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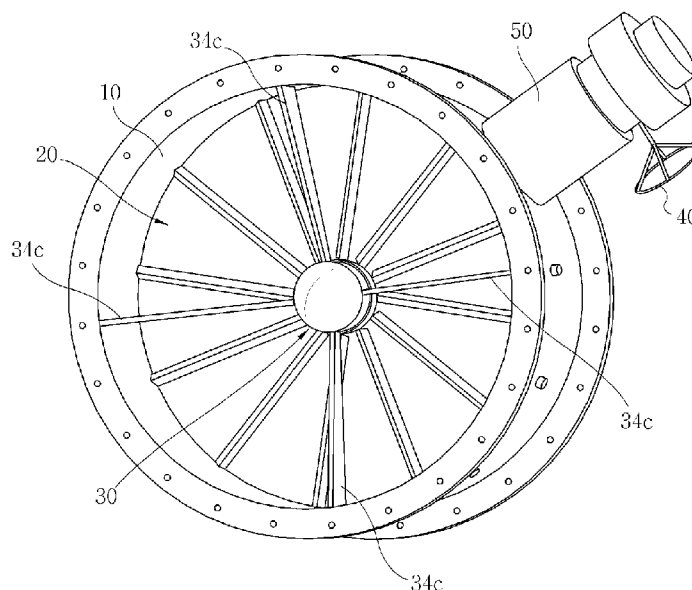
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(54) Title: DAMPER TYPE FLOW CONTROL APPARATUS

Fig. 5



(57) Abstract: The present invention relates to a flow control apparatus which can control a forced draft flow of a fan, and more particularly, to a flow control apparatus which can not only precisely control an opening/closing angle but also improve operating reliability. According to the present invention, a flow control apparatus includes a flange defining the outward appearance, a plurality of vanes rotatably installed on the flange to open and close the flange, a driving means for rotating the vanes, and a gear assembly for transferring a turning force of the driving means to the vanes.

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Description

DAMPER TYPE FLOW CONTROL APPARATUS

Technical Field

- [1] The present invention relates to a flow control apparatus which can control a forced draft flow of a fan, and more particularly, to a flow control apparatus which can not only precisely control an opening/closing angle but also improve operating reliability.

Background Art

- [2] In general, a forced draft fan (hereinafter, referred to as 'FD fan') is a key component of the shipbuilding equipment which performs forced draft of a ship boiler combustion apparatus. Recently, as the necessity of energy saving is increased in the ship equipment, there has been developed an FD fan consuming less power and having high efficiency. Therefore, in order to reduce power consumption, it is preferable to develop the FD fan to perform air control according to variations of external load conditions. In a case where such an FD fan is applied to a ship, even if external load conditions are seriously changed during the ship traveling, the external load conditions can be efficiently controlled to save much power. Recently, a fan capable of automatically or manually controlling a flow by means of a link type vane damper has been applied to most of ships.
- [3] FIG. 1 is a view illustrating one example of a conventional link type vane damper, and FIG. 2 is a view illustrating one example of a link assembly of FIG. 1. Referring to FIGS. 1 and 2, the conventional link type vane damper includes a flange 1 for guiding air toward a fan, a plurality of vanes 2 installed on the flange 1 to be openable and closable, a link type power transfer portion 3 for transferring power to the vanes 2, and a handle 4 and a motor 5 for manually or automatically supplying power to the link type power transfer portion 3.
- [4] The vanes 2 are arc-shaped disks arranged in a circumference direction, and rotation shafts(not shown) are installed in a radius direction to be supported on the flange 1. The vanes 2 are rotated by the link type power transfer portion 3 to open and close the flange 1.
- [5] In detail, the link type power transfer portion 3 includes bases 3a supported on the outer circumference of the flange 1 to communicate with ends of the rotation shafts, respectively, rotary links 3b installed on the bases 3a so that their centers can be connected to the ends of the rotation shafts, respectively, and first and second linear links 3c and 3d connected to one ends of adjacent arms at both ends of the rotary links

3b respectively so that a turning force can be transferred to between the rotary links 3b. The handle 4 or the motor 5 is connected to one of the rotary links 3b to manually or automatically transfer a turning force.

- [6] FIGS. 3 and 4 are views illustrating operating states of the link assembly of FIG. 1. As illustrated in FIG. 3, when the handle 4 or the motor 5 supplies a turning force in one direction, one of the rotary links 3b and the vane 2 connected thereto are rotated, the first and second linear links 3c and 3d interworking with the rotary link 3b are linearly moved in opposite directions, and the other rotary links 3b and the vanes 2 connected thereto are rotated. Accordingly, the vanes 2 are opened to open the flange 1. On the contrary, as shown in FIG. 4, when the handle 4 or the motor 5 supplies a turning force in the opposite direction, the vanes 2 are rotated in the opposite direction by the same procedure, to close the flange 1.
- [7] However, in the conventional link type vane damper, power is transferred through a complicate structure including the rotary links, the linear links and the likes. Therefore, the assembly unbalance may occur and the production cost may rise. In addition, a transfer torque applied to the links may not be uniformly distributed but concentrated on a specific link, or a twisting moment may be generated between the links to thereby damage the links.
- [8] Moreover, when the conventional link type vane damper is applied to an FD fan and a combustion apparatus of a ship, since power is not smoothly transferred due to chattering at the initial starting, the opening/closing angle of the vanes is difficult to control precisely. As a result, a flow introduced into the combustion apparatus by the FD fan is not precisely controlled, so that serious soot and smoke are generated in the combustion apparatus due to incomplete combustion.

Disclosure of Invention

Technical Problem

- [9] The present invention is conceived to solve the aforementioned problems in the prior art. An object of the present invention is to provide a flow control apparatus capable of precisely controlling an opening/closing angle by means of uniform power transfer.
- [10] Another object of the present invention is to provide a flow control apparatus with a simple configuration.

Technical Solution

- [11] According to an aspect of the present invention for achieving the above objects,

there is provided a damper type flow control apparatus, including a flange defining the outward appearance, a plurality of vanes rotatably installed on the flange to open and close the flange, a driving means for rotating the vanes, and a gear assembly for transferring a turning force of the driving means to the vanes.

- [12] In addition, the gear assembly includes a plurality of rotation shafts to which the vanes are to be fixed respectively, one ends of which being supported on the flange, the other ends of which being collected in the center of the flange, a plurality of gears formed at the other ends of the rotation shafts and arranged in a circumference direction, and a pinion engaged with the gears in an axis direction.
- [13] Moreover, one of the rotation shafts of the gear assembly protrudes to the outside of the flange to be connected to the driving means.
- [14] Further, the rotation shafts include assembly grooves formed in a radius direction, and the vanes include assembly protrusions formed in a radius direction to be fitted into the assembly grooves of the rotation shafts.
- [15] Furthermore, the gear assembly includes a cap fixed to the center of the flange to cover the gears, and further includes a cover coupled to the cap in an axis direction to cover the pinion, the other ends of the rotation shafts being rotatably installed therein.
- [16] Still furthermore, the cap is fixed by a plurality of supporters formed between the inner circumference of the flange and the outer circumference of the cap in a circumference direction.
- [17] Still furthermore, portions of the cap and the cover which are in contact with the rotation shafts include a plurality of grooves into which the rotation shafts are to be fitted.
- [18] Still furthermore, the gear assembly further includes a surface pressure control portion for controlling a pressure between the gears and the pinion according to an assembly degree.
- [19] Still furthermore, the cap and the surface pressure control portion are assembled in an axis direction, the cap is installed in a flow inlet direction, and the surface pressure control portion is installed in a flow outlet direction.
- [20] Still furthermore, the gears and a tooth surface of the pinion engaged with the gears in an axis direction are formed in a straight or spiral shape.
- [21] According to another aspect of the present invention, there is provided a damper type flow control apparatus, including a flange defining the outward appearance, a plurality of vanes rotatably installed on the flange to open and close the flange, and a gear assembly connected to the vanes to rotate the vanes, wherein the gear assembly

includes a plurality of rotation shafts, one ends of which being fixed to the flange, the other ends of which being formed in the center of the flange, a plurality of gears formed at the other ends of the rotation shafts, respectively, and a pinion engaged with the gears in an axis direction, and further comprises a driving member for driving the gear assembly, the driving member being connected to one of the rotation shafts, the rotation shafts and the vanes being integrally coupled to each other, respectively.

- [22] In addition, the gears and a tooth surface of the pinion engaged with the gears in an axis direction are formed in a straight or spiral shape.
- [23] Moreover, the vanes include overlapping portions bent to the front on one side, and assembly protrusions formed in a radius direction at the rear.
- [24] Further, the rotation shafts include assembly grooves formed in a radius direction to be coupled to the vanes.
- [25] Furthermore, in the gear assembly, a cap is fixed to one side of the rotation shafts to protect the gears in the center of the flange, and a cover is rotatably installed on the other side of the rotation shafts to protect the pinion.
- [26] Still furthermore, the cap is fixed by a plurality of supporters formed between the inner circumference of the flange and the outer circumference of the cap in a circumference direction.
- [27] Still furthermore, contact portions of the cap and the cover include a plurality of grooves into which the rotation shafts are to be fitted.
- [28] Still furthermore, the gear assembly further includes a surface pressure control portion for controlling a pressure between the gears and the pinion according to an assembly degree.
- [29] Still furthermore, the cap and the surface pressure control portion are assembled in an axis direction, the cap is installed in a flow inlet direction, and the surface pressure control portion is installed in a flow outlet direction.

Advantageous Effects

- [30] According to the flow control apparatus of the present invention with the above configuration, a turning force transferred to one rotation shaft can be uniformly transferred to the other rotation shafts through the gear assembly including the gears and the pinion engaged with each other, thereby improving operating reliability. The opening/closing angle of the rotation shafts and the vanes connected thereto can be precisely controlled according to the size of the gears such as a gear tooth number, thereby improving the flow control performance.
- [31] In addition, according to the flow control apparatus of the present invention, the

gears and the pinion are mounted between the cap and the cover, so that the configuration can be simplified and the assembly time and the production cost can be reduced. Since the surface pressure between the gears and the pinion is controllable by the surface pressure control portion, a backlash that may occur in the gear assembly can be prevented and the height can be easily controlled.

Brief Description of the Drawings

- [32] FIG. 1 is a view illustrating one example of a conventional link type vane damper;
- [33] FIG. 2 is a view illustrating one example of a link assembly of FIG. 1;
- [34] FIGS. 3 and 4 are views illustrating operating states of the link assembly of FIG. 1;
- [35] FIG. 5 is a perspective view illustrating a flow control apparatus according to a first embodiment of the present invention;
- [36]
- [37] FIG. 6 is an exploded perspective view illustrating a gear assembly according to the first embodiment of the present invention;
- [38] FIG. 7 is a perspective view illustrating a portion of an assembled vane and rotation shaft according to the first embodiment of the present invention;
- [39] FIG. 8 is a sectional view illustrating the gear assembly according to the first embodiment of the present invention; and
- [40] FIG. 9 is a perspective view illustrating a portion of a gear assembly according to a second embodiment of the present invention.

Mode for the Invention

- [41] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.
- [42] FIG. 5 is a perspective view illustrating a flow control apparatus according to a first embodiment of the present invention. The flow control apparatus includes a flange 10 through which a fluid passes, a plurality of vanes 20 for opening and closing the flange 10, a gear assembly 30 for transferring power to the vanes 20, and a handle 40 and a motor 50 for manually or automatically supplying power to the gear assembly 30.
- [43] The flange 10 is formed in the shape of a circular frame to define the outward appearance so that the fluid can pass therethrough in an axis direction. The vanes 20 are arranged in a circumference direction, and rotated in a radius direction by the gear assembly 30 to open and close the flange 10.
- [44] Here, the handle 40 and the motor 50 can be controlled to determine a flow according to an ambient temperature and to maintain an optimum opening/closing

angle of the vanes 20, and can be manually operated in case of repair. In addition, a separate display device for externally displaying the opening/closing angle of the vanes 20 can be further installed.

[45] FIG. 6 is an exploded perspective view illustrating the gear assembly according to the first embodiment of the present invention, and FIG. 7 is a perspective view illustrating a portion of the assembled vane and rotation shaft according to the first embodiment of the present invention. The gear assembly 30 includes a plurality of rotation shafts 31 connected to radius direction centers of the vanes 20, a plurality of gears 32 integrally formed with one ends of the rotation shafts 31 and arranged in a circumference direction, a pinion 33 engaged with the gears 32, a cap 34 and a cover 35 installed to surround the gears 32 and the pinion 33, a bearing 36 coupled to a shaft of the pinion 33 to rotatably install the pinion 33, a surface pressure control portion 37 for controlling a pressure between the gears 32 and the pinion 33 according to an assembly degree, and first and second mood bolts 38 and 39 for coupling the surface pressure control portion 37 to the cover 35.

[46] Here, the cap 34, the rotation shafts 31 and the gears 32, the pinion 33, the cover 35, the bearing 36 and the surface pressure control portion 37 are successively installed in a fluid flowing direction.

[47] In detail, one ends of the rotation shafts 31 are installed toward the center of the flange 10, and the other ends thereof are rotatably installed on the flange 10. One of the rotation shafts 31 penetrates through the flange 10 and connects to the handle 40 or the motor 50 on the outer circumference of the flange 10 to obtain a turning force.

[48] In addition, the rotation shafts 31 are connected to the vanes 20, respectively. Assembly protrusions 20a elongated in the radius direction centers of the vanes 20 are fitted into assembly grooves 31a elongated in the rotation shafts 31 in a radius direction. At this time, the gears 32 are integrally formed with inner diameter side ends of the rotation shafts 31, and the assembly grooves 31a are formed in outer diameter side ends of the rotation shafts 31. Therefore, the vanes 20 are assembled on the outer diameter side of the rotation shafts 31. When the rotation shafts 31 are arranged in a circumference direction, the gears 32 are arranged in a circumference direction at predetermined intervals, and overlapping portions 21 bently formed at one side circumference direction ends of the vanes 20 overlap with the adjacent vanes 20.

[49] The pinion 33 includes a front ring-shaped tooth surface 33a with gear teeth formed in a circumference direction to be engaged with the gears 32, and a rotation shaft 33b of the pinion 33 protruding from a rear center. The gears 32 are arranged on the tooth

surface 33a of the pinion 33 in a circumference direction and engaged therewith in an axis direction. The pinion 33 and the gears 32 are formed in a straight, i.e., linear shape.

- [50] For example, twelve vanes 20, rotation shafts 31 and gears 32 may be formed. Although one of the rotation shafts 31 is supplied with power and one of the gears 32 is driven, since the pinion 33 and the gears 32 are engaged with each other and rotated together, a turning force is transferred to the other gears 32 and the rotation shafts 31.
- [51] The cap 34 is installed to cover the gears 32. The cap 34 includes a streamlined leading portion 34a with a protruding center to minimize a flow resistance in a fluid inlet direction, and a plurality of grooves 34b formed in a rear end of the cap 34 in a circumference direction at predetermined intervals so that the rotation shafts 31 can be fitted thereto. Here, a plurality of supporters 34c are welded and fixed between the inner circumference of the flange 10 and the cap 34 so as to fix the cap 34 to the center of the flange 10, and the cover 35 is coupled to the rear end of the cap 34.
- [52] The cover 35 is coupled to the cap 34 to cover the pinion 33. The cover 35 includes a plurality of grooves 35a formed in a front end and engaged with the grooves 34b of the cap 34 so that the rotation shafts 31 can be fitted thereto, and a rear mounting hole 35b in which the rotation shaft 33b of the pinion 33, the bearing 36 and a part of the surface pressure control portion 37 are to be mounted. The cap 34 and the cover 35 can be implemented into various forms, e.g., may have a step difference so that the front end of the cover 35 can be easily coupled to the rear end of the cap 34.
- [53] The bearing 36 is a ball bearing coupled to the rotation shaft 33b of the pinion 33 to rotatably install the pinion 33. At this time, the rotation shaft 33b of the pinion 33 is coupled to the inner circumference of the bearing 36, and the outer circumference of the bearing 36 is coupled to the inner circumference of the surface pressure control portion 37.
- [54] The surface pressure control portion 37 includes a supporting portion 37a in which the bearing 36 is to be mounted, the supporting portion 37a penetrating through the mounting hole 35b of the cover 35 and supporting a rear surface of the pinion 33, a fastening portion 37b expanded from the supporting portion 37a in a radius direction, and provided with fastening holes to which the first and second mood bolts 38 and 39 are to be fastened, and a rear end portion 37c with a center formed to protrude from the fastening portion 37b to the rear in a streamlined shape so as to reduce a discharged flow resistance. Preferably, the surface pressure control portion 37 is smaller than the cap 34 and the cover 35.

[55] At this time, the fastening portion 37b of the surface pressure control portion 37 is fastened to a tap(not shown) formed on the rear surface of the cover 35 by means of the first mood bolts 38, so that the surface pressure control portion 37 is fixed to the cover 35. In addition, the fastening portion 37b of the surface pressure control portion 37 is fastened to push the rear surface of the cover 35 by means of the second mood bolts 39, thereby controlling an assembly degree of the surface pressure control portion 37.

[56] FIG. 8 is a sectional view illustrating the gear assembly according to the first embodiment of the present invention. The cap 34 is fixed by the supporters 34c by means of welding or the like to be positioned in the center of the flange 10, the gears 32 and the pinion 33 are engaged with each other in an axis direction, and the cap 34 and the cover 35 are assembled with the gears 32 and the pinion 33 positioned therebetween. The rotation shafts 31 penetrate through the grooves 34b and 35a of the cap 34 and the cover 35, respectively.

[57] In the meantime, the bearing 36 is seated inside the supporting portion 37a of the surface pressure control portion 37, the supporting portion 37a of the surface pressure control portion 37 passes through the mounting hole 35b of the cover 35 and presses the rear surface of the pinion 33 in an axis direction, and the rotation shaft 33b of the pinion 33 is inserted into the bearing 36. Here, the fastening portion 37b of the surface pressure control portion 37 is fastened to the rear surface of the cover 35 by the first and second mood bolts 38 and 39, controlling a fastening degree. As the surface pressure control portion 37 is fastened deeply to the cover 35, the supporting portion 37a of the surface pressure control portion 37 presses the rear surface of the pinion 33 and increases a contract pressure between the gears 32 and the pinion 33, thereby preventing a backlash that may occur in the gear assembly 30. The gear assembly 30 are installed on the assembled the vanes 20, fixed to the flange 10, and connected to the handle 40 and the motor 50.

[58] The operation of the first embodiment will be described in detail. When the handle 40 and the motor 50 are operated, the gears 32 are driven through the rotation shafts 31, the pinion 33 engaged with the gears 32 is driven together, and the vanes 20 coupled to the rotation shafts 31 are driven by the driving of the rotation shafts 31, thereby introducing a fluid. Particularly, although a turning force is transferred to one rotation shaft 31 and the gear 32 connected thereto, since the gear 32 is engaged with the pinion 33 and rotated, the turning force can be uniformly transferred to the other rotation shafts 31 through the other gears 32. The rotation shafts 31 can be simul-

taneously rotated in one direction to open the vanes 20 or in the opposite direction to close the vanes 20.

[59] FIG. 9 is a perspective view illustrating a portion of a gear assembly according to a second embodiment of the present invention. The constituent elements and the assembly method of the second embodiment are identical to those of the first embodiment. In the second embodiment, a plurality of gears 32' and a pinion 33' are formed in a spiral shape. Fig. 9 illustrates a gear 32', a ring-shaped tooth surface 33a' with gear teeth formed in a circumference direction so that a pinion 33' and the gear 32' can be engaged with each other, a rotation shaft 33b' protruding from a rear center of the pinion 33', and a part of one of rotation shafts 31 that is connected to a driving member (not shown).

[60] The tooth surface 33a' of the pinion 33' and the gears 32' are engaged with each other in an axis direction. When the gears 32' and the pinion 33' are driven by the driving member (not shown), since an engagement length of each gear 32' and the pinion 33' in a contact state is large, the motion is soft. Particularly, when the gears 32' and the pinion 33' are engaged at a high speed, vibration or noise can be suppressed.

[61] The operation of the second embodiment will be described in detail. When a handle 40 (see FIG. 5) and a motor 50 (see FIG. 5) are operated, the gears 32' are driven through the rotation shafts 31, the pinion 33' engaged with the gears 32' is driven together, and vanes 20 (see FIG. 5) coupled to the rotation shafts 31 are driven by the rotation shafts 31. Particularly, although a turning force is transferred to one rotation shaft 31 and the gear 32' connected thereto, since the gear 32' is engaged with the pinion 33' and rotated, the turning force can be uniformly transferred to the other rotation shafts 31 through the other gears 32'. The rotation shafts 31 can be simultaneously rotated in one direction to open the vanes 20 or in the opposite direction to close the vanes 20.

[62] As discussed earlier, according to the present invention, the turning force supplied from the handle 40 and the motor 50 can be uniformly transferred to the rotation shafts 31 through the gear assembly 30 including the gears and the pinion engaged with each other. Therefore, the opening/closing angle of the rotation shafts 31 and the vanes 20 connected thereto can be easily adjusted to control the flow passing through the flange 10.

[63] The gear type vane damper has been described in detail by way of example with reference to the embodiments and the attached drawings of the present invention. However, the scope of the present invention is not limited to these embodiments and

drawings, but defined by the appended claims..

Claims

- [1] A damper type flow control apparatus, comprising:
a flange defining the outward appearance,
a plurality of vanes rotatably installed on the flange to open and close the flange,
a driving means for rotating the vanes and
a gear assembly for transferring a turning force of the driving means to the vanes.
- [2] The damper type flow control apparatus of claim 1, wherein the gear assembly comprises a plurality of rotation shafts to which the vanes are to be fixed respectively, one ends of which being supported on the flange, the other ends of which being collected in the center of the flange, a plurality of gears formed at the other ends of the rotation shafts and arranged in a circumference direction, and a pinion engaged with the gears in an axis direction.
- [3] The damper type flow control apparatus of claim 2, wherein one of the rotation shafts of the gear assembly protrudes to the outside of the flange to be connected to the driving means.
- [4] The damper type flow control apparatus of claim 2, wherein the rotation shafts comprise assembly grooves formed in a radius direction, and the vanes comprise assembly protrusions formed in a radius direction to be fitted into the assembly grooves of the rotation shafts.
- [5] The damper type flow control apparatus of claim 2, wherein the gear assembly further comprises a cap fixed to the center of the flange to cover the gears, and a cover coupled to the cap in an axis direction to cover the pinion, the other ends of the rotation shafts being rotatably installed therein.
- [6] The damper type flow control apparatus of claim 5, wherein the cap is fixed by a plurality of supporters formed between the inner circumference of the flange and the outer circumference of the cap in a circumference direction.
- [7] The damper type flow control apparatus of claim 5, wherein portions of the cap and the cover which are in contact with the rotation shafts comprise a plurality of grooves into which the rotation shafts are to be fitted.
- [8] The damper type flow control apparatus of claim 2, wherein the gear assembly further comprises a surface pressure control portion for controlling a pressure between the gears and the pinion according to an assembly degree.
- [9] The damper type flow control apparatus of either claim 5 or 8, wherein the cap

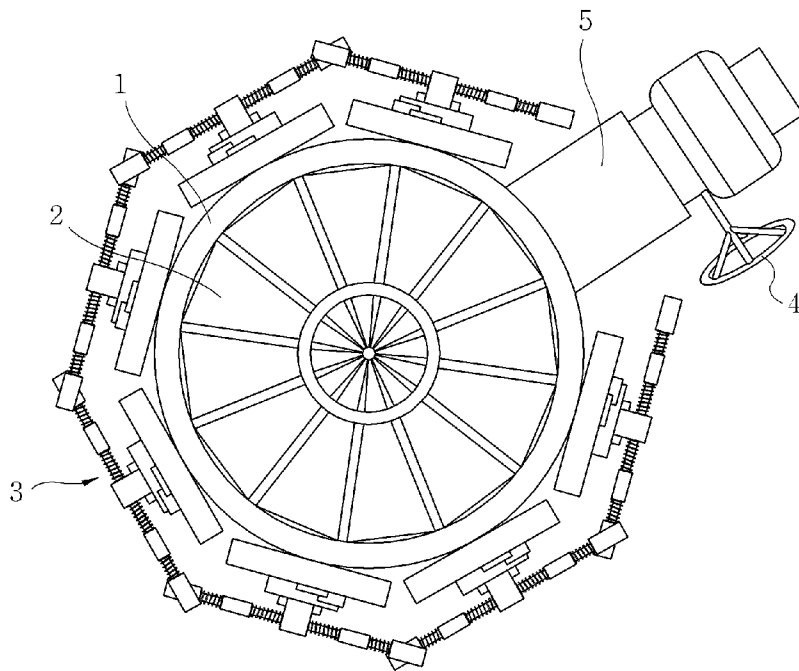
and the surface pressure control portion are assembled in an axis direction, the cap is installed in a flow inlet direction, and the surface pressure control portion is installed in a flow outlet direction.

- [10] The damper type flow control apparatus of claim 2, wherein the gears and a tooth surface of the pinion engaged with the gears in an axis direction are formed in a straight or spiral shape.
- [11] A damper type flow control apparatus, comprising:
a flange defining the outward appearance,
a plurality of vanes rotatably installed on the flange to open and close the flange and
a gear assembly connected to the vanes to rotate the vanes,
wherein the gear assembly comprises a plurality of rotation shafts, one ends of which being fixed to the flange, the other ends of which being formed in the center of the flange, a plurality of gears formed at the other ends of the rotation shafts, respectively, and a pinion engaged with the gears in an axis direction, and further comprises a driving member for driving the gear assembly, the driving member being connected to one of the rotation shafts, the rotation shafts and the vanes being integrally coupled to each other, respectively.
- [12] The damper type flow control apparatus of claim 11, wherein the gears and a tooth surface of the pinion engaged with the gears in an axis direction are formed in a straight or spiral shape.
- [13] The damper type flow control apparatus of claim 11, wherein the vanes comprise overlapping portions bent to the front on one side, and assembly protrusions formed in a radius direction at the rear.
- [14] The damper type flow control apparatus of either claim 11 or 13, wherein the rotation shafts comprise assembly grooves formed in a radius direction to be coupled to the vanes.
- [15] The damper type flow control apparatus of claim 11, wherein, in the gear assembly, a cap is fixed to one side of the rotation shafts to protect the gears in the center of the flange, and a cover is rotatably installed on the other side of the rotation shafts to protect the pinion.
- [16] The damper type flow control apparatus of claim 15, wherein the cap is fixed by a plurality of supporters formed between the inner circumference of the flange and the outer circumference of the cap in a circumference direction.
- [17] The damper type flow control apparatus of claim 15, wherein portions of the cap

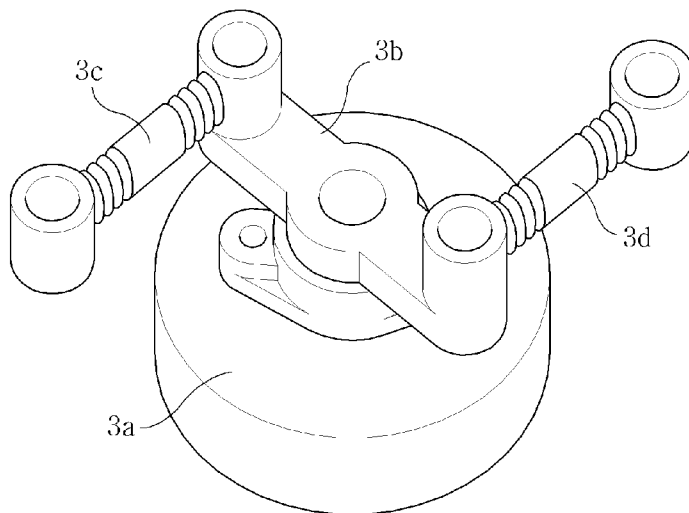
and the cover which are in contact with the rotation shafts comprise a plurality of grooves into which the rotation shafts are to be fitted.

- [18] The damper type flow control apparatus of either claim 11 or 15, wherein the gear assembly further comprises a surface pressure control portion for controlling a pressure between the gears and the pinion according to an assembly degree.
- [19] The damper type flow control apparatus of claim 18, wherein the cap and the surface pressure control portion are assembled in an axis direction, the cap is installed in a flow inlet direction, and the surface pressure control portion is installed in a flow outlet direction.

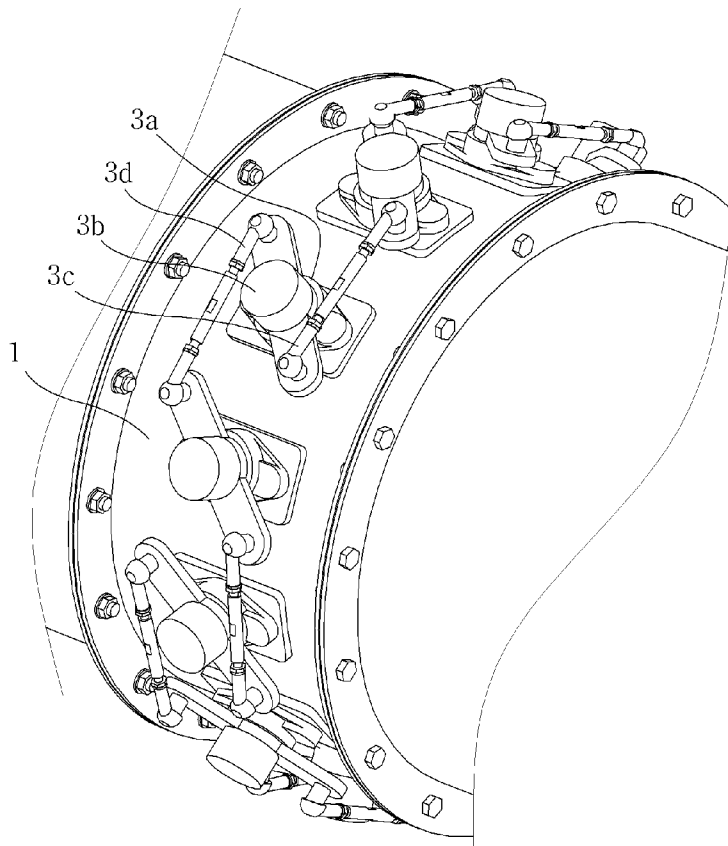
[Fig. 1]



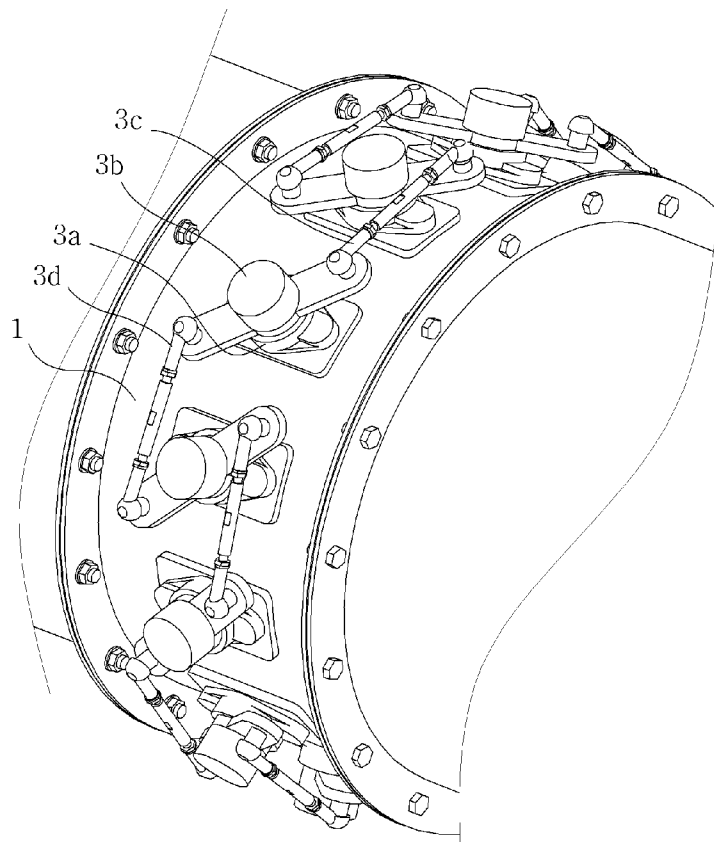
[Fig. 2]



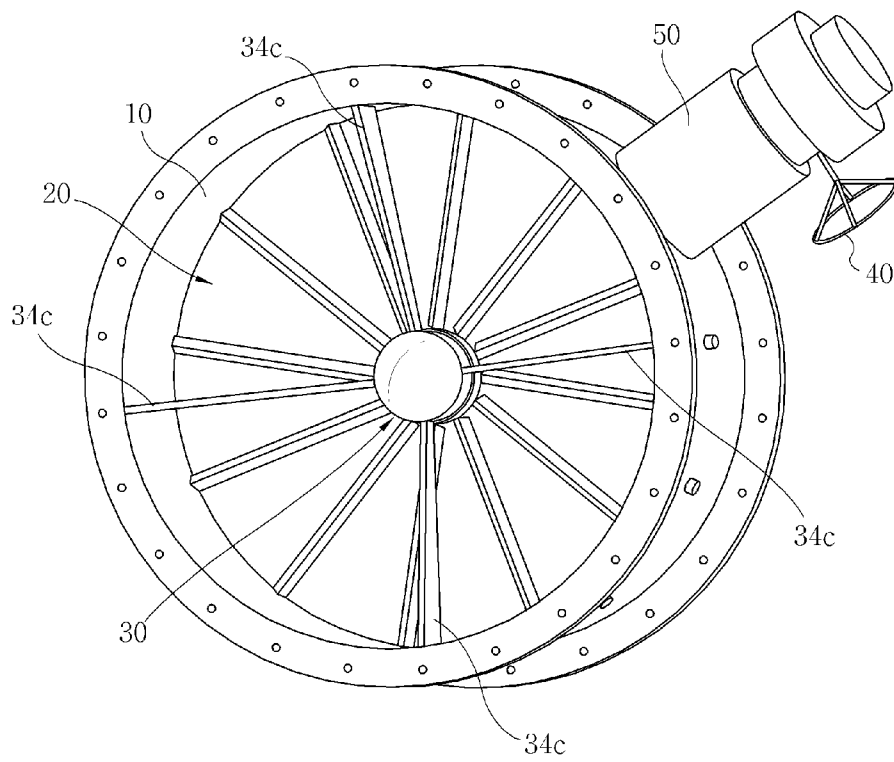
[Fig. 3]



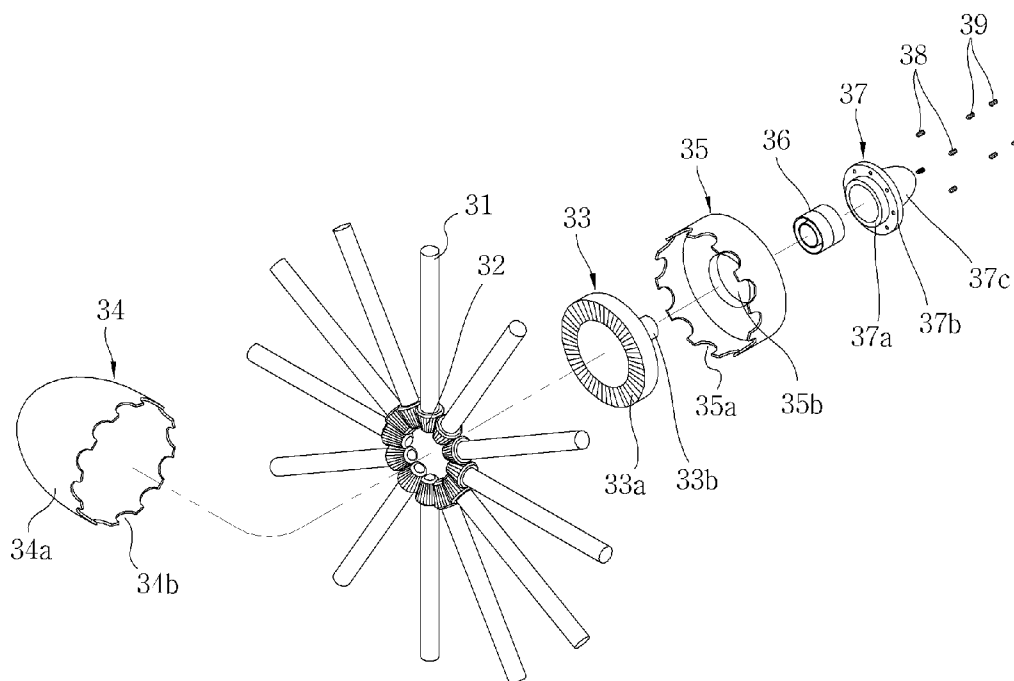
[Fig. 4]



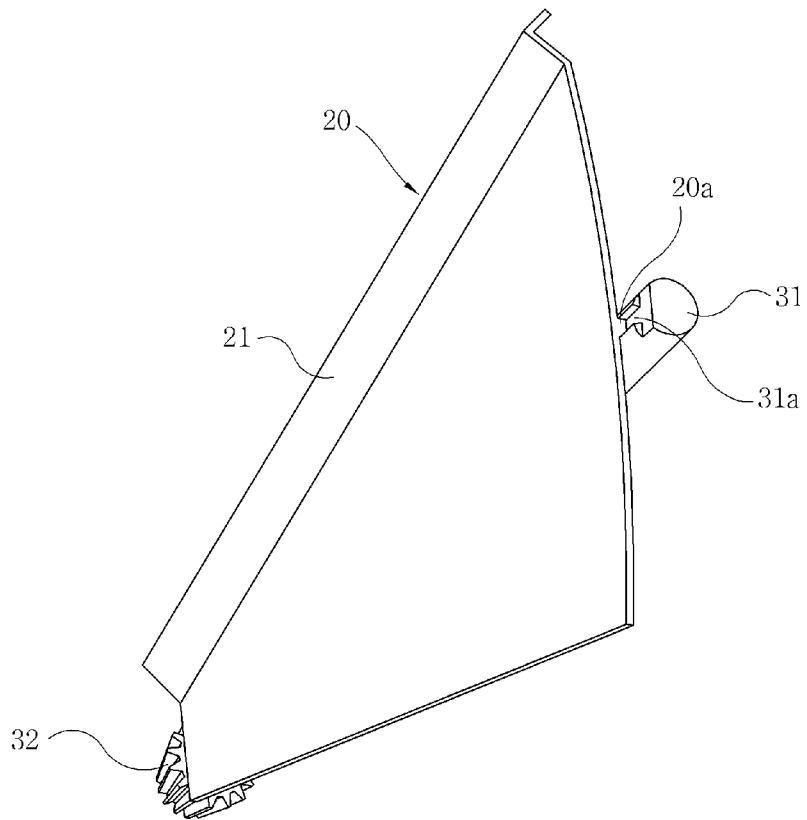
[Fig. 5]



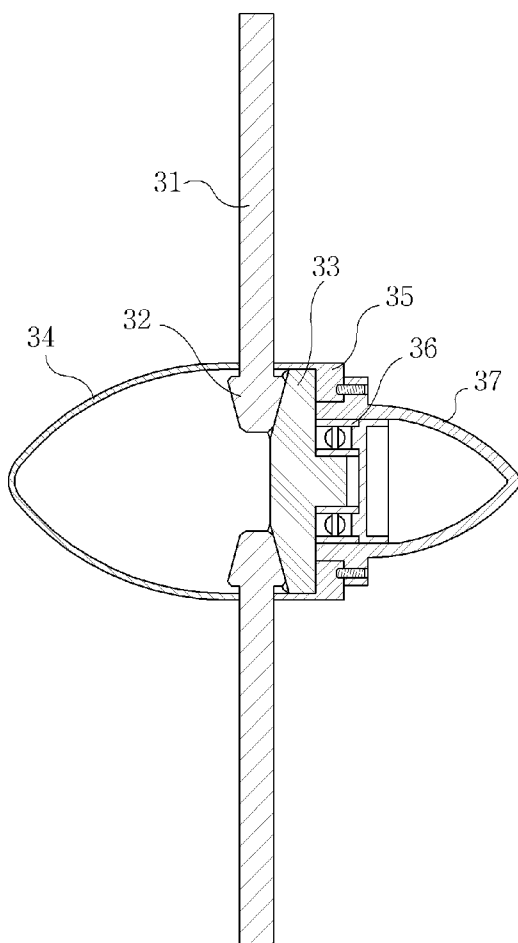
[Fig. 6]



[Fig. 7]



[Fig. 8]



[Fig. 9]

