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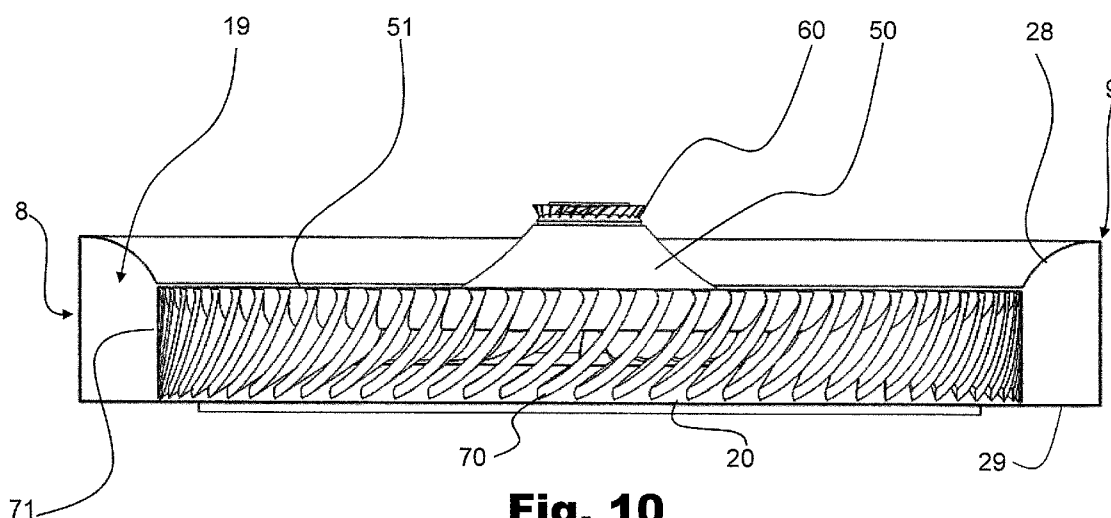


Fig. 10

(57) Abstract: A vertical axis fluid-flow turbine comprising a column structure having an inner wall (20) and an outer wall (9, 28) positioned in a predetermined distance to the inner wall (20), creating an air passage (19) in between, wherein the air passage is closed in the bottom section of the column section as well as at the top section of the column through closing walls fully connecting the inner wall (20) and the outer wall (9; 28), wherein the outer wall (9; 28) comprises at least one opening (8) in the lower portion at or near the bottom section and an opening in the upper portion at or near the top section, wherein a vertical axis wind rotor (70) is provided within the air passage near the bottom section between the inner wall (20) and the outer wall (9; 28)



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TITLE

VERTICAL AXIS MEDIA-FLOW TURBINE

5

TECHNICAL FIELD

The present invention relates to a vertical axis media-flow turbine comprising a column structure.

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PRIOR ART

Media-flow turbines can also be named fluid-flow turbines and are usually wind, water or underwater turbines comprising a central shaft or column, usually mounted within a base structure, and one or more blades distanced from the shaft and connected to it by means of connecting arms or link rods. The shaft is connected, either at its base or at a chosen point
15 along its height, to a power generation assembly including an electrical generator. In use, incoming wind or other fluid flow causes the blades to rotate about the shaft, in turn causing the shaft itself to rotate and introducing mechanical energy that is converted by the generator into electrical energy suitable for output. The column's main function can be – inter alia - providing stability for the functional structure at the top and usually houses a
20 staircase and/or a lift.

Media-flow can be based on fluids or gases.

WO 2007/066207 discloses a machine for production of electric power from
25 complementary renewable sources provided with an electrical generator connected to a motion driving shaft. The shaft is vertical and has at least one lower turbine powered by an Aeolian flow by means of a respective toroidal shaped lower stator coaxial to the shaft. Said lower stator has fixed blades fit to convey the Aeolian flow to at least one lower turbine.

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US 5,300,817 shows a solar venturi turbine including an upwardly oriented venturi tube supported by a venturi support skirt. The venturi tube includes a tapered thermopane glass enclosure which allows sunlight to project therethrough and impinge on a tapered

centrifugal fan fronting the thermopane enclosure and mounted within the venturi tube. Located above the centrifugal fan in the neck of the venturi tube is a high velocity fan. A high pressure compressor is mounted above the high velocity fan, and finally a turbine is mounted above the high pressure compressor. A venturi tube outlet flares outwardly
5 directly above the turbine and is mounted to the venturi tube. The turbine is connected to a shaft to drive an electrical generator thereby producing electricity. The sun's rays heat the air within the thermopane glass enclosure causing the reduced density air to rise within the venturi tube and propel the centrifugal fan. The air continues upwardly through the high speed fan and the high pressure compressor increasing in velocity and finally passing
10 through and turning the turbine which is connected to the generator by the turbine shaft.

US 2016/102499 discloses a turbine, such as a fluid or liquid driven turbine or a hydraulic turbine including a downhole turbine for the oil/gas and geothermal industries, such as a drilling turbine or downhole drilling turbine. The turbine provides a fluid passage
15 comprising at least one portion or zone arranged to cause a drive fluid to be moved or diverted, such as at least partly radially. The turbine may comprise a rotor and/or a stator having a rotor and/or a stator blade extending within the fluid passage.

SUMMARY OF THE INVENTION

20 Usual vertical axis turbines are built to generate energy from the fluid-flow intercepted above ground. A column, however, only has the function to provide a stand for a mounted structure having a functional unit at the top. The same approach is true for other tall buildings as towers with transmission means, watchtowers etc. It is an aim of the present invention to provide a vertical axis fluid-flow turbine integrated into such a column.

25 The above mentioned object can be achieved with a vertical axis fluid-flow turbine comprising a column structure having an inner wall and an outer wall positioned in a predetermined distance to the inner wall, creating an air passage in between, wherein the air passage is closed in the bottom section of the column section as well as at the top
30 section of the column through closing walls fully connecting the inner wall and the outer wall, wherein the outer wall comprises at least one opening in the lower portion at or near the bottom section and an opening in the upper portion at or near the top section, wherein at least one vertical axis wind rotor is provided within the air passage, preferably near the

bottom section between the inner wall and the outer wall. The closing walls can be at the bottom section the bottom wall of the column structure or the ground, where the column structure is standing upon as well as a top wall at the top section. There it can also be a curved portion connecting the inner wall with the outer wall vertical front.

5

The opening is a vertically oriented grid opening provided 360° around the column or provided in sections of e.g. 90°, adjacent or not. Preferably vertically oriented edges of fins of the vertical axis wind rotor or multiple rotors are positioned for a rotation movement near the lower portion opening on a curved base wall providing the inner wall. The rotor(s) are mounted near the grid opening and the fins and its free ends almost completely close the space between the inner wall and the outer wall in a lower section of the vertical turbine. The wall surface of the curved base wall is nearly horizontal at its lower base and said wall surface comprises an increasing angle until the end of the inner wall with an upper base wall surface having an angle between 45° to 70°, especially between 50° and 60°, and having a reduced diameter compared to its diameter at the lower base. The fins are attached at a rotating body (or body of rotation) starting from a large diameter at the lower base to a reduced diameter at the upper base wall surface. Said reduced diameter end can be used to provide a bearing for the rotor and a connecting shaft for a generator.

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The vertical turbine can comprise a plurality of sequences of groups of fins encompassing two fins or encompassing three fins, wherein one member of the group of fins extends from the edge at the opening towards the upper end of the inner wall, i.e. is connected over the whole used radius of the rotating body and wherein the intercalated other members of the group of fins are shorter and end in between the edge and the upper end of the inner wall, especially for the group of two fins in the middle between those and for the group of three fins at 1/3 and 2/3 of the distance between the edge at the opening towards the upper end of the inner wall.

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The height of the opening at the bottom section or bottom wall is preferably higher than the vertical edge length of the fins, especially by between 10% and 50%, preferably about 30%. Additionally, a descending wall portion is provided between the upper edge of the wall of the column above the grid opening and the upper surface of the rotor creating a tapered volume for pre-concentrating the incoming airflow.

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The fins are mounted in an approximately 45° direction seen in the tangential direction along the circumference of the turbine blade and the lower end of the directional fins is almost directed horizontally, so that, in a side view, the fins are convex.

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The rotor can be positioned on a central bearing provided centrally of the inner wall having said reduced diameter, especially at approximately half of the height of the column to provide a further air distribution in laminar flow beyond the rotor.

- 10 Said upper portion of the column can comprise an outer inverted funnel wall, positioned near the upper end of the vertical wind rotor around said reduced diameter, starting with a lower diameter at its lower edge with an opening angle between 30° and 60°, preferably between 40° and 50°, reducing the angle of the outer inverted funnel wall to almost a horizontal portion and increasing the angle again in approximately toroidal shape to end
- 15 with an almost vertical upper edge. Then an inner inverted funnel wall comprises a complementary inclination to the outer inverted funnel wall to create an annular shaped passage of essentially the same diameter between the lower edge and the upper edge.

- In order to support the laminar flow and avoid airflow rotation inside the passage, two or
- 20 more radially oriented section separating walls are provided within the annular cavity separating it into three or more distinct cavities.

- A central opening can be provided inside the inner inverted funnel wall to receive a shaft to be connected with a gearbox leading to or standalone generator for electrical power
- 25 generation.

- Beyond the upper edge of the column, circumferential air deflecting shields can be provided for deflecting air having travelled from the grid opening at the lower bottom through the turbine, wherein especially such air deflecting shields are provided around the
- 30 rim of the upper surface of the column that eject turbulent air outwards.

The column wall can comprise at least one sequence of a plurality of side air entries connecting the outside of the column with the air passage mentioned above creating a riser

shaft in the column wall, adding additional air to the vertical air flow in the riser shaft. It is possible that an air passage separating or riser shaft separating wall is provided behind each sequence of side air entries to initially divert the inflowing air into the vertical direction before mixing the air with the air rising in the riser shaft in a mostly laminar way.

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Beside positioning a rotor at the bottom it is possible to provide alternatively or additionally a vertical axis wind rotor in the upper section of the column. Such an upper vertical axis wind rotor comprises at least one upper rotor with a vertical central rotation axis being mounted in the upper portion of the column, wherein the rotor blades are positioned in a circumferential space above the annular riser shaft in the column wall. Then air rising in the riser shaft are travelling through the one or more rotors bringing these into rotation. It is possible that the inner of the rotors comprise inner blocking cylindrical jackets so that the air can only rise and leave the rotor into an adjacent upper riser shaft portion leading to the virtual ledge and exhaust opening.

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Instead of only one upper rotor there might be two or more upper rotors, wherein the lower positioned rotor out of a pair of adjacent rotors comprises a smaller rotational momentum at the same angular velocity compared to the rotational momentum of the higher adjacent positioned rotor. Of course, the rotors can also be four identical rotors mounted on concentric shafts, but providing a small rotational momentum at the bottom of such a cascade allows for an easier start of rotation of the sequence of rotors.

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It is inter alia a further object of the invention to transport air ported upwards to ensure cooling of the column structure, e.g. when heat generating elements are incorporated in the structure. Therefore the teaching of the independent claim comprises a lower rotor with blades forcing air induction into the system and channel air up the length of the column to the upper sill. Exhaust ports are provided at the upper ledge acting as a virtual aerofoil that creates a stream of air that can additionally deflect head winds at and around the port.

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Further embodiments of the invention are laid down in the dependent claims.

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BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are described in the following with reference to

the drawings, which are for the purpose of illustrating the present preferred embodiments of the invention and not for the purpose of limiting the same. In the drawings,

- Fig. 1A shows a schematic side view of a column with an integrated wind energy generator according to an embodiment of the invention;
- 5 Fig. 1B shows a schematic combined side view and cross-section view of a column with an integrated wind energy generator according to a further embodiment of the invention;
- Fig. 1C shows a schematic combined side view and cross-section view of a column with an integrated wind energy generator according to Fig. 1B;
- 10 Fig. 2 shows a partial view on inner elements of the column according to Fig. 1A, Fig. 1B or Fig. 1C;
- Fig. 3 shows a partial transparent view of the elements as shown in Fig. 2;
- Fig. 4 shows a schematic perspective view from above on the inner elements according to Fig. 2 and Fig. 3;
- 15 Fig. 5 shows a partial side view of the inner rotor of the generator according to Fig. 1A, Fig. 1B or Fig. 1C;
- Fig. 6A & B show a partial perspective view from above of the inner rotor according to Fig. 5 in two operational modes;
- Fig. 7A shows an enlarged detail view of an upper energy generator of a further
20 embodiment of the invention;
- Fig. 7B shows a side view of a four stage upper energy generator of a further embodiment of the invention as used in connection with Fig. 1B and Fig. 1C;
- Fig. 8 shows a partial perspective view from below on the rotor of Fig. 1;
- 25 Fig. 9A & B show two side views of the housing of the column of Fig. 1A, Fig. 1B or Fig. 1C;
- Fig. 10 shows a schematic partial cross sectional view of the outer wall element near the base wall;
- Fig. 11 shows an enlarged detail view of Fig. 10;
- 30 Fig. 12 shows the airway structure of the embodiment of Fig. 1B or Fig. 1C in a partial side view and partial cross section view of the technical aspects with almost no parts of the casing;
- Fig. 13 shows a detail view of the base of Fig. 12;

Fig. 14 shows a partial side view and cross section view of the wall above the lower rotor;

Fig. 15 shows a partial side view and cross section view of the wall just below the exhaust ledge;

5 Fig. 16A, B & C show a side view of the upper section of Fig. 15 with different position of the exhaust closing shutter; and

Fig. 17A, B & C show three schematic side views of the riser shaft in the column jacket with sequences of air side entries with different closing shutter positions.

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DESCRIPTION OF PREFERRED EMBODIMENTS

The following describes in detail embodiments of the present disclosure. Examples of the embodiments are shown in the accompanying drawings, where reference signs that are the same or similar from beginning to end represent same or similar components or
15 components that have same or similar functions.

Fig. 1A shows a schematic view of a column 5 standing on a ground 6 and usually having a functional element 7 at its top. Functional element 7 is only partly shown as two struts allowing to mount a functional unit at the top. Ground 6 can be a solid ground or it can also
20 be a water surface. In case of a water surface as ground, there is an additional column portion under water supporting the column 5. It is also possible to provide the column 5 on a sea bed as ground 6, especially in tidal areas with an important difference between high and low water, or in a river having a decent flow. Within the embodiment shown in the drawings, the column 5 is exposed to wind forces of the surrounding air.

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At the top of the column 5 is mounted said functional element 7 comprising a functional unit (not shown in the drawings) which can be inter alia a solar panel or a light signal. This functional unit can also be a vertical wind generator, a windmill or the column itself can be a stand for a high voltage power line stand.

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Within the lower portion of column 5 is provided a grid like opening 8 extending around the bottom portion 18 of column 5. The opening 8 comprises a mesh in order to avoid that objects from the outside enter inside the space of the column, but provides enough free

space to allow an air flow entering the column 5 at the opening 8. In case of an underwater mounted column the fluid flow is a water flow.

It is possible to provide a number of separated openings 8 extending over predetermined
5 angles around the circumference of the cylindrical column 5. Such openings can be oriented only in the direction of predominant winds (or water flow) or they can be provided around all 360° of the outer column wall 10.

It is noted that the bottom portion 18 of column 5 of Fig. 1A has a larger diameter
10 compared to the column section. It is of course possible to provide a cylindrical column 5 having a constant diameter. Here, the remaining space provided by the difference between the diameter of the bottom portion 18 and the remaining sections of column 5 can be used to provide e.g. a staircase or control elements of the apparatuses integrated into the column as will be described in connection with the further drawings. It is also noted that the upper
15 surface 15 of the column comprises outlets (not shown in Fig. 1A). These outlets could also be provided integrated in the upper part of the cylinder barrel.

Fig. 1B shows a schematic combined side view and cross-section view of a column 105
with an integrated wind energy generator 80 according to a further embodiment of the
20 invention. Fig. 1C shows a schematic combined side view and cross-section view of the column 105 with the integrated wind energy generator 80 according to Fig. 1B. As mentioned in connection with Fig. 1A, grid opening 8 allows a fluid to enter the column and traveling upwards, as will be explained later up an inverted funnel, where Fig. 1B shows the outer funnel wall 30. In this zone of the column is a first generator. Then follows
25 in the preferred embodiment of Fig. 1B, Fig. 1C, five sequences 150 of side air entries 151, wherein each sequence 150 comprises a plurality of such side air entries 151 into a riser shaft 139 (shown in Fig. 12 and 14) combining with the fluid rising from the lower generator unit. This laminar fluid flow is rising further and enters the upper energy generator 80 shown in detail in Fig. 7B (more simple embodiment shown in Fig. 7A)
30 before the fluid is leaving the column at the virtual ledge 140, providing an exhaust opening around the column 105. Five vertical fins 160 are visible, provided in a 45 degree angular distance around the circumference and completely or at least partially closing the riser shaft 139 volume against any tangential airflow, creating a strong laminar upward

flow.

- Fig. 2 shows a partial view on inner elements of the column 5 according to Fig. 1A, Fig. 1B or Fig. 1C. A curved base wall 20 is inside the lower portion, especially the lower half of the column 5, and comprises a rotating body starting from a large diameter at the lower base where the wall surface 21 is nearly horizontal and increases the angle until the end of the base element at approximately half of the height of the column 5 with an upper base wall surface 22 having an angle between 45° to 70° , especially between 50° and 60° . The lower base wall surface 21 has a circumferential skirt 23 with an approximately 45° inclination. The base wall 20 provides the inner structure for a wind turbine shown in Figs. 5pp, gathering the wind force entering through the grid openings 8, concentrating it and delivering it into the opening 32 under the outer inverted funnel wall 30. The outer inverted funnel wall 30 starts with a lower diameter at its lower edge 31 with an opening angle between 30° and 60° , preferably between 40° and 50° , reducing the angle of the outer inverted funnel wall 30 to almost a horizontal portion 33 and increasing the angle again in approximately toroidal shape 34 to end with an almost vertical upper edge 36, wherein the upper edge 36 has approximately the same diameter as the lower circumferential skirt 23 in order to use the inner volume of the column 5 through its maximum extent.
- Fig. 3 shows a partial transparent view of the elements as shown in Fig. 2. Base wall 20 essentially ends at the lower edge 31 of the outer inverted funnel wall 30. It comprises an inner reception feature 24 to provide a bearing for the turbine to be mounted on the base wall 20 (not shown in Fig. 3).
- Fig. 3 shows that inside the outer inverted funnel wall 30 are provided four radially oriented section separating walls 35 in an angle or distance of 90° one from the other. These section separating walls 35 are mounted between the outer inverted funnel wall 30 and the inner inverted funnel wall 40 which can be seen in connection with Fig. 4. It is preferred, that these section separating walls 35 are continuing as fins 160 in the riser shaft 139, Beside these four section separating walls 35 being fully blocking fins 160 in an angular distance of 90° , four further fins 160 are provided in between at 45° to these blocking fins 160 which can be provided to be only partly blocking the riser shaft 139.

Fig. 4 shows a schematic perspective view from above on the inner elements of the outer inverted funnel wall 30 according to Fig. 2 and 3. It can be seen that the upper edge 36 of outer wall 30 is at the same level as the upper edge of the inner inverted funnel wall 40 which has a complementary inclination to the outer inverted funnel wall 30 to provide an annular shaped passage of essentially the same diameter between the lower edge 31 and the upper edge 36. This annular cavity 45 is in fact separated into four distinct cavities 45 through the four radially oriented section separating walls 35. However, it is of course possible to provide lesser, e.g. only two or three, or more, as e.g. five or six walls 35 to separate the annular cavity 45 into a different number of circumferential sections. A higher number of sections 45 as e.g. four have the advantage that the rotation of the fluid, here air, as will be described in connection with the other drawings will be directed into a laminar airflow in the longitudinal direction of the column 5.

Beyond the upper edge 36 can be provided circumferentially provided air deflecting shields, shown in Fig. 1B and Fig. 1C as virtual ledge 140 openings and exhaust opening, deflecting the air having travelled from the grid opening 8 at the lower bottom through the turbine to be described in connection with further drawings through the funnel opening 32 through the cavity 45 to the environment around the column 5 near the upper surface 15. Such air deflecting shields can be provided around the rim of upper surface 15 of Fig. 1, especially inside of the functional elements 7.

In the center of Fig. 4, a central opening 42 is provided which delimits the inner portion of the annular air opening 32 at the lower edge 31 of the inverted funnel wall 30 as mentioned in connection with the description of Fig. 2 and 3. The inner reception 24 in base wall 20 is adapted to mount a turbine to turn around the longitudinal access and a shaft connected to the turbine can extend to the central opening 42 in order to be connected with a – motor for – positive airflow onto an electrical power generator. In other words, it relates to a hybrid generator that can be used as a motor in case of low media flow to create positive air/media flow and multiplying air through the upper channels to drive the upper turbine arrangement.

It can be seen that Fig. 4 does not only show the lower base wall 20 extending into the circumferential skirt 23 but that the apparatus provides a cavity reducing wall 28 which

starts at the cover of the base wall 20 and the distance from the ground until the outer wall 9 is reached in which the grid openings 8 are provided.

Fig. 5 shows a partial side view of the inner rotor 50 of the generator. The inner rotor 50 comprises an outer surface 51 following more or less the curvature of the base wall 20 below above which the rotor is positioned in a specific predetermined distance which reduces from the outer wall 9 up to the upper end 22 of base wall 20. On the lower side of the inner rotor 50 are provided a sequence of directional fins 70, 72 and 74 being part of the lower turbine blade 60. The directional fins 70, 72, 74 have a vertical edge 71 to rotate in distance to outer wall 9 on the inner side of the column 5 as will be seen in connection with Fig. 10 and Fig. 11. The length of the fins 70, 72 and 74 is such that there remains a cavity 19 below the cavity reducing wall 28. The fins 70, 72 and 74 are mounted in approximately 45° direction in a tangential direction along the circumference of the turbine blade 60 and the lower end 73 of the directional fins 70, 72 and 74 is almost directed horizontally. The first longitudinal fins 70 are extending from the outer edge 71 all the way below the outer surface of inner rotor 50 up to the upper edge 52 where a connection via ribs are provided to contact the lower turbine blade 60 with the upper turbine blade 65 on a central portion 66. Directional fins 70, 72 and 74 transport the air coming between the first directional fins 70 and the other fins 72 and 74 to the inner portion of the rotor 50 through the openings 8 into the cavity 45 of the outer inverted funnel 30. The circumferential distance between two adjacent fins 70, 72, 74, respectively, is identical over all fins 70, 72 and 74 but is higher near the upper solid surface of the inner rotor 50 than at the free ends 75 of the directional fins 70, 72 and 74. In a view on the edge side 71 end the fins 70, 72 and 74 are convex.

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Fig. 6A and Fig. 6B show a partial perspective view from above of the inner rotor 50 according to Fig. 5. The outer surface 51 of the inner rotor 50 surrounds the remaining image at the outer portion of the drawing and ends at its upper edge 52 so that a first directional fin 70 can be seen extending beyond the inner rotor 50. The upper turbine blade portion 65 comprises a number of fins 62 extending between the central bearing portion 66 and an additional support ring 61 providing the inner end abutment for the first directional fins 70. As it will be seen in connection with Fig. 10, the two Fig. 6A and Fig. 6B show what happens if there is a high volume airflow and what happens if there is a low volume

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airflow, respectively. Reference numeral 67 relates to a center base in relation with the base wall 20. When air enters the fins 70, 72, 74, the rotor 60 starts to turn and additional air will receive more resistance which is not only translated into a faster rotation but that the air is pushing the rotor 60 from the base 20 and lifting it. Therefore, the rotor is lifted
5 and a distance appears between the center base 67 and the central portion 67.

Fig. 7A shows an enlarged detail view of an upper energy generator 180, while Fig. 7B shows a side view of an upper energy generator 80 as applied in the embodiment of Fig. 1B and Fig. 1C. The rotor 180 of Fig. 7A comprises a sequence of fins 162 attached at the
10 inner ring 161. Each fin 162 is oriented approximately 45° to the circumferential direction around the inner ring 161 wherein the rectangular fins have an upper and lower tapered free end 163 and 164, respectively, with a sharp edge 164 to clearly cut through the airstream passing between the fins 62 entering the cavity from below. The fins 162 are rectangular blades with tapered 163 and 164 free ends. The distance between two neighbor
15 blades 162 is identical over the height of the fins 162.

Fig. 7B shows four independent stages 81, 82, 83, 84 with four independent inner rings 161 having fins 162 as explained above. The independent inner rings 161 are mounted on independent concentric axes 171, 172, 173, 174. The axes 171 to 174 are then connected
20 with a generator. The four stages of Fig. 7B are all identical. It is possible, to provide different stages, e.g. a lighter lower stages 81 with a smaller angular momentum than the higher positioned stages 82, 83 and 84, whereas the uppermost stage 84 is the heaviest one, perhaps with longer and higher fins in the direction of the axis 174. This disposition ensures that the lowest rotor starts to rotate with a small fluidflow impacting from below,
25 whereas the heaviest upper stage 84 is adapted to accept higher torques. The distance between the different stages is as small as possible. Of course, it is possible to provide 2 or 3 and more than 4 stages. The rotor combination of Fig. 7A and/or Fig. 7B are mounted just below the top surface 15 of the column.

30 Fig. 8 shows a partial perspective view from below on the rotor of Fig. 1. A number of first long directional fins 70 can be identified starting at the vertical edge 71 and ending near the inner ring 61. In between two first neighboring long directional fins 70 are provided second intermediate directional fins 72 and third short directional fins 74. Therefore, the

number of first long directional fins is equal to the number of second intermediate directional fins and third short directional fins 74. The intermediate directional fins 72 start at the vertical edge 71 but end in a predetermined distance at edge 76 when the diameter of the rotor 50 is decreasing so that an larger remaining cavity space 77 is created to ease the
5 airflow as directional stream, avoiding that the air flow is reduced. The same is true for the third short directional fins 74 which end at an even larger distance from the inner ring 61 at the third fin edges 78 also provided in a regular distance from the inner ring 61. All fins 70, 72 and 74 are curved and oriented with their base orientation in an angle to the vertical direction. In an embodiment, not shown in the drawings, it is possible to provide fins of the
10 same size rather than a staggered pattern as illustrated.

Fig. 9A and Fig. 9B show two possible outer wall construction with a main column wall 10 surrounded by a larger diameter outer wall 9 within which the grid openings 8 are provided with here two neighboring elements of 45° sections or a totally surrounding gird opening 8,
15 respectively, allowing for an air flow to enter the rotor 50 at the vertical edge 71.

Fig. 10 shows a schematic partial cross sectional view of the outer wall element 9 near the base wall 20 within which it can be seen that the outer edges of the fin 70 (mentioned in Fig. 10 but equally correct for fins 72 and 74) are adapted to be positioned in a small
20 distance from base wall 20 to take all inflowing air between neighboring fins 70 and 72 and 74 above the base wall 20. Fig. 11 shows an enlarged detail view of Fig. 10. On the outside of the fins 70 is provided a fluid gathering cavity 19 between the vertical grid openings 8 and the descending wall portion 28 allowing to concentrate the inflowing air by reduction of the diameter height by about 30% from the upper circumferential edge 16 of
25 the wall 9 to the level of the outer surface 51 of rotor 50 (when not rotating) to pre-concentrate the wind energy entering between the neighboring fins 70 and 72 and 74. When the fluid force becomes stronger, the fluid entering the vertical fin edge surface 71 accelerates the rotor and, at the same time, is capable to lift the rotor 50 from its center base 67. Then surface 51 of the rotor rises and passes inside of the inner circumferential
30 edge 17 while lifting against the incoming fluid force.

Fig. 12 shows the airway structure of the embodiment of the column 105 of Fig. 1B or Fig. 1C in a partial side view and partial cross section view of the technical aspects with almost

no parts of the casing. Fluid entering through grid openings 8 is entering between fins 70 of the lower rotor turning it for the lower generator element. Then, the fluid is guided through funnel 30 to a number of riser shafts 139 separated by vertical fins 160 extending from the end of the funnel 30 up to an upper virtual ledge 140 (not shown in Fig. 12). The
5 fins 160 are extending between an inner essentially cylindrical wall and the outer wall of column 105 blocking the way of the fluid to be in any circumferential rotation. The fins 160 are then reducing the height between the two walls to become reduced height fins 165 to allow the vertical fluid flow to enter the upper generator with its four stages as shown in Fig. 7B. The rotors 81 to 84 are rotating and transmit the energy onto an upper generator
10 (not shown).

Fig. 13 shows a detail view of the base of Fig. 12. It can be seen that the grid 8 comprises a plurality of round holes in a mesh and that the grid 8 is subdivided through vertical webs 8'.

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Fig. 14 shows a partial side view and cross section view of the wall portion above the lower rotor and generator. At the bottom of Fig. 14 ends the inverted funnel wall 30 with the annular cavity 45 separated by the section separating walls 35. These walls 35 are in continuation with fins 160. The fin 160 on the right side is not fully extending to the outer
20 wall and provides a short distance opening 131 between the radial edge of the fin and the wall 130. The outer wall 130 of Fig. 1B or Fig. 1C comprises five sequences 150 of a plurality of seven side air entries 151, separated by horizontal webs 132, allowing the surrounding fluid, e.g. air to enter behind the column wall 130 into the riser shaft 139 and travelling upwards to the upper generator. The center of the column 105 can house a
25 battery system, the generators and further components. The fins 160 can dissipate heat of the surrounding fluid. The column 105 can have the height of only 2.5 metres or have several stories, wherein each sequence 150 can have a height of one storey and comprise of course more than only seven side air entry openings 151, e.g. twenty or more having a height of 2 to 5 centimetres each with a similar height of each web 132. Webs 132 can
30 have an air inward guiding profile but nevertheless directing fluid into the up direction. A further embodiment of these sequences 150 of side air entry openings 151 is shown in Fig. 17.

Fig. 15 shows a partial side view and cross section view of the wall just below the exhaust ledge; and Fig. 16A, B & C show similar side views of the upper section of Fig. 15 with different position of the exhaust closing 143. Fig. 16A shows the fully open exhaust opening, Fig. 16B the partially closed exhaust opening and Fig. 16C the closed and
5 therefore shut-down position of the upper and lower generators, since no incoming fluid can leave the column.

The exhaust opening provides an integrated virtual ledge 140 comprising a rounded ledge wall 141 at the top. Just beyond and inside the shutter closing 143 is positioned the upper
10 edge surface 163 of the uppermost stage 84 of the upper generator, directing the airflow outside and beyond the upper surface 15 of the column 105.

At the bottom, the lateral face element 230 is positioned above the base element 120 so that any air entering between the openings 123 of such a base element 120'' is guided in an
15 essentially laminar flow according to arrow 232 upward in front of the back wall 231.

Fig. 17A to Fig. 17C show schematic cross-sectional side views of a further embodiment of a column 105 wall with three different positions of the shutter wall 243.

20 The outer wall 130 can be provided in the vertical direction between the base of the column 105 and the virtual ledge element 240. Fig. 17A to Fig. 17C does not integrate the optional upper rotors of Fig. 7A and 7B. They would be provided between the upper edge of the intermediate wall 231' and the positioning of the shutter wall 243. The outer wall 130 preferably comprises a plurality of sequences 150 of side flow entries 151 which are
25 separated by horizontally oriented webs 152. The webs 152 have - in a cross sectional view - the form of a front slat parallel to the side wall, followed by an inside directed transfer portion and ending with a back slat parallel to the column wall and positioned at least partly behind the front slat of the next web 152, creating said openings 151 for an additional air flow stemming from air blowing against the column 105 at the height
30 position of the sequence 150 of openings 151.

Air entering through the entries 151 adds to the laminar air flow in the direction of arrow 232 and accelerates this enhanced air flow up to the virtual ledge wall 240. A closing

shutter wall 243 is positioned on the front wall 130, wherein said shutter wall 243 is shown in Fig. 17A in its open configuration. Fig. 17b shows the embodiment of Fig. 17A with a closed shutter wall 243 so that the air flow, rising up according to arrow 232, comes to a stop. Fig. 17C shows a partially opened closing shutter wall 243, allowing an air flow,
5 according to arrow 232, to evacuate from the chimney like riser shaft 139 between back wall 231 and front wall 130.

The outer surface of the closing shutter wall 243 is a cylindrical jacket surface, oriented to the outside of the column 105. The opposite side is mounted in a vertically sliding way on
10 the outside of the front wall 130. This can be achieved with guide rails, not shown in the drawings. The upper edge 245 of the closing shutter wall 243 has in its cross sectional view a triangular shape, having an inwardly directed protrusion which preferably ends flush with the inner side of the front wall 130 when the closing shutter wall 243 is fully open, but presents an obstacle to the vertical air flow when the shutter wall 243 is partially
15 closed as shown in Fig. 17C and provides an upper sealing surface against the rounded end of the ledge wall in the closed position of Fig. 17B.

It is possible, in other embodiments, to provide a different output angle for the upper portion of the virtual ledge 240; especially this angle could be 45° so that the airflow is
20 essentially directed in an angle of about 45° towards the region above the column 105. The angle can also be chosen between 30° and 60° .

The difference between the embodiment of the sequences 150 of Fig. 14 and Fig. 17A to Fig. 17C is related to said additional intermediate wall 231' which is attached at the lower
25 end beginning of every sequence 150 at the front wall 130 and extends parallel to the back wall 231 for a length which it approximately equivalent to the length of the side flow entries 151 of the respective sequence 150. Therefore, the embodiment according to Fig. 17A reduces the available space for the air flow which is going up according to arrow 232, into a smaller space 233, separated from another air space 234 oriented in parallel to space
30 233, so that both air flows are combined according to arrow 235 in the riser shaft 139 between two subsequent side flow entries sequences 150.

This disposition of intermediate walls 231' allows for a smoother air flow within the riser

shaft 139, enhances the laminar air flow and mixes the two air flows at any air entry sequence 150 between the side flow entries 151 to a combined air flow, which is again forced in the next reduced diameter portion 233.

- 5 The construction of the vertical axial generator in the column 5 or 105 allows using the wind force in the environment of the ground and additionally protects the column against wind wear since an important part of the incoming wind energy is initially gathered at the basis of the column 5, is then converted through diverting the direction of the wind into a vertical direction and leaving the air outside the wall in a predefined height around upper
- 10 surface 15, while at the same time additional air is gathered at different heights, preferably up the entire height of the column. Collecting air along the vertical profile of the column via ported ducts allow for directional airflow through slipstream.

15

LIST OF REFERENCE SIGNS

5	column	24	inner reception
6	ground	28	cavity reducing wall
7	functional element	29	bottom closing wall
8	grid opening	30	outer inverted funnel wall
8'	vertical web	31	lower edge
9	outer wall	32	funnel opening
10	column outer wall	33	horizontal portion
12	section opening	34	toroidal shape
15	upper surface	35	section separating wall
16	outer circumferential edge	36	upper edge
17	inner circumferential edge	40	inner inverted funnel wall
18	bottom portion	42	central opening
19	gathering cavity	45	cavity
20	base wall	50	inner rotor
21	lower base wall surface	51	outer surface
22	upper base wall surface	52	upper edge
23	circumferential skirt	60	lower turbine blade

61	support ring		opening
62	fin	141	curved portion
66	central portion	143	exhaust closing
67	center base	150	sequence
70	first / long directional fin	151	side air entry
71	vertical edge	160	fin
72	second / intermediate	161	inner ring
	directional fin	162	fin / blade (of rotor)
73	lower edge	163	tapered free end
74	third / short directional fin	164	sharp edge
75	free end	165	reduced height fin
76	edge	180	upper energy generator
77	remaining cavity space	231	back wall
78	edge	231'	intermediate wall
80	upper energy generator	232	riser shaft airflow
81-84	four stages	233	smaller space
105	column	234	further space
130	outer wall	235	combined air flow
131	inner distance	243	shutter wall
139	riser shaft		
140	virtual ledge / exhaust		

CLAIMS

1. A vertical axis media-flow turbine comprising a column structure (5, 105) having an inner wall (20, 40) and an outer wall (51, 30) positioned in a predetermined distance to the inner wall (20, 40), creating an air passage (19, 77, 45; 139) in between, wherein the air passage is closed in the bottom section (18) of the column (5, 105) section as well as at the top section of the column (5, 105) through closing walls (29, 141) fully connecting the inner wall (20, 40) and the outer wall (51, 30), wherein the outer wall (51, 30) comprises at least one opening (8) in the lower portion (18) at or near the bottom section and an opening (15) in the upper portion at or near the top section, wherein at least one vertical axis wind rotor (50, 80) is provided within the air passage (19, 77, 45) between the inner wall (20, 40) and the outer wall (51, 30).

2. The vertical turbine according to claim 1, wherein one of the at least one vertical axis wind rotor (50) is positioned for a rotation movement near the lower portion opening (8) on a curved base wall providing the inner wall (20), wherein the wall surface (21) of the curved base wall is nearly horizontal at its lower base and wherein said wall surface (21) comprises an increasing angle until the end of the inner wall (20) with an upper base wall surface (22) having an angle between 45° to 70° , especially between 50° and 60° , and having a reduced diameter compared to its diameter at the lower base, and, wherein the lower portion opening (8) is a vertically oriented grid-like opening (8), wherein vertically oriented edges (71) of fins (70, 72, 74) of the vertical axis wind rotor (50) are mounted behind the grid opening (8), wherein the fins (70, 72, 74) are attached at a rotating body starting from a large diameter at the lower base to a reduced diameter at the upper base wall surface (22).

3. The vertical turbine according to claim 2, wherein the vertical axis wind rotor (50) comprises a plurality of sequences of groups of fins encompassing two fins (70, 72) or encompassing three fins (70, 72, 74), wherein one member (70) of the group of fins extends from the edge (71) at the opening (8) towards the upper end of the inner wall (20) and wherein the intercalated other members (72, 74) of the group of fins are shorter and end in between the edge (71) and the upper end of the inner wall (20), especially for the group of two fins in the middle between those and for the group of three fins at $1/3$ and $2/3$ of the distance between the edge (71) at the opening (8) towards the upper end of the inner

wall (20).

4. The vertical turbine according to claim 2 or 3, wherein the height of the opening (8) at the bottom section (18) is higher than the vertical edge length of the fins (70, 72, 74), especially by between 10% and 50%, preferably about 30%, and wherein a descending wall portion (28) is provided between the wall (9) and the upper surface (51) of the rotor (50) creating a tapered volume (19).

5. The vertical turbine according to any one of claims 2 to 4, wherein the fins (70, 72 and 74) are mounted in approximately 45° direction in a tangential direction along the circumference of the turbine blade (60) and the lower end (73) of the directional fins (70, 72, 74) is almost directed horizontally, so that, in a side view, the fins (70, 72, 74) are convex.

6. The vertical turbine according to any one of claims 2 to 5, wherein the rotor (50) is positioned on a central bearing (24) provided centrally of the inner wall (20) having said reduced diameter, especially at approximately half of the height of the column (5, 105), especially allowing the rotor (50) to be lifted above the base (20).

7. The vertical turbine according to any one of claims 2 to 6, further comprising an outer inverted funnel wall (30), positioned near the upper end of the vertical wind rotor (50) around said reduced diameter, starting with a lower diameter at its lower edge (31) with an opening angle between 30° and 60°, preferably between 40° and 50°, reducing the angle of the outer inverted funnel wall (30) to almost a horizontal portion (33) and increasing the angle again in approximately toroidal shape (34) to end with an almost vertical upper edge (36).

8. The vertical turbine according to claim 7, wherein an inner inverted funnel wall (40) comprising a complementary inclination to the outer inverted funnel wall (30) is provided to create an annular shaped passage or a straight passage of essentially the same diameter between the lower edge (31) and the upper edge (36).

9. The vertical turbine according to claim 8, wherein two or more radially oriented section separating walls (35) are provided within the annular cavity (45) separating it into three or more distinct cavities.

10. The vertical turbine according to claim 8 or 9, wherein a central opening (42) is provided inside the inner inverted funnel wall (40) to receive a shaft to be connected with a generator for electrical power generation.

11. The vertical turbine according to any one of claims 1 to 10, wherein, beyond the upper edge (36) of the column (5, 105), circumferential air deflecting shields (140) are provided for deflecting air having travelled from the grid opening (8) at the lower bottom through the turbine, wherein especially such air deflecting shields (140) are provided around the rim of the upper surface (15) of the column (5, 105).

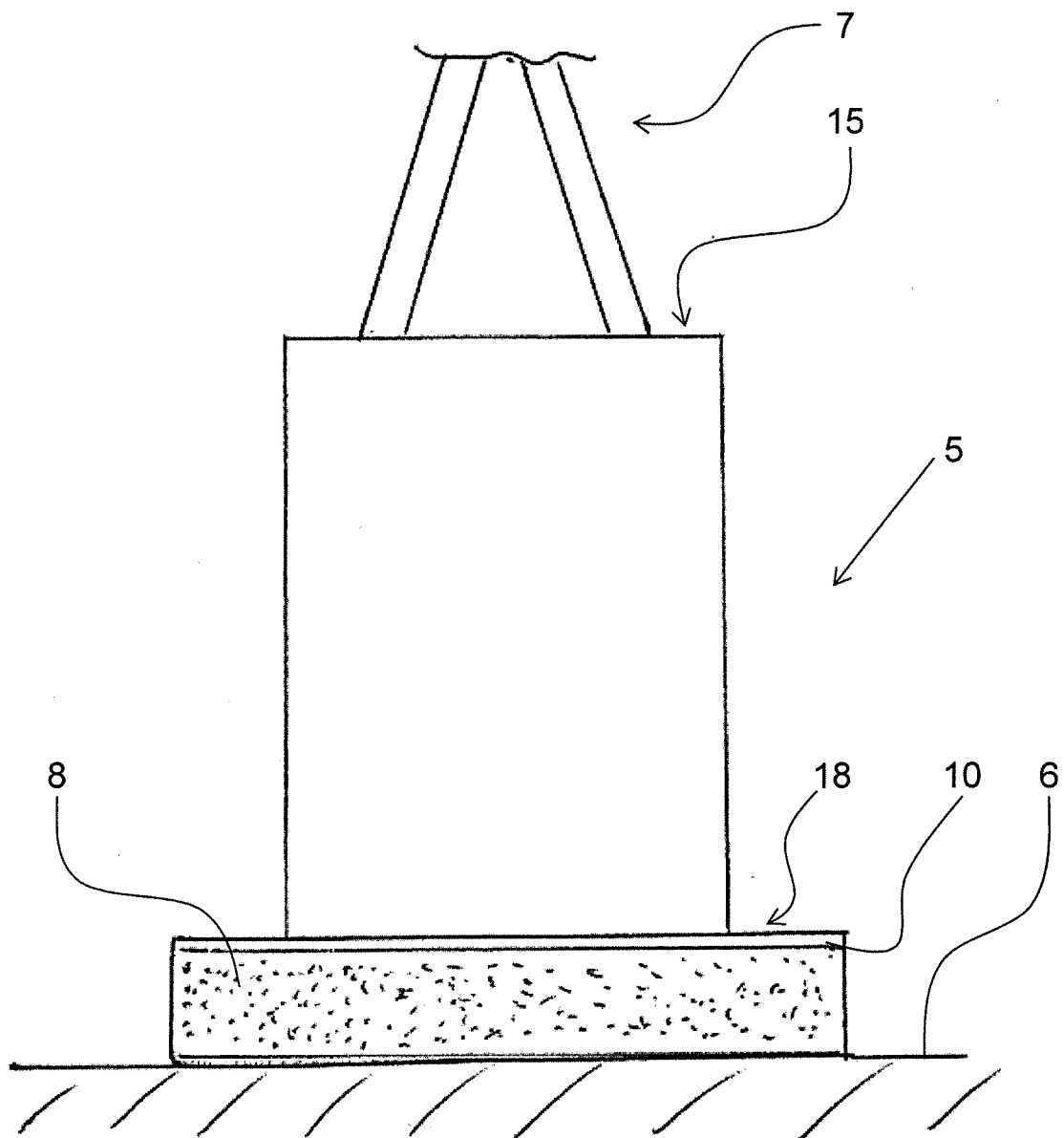
12. The vertical turbine according to any one of claims 1 to 11, wherein the column wall (130) comprises at least one sequence (150) of a plurality of side air entries (151) connecting the outside of the column (5, 105) with the air passage in the column wall, providing a riser shaft (139), wherein especially a riser shaft separating wall (231') is provided behind each sequence (150) of side air entries (151).

13. The vertical turbine according to any one of claims 1 to 12, wherein one of the at least one vertical axis wind rotor (80) is provided in the upper section of the column (5, 105), wherein the vertical axis wind rotor (80) comprises at least one upper rotor (81, 82, 83, 84) with a vertical central rotation axis being mounted in the upper portion of the column (5, 105), wherein the rotor blades (162) are positioned in a circumferential space above the annular air passage in the column wall, providing a riser shaft (139).

14. The vertical turbine according to claim 13, wherein the at least one upper rotor (81, 82, 83, 84) comprises at least two upper rotors (81, 84), wherein the lower positioned rotor (81) comprises a smaller rotational momentum at the same angular velocity compared to the rotational momentum of the higher positioned rotor (84).

15. The vertical turbine according to any one of claims 1 to 14, wherein the closing walls comprise in the bottom section (18) a bottom wall (29) of the column structure and comprise at the top section a top wall (141) of the column structure.

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**Fig. 1A**

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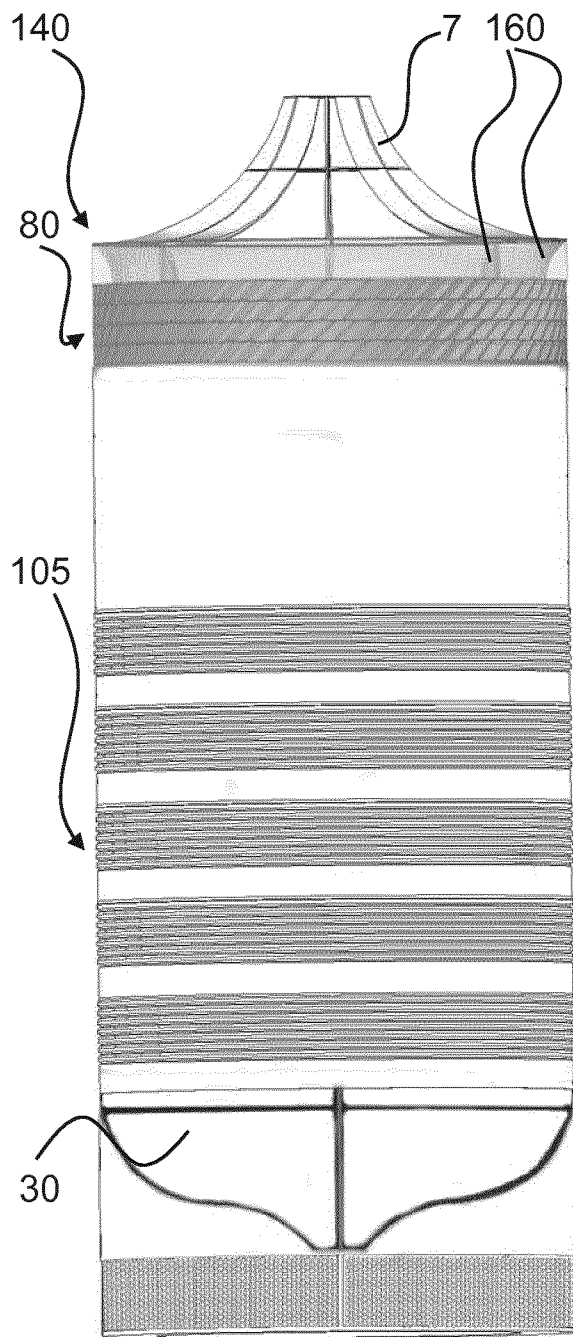


Fig. 1B

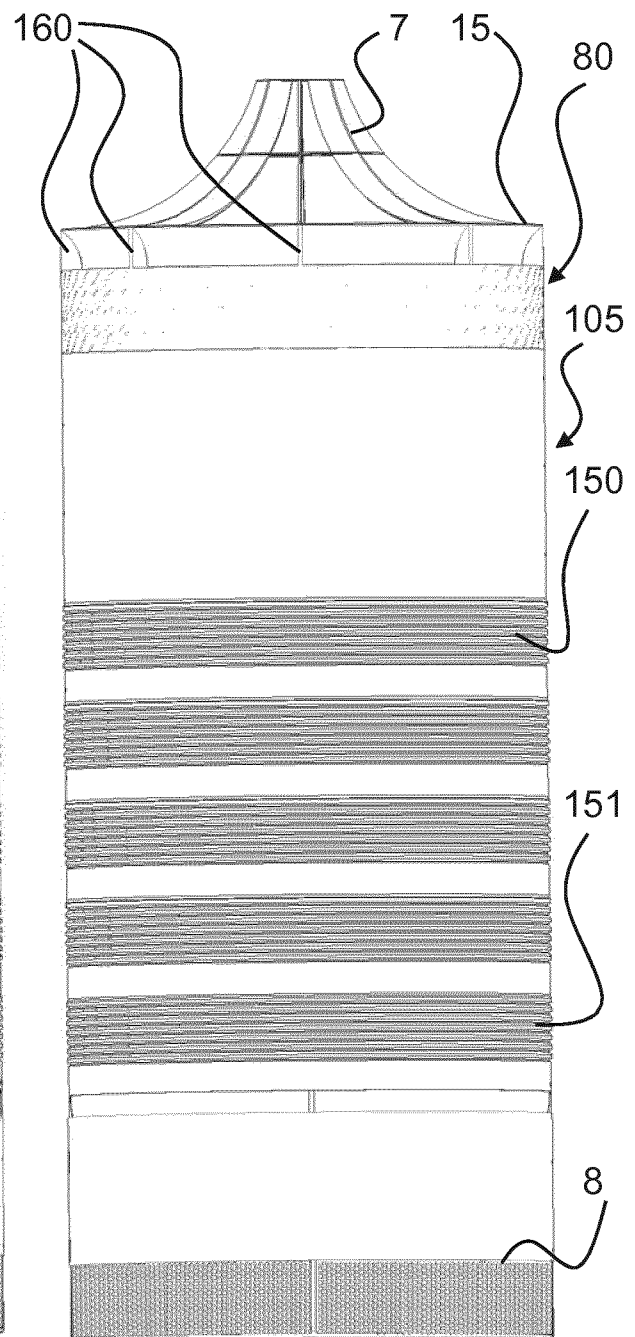


Fig. 1C

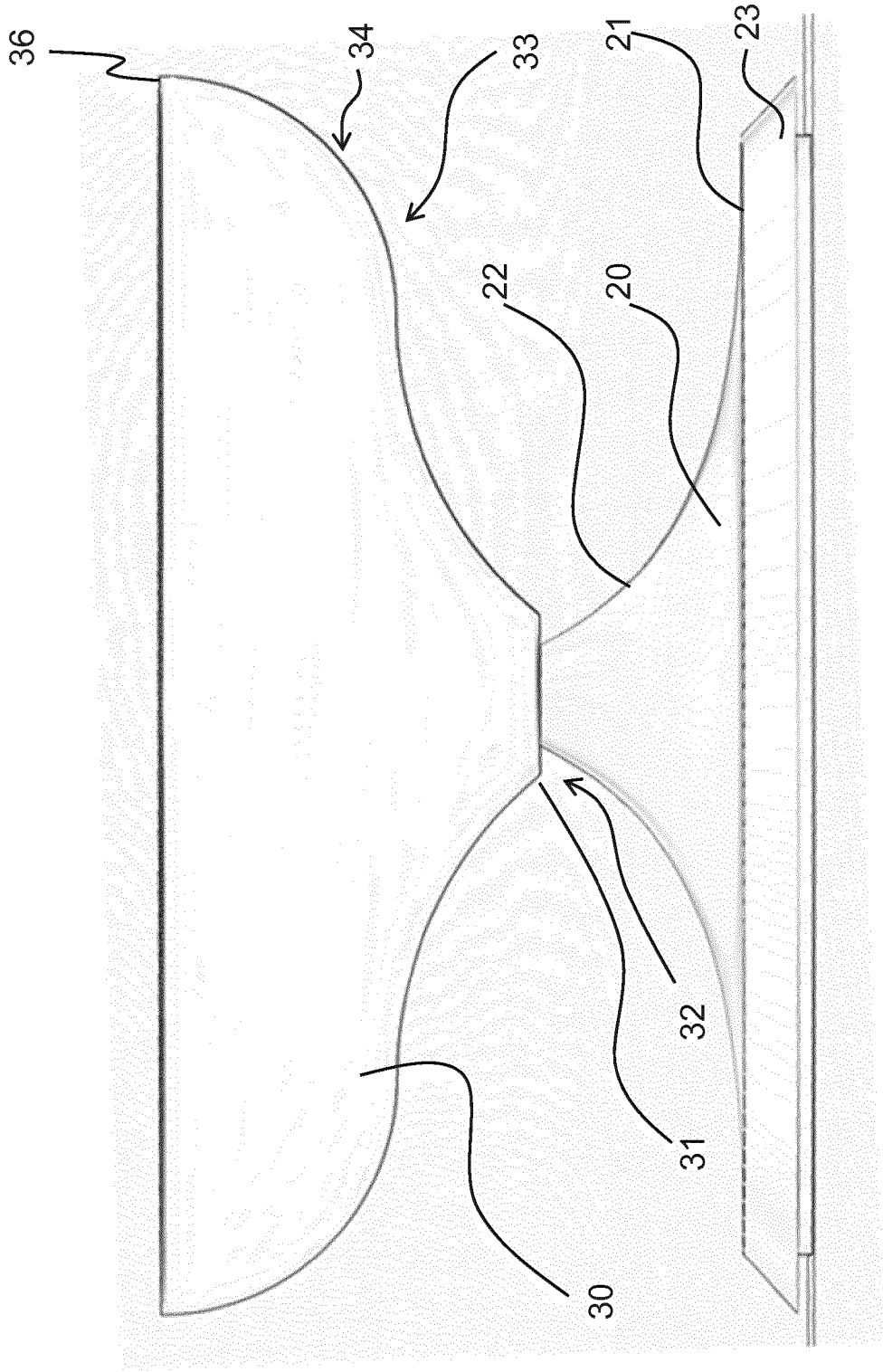


Fig. 2

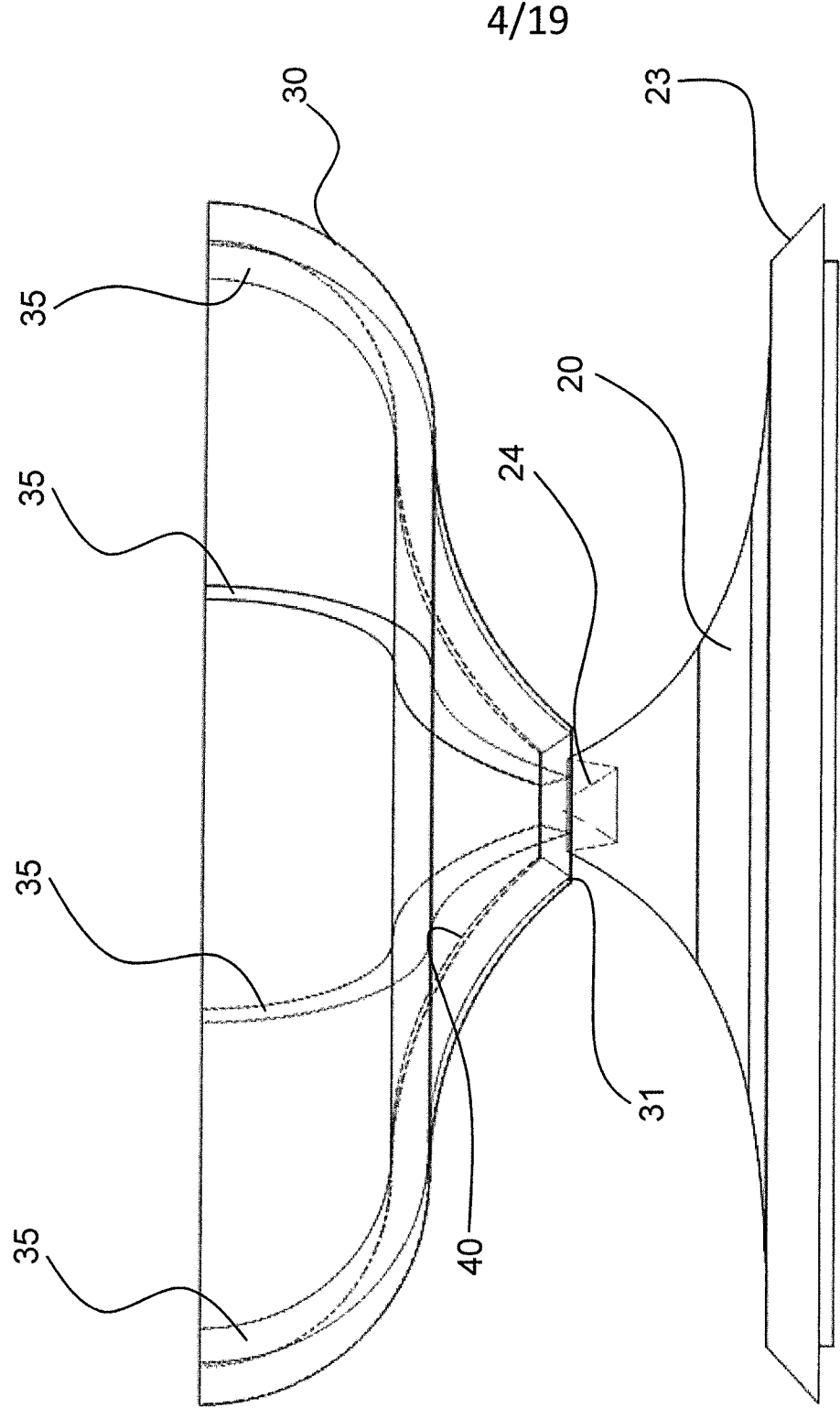


Fig. 3

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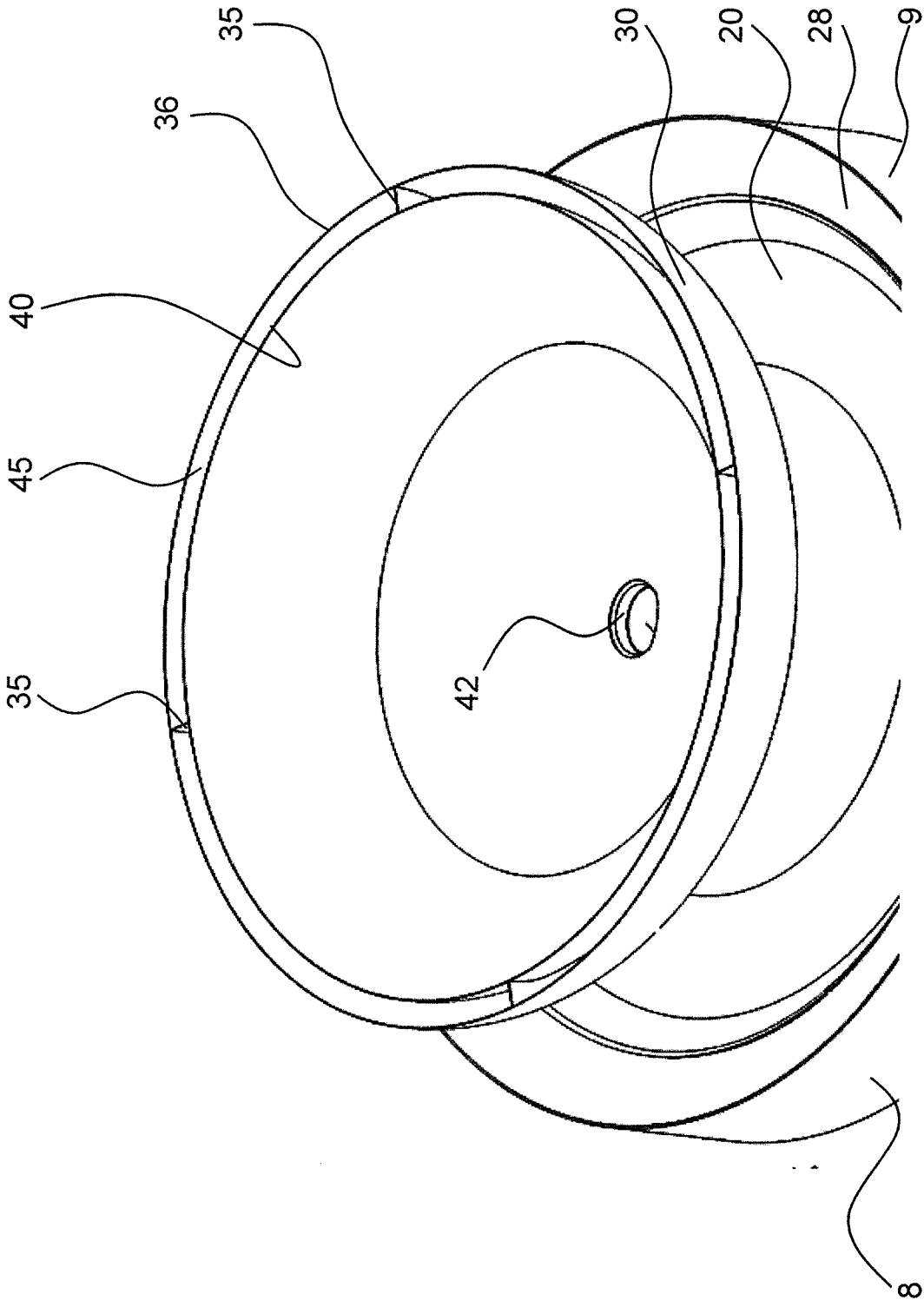


Fig. 4

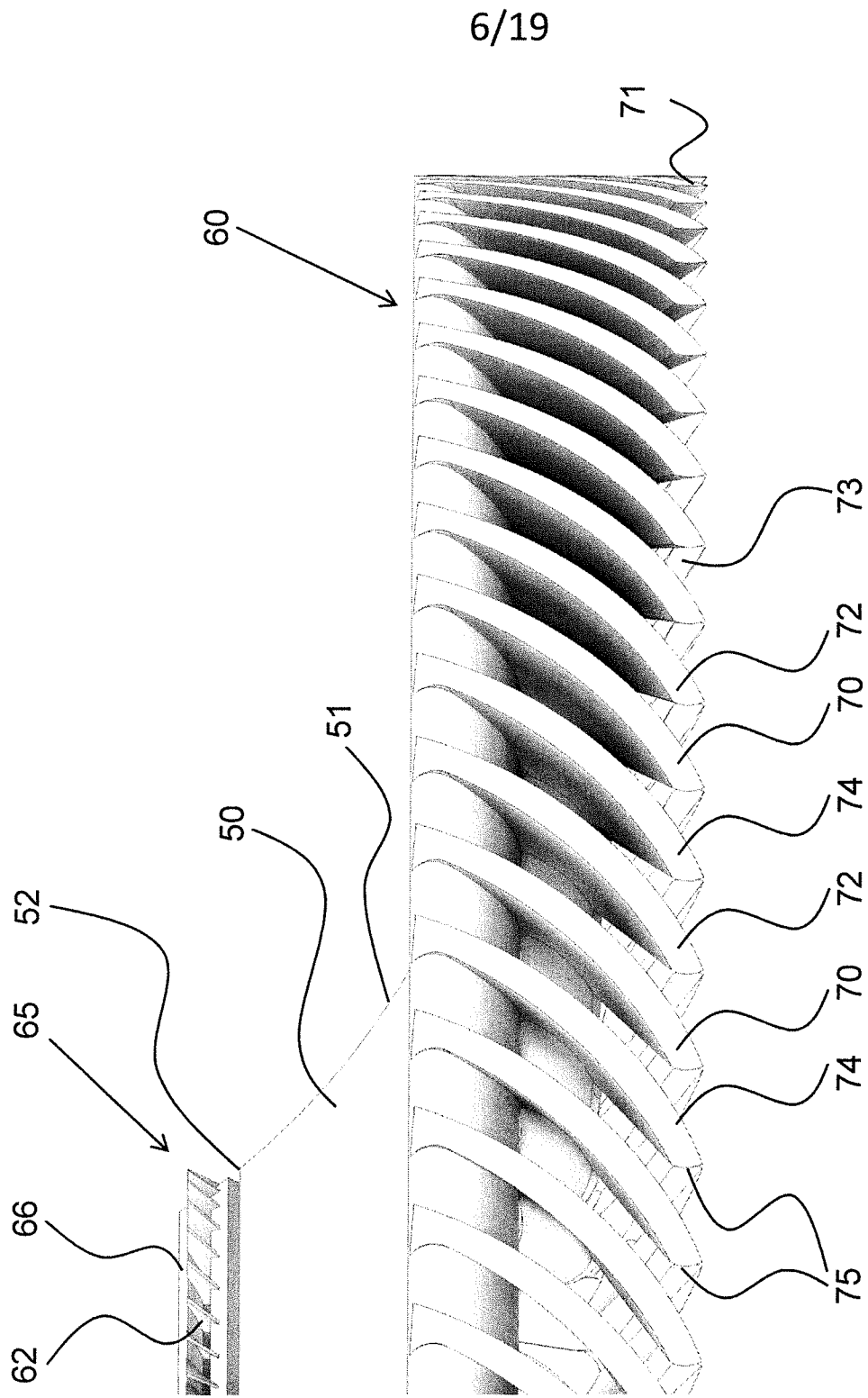


Fig. 5

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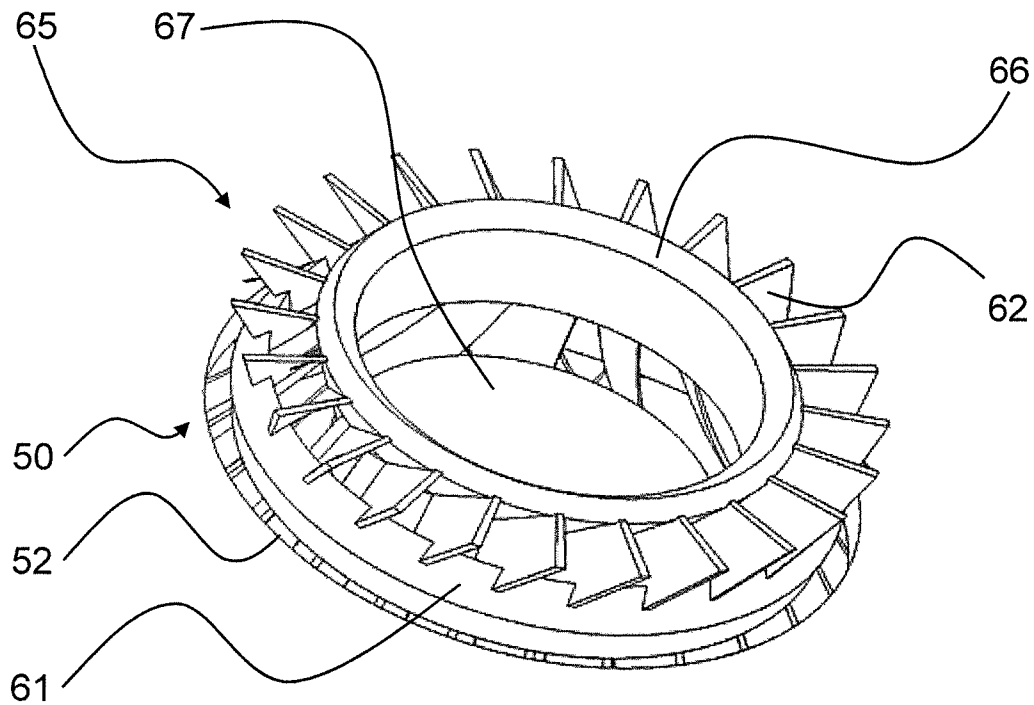


Fig. 6A

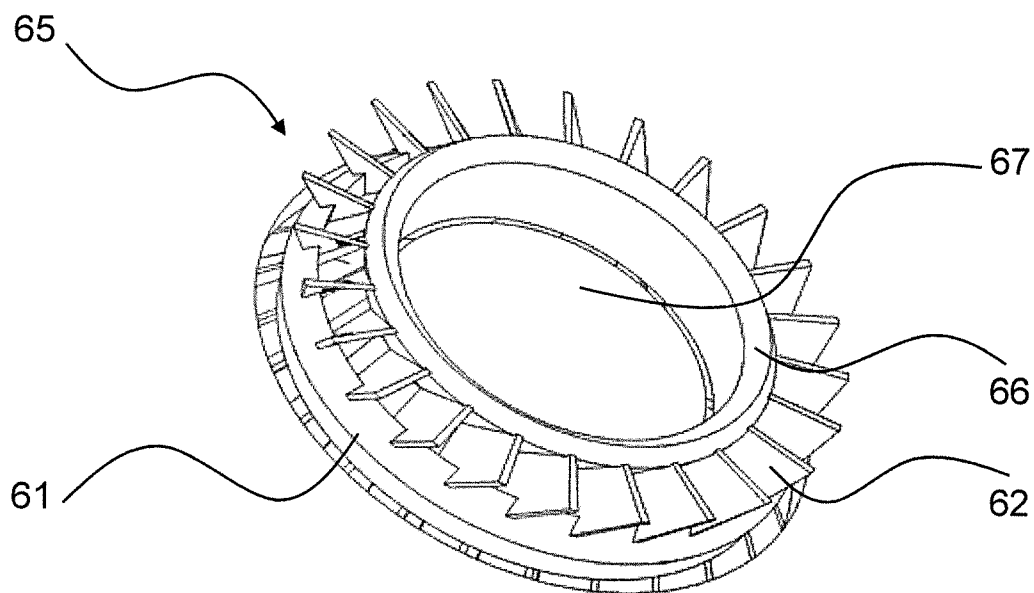


Fig. 6B

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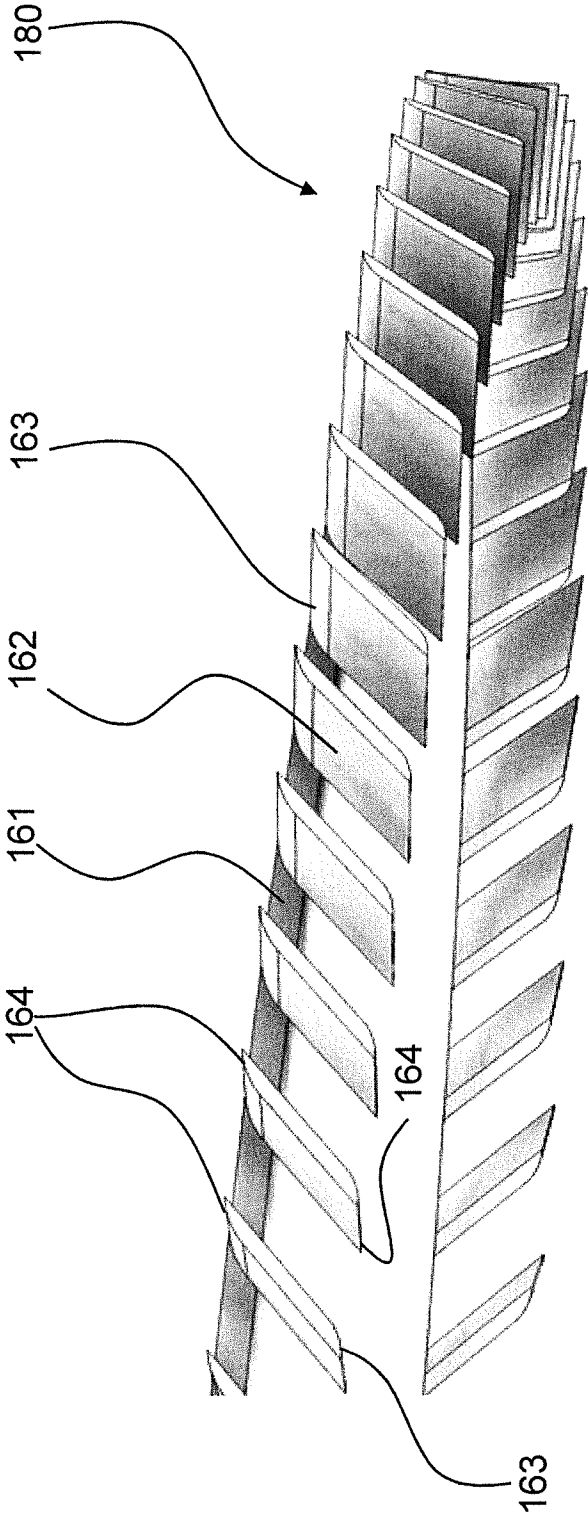


Fig. 7A

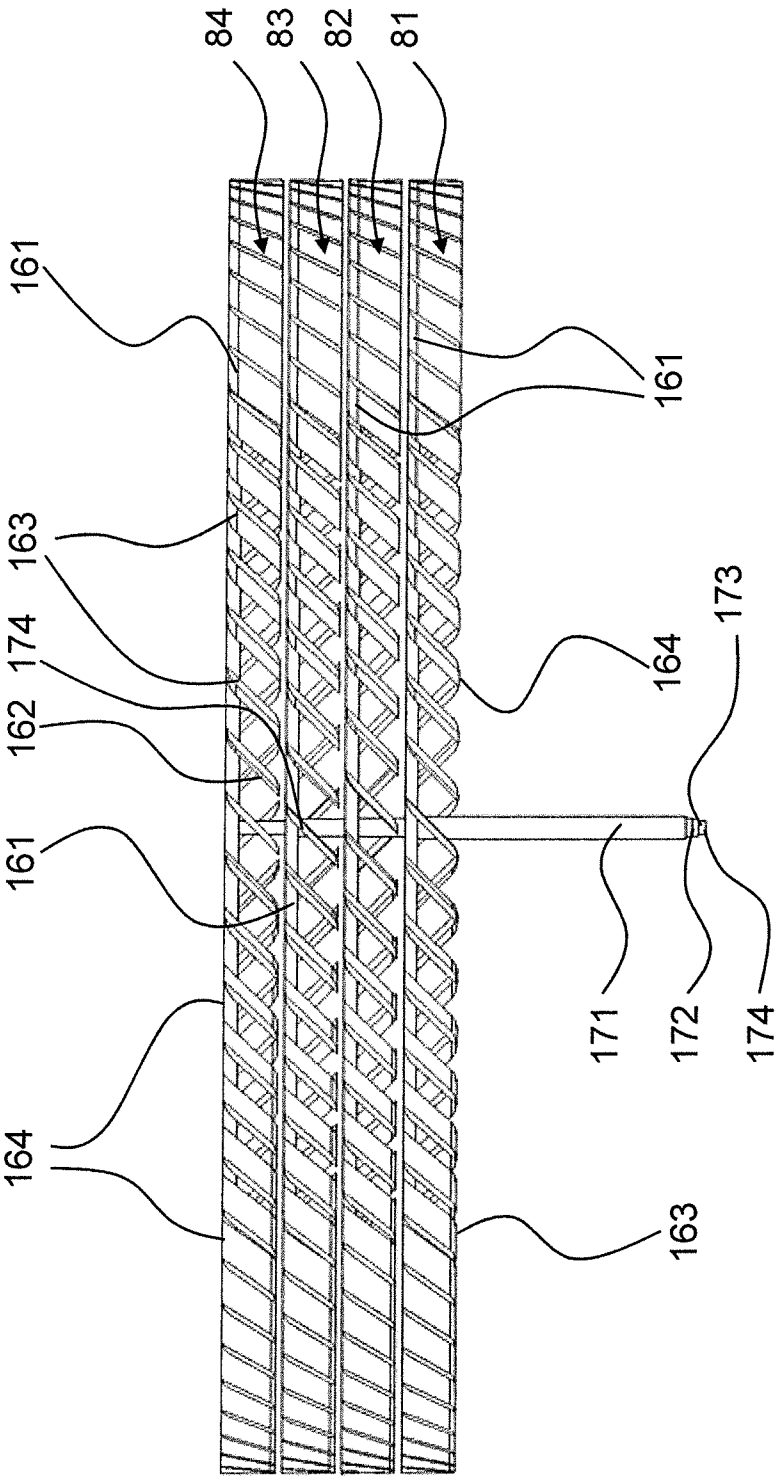


Fig. 7B

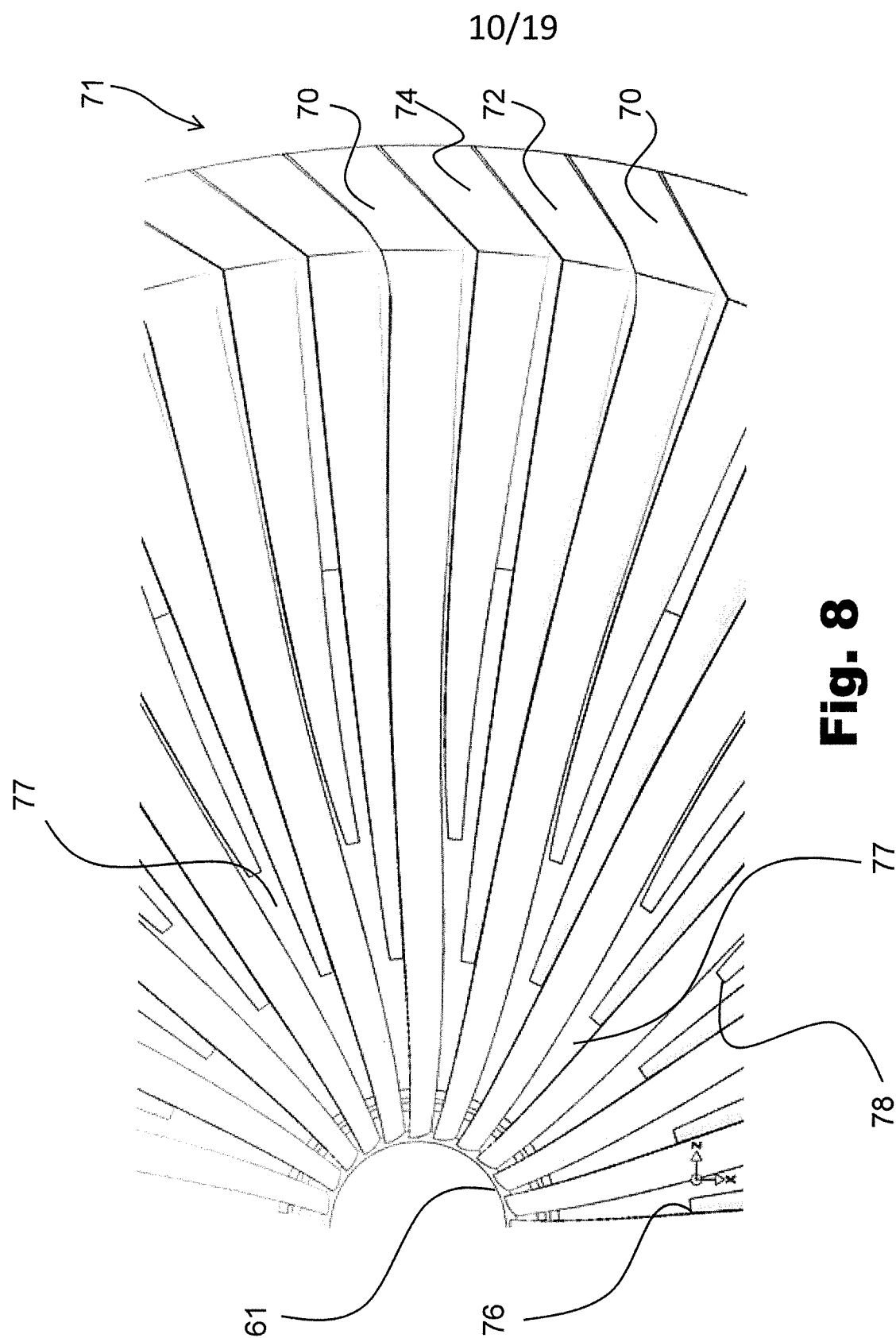
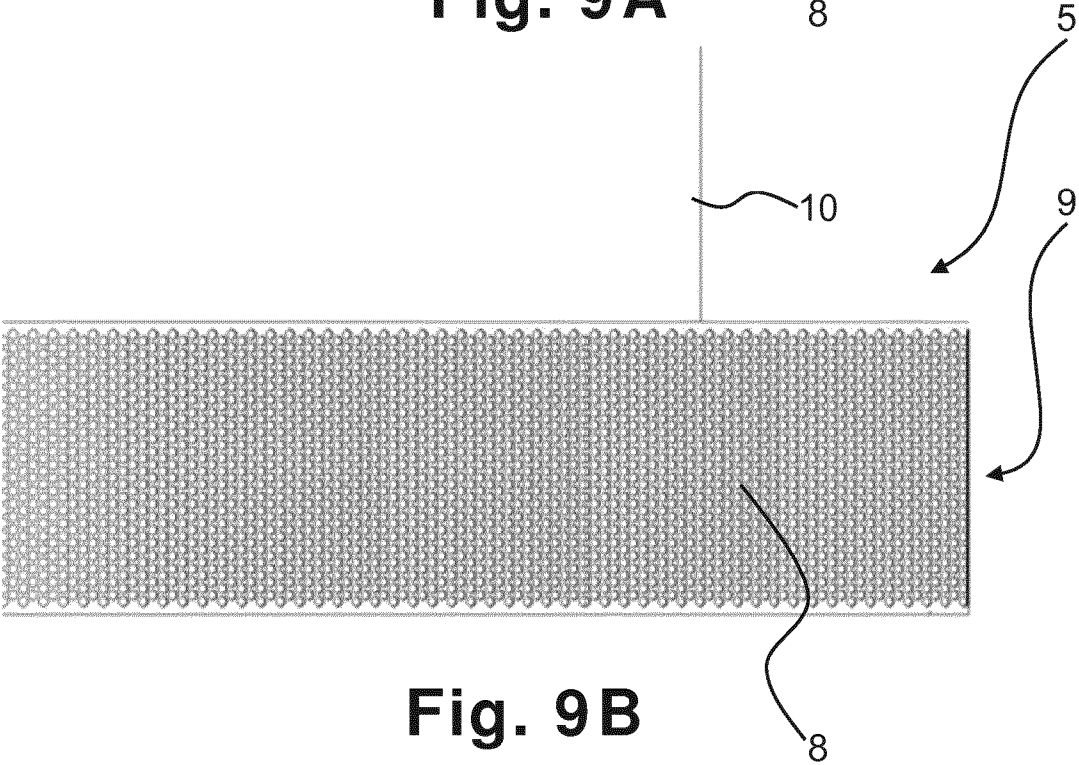
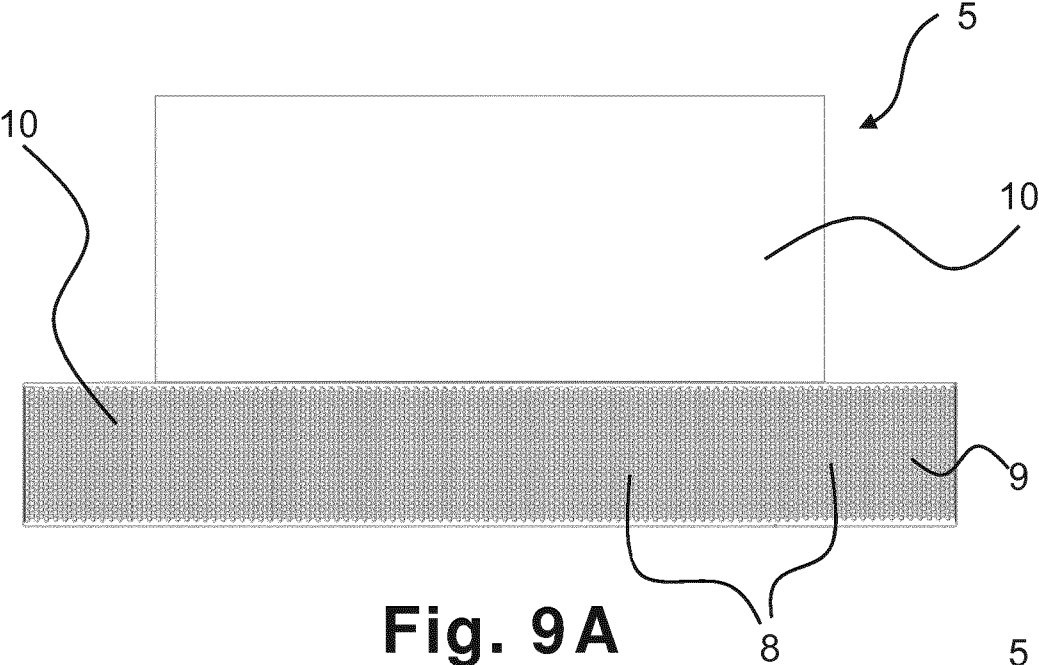


Fig. 8

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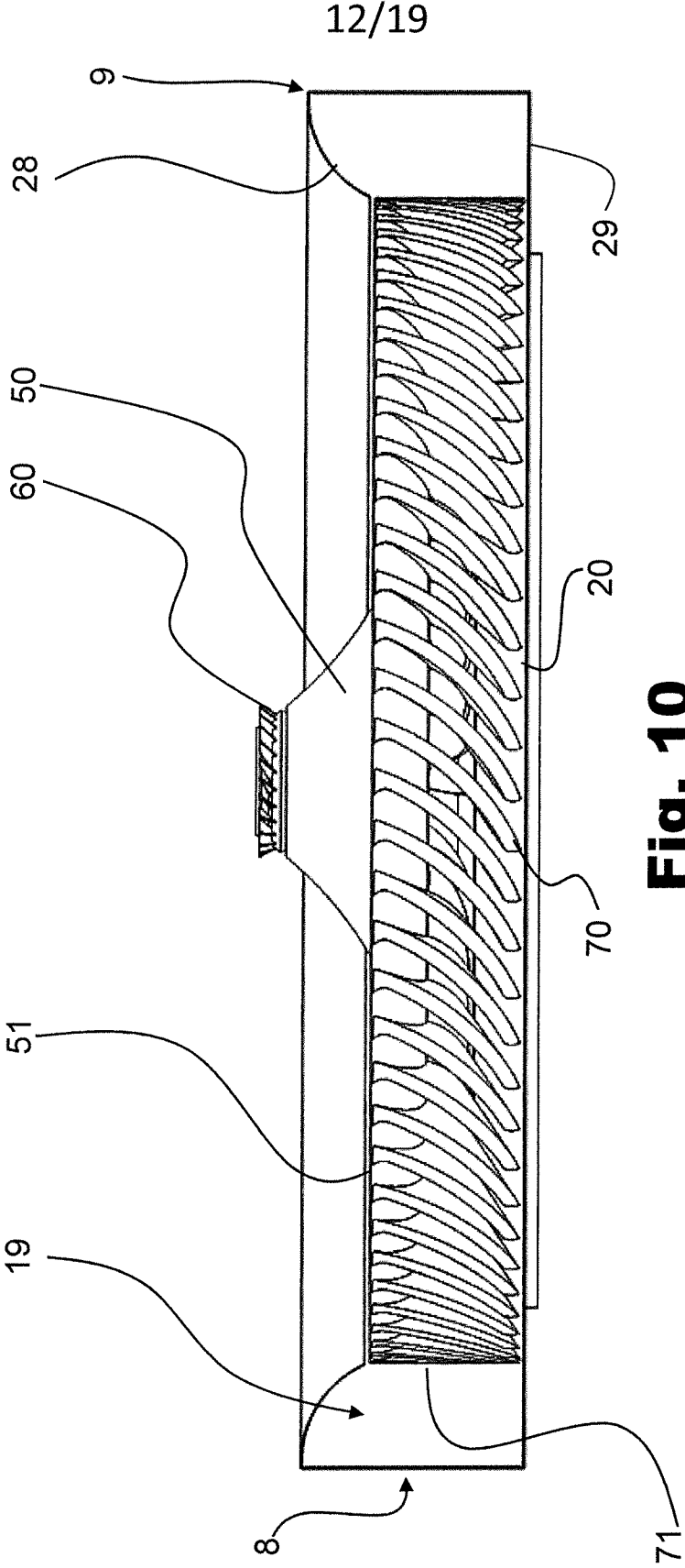


Fig. 10

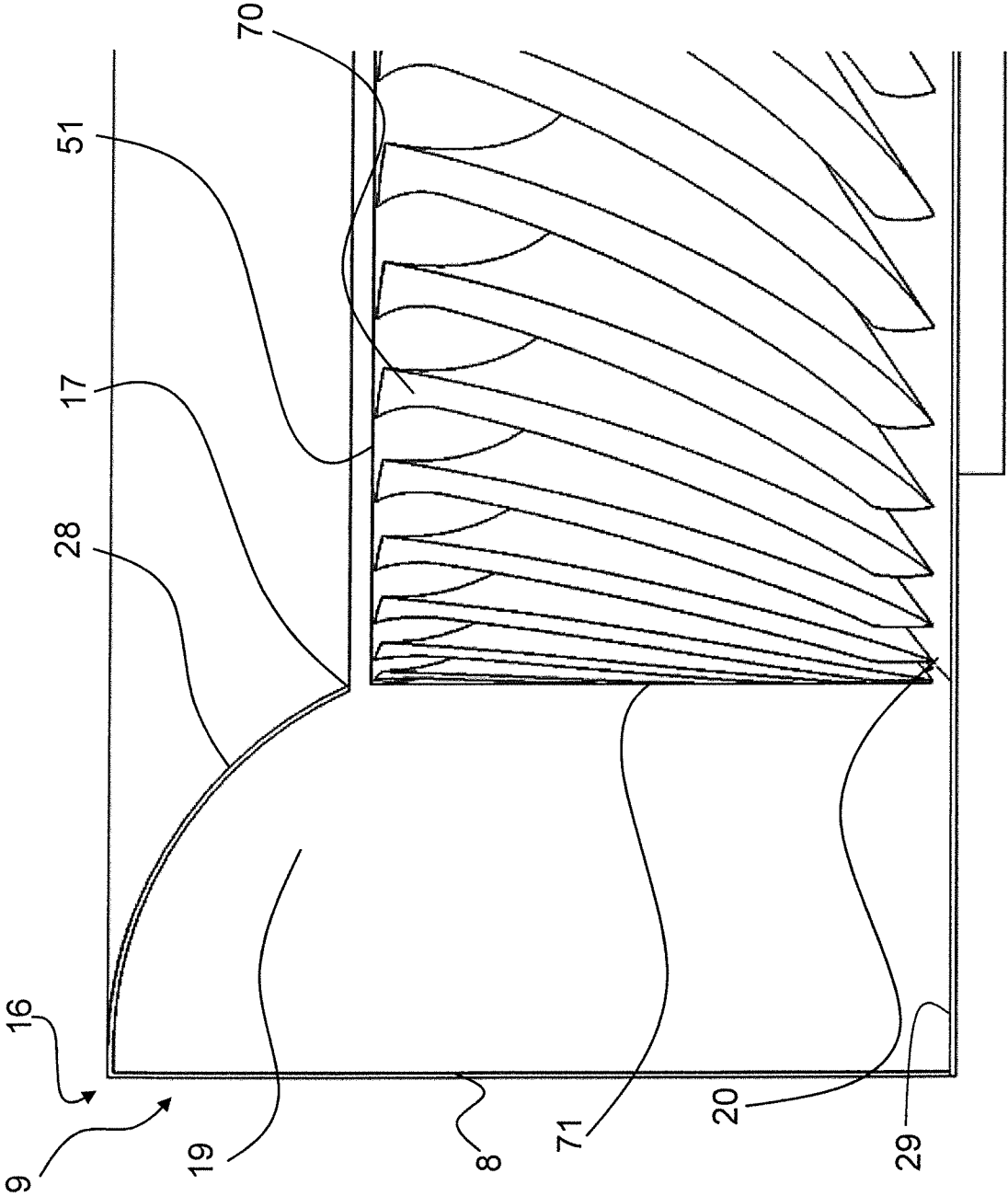


Fig. 11

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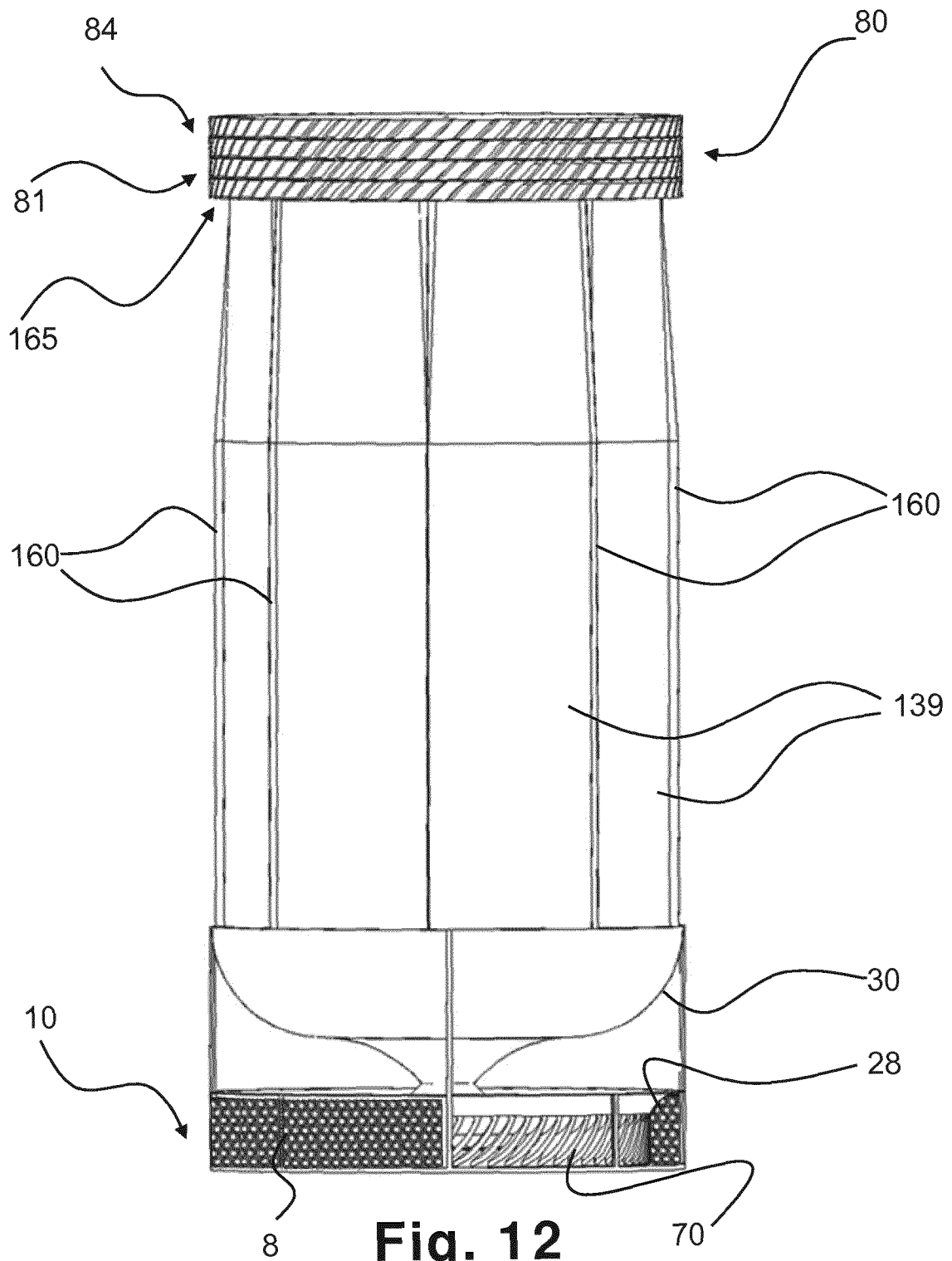
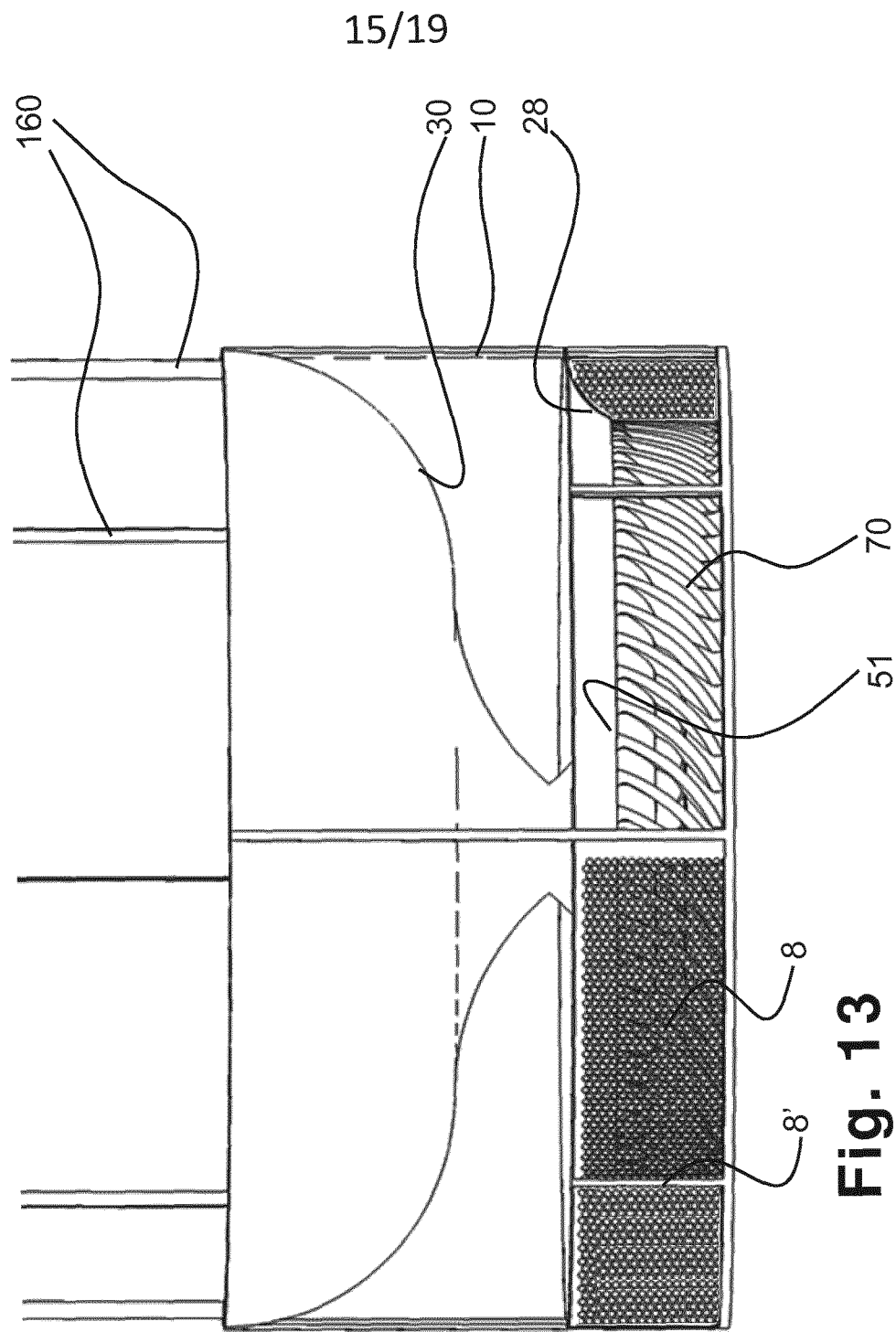


Fig. 12



Substitute Sheet

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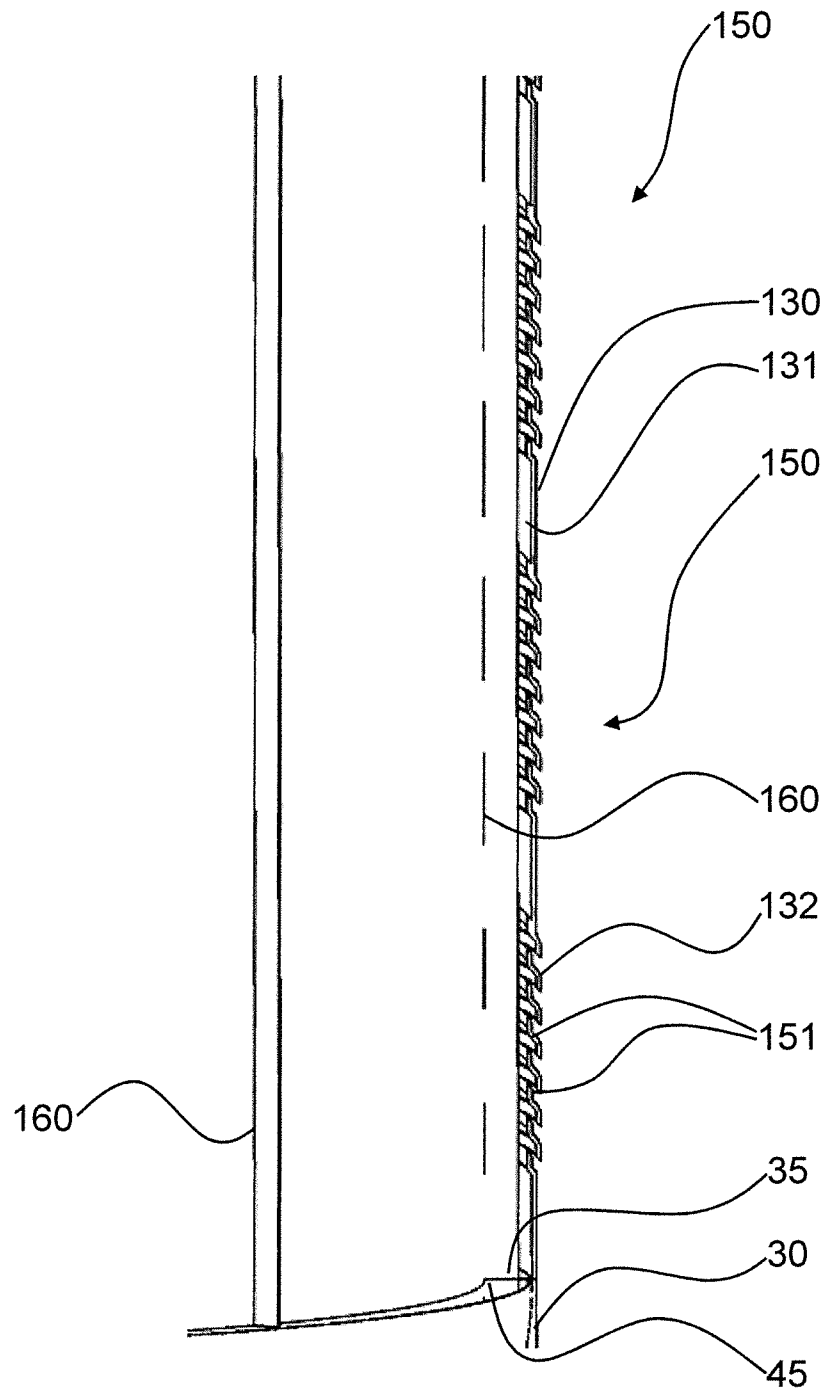


Fig. 14

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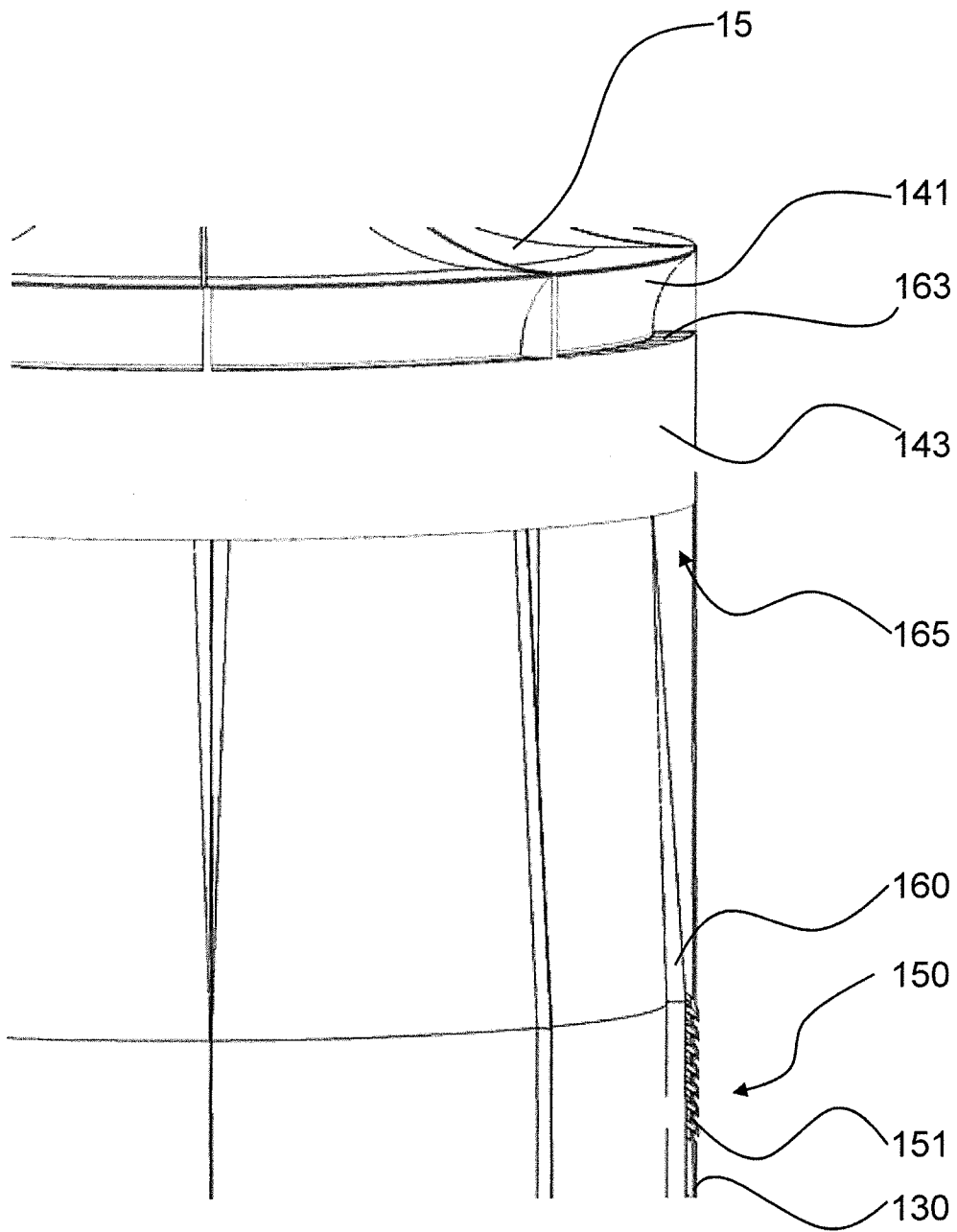


Fig. 15

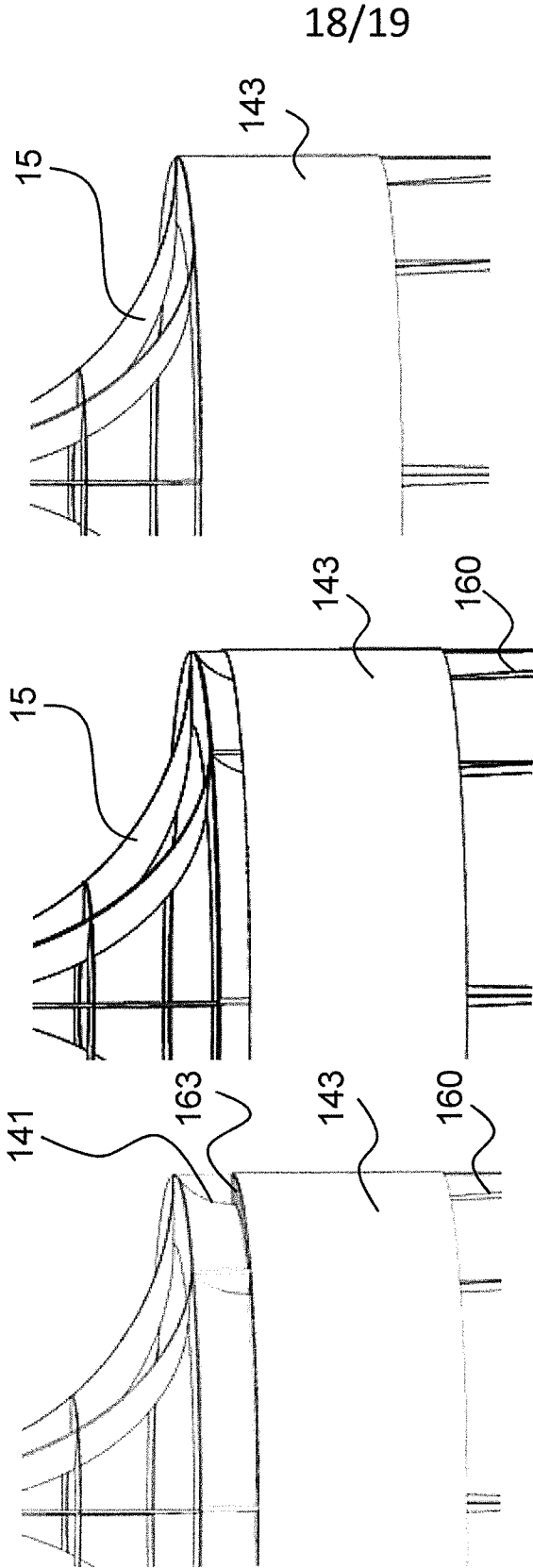


Fig. 16A

Fig. 16B

Fig. 16C

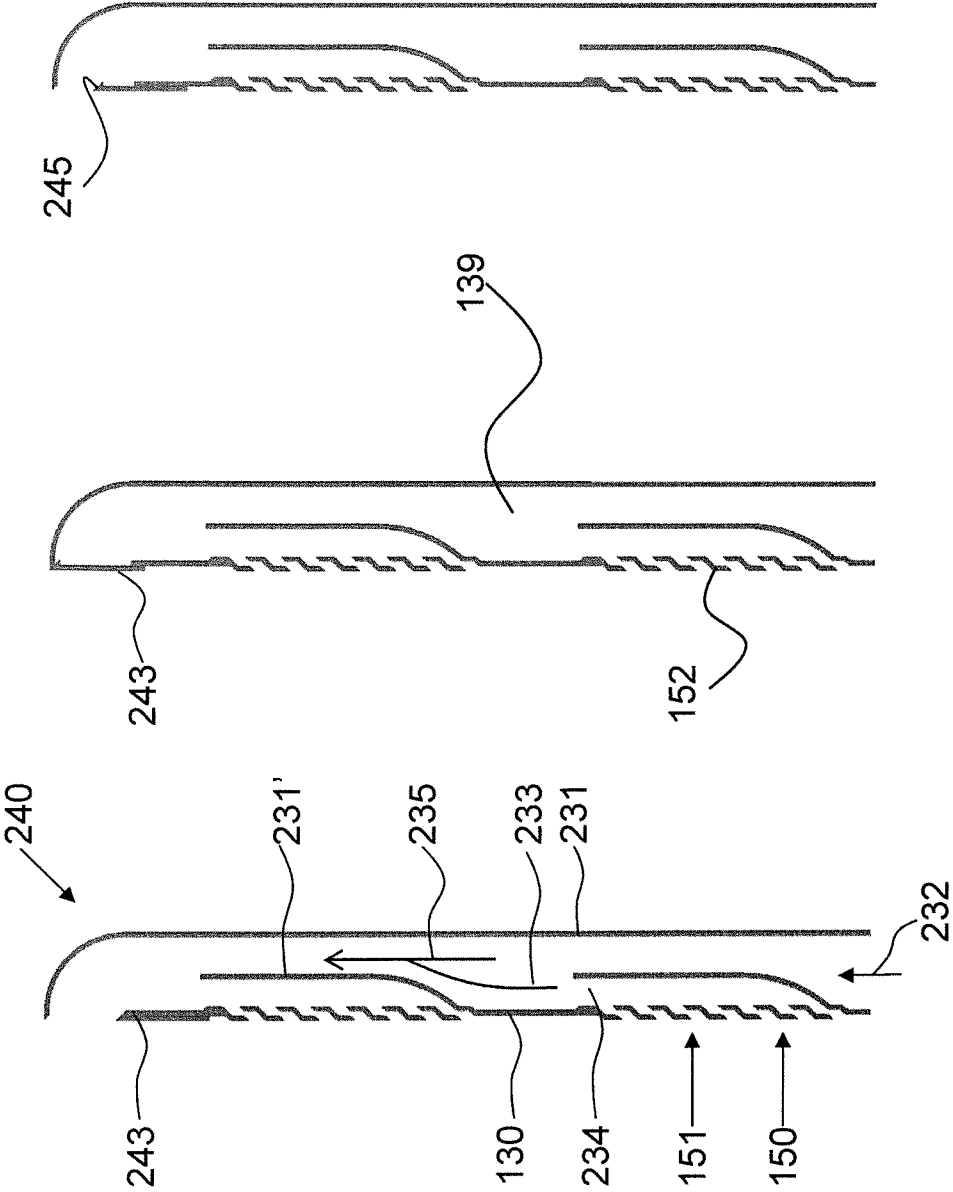


Fig. 17C

Fig. 17B

Fig. 17A

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/059480

A. CLASSIFICATION OF SUBJECT MATTER INV. F03D3/00 F03D9/35 F03D3/02 F03D3/04 F03D3/06 ADD.																				
According to International Patent Classification (IPC) or to both national classification and IPC																				
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F03D F03B F04D Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data																				
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>WO 2007/066207 A2 (IMPERA S R L [IT]; MELCHIORRI FILIPPO [IT]) 14 June 2007 (2007-06-14)</td> <td>1,2,4-6, 11-15</td> </tr> <tr> <td>Y</td> <td>page 2, line 23 - page 5, line 20; figures 1-8</td> <td>3</td> </tr> <tr> <td>Y</td> <td>----- US 5 213 473 A (FIALA ANDREAS [DE]) 25 May 1993 (1993-05-25) column 1, line 5 - line 8 column 4, line 5 - line 32; figures 1-4 column 5, line 55 - column 7, line 15</td> <td>3</td> </tr> <tr> <td>X</td> <td>----- US 5 300 817 A (BAIRD WILLIAM R [US]) 5 April 1994 (1994-04-05) column 3, line 40 - column 6, line 30; figures 1-7</td> <td>1-4,6, 11,13-15</td> </tr> <tr> <td></td> <td>----- -/--</td> <td></td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	WO 2007/066207 A2 (IMPERA S R L [IT]; MELCHIORRI FILIPPO [IT]) 14 June 2007 (2007-06-14)	1,2,4-6, 11-15	Y	page 2, line 23 - page 5, line 20; figures 1-8	3	Y	----- US 5 213 473 A (FIALA ANDREAS [DE]) 25 May 1993 (1993-05-25) column 1, line 5 - line 8 column 4, line 5 - line 32; figures 1-4 column 5, line 55 - column 7, line 15	3	X	----- US 5 300 817 A (BAIRD WILLIAM R [US]) 5 April 1994 (1994-04-05) column 3, line 40 - column 6, line 30; figures 1-7	1-4,6, 11,13-15		----- -/--	
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X	WO 2007/066207 A2 (IMPERA S R L [IT]; MELCHIORRI FILIPPO [IT]) 14 June 2007 (2007-06-14)	1,2,4-6, 11-15																		
Y	page 2, line 23 - page 5, line 20; figures 1-8	3																		
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Date of the actual completion of the international search		Date of mailing of the international search report																		
28 June 2018		05/07/2018																		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Herdemann, Claire																		

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/059480

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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X	US 2016/102499 A1 (STEWART KENNETH RODERICK [GB] ET AL) 14 April 2016 (2016-04-14) paragraph [0259] - paragraph [0263]; figures 1-10 paragraph [0001] paragraph [0180] - paragraph [0263]; figures 1-10 -----	1-3,5, 7-10, 13-15
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Information on patent family members

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