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(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

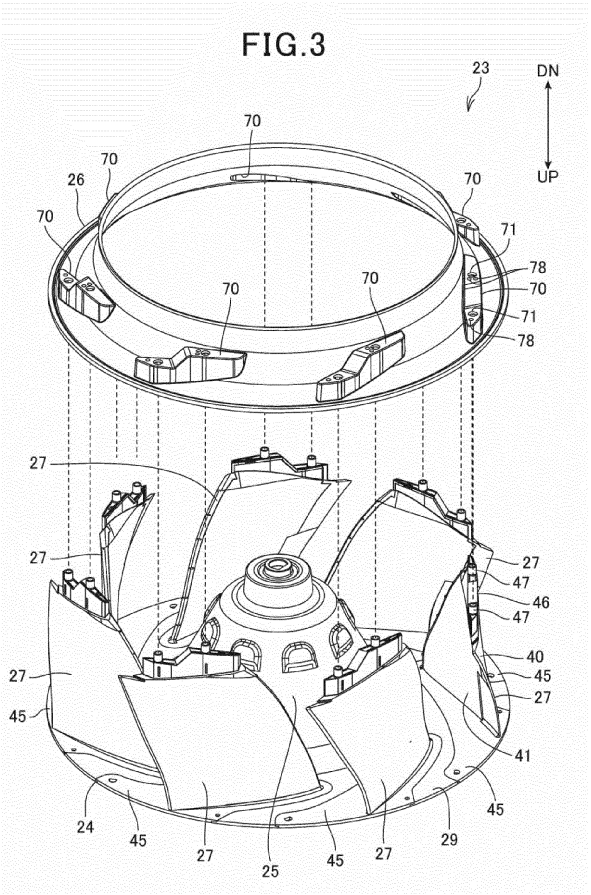
(72) Inventors:
- **DOI, Yasuyuki**
  Osaka, 540-6207 (JP)
- **OKABE, Kiyoshi**
  Osaka, 540-6207 (JP)
- **KURASHIGE, Shunichi**
  Osaka, 540-6207 (JP)

(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

(54) **CENTRIFUGAL FAN**

(57) [Problem to be Solved] The present disclosure provides a centrifugal fan in which a weld of a blade member and a shroud can be visually checked. [Solution] A centrifugal fan (23) in the present disclosure includes a main plate (24), a shroud (26), and a plurality of blade members (27). Each of the blade members is provided with a joining part (46) to be joined to the shroud. The joining part is provided with a rib. The joining part is joined to the shroud by welding the rib to the shroud. The shroud is provided with, as viewed from the height direction of the rib, a through hole (78) at a position overlapping with the rib.

FIG.3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a centrifugal fan.

Description of the Related Art

[0002] Japanese Patent Laid-Open No. 2014-206084 discloses a centrifugal fan which is equipped in, for example, an indoor unit of an air conditioner and serves as a turbofan including a main plate, a shroud, and a plurality of blade members. The shroud and the plurality of blade members are separately molded of thermoplastic resin, the shroud has engagement parts for the plurality of blade members, and the plurality of blade members are engaged with a plurality of the respective engagement parts of the shroud and integrated therewith by ultrasonic welding, thereby forming the centrifugal fan.

[0003] The present invention provides a centrifugal fan in which the quality of a weld of a blade member and a shroud can be visually determined without destructive testing.

SUMMARY OF THE INVENTION

[0004] A centrifugal fan in the present disclosure includes a main plate, a shroud, and a plurality of blade members, each of the blade members being provided with a joining part to be joined to the shroud, the joining part being provided with a rib, the joining part being joined to the shroud by welding the rib to the shroud, the shroud being provided with, as viewed from a height direction of the rib, a through hole at a position overlapping with the rib.

[Advantageous Effect of Invention]

[0005] According to the present disclosure, it is possible for the worker to visually check the rib via the through hole. Therefore, the worker can visually determine the quality of the weld of the blade member and the shroud without destructive testing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1 is a perspective view of an indoor unit of an air conditioning apparatus in which a centrifugal fan in an embodiment is used;

Fig. 2 is a vertical cross-sectional view of the indoor unit;

Fig. 3 is an exploded perspective view of the centrifugal fan;

Fig. 4 is a plan view of the centrifugal fan as viewed from the drain pan side;

Fig. 5 is a perspective view of a blade member as viewed from the drain pan side;

Fig. 6 is a plan view of a shroud as viewed from the main plate side;

Fig. 7 is a cross-sectional view taken along VII-VII of Fig. 4;

Fig. 8 is a cross-sectional view taken along VIII-VIII of Fig. 4; and

Fig. 9 is a plan view of a welding engagement part with a joining part inserted thereinto, as viewed from the drain pan side.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0007] Underlying knowledge and the like forming the basis of the present disclosure

[0008] At the time when the inventors conceived the present disclosure, a centrifugal fan was known which is equipped in, for example, an indoor unit of an air conditioner and serves as a turbofan including a main plate, a shroud, and a plurality of vanes.

[0009] In this centrifugal fan, the shroud and the plurality of blade members are separately molded of thermoplastic resin. The shroud has engagement parts for the plurality of blade members, and each of the blade members has a joining part to be engaged with the engagement part of the shroud. The joining part of each of the blade members is engaged with each of the engagement parts of the shroud and integrally joined thereto by ultrasonic welding, thereby forming the centrifugal fan.

[0010] However, in such a conventional turbofan, the joining part of each of the blade members is covered with the engagement part of the shroud. Accordingly, the inventors have found a problem in which because of the ultrasonic welding, it cannot be checked whether the blade members and the shroud are integrally joined together, and the inventors, in order to solve the problem, have configured the subject matter of the present disclosure.

[0011] Thus, the present disclosure provides a centrifugal fan in which a weld of a blade member and a shroud can be visually checked.

[0012] Hereinafter, an embodiment will be described in detail with reference to the drawings. However, unnecessarily detailed description may be omitted. For example, detailed description of already well-known matters or redundant description of substantially the same configurations may be omitted. This is to avoid unnecessary redundancy in the following description and to make it easier for those skilled in the art to understand.

[0013] The attached drawings and the following description are provided to allow those skilled in the art to sufficiently understand the present disclosure and are not intended to limit the subject matter described in the claims.

Embodiment

[0014] Hereinafter, the embodiment will be described with reference to Figs. 1 to 9.

[1-1. Configuration]

[1-1-1. Configuration of indoor unit]

[0015] Fig. 1 is a perspective view of an indoor unit 10 of an air conditioning apparatus 1 in which a centrifugal fan 23 in the present embodiment is used. Fig. 2 is a vertical cross-sectional view of the indoor unit 10.

[0016] The air conditioning apparatus 1 includes an indoor heat exchanger 30 housed in the indoor unit 10; a compressor, a decompression device, an outdoor heat exchanger, and the like which are housed in an outdoor unit; and a refrigeration cycle formed by an expansion valve, a switching valve, and the like. The air conditioning apparatus 1 causes a refrigerant to flow in the refrigeration cycle, thereby air-conditioning an indoor space provided with the indoor unit 10.

[0017] As illustrated in Fig. 1, the indoor unit 10 included in the air conditioning apparatus 1 of the present embodiment is a so-called ceiling-embedded indoor unit capable of sending air in four directions. As illustrated in Fig. 2, the indoor unit 10 is installed in a ceiling space 13 between a ceiling 11 of a building and a ceiling plate 12 installed below the ceiling 11. Hereinafter, for convenience of description, the up and down directions mean up and down in the state where the indoor unit 10 is installed, and the up direction is indicated by UP and the down direction is indicated by DN in each of the drawings.

[0018] The indoor unit 10 includes an indoor unit body 14 formed in a box shape having an open lower surface, and a suspension fitting 18 is attached to an outside corner portion of the indoor unit body 14. The indoor unit body 14 is installed in the state of being suspended from the ceiling 11 by a suspension bolt 15 connected to the suspension fitting 18. Inside the indoor unit body 14, a heat insulation member 16 made of styrene foam is provided. The heat insulation member 16 is disposed in the state of contacting an inner surface of a side plate 17 of the indoor unit body 14 and prevents condensation on the side plate 17.

[0019] A fan motor 21 is attached to a lower surface of an upper plate of the indoor unit body 14, and the fan motor 21 is provided with a rotation shaft 22 which extends downward and is rotationally driven by driving of the fan motor 21. The centrifugal fan 23 is attached to a lower end portion of the rotation shaft 22, and the fan motor 21 and the centrifugal fan 23 form a blower 20.

[0020] The centrifugal fan 23 includes a main plate 24 formed in an annular plate shape. At a central portion of the main plate 24, a motor housing part 25 is formed which has an inverted truncated cone shape extending downward.

[0021] The fan motor 21 is housed in the motor housing part 25, and the rotation shaft 22 of the fan motor 21 extends downward and is connected to a bottom surface of the motor housing part 25. Rotational driving of the fan motor 21 causes rotational operation of the centrifugal fan 23 via the rotation shaft 22.

[0022] At an outer periphery of the motor housing part 25, a main plate extension part 29 is provided which has a flat plate shape and extends outward to form an outer peripheral edge of the main plate 24.

[0023] A shroud 26 is provided below the main plate 24, and the shroud 26 is formed in an annular shape having an arc-shaped peripheral surface. A plurality of blade members 27 disposed at predetermined intervals in the circumferential direction is integrally formed between the main plate 24 and an inner peripheral surface of the shroud 26.

[0024] An orifice 28 is disposed below the shroud 26, and the orifice 28 is formed in an annular shape having an arc-shaped peripheral surface.

[0025] Between the blower 20 and the heat insulation member 16, the indoor heat exchanger 30 formed so as to bend in a substantially rectangular shape in a plan view is disposed so as to surround the side of the blower 20.

[0026] The indoor heat exchanger 30 is the indoor heat exchanger 30 that functions as a refrigerant evaporator in the cooling operation and that functions as a refrigerant condenser in the heating operation. The indoor heat exchanger 30 is configured to exchange heat between indoor air sucked into the indoor unit body 14 and the refrigerant such that air in an air-conditioned room can be cooled in the cooling operation and the indoor air can be heated in the heating operation.

[0027] On the lower side of the indoor heat exchanger 30, a drain pan 31 is disposed so as to correspond to a lower surface of the indoor heat exchanger 30. The drain pan 31 is for receiving drain water generated in the indoor heat exchanger 30. Furthermore, a suction port 32 of the blower 20 is formed at a central portion of the drain pan 31.

[0028] A decorative panel 33 having a substantially rectangular shape is attached to the lower surface of the indoor unit body 14 and covers a lower opening of the indoor unit body 14.

[0029] A suction port 34 communicating with the suction port 32 of the drain pan 31 is formed at a central portion of the decorative panel 33, and a suction grille 35 covering the suction port 34 is detachably attached to a portion of the decorative panel 33 where the suction port 34 is located. A filter 36 for removing dust and the like in the air is provided on the indoor unit body 14 side of the suction grille 35.

[0030] Outlet ports 37 for sending air-conditioned air into the room are respectively formed at positions along each side of the decorative panel 33 outside of the suction port 34 of the decorative panel 33. Each of the outlet ports 37 is provided with a flap 38 for opening and closing the outlet port 37 and changing the direction of air from

the outlet port 37.

[0031] In the indoor unit 10 of the present embodiment, by driving the blower 20, air in the indoor space is sucked from the suction port 34. The sucked air, after passing through the filter 36, passes through the indoor heat exchanger 30 and is heat-exchanged, and the air-conditioned air is, as a current of air, sent into the indoor space from the outlet port 37.

[1-1-2. Configuration of centrifugal fan]

[0032] Next, the centrifugal fan 23 will be described in detail.

[0033] Fig. 3 is an exploded perspective view of the centrifugal fan 23. Fig. 4 is a plan view of the centrifugal fan 23 as viewed from the drain pan 31 side (lower side).

[0034] As illustrated in Figs. 3 and 4, the centrifugal fan 23 is a so-called turbofan, and the centrifugal fan 23 is formed by the main plate 24, the shroud 26, and the plurality of blade members 27. These are separately manufactured and then assembled, thereby forming the centrifugal fan 23. In the present embodiment, each of the main plate 24, the shroud 26, and the plurality of blade members 27 is formed of thermoplastic resin.

[0035] Each of the main plate 24, the shroud 26, and the plurality of blade members 27 is formed of resin material having thermoplasticity. The material used in the shroud 26 and the material used in the plurality of blade members 27 are different from each other in color.

[0036] Fig. 5 is a perspective view of the blade member 27 as viewed from the drain pan 31 side (lower side).

[0037] As illustrated in Fig. 5, each of the blade members 27 is a member formed in a flat plate shape. Each of the blade members 27 is formed integrally with the main plate 24. Each of the blade members 27 includes a positive pressure surface 40 disposed so as to face the motor housing part 25 and located on the positive pressure side of the centrifugal fan 23, and a negative pressure surface 41 disposed so as to face the indoor heat exchanger 30 and located on the negative pressure side of the centrifugal fan 23. Each of the blade members 27 includes, in the rotational direction of the centrifugal fan 23, a front edge 48 located on the front side and a rear edge 49 located on the rear side.

[0038] An upper end 43 of each of the blade members 27 has a flat surface formed thereon, and the upper end 43 is provided with a flange 45 extending outward over the entire periphery. An upper surface of the flange 45 forms a plane continuous with the flat surface of the upper end of each of the blade members 27. The flange 45 forms a part of the main plate extension part 29 in the assembled centrifugal fan 23.

[0039] A lower end 44 of each of the blade members 27 is provided with a joining part 46 protruding downward. The joining part 46 is formed so as to extend from the front edge 48 side to the rear edge 49 side in a plan view. The joining part 46 is formed in a step shape having different heights from the front edge 48 side to the rear edge 49 side. In the present embodiment, the joining part 46 is provided with an upper step portion 52 on the front edge 48 side and is provided with a lower step portion 54 on the rear edge 49 side which protrudes downward from the upper step portion 52.

[0040] Each of upper surfaces of the upper step portion 52 and the lower step portion 54 is formed into a flat surface. The upper surfaces of the upper step portion 52 and the lower step portion 54 are connected by an inclined surface 42.

[0041] Each of the upper surfaces of the upper step portion 52 and the lower step portion 54 is provided with a joining pin 47. The joining pin 47 is formed in a cylindrical shape having a diameter dimension substantially identical to the width dimension of the joining part 46 and protrudes downward from each of the upper surfaces of the upper step portion 52 and the lower step portion 54.

[0042] Each of the upper surfaces of the upper step portion 52 and the lower step portion 54 is provided with a plurality of welding ribs 56. Each of the welding ribs 56 is formed in a triangular shape in a lateral cross-sectional view (Fig. 7). Each of the welding ribs 56 is disposed so as to extend along, in a peripheral edge of each of the upper surfaces of the upper step portion 52 and the lower step portion 54, an edge portion located in the direction orthogonal to the longitudinal direction of the joining part 46. That is, each of the welding ribs 56 is disposed so as to extend along the longitudinal direction of the joining part 46 at a position in proximity to the edge portion located on each of the positive pressure surface 40 side and the negative pressure surface 41 side in each of the upper surfaces of the upper step portion 52 and the lower step portion 54. Thus, each of the upper surfaces of the upper step portion 52 and the lower step portion 54 is provided with two welding ribs 56 along the direction orthogonal to the longitudinal direction of the joining part 46, that is, the width direction of the joining part 46.

[0043] Furthermore, each of the welding ribs 56 is disposed at a position avoiding the joining pin 47 in each of the upper surfaces of the upper step portion 52 and the lower step portion 54.

[0044] In the present embodiment, the welding rib 56 is omitted on the positive pressure surface 40 side on the front edge 48 side of the upper step portion 52.

[0045] Fig. 6 is a plan view of the shroud 26 as viewed from the main plate 24 side (upper side).

[0046] As illustrated in Fig. 6, the shroud 26 is provided with a plurality of welding engagement parts 70 with which the respective joining parts 46 of the blade members 27 are engaged. Each of the welding engagement parts 70 is formed in a recessed shape as viewed from the inside surface side of the shroud 26, and each of the welding engagement parts 70 is formed so as to bulge from the inside surface side of the shroud 26 toward the outside surface side of the shroud 26.

[0047] Fig. 7 is a cross-sectional view taken along VII-VII of Fig. 4. Fig. 8 is a cross-sectional view taken along VIII-VIII of Fig. 4.

[0048] As illustrated in Figs. 7 and 8, the shape of an inner peripheral surface of each of the welding engagement parts 70 is formed so as to be substantially identical to the outer shape of the joining part 46. When the joining part 46 of the blade member 27 is inserted into and engaged with the welding engagement part 70, the blade member 27 and the shroud 26 are supported stably on each other.

[0049] In the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, an upper step abutment surface 72 disposed so as to face the upper surface of the upper step portion 52 of the joining part 46 and a lower step abutment surface 74 disposed so as to face the upper surface of the lower step portion 54 are provided at predetermined areas of the welding engagement part 70. Each of the upper step abutment surface 72 and the lower step abutment surface 74 is provided with an insertion hole 71 serving as a through hole for allowing the inside surface side of the shroud 26 and the outside surface side of the shroud 26 to communicate with each other. When the joining part 46 is inserted into and engaged with the welding engagement part 70, each of the joining pins 47 is inserted into each of the insertion holes 71.

[0050] A plurality of welding ribs 76 extending along the longitudinal direction of the welding engagement part 70 is provided at substantially the center of each of the upper step abutment surface 72 and the lower step abutment surface 74. Each of the welding ribs 76 is disposed at a position avoiding the insertion hole 71 in each of the upper step abutment surface 72 and the lower step abutment surface 74.

[0051] When the joining part 46 is inserted into and engaged with the welding engagement part 70, the welding rib 76 is disposed between a pair of the welding ribs 56 in the direction orthogonal to the longitudinal direction of the joining part 46, as illustrated in Fig. 7.

[0052] In the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, an upper end of each of the welding ribs 76 abuts against the upper surface of the upper step portion 52 of the joining part 46 or the upper surface of the lower step portion 54 of the joining part 46. Furthermore, in the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, an upper end of each of the welding ribs 56 abuts against the upper step abutment surface 72 or the lower step abutment surface 74.

[0053] Each of the upper step abutment surface 72 and the lower step abutment surface 74 is provided with a checking hole 78. The checking hole 78 is a through hole for allowing the inside surface side of the shroud 26 and the outside surface side of the shroud 26 to communicate with each other.

[0054] In the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, each of the checking holes 78 is, as viewed from the height direction of the welding ribs 56, provided at a position overlapping with at least one of the welding ribs 56. That is, in the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, each of the checking holes 78 is, as viewed from the height direction of the welding ribs 56, provided within at least one of projection surfaces of the welding ribs 56.

[0055] In the present embodiment, two checking holes 78 are provided on the upper step abutment surface 72, and one checking hole 78 is provided on the lower step abutment surface 74. That is, the checking holes 78 are provided at predetermined intervals along the longitudinal direction of the joining part 46.

[0056] Of these, the two checking holes 78 provided on the upper step abutment surface 72 are provided at predetermined intervals along the direction orthogonal to the longitudinal direction of the joining part 46. Thus, the two checking holes 78 provided on the upper step abutment surface 72 are respectively provided at the position overlapping with the welding rib 56 provided at the position in proximity to the edge portion on the positive pressure surface 40 side and at the position overlapping with the welding rib 56 provided at the position in proximity to the edge portion on the negative pressure surface 41 side. In the present embodiment, the welding rib 76 is disposed at an area located between the two checking holes 78 provided on the upper step abutment surface 72.

[0057] Furthermore, each of the checking holes 78 is disposed in the vicinity of the insertion hole 71.

[0058] Any number of the checking holes 78 may be provided at any arrangement positions according to the shape or size of each of the joining part 46 and the welding engagement part 70.

[0059] Fig. 9 is a plan view of the welding engagement part 70 with the joining part 46 inserted thereinto, as viewed from the drain pan 31 side.

[0060] The diameter dimension of each of the checking holes 78 is formed so as to be larger than the width dimension of the welding rib 56. Accordingly, in the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, the entire welding rib 56 in the width direction which is provided at the position overlapping with the checking hole 78 can be visually checked from the drain pan 31 side via the checking hole 78.

[0061] Furthermore, as described above, each of the blade members 27 and the shroud 26 are formed of members having different colors from each other. Thus, the welding rib 56 and the welding engagement part 70 are formed of members having different colors from each other. Accordingly, via each of the checking holes 78, the corresponding welding rib 56 can be more reliably visually checked.

[1-2. Assembly procedures]

[0062] Next, assembly procedures of the centrifugal fan 23 will be described.

[0063] In the present embodiment, the main plate 24

and each of the blade members 27 are fixed by being housed in a predetermined mold and then are insert-molded, so that the main plate 24 and each of the blade members 27 are integrally formed. Each of the blade members 27 is thereby provided on an upper surface of the main plate extension part 29 of the main plate 24.

[0064] Next, each of the blade members 27 and the shroud 26 are integrally fixed by ultrasonic welding.

[0065] Specifically, the joining part 46 of each of the blade members 27 is inserted into and engaged with the welding engagement part 70. At this time, the joining pin 47 of the joining part 46 is inserted into the insertion hole 71 of the welding engagement part 70 and protrudes toward the outside surface side of the shroud 26.

[0066] At this time, it is possible for a worker to check whether or not, via each of the checking holes 78, the corresponding welding rib 56 can be visually checked. This makes it possible to check that each of the welding ribs 56 has a rib shape and check whether or not the joining part 46 and the welding engagement part 70 are reliably engaged with each other.

[0067] As described above, the joining part 46 is inserted into and engaged with the welding engagement part 70, so that it is possible to support the welding engagement part 70 and the joining part 46 on each other.

[0068] Furthermore, in this state, the upper end of each of the welding ribs 76 abuts against the upper surface of the upper step portion 52 of the joining part 46 or the upper surface of the lower step portion 54 of the joining part 46. Furthermore, in the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, the upper end of each of the welding ribs 56 abuts against the upper step abutment surface 72 or the lower step abutment surface 74.

[0069] In the above-described state, when a horn of an ultrasonic welding machine is pressed against a predetermined area of the welding engagement part 70 with a predetermined pressure and then the horn is ultrasonically vibrated, ultrasonic vibration is given to the welding engagement part 70 and the joining part 46.

[0070] As described above, the welding engagement part 70 and the joining part 46 are in contact with each other via each of the welding ribs 56 and each of the welding ribs 76. Furthermore, each of the welding ribs 56 and each of the welding ribs 76 are formed in a triangular shape in a lateral cross-section. Thus, when ultrasonic vibration is given to the welding engagement part 70 and the joining part 46, each of the welding ribs 56 and each of the welding ribs 76 function as a so-called energy director in which intensive expansion and contraction movement is generated. Due to frictional heat generated by the vibration, each of the welding ribs 56 and each of the welding ribs 76 generate heat in a short time and melt when reaching a predetermined resin melting temperature.

[0071] Accordingly, the upper surface of the upper step portion 52 and the upper step abutment surface 72 are welded together, and the upper surface of the lower step portion 54 and the lower step abutment surface 74 are welded together, so that the welding engagement part 70 and the joining part 46 are joined together. Thus, the shroud 26 is fixed to the lower end of each of the blade members 27.

[0072] As described above, each of the checking holes 78, as viewed from the height direction of the welding rib 56, opens in contact with the upper end of the welding rib 56 disposed at the position overlapping with the checking hole 78. Thus, when each of the welding ribs 56 is melted by ultrasonic welding, the melted welding rib 56 enters the inside of the checking hole 78 and raises toward an opening of the checking hole 78 which is located on the outside surface side of the shroud 26.

[0073] The worker, via each of the checking holes 78, visually checks the state of the welding rib 56 which can be visually checked from the checking hole 78, so that the worker can check whether or not the welding rib 56 has melted.

[0074] This makes it possible for the worker to easily check whether the blade member 27 and the shroud 26 are welded and joined together.

[0075] This prevents checking of the joining area of the welding engagement part 70 and the joining part 46 through, for example, experimentally destroying the joining area. Specifically, the worker can visually determine the quality of the weld of the blade member and the shroud without destructive testing. That is, in the present embodiment, the manufacturing cost of the centrifugal fan 23 can be reduced.

[1-3. Effects and the like]

[0076] As above, in the present embodiment, the centrifugal fan 23 includes the main plate 24, the shroud 26, and the plurality of blade members 27. Each of the blade members 27 is provided with the joining part 46 to be joined to the welding engagement part 70 of the shroud 26, and the joining part 46 is provided with the plurality of welding ribs 56. Each of the joining parts 46 is joined to the shroud 26 by welding the welding rib 56 to the shroud 26. The shroud 26 is, as viewed from the height direction of the welding rib 56, provided with the checking hole 78 at the position overlapping with the welding rib 56.

[0077] Accordingly, the worker, when joining the blade member 27 and the shroud 26 together by means of ultrasonic welding, via each of the checking holes 78, visually checks the state of the welding rib 56 which can be visually checked from the checking hole 78, so that the worker can check whether or not the welding rib 56 has melted. Therefore, the worker can easily check whether or not the blade member 27 and the shroud 26 are welded and joined together and thus can visually determine the quality without destructive testing.

[0078] As in the present embodiment, at least two checking holes 78 may be provided along the longitudinal direction of the joining part 46.

[0079] Accordingly, in at least two areas along the lon-

gitudinal direction of the joining part 46, the worker can visually check the welding rib 76 via the checking hole 78. Therefore, the worker, when joining the blade member 27 and the shroud 26 together, can check positional deviation of the joining part 46 and the welding engagement part 70 in the longitudinal direction of the joining part 46 or a presence or absence of nonuniformity of a pressing force of the horn of the ultrasonic welding machine.

[0080] As in the present embodiment, at least two checking holes 78 may be provided along the direction orthogonal to the longitudinal direction of the joining part 46.

[0081] Accordingly, in at least two areas along the direction orthogonal to the longitudinal direction of the joining part 46, the worker can visually check the welding rib 76 via the checking hole 78. Therefore, the worker, when joining the blade member 27 and the shroud 26 together, can check positional deviation of the joining part 46 and the welding engagement part 70 in the direction orthogonal to the longitudinal direction of the joining part 46 or a presence or absence of nonuniformity of a pressing force of the horn of the ultrasonic welding machine.

[0082] As in the present embodiment, the diameter dimension of the checking hole 78 may be formed so as to be larger than the width dimension of the welding rib 56.

[0083] Accordingly, in the state where the joining part 46 is inserted into and engaged with the welding engagement part 70, the entire welding rib 56 in the width direction which is provided at the position overlapping with the checking hole 78 can be visually checked from the drain pan 31 side via the checking hole 78. Therefore, when the welding engagement part 70 and the joining part 46 are not welded together, the worker can visually check an outer edge of the welding rib 56 in the width direction via the checking hole 78. Thus, the worker can check whether or not the welding engagement part 70 and the joining part 46 are welded together.

[0084] As in the present embodiment, the welding rib 56 may be formed of a member having a color different from a color of a member forming the shroud 26.

[0085] This makes it possible for the worker to improve the visibility of the welding rib 56 via each of the checking holes 78. Therefore, it is possible to more reliably check whether or not the welding engagement part 70 and the joining part 46 are appropriately engaged with each other or whether or not the welding engagement part 70 and the joining part 46 are welded together.

Other embodiments

[0086] As above, the embodiment has been described as an example of the technique disclosed in the present application. However, the technique in the present disclosure is not limited to this and is also applicable to embodiments in which changes, replacements, additions, omissions, and the like are made. Furthermore, it is possible to combine each of the components described in the embodiment to form a new embodiment.

[0087] Accordingly, other embodiments will be exemplified below.

[0088] In the above-described embodiment, each of the checking holes 78 is provided in the vicinity of each of the insertion holes 71. However, not limited to this, each of the checking holes 78 may be provided at positions close to each of both ends of the joining part 46 in the longitudinal direction.

[0089] This makes it possible for the worker to visually check the welding rib 76 via the checking hole 78, in the vicinity of both ends of the joining part 46 in the longitudinal direction. Therefore, the worker, when joining the blade member 27 and the shroud 26 together, can more reliably check positional deviation of the joining part 46 and the welding engagement part 70 in the direction orthogonal to the longitudinal direction of the joining part 46 or a presence or absence of nonuniformity of a pressing force of the horn of the ultrasonic welding machine.

[0090] In the above-described embodiment, ultrasonic welding is used as means for welding each of the blade members 27 and the shroud 26 together. However, not limited to this, another welding means, such as impulse welding (heater welding) or infrared heater welding, may be used.

[0091] In the above-described embodiment, each of the welding ribs 56 and 76 is formed in a triangular shape in a lateral cross-section. However, not limited to this, the upper end of each of the welding ribs 56 and 76 may be formed in another shape, such as a flat surface, a gable shape, or an arch shape.

[Industrial Applicability]

[0092] The present disclosure is applicable to a centrifugal fan that allows a worker to visually check a weld of a blade member and a shroud. Specifically, the present disclosure is applicable to, for example, an indoor unit of an air conditioning apparatus.

[Reference Signs List]

[0093]

1	air conditioning apparatus
10	indoor unit
20	blower
21	fan motor
22	rotation shaft
23	centrifugal fan
24	main plate
25	motor housing part
26	shroud
27	blade member
30	indoor heat exchanger
31	drain pan
46	joining part
56, 76	welding rib

70 welding engagement part
78 checking hole (through hole)

Claims

1. A centrifugal fan comprising a main plate (24), a shroud (26), and a plurality of blade members (27), **characterized in that**

   each of the blade members is provided with a joining part (46) to be joined to the shroud,
   the joining part is provided with a rib (56, 76),
   the joining part is joined to the shroud by welding the rib to the shroud,
   the shroud is provided with, as viewed from a height direction of the rib, a through hole (78) at a position overlapping with the rib.

2. The centrifugal fan according to claim 1, wherein at least two of the through holes are provided along a longitudinal direction of the joining part.

3. The centrifugal fan according to claim 2, wherein the through holes are provided at positions close to each of both ends of the joining part in the longitudinal direction.

4. The centrifugal fan according to any one of claims 1 to 3, wherein at least two of the through holes are provided along a direction orthogonal to a longitudinal direction of the joining part.

5. The centrifugal fan according to any one of claims 1 to 4, wherein a diameter dimension of the through hole is formed so as to be larger than a width dimension of the rib.

6. The centrifugal fan according to any one of claims 1 to 5, wherein the rib is formed of a member having a color different from a color of a member forming the shroud.

FIG.1

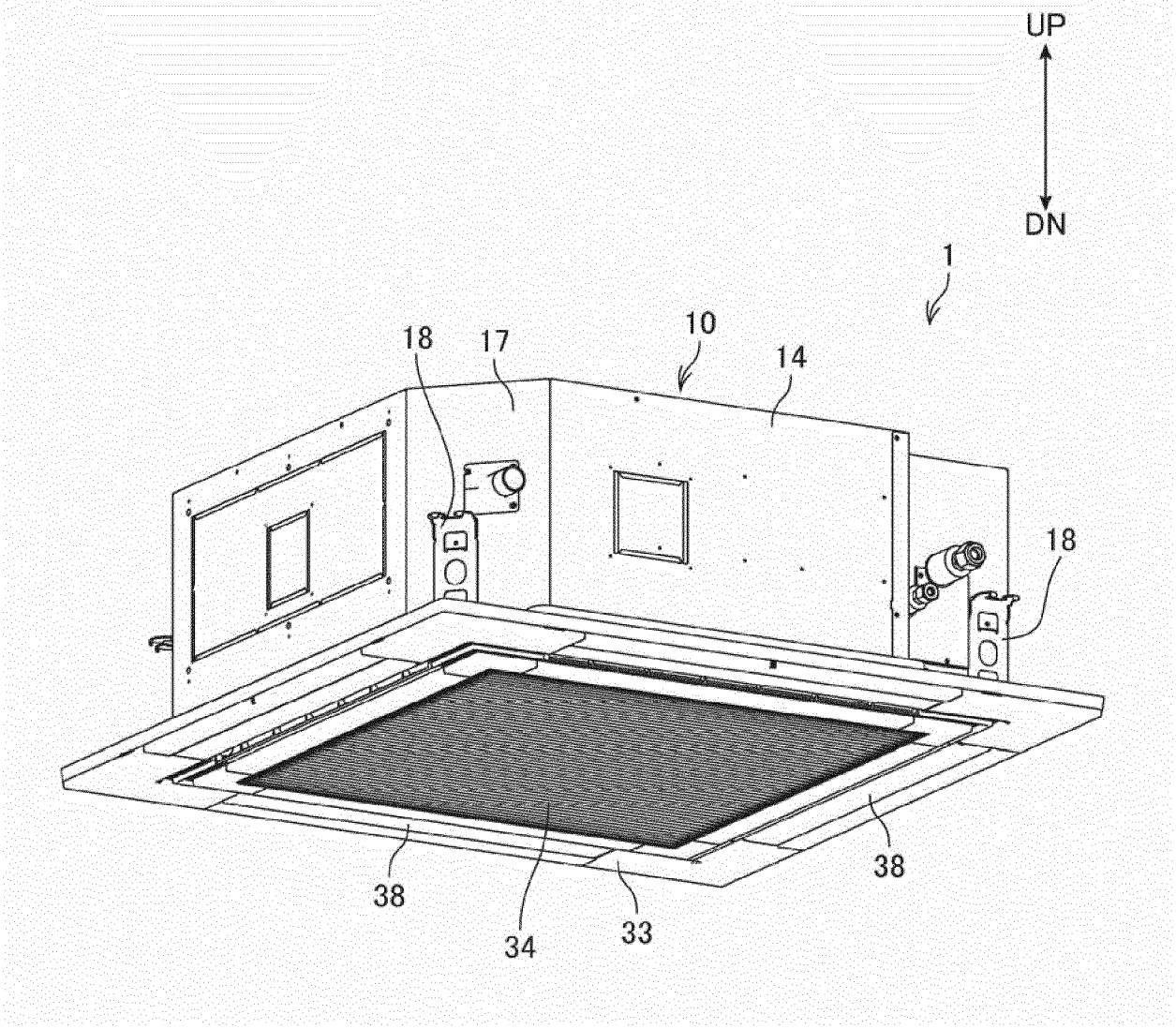

FIG.2

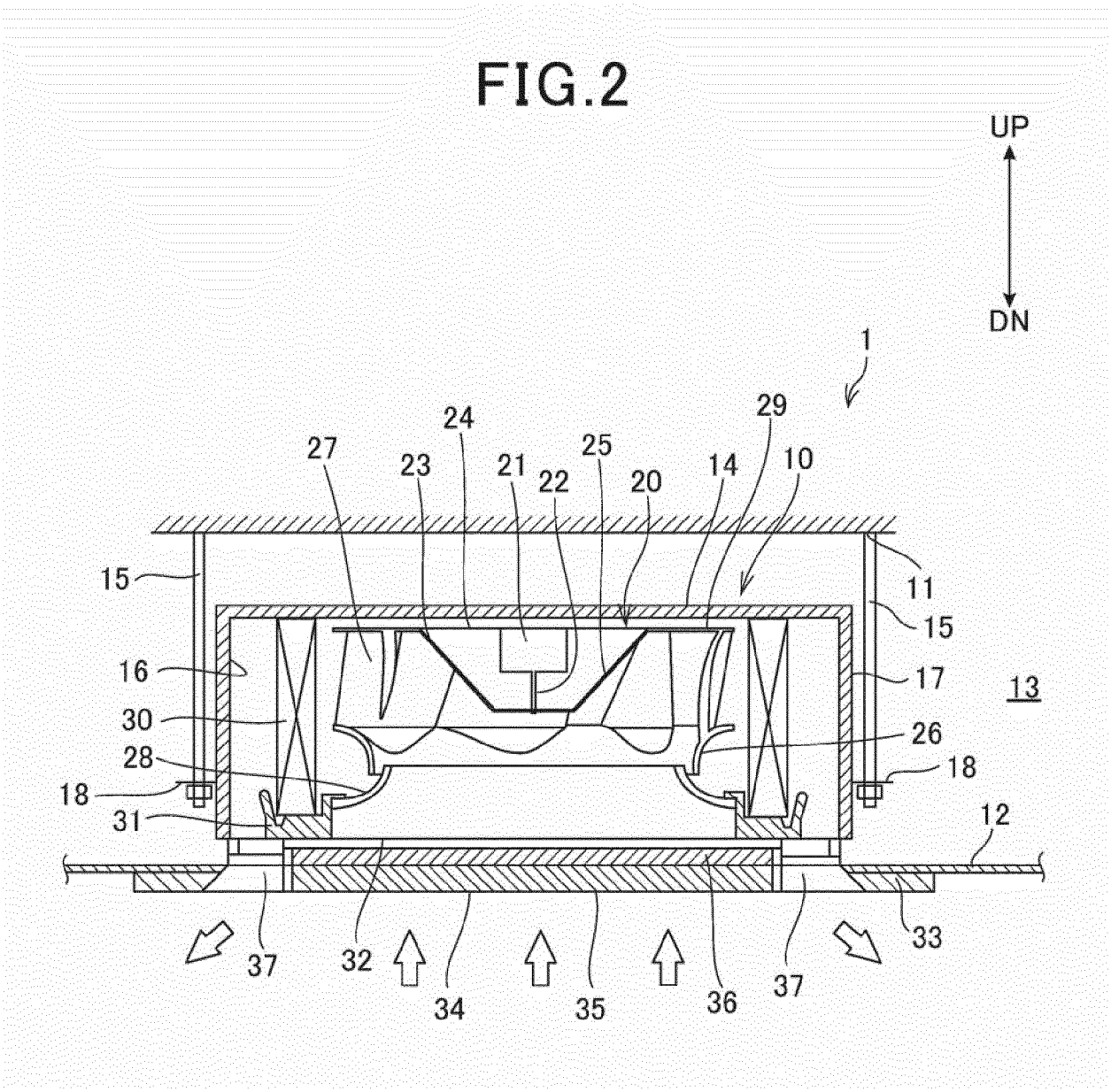
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FIG.3

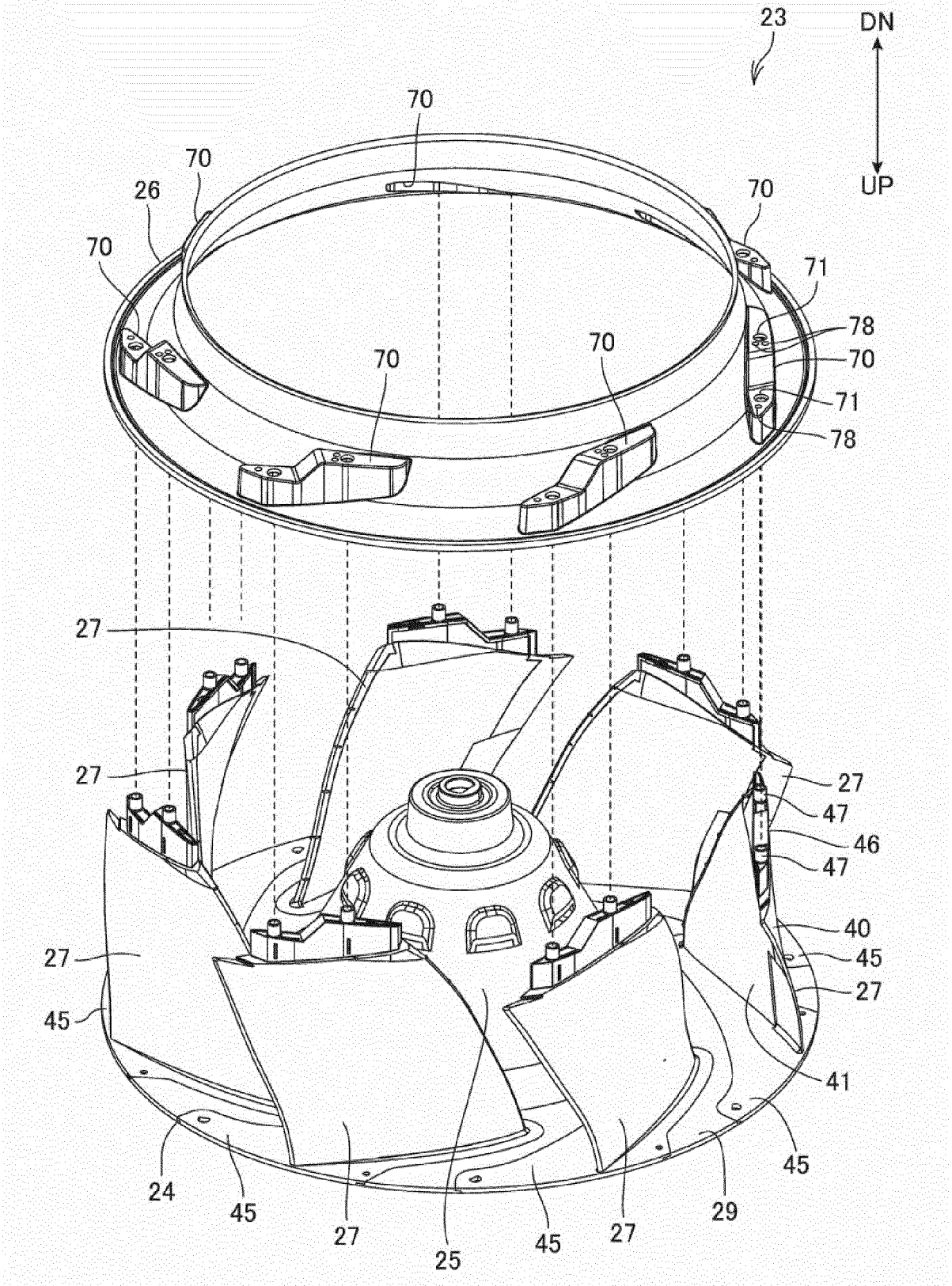
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FIG.4

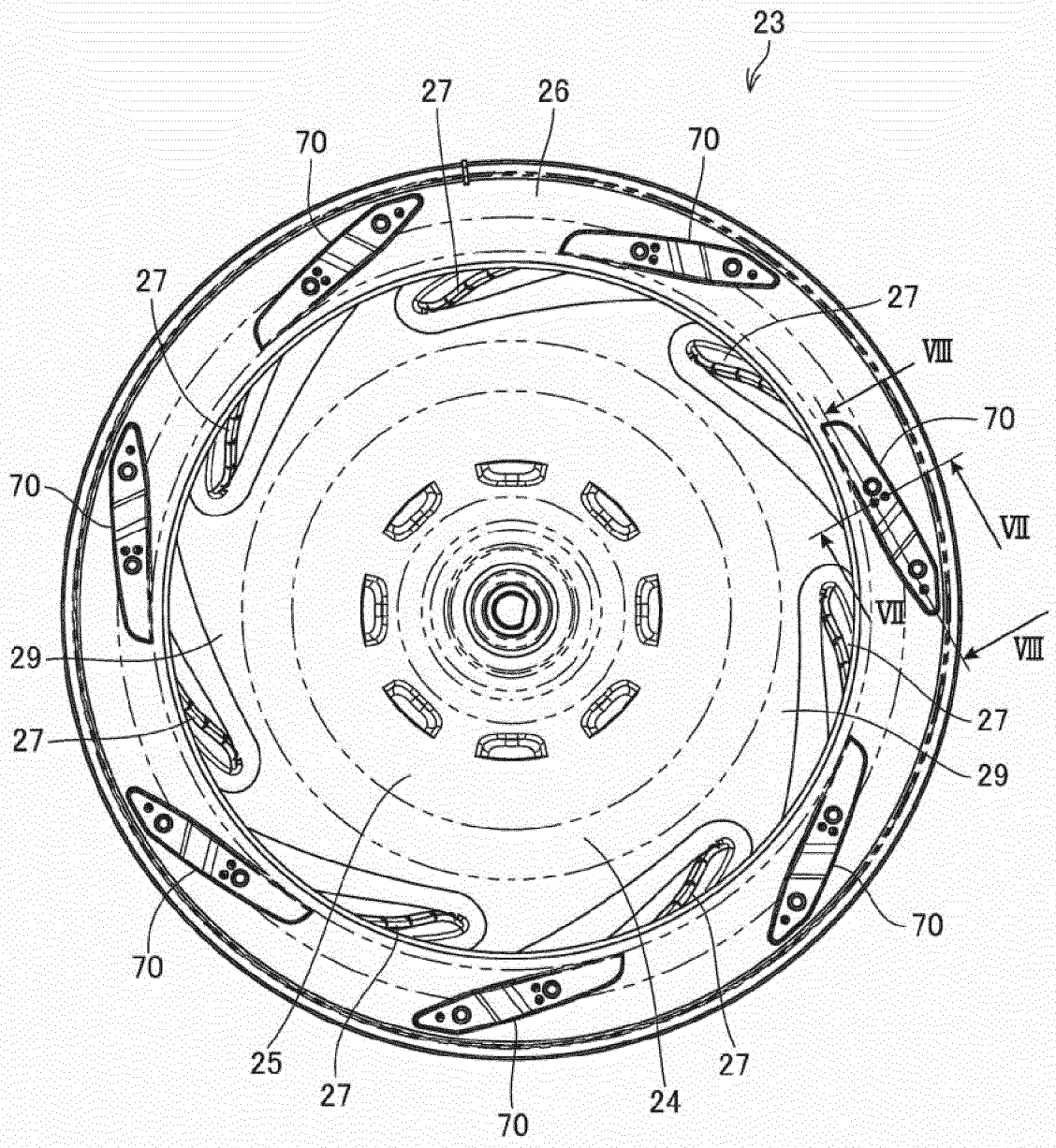
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FIG.5

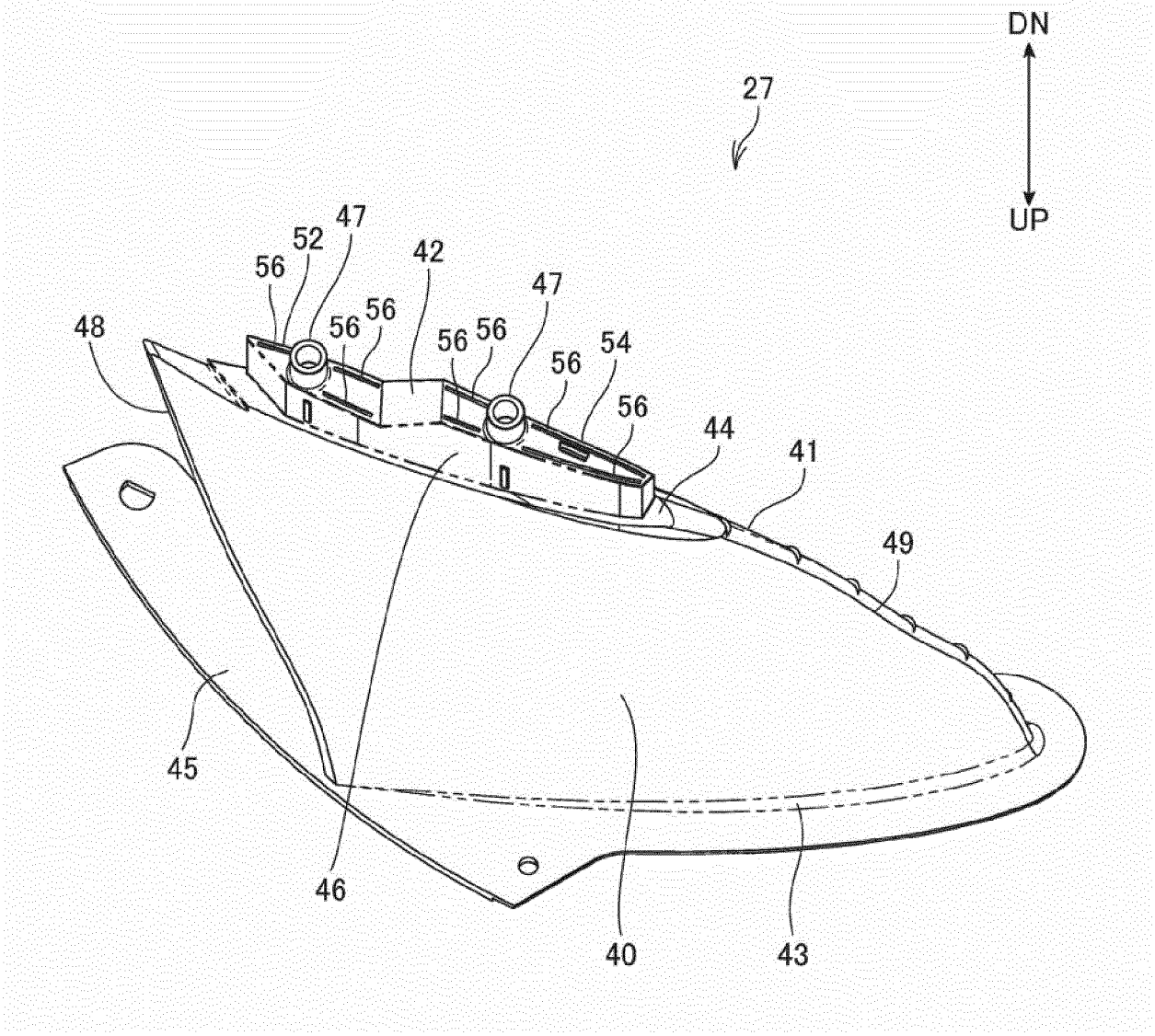


FIG.6

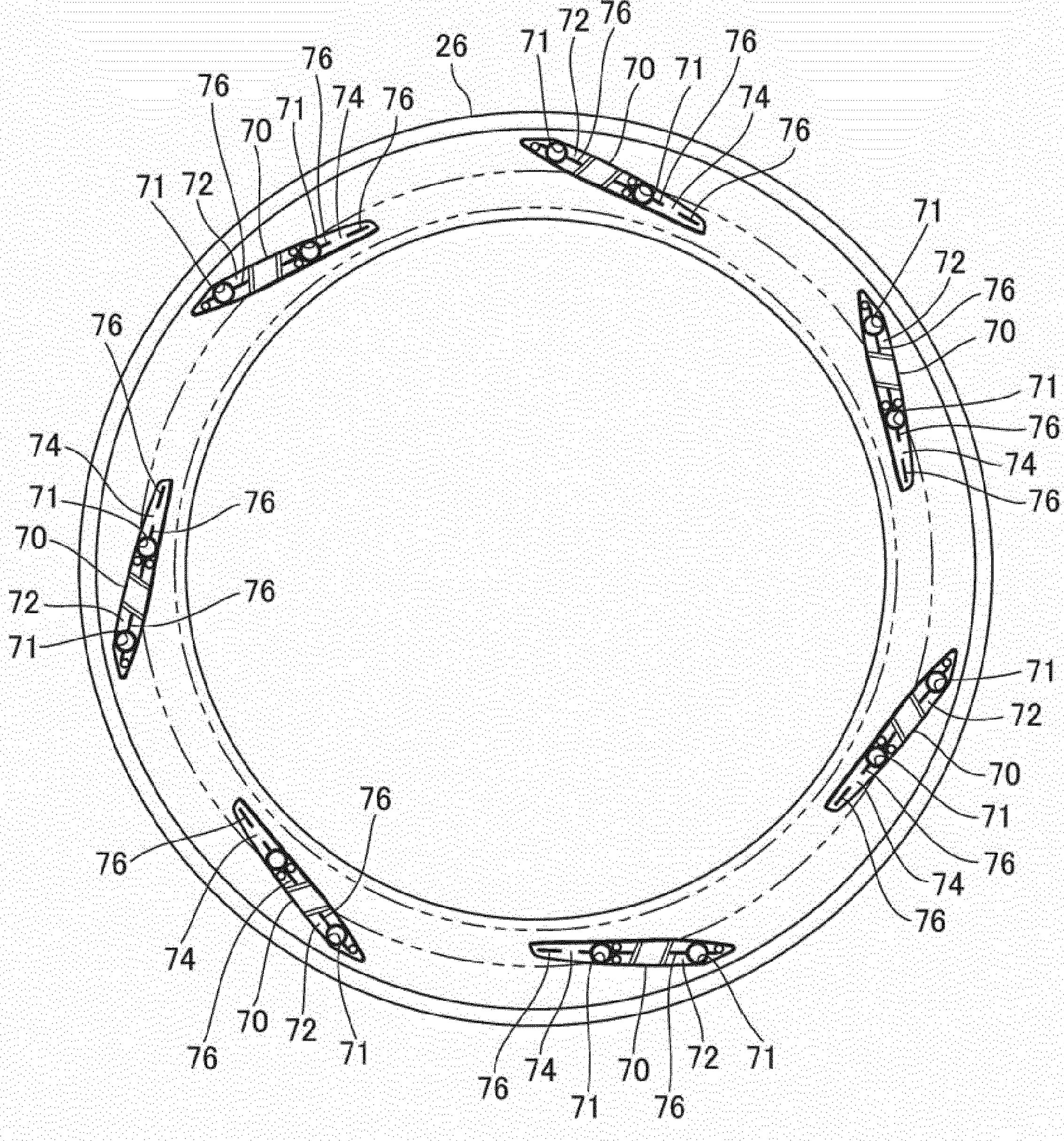


FIG.7

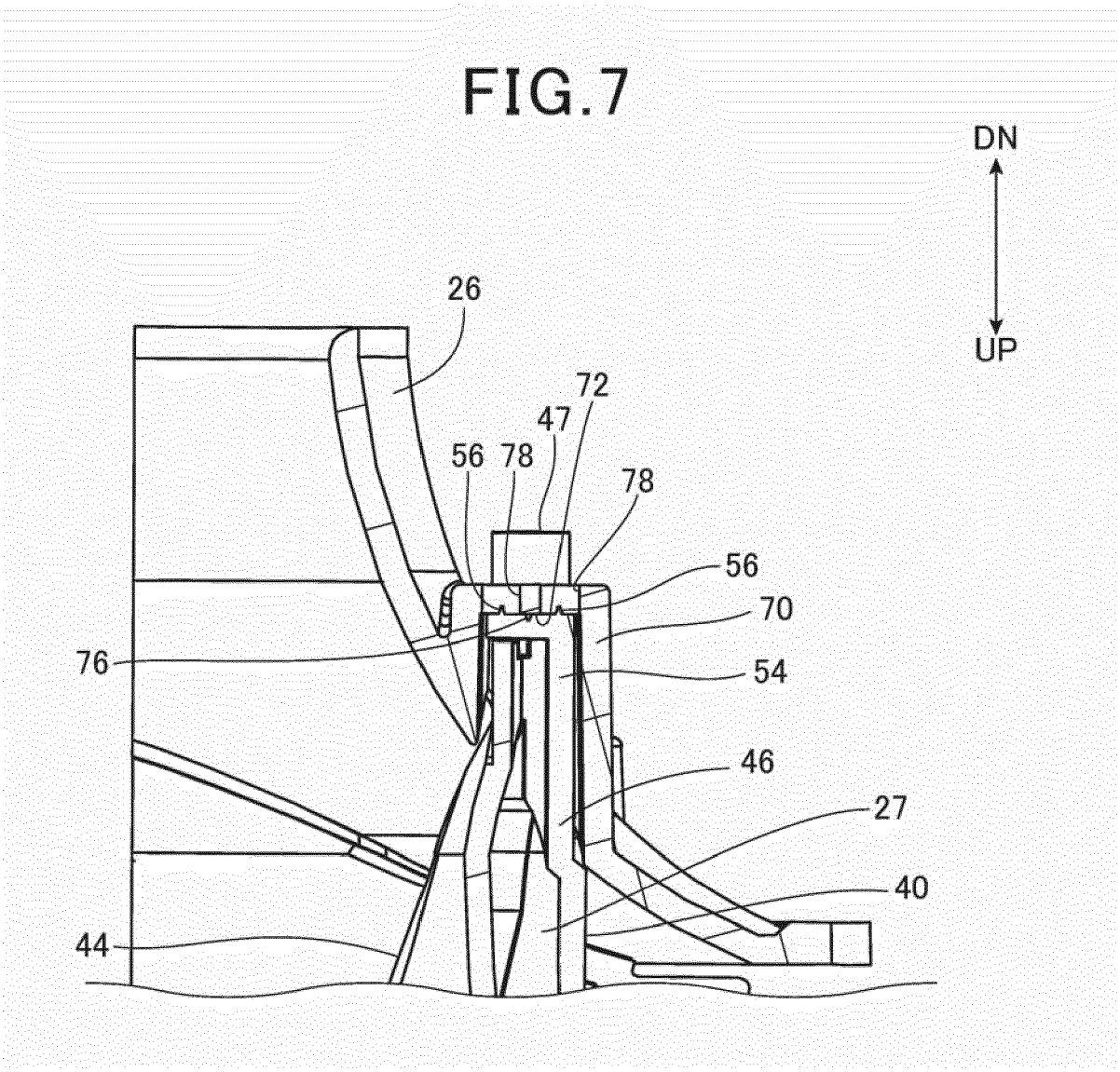


FIG.8

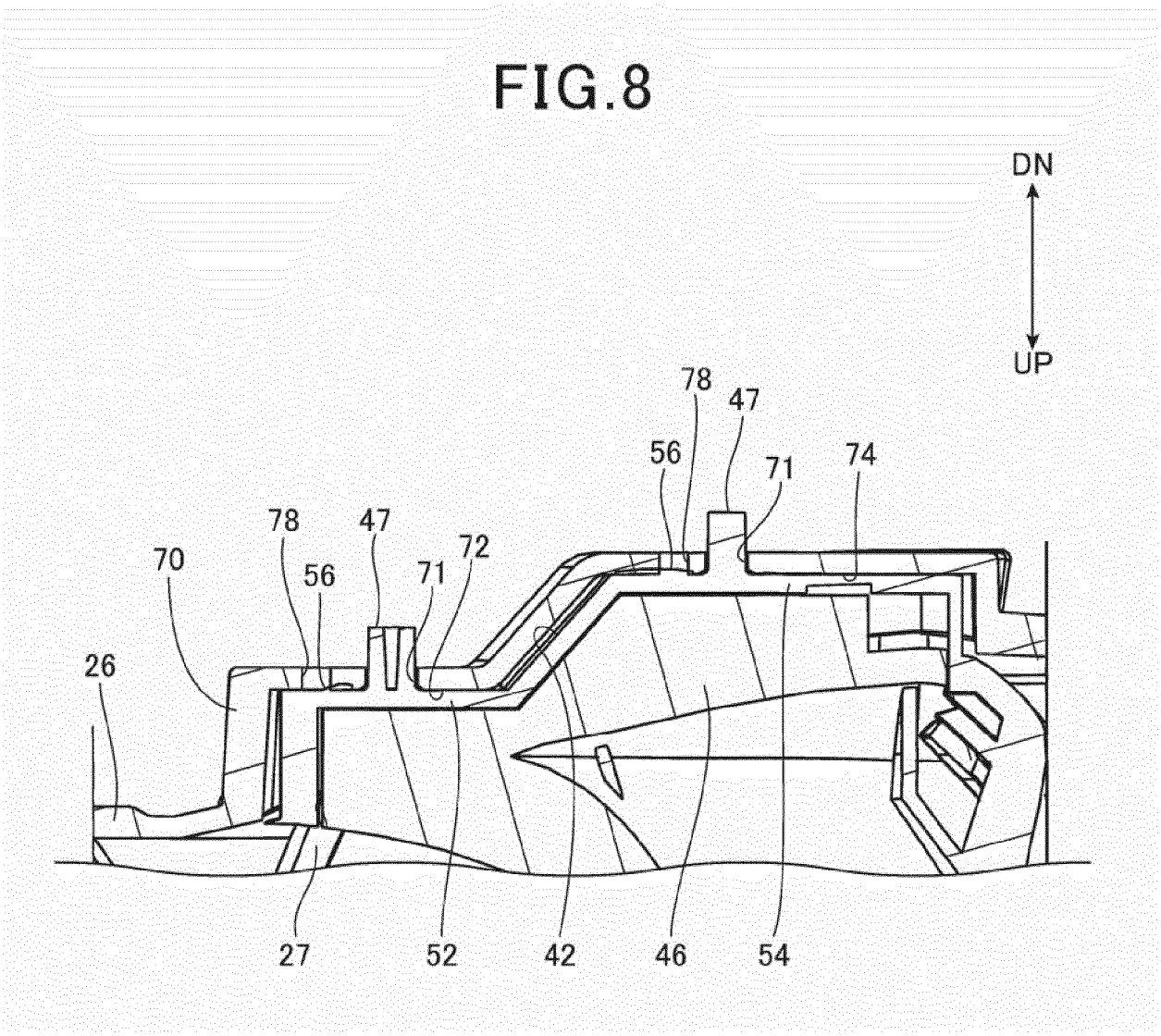
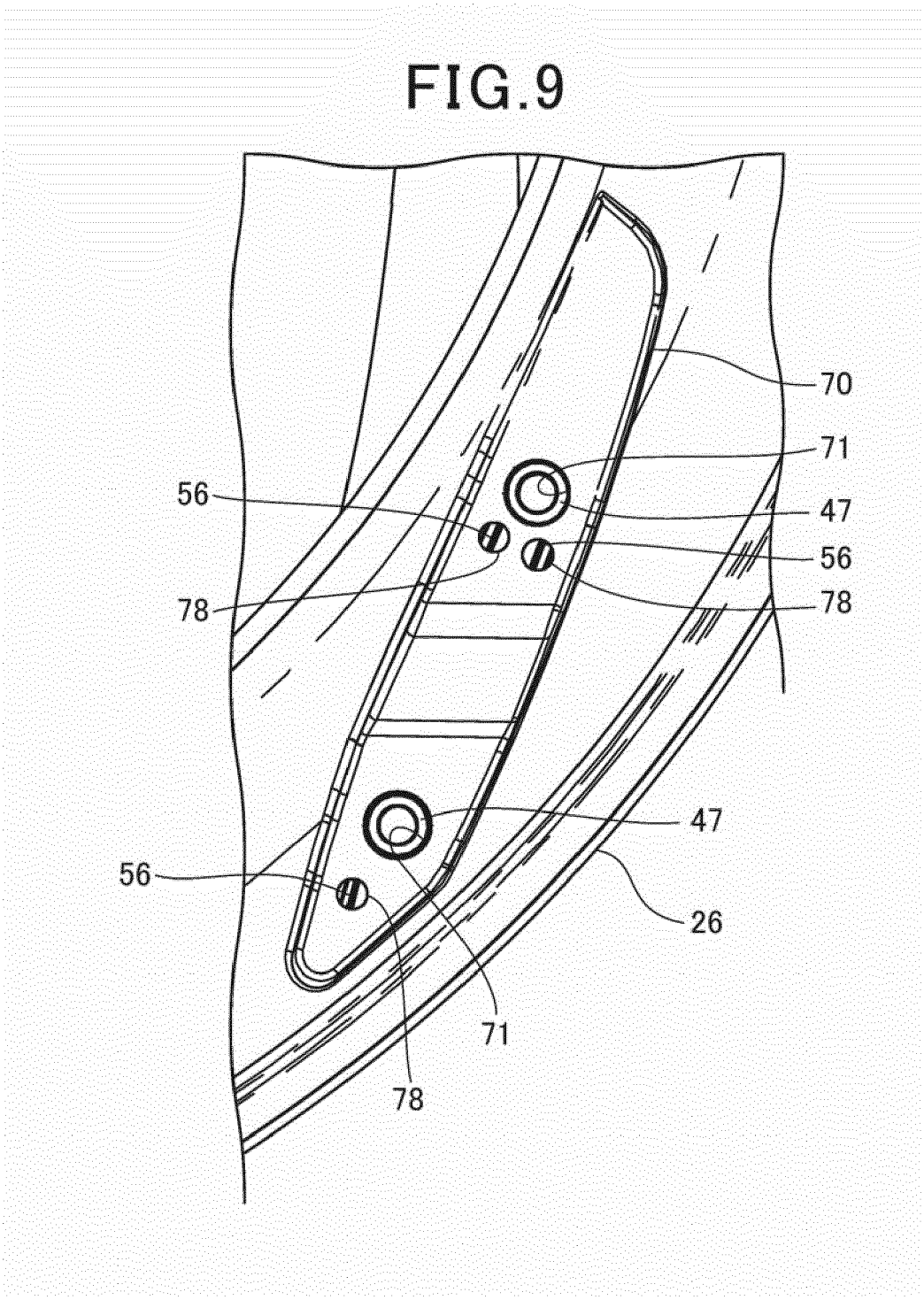


FIG.9



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EUROPEAN SEARCH REPORT

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Place of search	Date of completion of the search	Examiner
The Hague	3 February 2022	Hermens, Sjoerd

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