25
7. The Fan according to any of claims 1-6, wherein an outer blade trail extension has a width that increase from an extension tip towards the blade, and/or wherein an outer blade trail extension comprises a recess (9b) at a peripheral side thereof, and/or wherein each blade trail extension comprises a rounded tip (9c). 30
8. The Fan according to any of claims 1-7, wherein 35

the grill shaped back-side (2b) comprises a wing shaped back side grill ring (2i), in particular wherein said back side grill ring (2i) is provided at an intersection of the back-side (2b) and the side section (2c), in particular wherein the ring has a ring thickness, and a ring height, wherein the ring thickness is substantially equal to that of the radial extensions (5), and/or wherein the ring height is 1-3 times as large as the ring thickness, and/or wherein the ring thickness increase from an inner part of the ring towards an outer part of the ring, in particular wherein the ring thickness increases 20-70% with respect to its smallest thickness, and/or wherein each radial extension comprises an inner radial extension (5a), which inner radial extension splits into at least two outer radial extensions (5b), in particular each radial extension of at least one of the front-side grill and the back-side grill, and/or

wherein each radial extension comprises a cross-section that is substantially rectangular, wherein the radial extension comprises a leading edge cut (5d) such that the rectangular cross-section comprises 5 corners, in particular wherein the substantially rectangular cross-section comprises rounded corners and/or a central thickness of 5-10% larger than a peripheral thickness, more in particular wherein at least one of the grill shaped front-side (2a) and the grill shaped back side (2b) comprise radial extensions with said cross section, and/or wherein the grill shaped front-side (2a) comprise a central part (2d) in connection with the radial extensions (5), in particular in connection with the radial extensions through an intermediate sub-ring (2j), more in particular wherein in between said sub-ring (2j) and said central part at least one central opening (2k) is provided. 40

9. The Fan according to any of claims 1-8, wherein the fan is an axial ventilator, in particular selected from a domestic fan, a domestic air circulator, and a window air circulator, more in particular a standing fan. 45
10. The Fan according to any of claims 1-9, wherein the front-side (2b) comprises a central part (2d), which central part is substantially closed, and which central part has a radius of <25% of the radius of the front-side, preferably <20% thereof, such as <15% thereof, and/or which central part (2d) has a surface area of >2% of the surface area of the front side, preferably >6.25% thereof, more preferably > 9% thereof. 50
11. The Fan according to any of claims 1-10, wherein each radial extension individually has a height h of 55

- 1-5 mm, preferably 2-4 mm, such 3 mm, preferably wherein each radial extension individually has a thickness of 1-3 mm, and/or wherein a maximum spacing between two adjacent radial extensions is <10 mm, preferably < 9mm, such as < 8.6 mm. in particular wherein each blade individually has a cross-sectional wing profile (air foil) with a leading edge (4a) and a trail edge (4b), wherein the front edge is 1.2-4 times as thick as the trail edge, preferably 1.5-3 times as thick, more preferably 1.8-2.5 times as thick, such as 2-2.2 times as thick, and/or wherein each blade has a cross-sectional wing profile (air foil) which at a rotor side is at least 50% larger than at a side section (2c) side.
- 12.** The Fan according to any of claims 1-11, wherein each blade is attached at a pitch angle  $\alpha$  to the rotor, wherein the pitch angle is  $\alpha$  is 10-35 degrees with respect to a central axis of the rotor, preferably 15-30 degrees with respect to said central axis, such as 20-25 degrees, wherein the leading edge (4a) is further away from the front side (2a) than the trailing edge (4b), and/or wherein each blade individually is curved over a cross-section A-A' providing a concave curvature at a front side of the blade and a convex curvature at a back side of the blade, and/or wherein each blade individually is torqued backwards over an angle  $\beta$  of 10-35 degrees, preferably 20-30 degrees, and/or wherein each blade individually is substantially straight at a trail edge, or slightly curved, such as with a curve substantially following a circumference of the side section (2c), and/or wherein each blade individually is curved at a leading edge, and/or wherein each blade individually has an average thickness of 1-3.5 mm, such as 1.5-2.5 mm, and/or wherein a width of each blade individually is smaller at a side near rotor than at a periphery, preferably 10-60% smaller, such as 30-50% smaller, and/or wherein a width of each blade individually gradually increases from the side at the rotor to a periphery, and/or wherein a combined surface area of the blades projected in a plan perpendicular to the central axis is 30-70% of an area of the front-side, preferably 40-60% of said area, more preferably 45-55% of said area, such as 47-53% thereof.
- 13.** The Fan according to any of claims 1-12, comprising a fan support (7), wherein the fan support is attached to a back side of the fan, wherein the fan support comprising at least one electrical wire, wherein the fan support extends towards a front side of the fan, such that a centre of mass of the fan substantially coincides with a foot of the fan support.
- 14.** The Fan according to any of claims 1-13, wherein an open surface area at a front side of the fan is from 40-90% of a total front side surface area, preferably 60-80% thereof, such as 70-75% thereof, and/or wherein an open surface area at a back side of the fan is from 40-95% of a total back side surface area, preferably 60-90% thereof, such as 75-85% thereof, and/or wherein the side section forms a ring-shaped section of a sphere, such as 2-12% of said sphere, preferably 3-10% thereof, such as 4-6% thereof.
- 15.** The Fan according to any of claims 1-14, wherein blades extend 70-99 % in a direction perpendicular to a central axis of the rotor towards the side section of the fan, preferably extend 85-98%, such as 92-95%, and/or comprising 4-12 blades, in particular 5-11 blades, more in particular 7-9 blades, preferably an odd number of blades, and/or wherein the blade is obtained by forced extrusion, by 3d-printing, or by moulding, and/or wherein the blades are made from a light-weight material with a density of <1.2 g/cm<sup>3</sup>, preferably <1.1 g/cm<sup>3</sup>, and/or wherein the blades are made from a material with a tensile strength (ISO 527-1:2019) of > 25 MPa, such as > 35 MPa, and/or wherein the blades are made from a material with a shear stress (ASTM D732) of > 35 MPa, such as > 50 MPa, and/or wherein the blades are made from a material with a surface roughness Ra (ISO 4287:2000) of < 5  $\mu$ m, preferably < 2  $\mu$ m, more preferably < 1  $\mu$ m, such as < 0.8  $\mu$ m, and/or wherein at least a part of the blades, the front-side, the back-side, the rotor, and the side section are made from a polymer material, such as ABS (CAS 9003-56-9), PE or PP, and/or wherein at least a part of the rotor is made of a metal, such as stainless steel, or aluminium, and/or wherein the fan has an air flow of > 0.1 m<sup>3</sup>/minute, and/or wherein the fan has an air flow of < 50 m<sup>3</sup>/min-

ute, and/or

wherein a diameter of the fan is from 15-80 cm, preferably from 20-70 cm, such as from 25-60cm, and/or

wherein a depth of the fan is from 5-20 cm, preferably from 7-15 cm, such as from 10-12cm, and/or

wherein the fan in operation produces < 70 dB noise, preferably <60 dB, more preferably <50 dB, such as < 46 dB, and/or

wherein the fan in operation produces a substantially linear air-flow, and/or

wherein the fan in operation produces an air-flow which diverges <20 degrees from a central axis, preferably < 10 degrees, such as < 6 degrees, and/or

wherein the fan in operation produces an air-flow over a distance >5 times a diameter of the fan, preferably >10 times said distance.

20

25

30

35

40

45

50

55

Fig. 1a

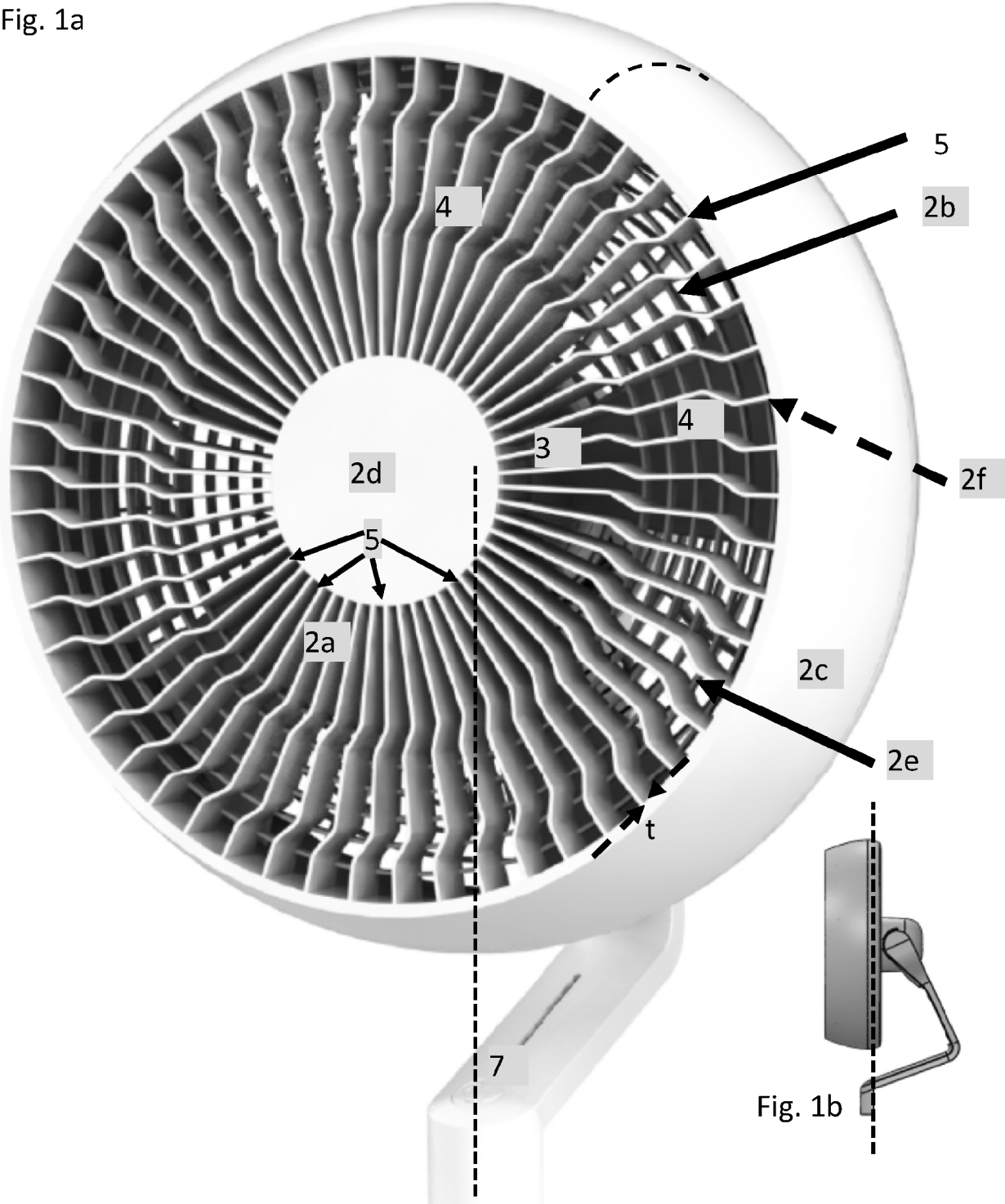


Fig. 1b



Fig. 1c

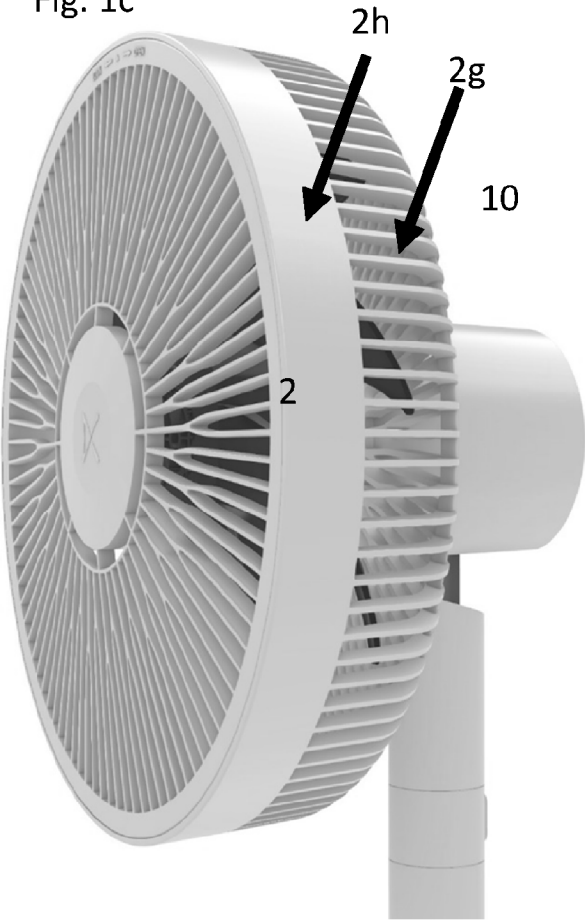


Fig. 2a

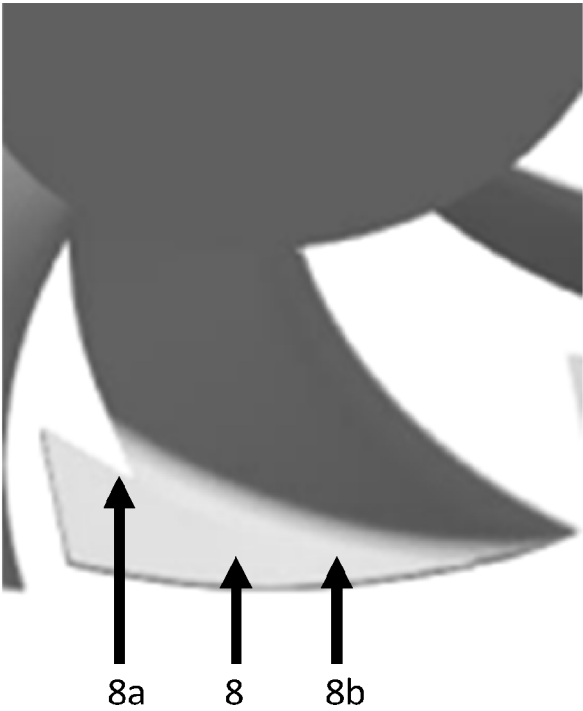
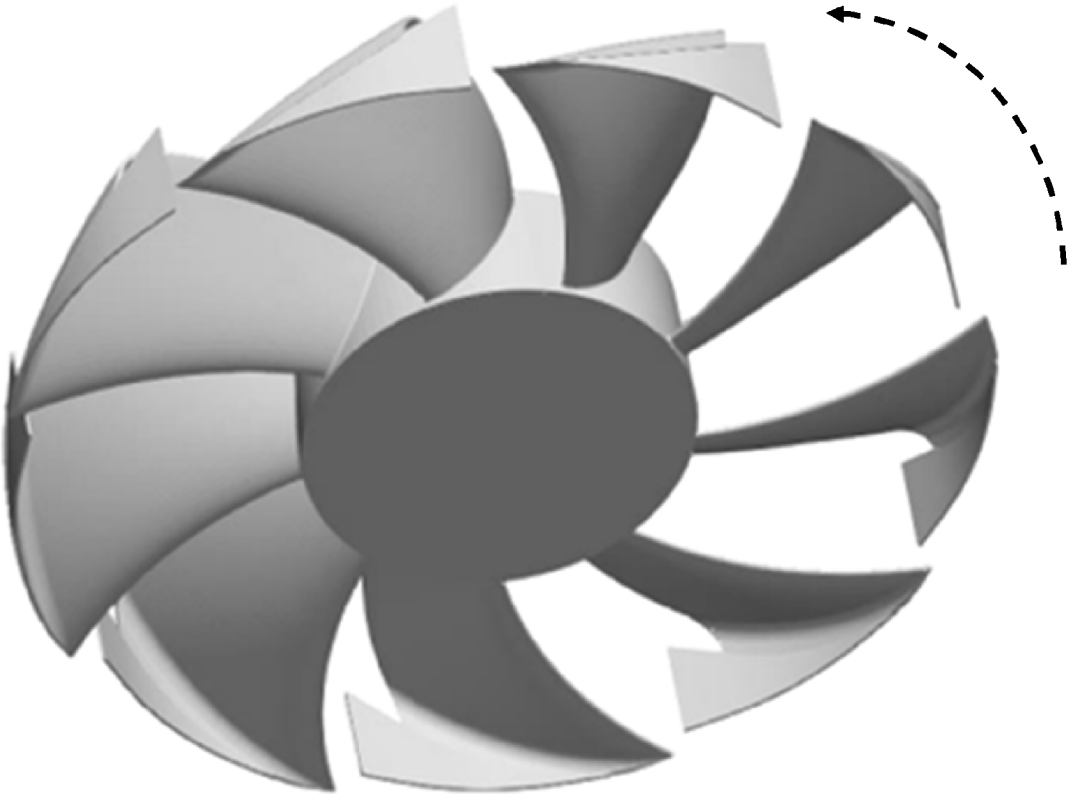
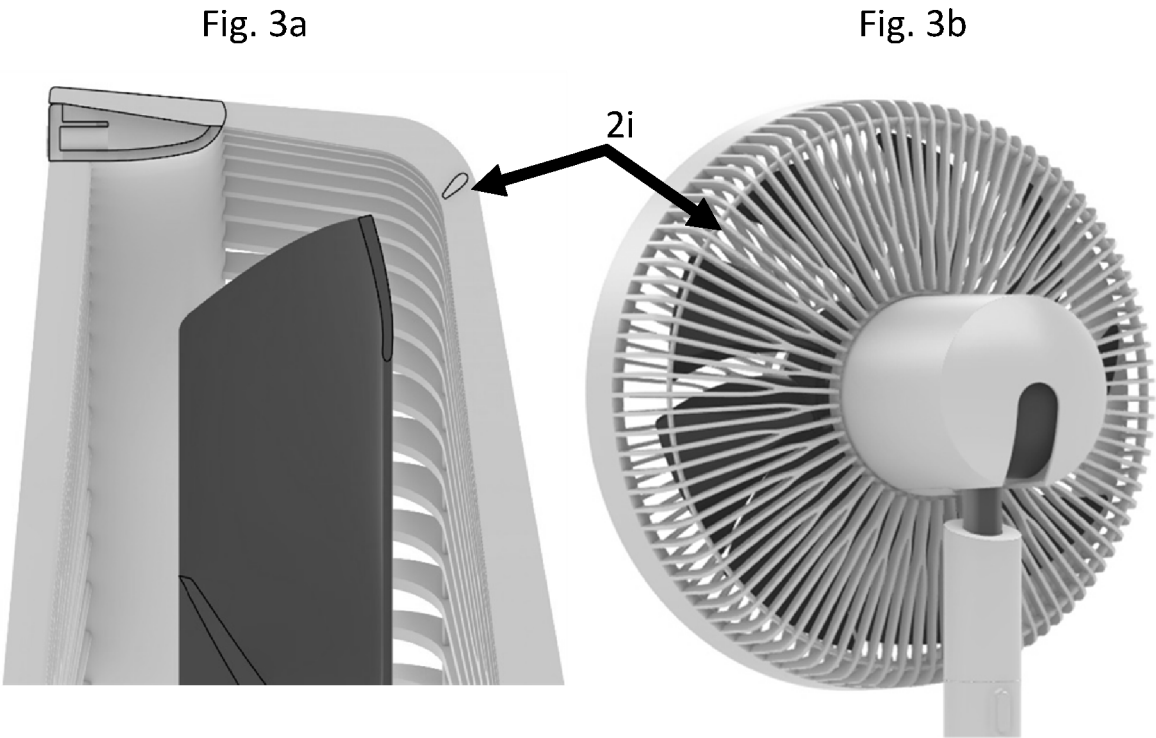
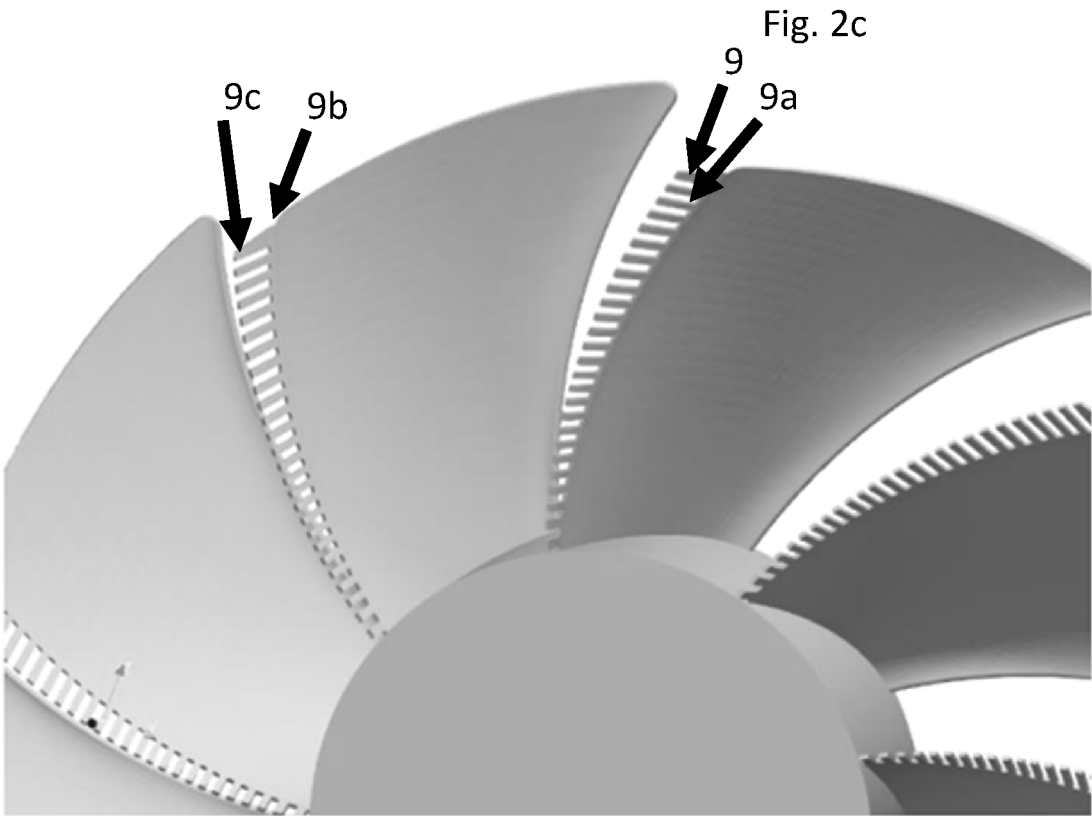
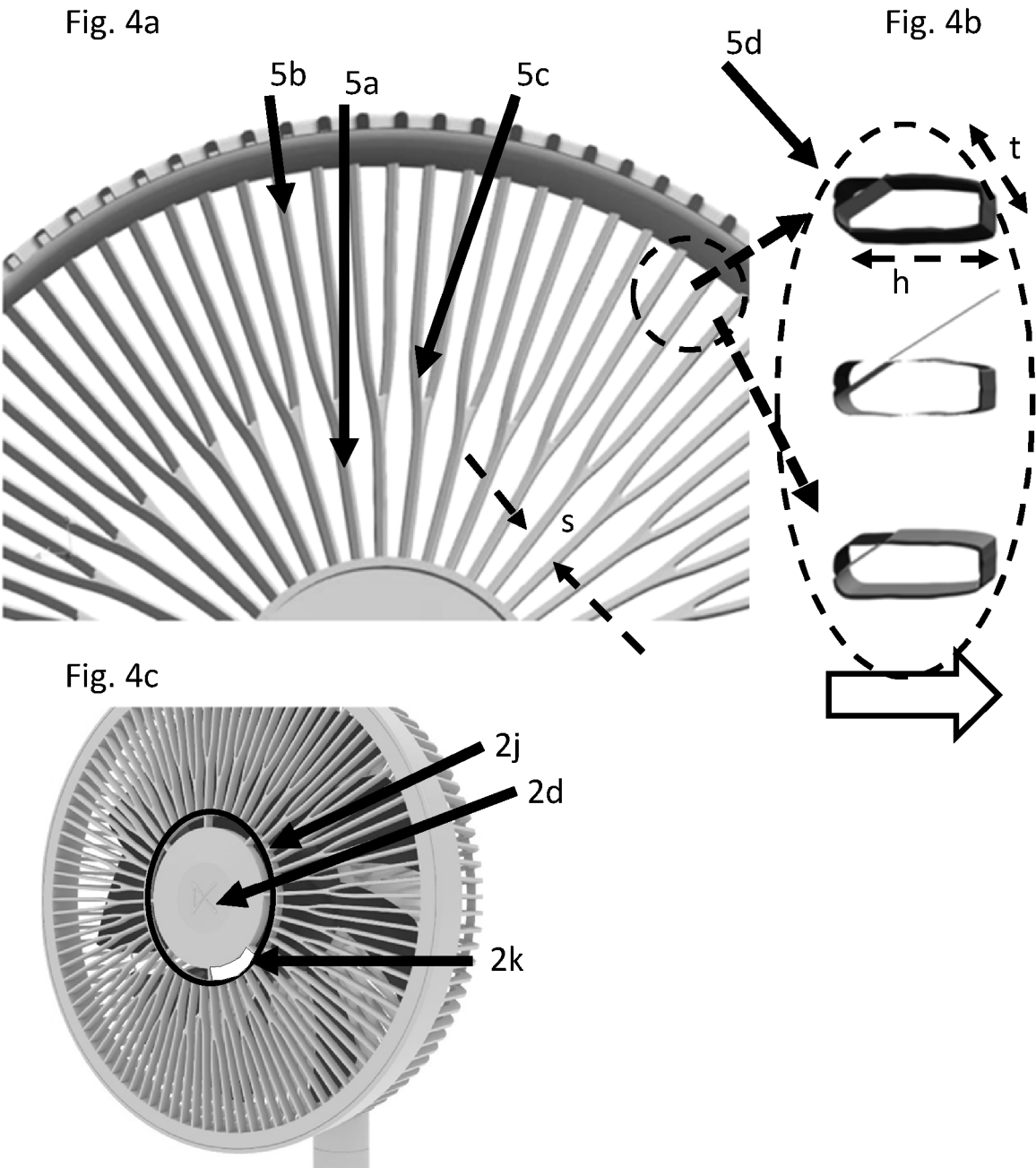


Fig. 2b







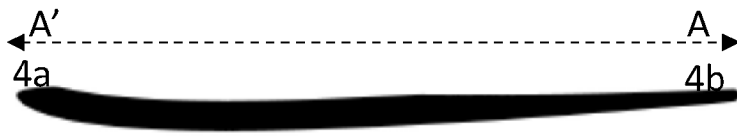


Fig. 5a

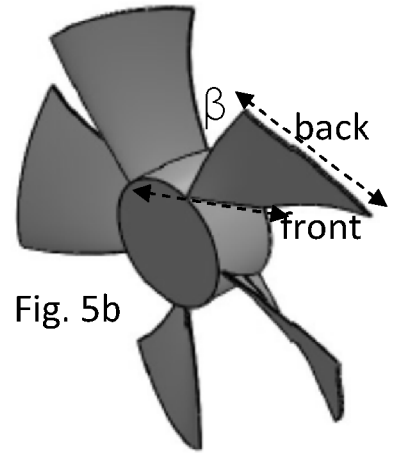


Fig. 5b

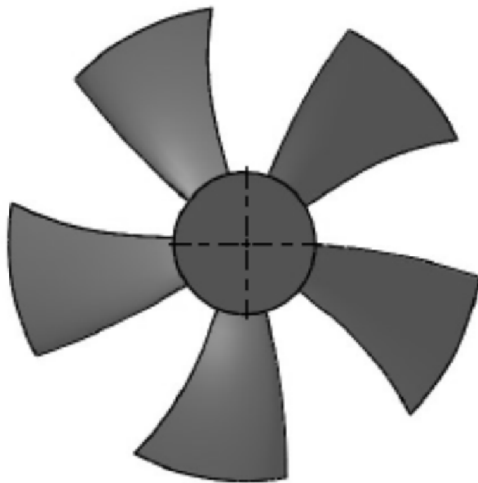


Fig. 5c

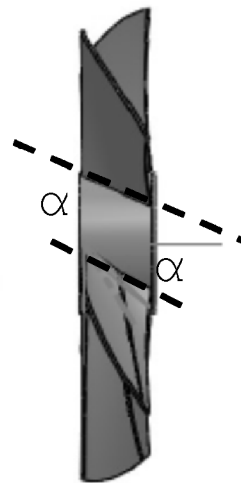


Fig. 5d

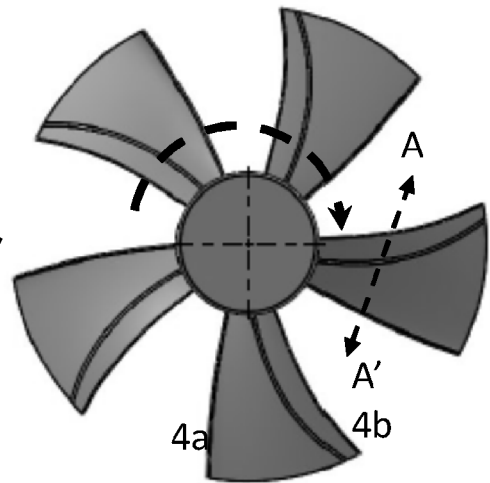


Fig. 5e

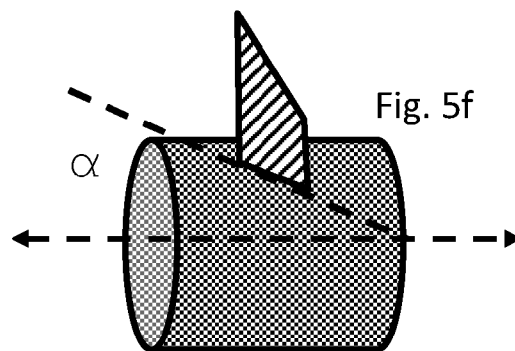
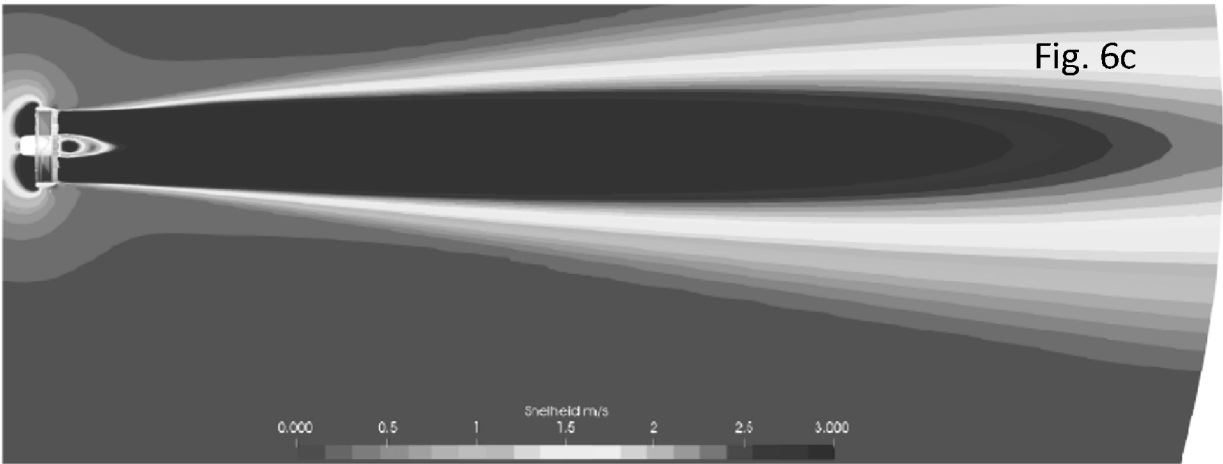
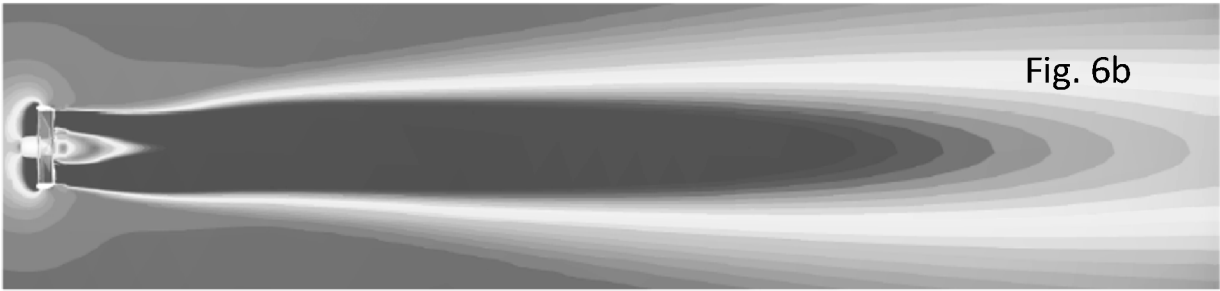
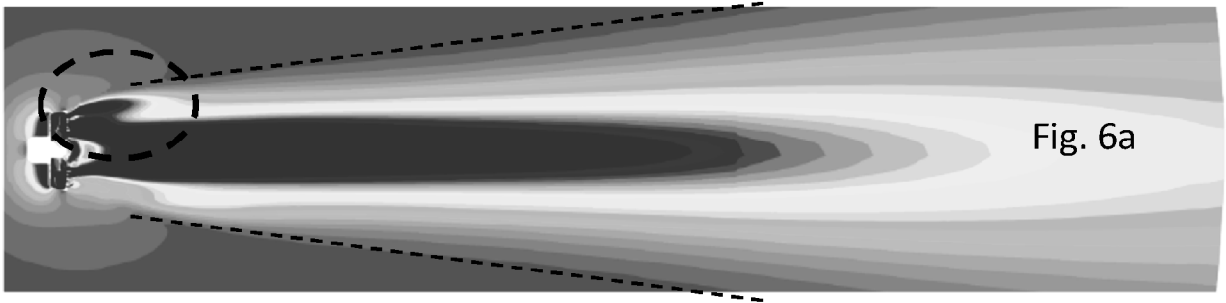


Fig. 5f



**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- NL 2037418 [0002]
- WO 2019065679 A1 [0008]
- WO 2025216632 A1 [0065]

**Non-patent literature cited in the description**

- CHEMICAL ABSTRACTS, 9003-56-9 [0065]