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(54) **Marine vehicle with thrust boosting device**

(57) A marine vehicle (200) includes a hull (210), a propeller (201), anda thrust boosting device (2) mounted to the hull (210) and disposed forwardly of the propeller (201). The thrust boosting device (2) includes first, second and third fin members (21, 22, 23) extending radially with respect to a rotational axis (L) of the propeller (201). The first, second and third fin members (21, 22, 23) form first, second and third angles (θ1, θ2, θ3) with a reference line (S) that extends upwardly from and that is perpendicular to the rotational axis (L), respectively. The first angle (θ1) ranges between 70 and 110°, the second angle (θ2) ranges between 225° and 255°, and the third angle (θ3) ranges between 285° and 315°.

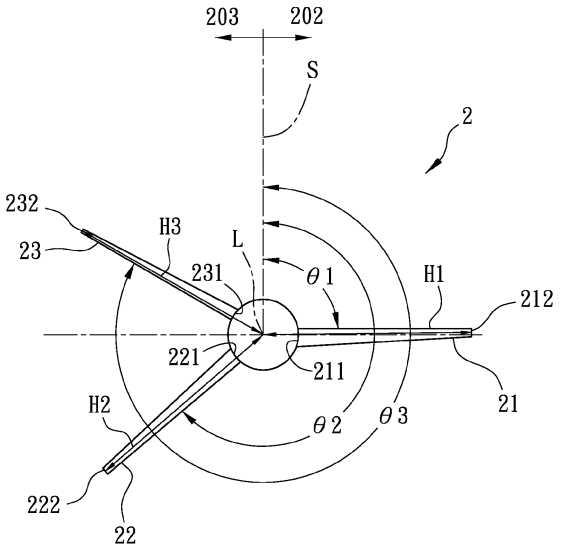

FIG. 5

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Description

[0001] The present invention relates to a marine vehicle, more particularly to a marine vehicle with a thrust boosting device.

[0002] Referring to Figure 1, a conventional marine vehicle 1 comprises a hull 11, and a propeller 12 that is mounted to the hull 11 and disposed under a waterline 10. When the propeller 12 rotates, propeller blades thereof produce a propulsive force that drives the marine vehicle 1 to move forward or rearward.

[0003] Due to the working mechanism of the propeller 12 and ship hull, the propeller 12 produces a lot of turbulence and energy dissipation while generating the propulsive force. If the rotationalal speed of the propeller 12 is increased, more turbulence and energy dissipation will result, thereby failing to enhance propulsion and speed of the marine vehicle 1.

[0004] Referring to Figure 2 and Figure 3, in order to enhance propulsion and advance speed of the marine vehicle 1, Chinese Patent Publication No. 1048461C discloses a thrust boosting device 14 disposed forwardly of the propeller 12 and formed of six fin members 13 for changing a stern flow field of the marine vehicle 1.

[0005] However, the fin members 13 of the thrust boosting device 14 should be large in number and be formed to be huge enough to suit a large- sized marine vehicle, thereby incurring high cost.

[0006] Therefore, an object of the present invention is to provide a marine vehicle with a thrust boosting device that is relatively low cost and low in complexity, and that is capable of improving speed and propulsion efficiency of the marine vehicle.

[0007] Accordingly, the marine vehicle of the present invention comprises a hull, a propeller mounted to the hull and rotatable about a rotational axis, and a thrust boosting device mounted to the hull and disposed forwardly of the propeller with respect to a bow of the hull. A reference line extends upwardly from and is perpendicular to the rotational axis of the propeller.

[0008] The thrust boosting device comprises a first fin member, a second fin member and a third fin member. The first fin member is disposed on a starboard side of the hull, extends radially with respect to the rotational axis of the propeller, and forms a first angle in an angular direction with the reference line. The first angle ranges between 70° and 110°. The second fin member is disposed on a port side of the hull, extends radially with respect to the rotational axis of the propeller, and forms a second angle in the angular direction with the reference line. The second angle ranges between 225° and 255°. The third fin member is disposed on the port side of the hull, extends radially with respect to the rotational axis of the propeller, and forms a third angle in the angular direction with the reference line. The third angle ranges between 285° and 315°.

[0009] Other features and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments with reference to the accompanying drawings, of which:

Figure 1 is a side view of a stern of a conventional marine vehicle illustrating the relationship between the marine vehicle and a propeller thereof;

Figure 2 is a schematic side view of a stern of a marine vehicle showing a propeller and a thrust boosting device according to Chinese Patent Publication No. 1048461C;

Figure 3 is a schematic view of the thrust boosting device in Figure 2 when viewed from the direction of the stern of the marine vehicle;

Figure 4 is a schematic side view of a stern of a marine vehicle of the first preferred embodiment illustrating a propeller and a thrust boosting device according to the present invention;

Figure 5 is a schematic view of the thrust boosting device of the first preferred embodiment in Figure 4 when viewed from the direction of the stern of the marine vehicle;

Figures 6-9 are fragmentary side views of the first preferred embodiment illustrating four different forms of the first, second and third fin members;

Figure 10 is a fragmentary enlarged view of the first fin member of the first preferred embodiment when viewed from the direction of a starboard side of the marine vehicle, illustrating a first angle of attack;

Figure 11 is a fragmentary enlarged view of the second fin member of the first preferred embodiment when viewed from the direction of a port side of the marine vehicle, illustrating a second angle of attack;

Figure 12 is a fragmentary enlarged view of the third fin member of the first preferred embodiment when viewed from the direction of the port side of the marine vehicle, illustrating a third angle of attack;

Figure 13 is a chart comparing the propeller exciting force of a control group and an experimental group of the first preferred embodiment according to the present invention;

Figure 14 is a schematic view of the propeller and the thrust boosting device of the second preferred embodiment when viewed from the direction of a bow of the marine vehicle, illustrating a possible form of a tip appendage of the second preferred embodiment;

Figure 15 is a fragmentary enlarged view of one of the fin members in Figure 14;

Figure 16 is a schematic view of the propeller and the thrust boosting device of the second preferred embodiment

when viewed from the direction of the bow of the marine vehicle, illustrating another possible form of the tip appendage of the second preferred embodiment;

Figure 17 is a fragmentary enlarged view of one of the fin members in Figure 16;

Figure 18 is a schematic view of the propeller and the thrust boosting device of the second preferred embodiment when viewed from the direction of the bow of the marine vehicle, illustrating yet another possible form of the tip appendage of the second preferred embodiment; and

Figure 19 is a fragmentary enlarged view of one of the fin members in Figure 18.

[0010] Before the present invention is described in greater detail, it should be noted that like elements are denoted by the same reference numerals throughout the disclosure.

[0011] Referring to Figure 4 and Figure 5, a marine vehicle 200 according to the first preferred embodiment of the present invention includes a hull 210, a propeller 201 mounted to the hull 210 and rotatable about a rotational axis (L), a thrust boosting device 2. The hull 210 has a starboard side 202, a port side 203, a stern 204 and a bow 205. A reference line (S) extends upwardly from and is perpendicular to the rotational axis (L) of the propeller 201.

[0012] The thrust boosting device 2 is mounted to the hull 210 and is disposed forwardly of the propeller 201 with respect to the bow 205. The thrust boosting device 2 includes a first fin member 21 disposed on the starboard side 202, a second fin member 22 disposed on the port side 203 and a third fin member 23 disposed on the port side 203. Each of the first, second and third fin members (21, 22, 23) extends radially with respect to the rotational axis (L) of the propeller 201. A distance (T) between the thrust boosting device 2 and the propeller 201 along the rotational axis (L) is 0.2 to 2 times a diameter (D) of the propeller 201.

[0013] Assuming that the reference line (S) is 0°, the first fin member 21 forms a first angle ($\theta 1$) in a clockwise direction with the reference line (S), the second fin member 22 forms a second angle ($\theta 2$) in the clockwise direction with the reference line (S), and the third fin member 23 forms a third angle ($\theta 3$) in the clockwise direction with the reference line (S), all viewed from the stern 204. Specifically, the first angle ($\theta 1$) ranges between 70° and 110°, the second angle ($\theta 2$) ranges between 225° and 255°, and the third angle ($\theta 3$) ranges between 285° and 315°.

[0014] The first fin member 21 has a first connecting end portion 211 connected to the starboard side 202 and a first free end portion 212 opposite to the first connecting end portion 211. The second fin member 22 has a second connecting end portion 221 connected to the port side 203 and a second free end portion 222 opposite to the second connecting end portion 221. The third fin member 23 has a third connecting end portion 231 connected to the port side 203 and a third free end portion 232 opposite to the third connecting end portion 231.

[0015] Moreover, each of a distance (H1) between the first free end portion 212 of the first fin member 21 and the rotational axis (L) of the propeller 201, a distance (H2) between the second free endportion 222 of the second fin member 22 and the rotational axis (L) of the propeller 201, and a distance (H3) between the third free end portion 232 of the third fin member 23 and the rotational axis (L) of the propeller 201 is 1 to 1.2 times a radius (R) of the propeller 201.

[0016] In the first preferred embodiment, each of the first fin member 21, the second fin member 22 and the third fin member 23 has a shape selected from a trapezoid as shown in Figure 6, an ellipse as shown in Figure 7, a triangle as shown in Figure 8, and a rectangle as shown in Figure 9.

[0017] Referring to Figure 10, the first fin member 21 inclines downwardly in a direction from the stern 204 toward the bow 205 and forms a first angle of attack ($\alpha 1$) ranging between 9° and 15° with reference to the rotational axis (L) of the propeller 201.

[0018] Referring to Figure 11, the second fin member 22 inclines downward in a direction from the bow 205 toward the stern 204 and forms a second angle of attack ($\alpha 2$) ranging between 4° and 10° with reference to the rotational axis (L) of the propeller 201.

[0019] Referring to Figure 12, the third fin member 23 inclines downwardly in the direction from the bow 205 toward the stern 204 and forms a third angle of attack ($\alpha 3$) ranging between 2° and 8° with reference to the rotational axis (L) of the propeller 201.

[0020] In order to prove the efficiency of thrust boosting device 2 according to the present invention, a model test was conducted in Hamburg Ship Model Basin (HSVA) in Germany. The control group in this experiment involved a 1,800 Twenty-foot Equivalent Unit (1,800TEU) container ship designed by CSBC Corporation, Taiwan. The experimental group involved the same marine vehicle as in the control group in this model test, however, the only difference resides in that the container ship in the experimental group was provided with the thrust boosting device 2. The results of model test are shown in Figure 13, Table 1 and Table 2.

[0021] In the experimental group, the distance (T) between the thrust boosting device 2 and the propeller 201 along the rotational axis (L) is 0.2 times the diameter (D) of the propeller 201. The first angle ($\theta 1$) formed by the first fin member 21 in the clockwise direction with the reference line (S) is 90°, the second angle ($\theta 2$) formed by the second fin member 22 in the clockwise direction with the reference line (S) is 230°, and the third angle ($\theta 3$) formed by the third fin member 23 in the clockwise direction with the reference line (S) is 300°. The first angle of attack ($\alpha 1$) formed by inclination of the first fin member 21 and the rotational axis (L) is 13°, the second angle of attack ($\alpha 2$) formed by inclination of the second

fin member 22 and the rotational axis (L) is 4°, the third angle of attack ($\alpha 3$) formed by inclination of the third fin member 23 and the rotational axis (L) is 4°. Moreover, each of the distance (H1) between the first free end portion 212 of the first fin member 21 and the rotational axis (L), the distance (H2) between the second free end portion 222 of the second fin member 22 and the rotational axis (L), and the distance (H3) between the third free end portion 232 of the third fin member 23 and the rotational axis (L) is 1.05 times the radius (R) of the propeller 201.

[0022] While the distances (H1, H2, H3) in this experiment are equal, the distances (H1, H2, H3) may not be equal in some applications. The same result may still be achieved as long as each of the distances (H1, H2, H3) is 1 to 1.2 times the radius (R) of the propeller 201.

[0023] According to Table 1 and Table 2, the ship speed of the experimental group provided with the thrust boosting device 2 is higher than the ship speed of the control group without the thrust boosting device 2 when provided with the same horsepower. The required horsepower of the experimental group provided with the thrust boosting device 2 is 5% lower than the required horsepower of the control group without the thrust boosting device 2 when moving at the same ship speed. Furthermore, according to Figure 13, the propeller exciting force of the experimental group is lower than the propeller exciting force of the control group.

Table 1

Same Horsepower (12723 kW)	Control Group	Experimental Group
Ship Speed	19.78 knot	20.00 knot
Revolution Per Minute	103.6 rpm	100.8 rpm

Table 2

Same Ship Speed (20.00 knot)	Control Group	Experimental Group
Required Propulsive Horsepower	13391 kW	12734 kW
Rate of Required Horsepower	100%	95.0%

[0024] Referring to Figure 14 and Figure 15, the second preferred embodiment of the thrust boosting device 2 of the present invention is similar to the first preferred embodiment. The difference resides in that the thrust boosting device 2 further includes a plurality of tip appendages 24 disposed respectively on the first free end portion 212 of the first fin member 21, the second free end portion 222 of the second fin member 22 and the third free end portion 232 of the third fin member 23. The tip appendages 24 may alleviate tip vortex caused by the flow leaking from high pressure to low pressure near the free end portions 212, 222, 232 of the fin member 2.

[0025] Specifically, the tip appendage 24 may have a shape of an elliptic streamline as shown in Figure 14 and Figure 15, a plate as shown in Figure 16 and Figure 17, or a curved plate as shown in Figure 18 and Figure 19. As long as the same results can be achieved, the present invention should not be limited to the second preferred embodiment.

[0026] To sum up, the present invention utilizes the first fin member 21, the second fin member 22 and the third fin member 23 of the thrust boosting device 2 to change the upstream flow field of the propeller 201 before fluid flows past the propeller 201 so as to reduce the eddy kinetic energy. This invention not only is low cost and low in complexity, but also is able to alleviate propeller exciting force and cavitation on the surface of the propeller 201, as well as to improve the propulsion efficiency and speed of the marine vehicle 200.

Claims

1. A marine vehicle (200), including:

a hull (210); and
a propeller (201) mounted to said hull (210) and rotatable about a rotational axis (L);
said marine vehicle **characterized by** a thrust boosting device (2) mounted to said hull (210) and disposed forwardly of said propeller (201) with respect to a bow (205) of said hull (210), said thrust boosting device (2) including:

a first fin member (21) disposed on a starboard side (202) of said hull (210), extending radially with respect to the rotational axis (L) of said propeller (201), and forming a first angle ($\theta 1$) in an angular direction with a

reference line (S) that extends upwardly from and that is perpendicular to the rotational axis (L) of said propeller (201), the first angle ($\theta 1$) ranging between 70° and 110°;
a second fin member (22) disposed on a port side (203) of saidhull (210), extending radially with respect to the rotational axis (L) of said propeller (201), and forming a second angle ($\theta 2$) in the angular direction with the reference line (S), the second angle ($\theta 2$) ranging between 225° and 255°; and
a third fin member (23) disposed on the port side (203) of saidhull (210), extending radially with respect to the rotational axis (L) of said propeller (201), and forming a third angle ($\theta 3$) in the angular direction with the reference line (S), the third angle ($\theta 3$) ranging between 285° and 315°.

2. The marine vehicle (200) as claimed in Claim 1, **characterized in that** said first fin member (21) has a first connecting end portion (211) connected to said starboard side (202) of said hull (210) and a first free end portion (212) opposite to said first connecting end portion (211), said first fin member (21) inclining downward in a direction from a stern (204) of said hull (210) towardsaidbow (205) of saidhull (210) and forming a first angle of attack ($\alpha 1$) ranging between 9° and 15° with reference to the rotational axis (L) of said propeller (201).

3. The marine vehicle (200) as claimed in Claim 2, further **characterized in that** said second fin member (22) has a second connecting end portion (221) connected to said port side (203) of said hull (210) and a second free end portion (222) opposite to said second connecting endportion (221), said second fin member (22) inclining downwardly in a direction from said bow (205) of said hull (210) toward said stern (204) of said hull (210) and forming a second angle of attack ($\alpha 2$) ranging between 4° and 10° with reference to the rotational axis (L) of said propeller (201).

4. The marine vehicle (200) as claimed in Claim 3, further **characterized in that** said third fin member (23) has a third connecting end portion (231) connected to said port side (203) of said hull (210) and a third free end portion (232) opposite to said third connecting end portion (231), said third fin member (23) inclining downwardly in the direction from said bow (205) of said hull (210) toward said stern (204) of said hull (210) and forming a third angle of attack ($\alpha 3$) ranging between 2° and 8° with respect to the rotational axis (L) of said propeller (201).

5. The marine vehicle (200) as claimed in Claim 1 **characterized in that** each of said first fin member (21), said second fin member (22) and said third fin member (23) has a free end portion (212, 222, 232) distal from said hull (210), and each of a distance (H1) between said first free end portion (212) of said first f in member (21) and the rotational axis (L) of said propeller (201), a distance (H2) between said second free end portion (222) of said second fin member (22) and the rotational axis (L) of said propeller (201), and a distance (H3) between said third free end portion (232) of said third fin member (23) and the rotational axis (L) of said propeller (201) is 1 to 1.2 times a radius (R) of said propeller (201).

6. The marine vehicle (200) as claimed in Claim 1, **characterized in that** each of said first fin member (21), said second fin member (22) and said third fin member (23) has a free end portion (212, 222, 232) distal from said hull (210) and provided with a tip appendage (24).

7. The marine vehicle (200) as claimed in any one of the preceding claims, **characterized in that** each of said first fin member (21), said second fin member (22) and said third fin member (23) has a shape selected from a trapezoid, a rectangle, a triangle, and an ellipse.

8. The marine vehicle (200) as claimed in any one of the preceding claims, **characterized in that** a distance (T) between said thrust boosting device (2) and said propeller (201) along the rotational axis (L) is 0.2 to 2 times a diameter (D) of said propeller (201).

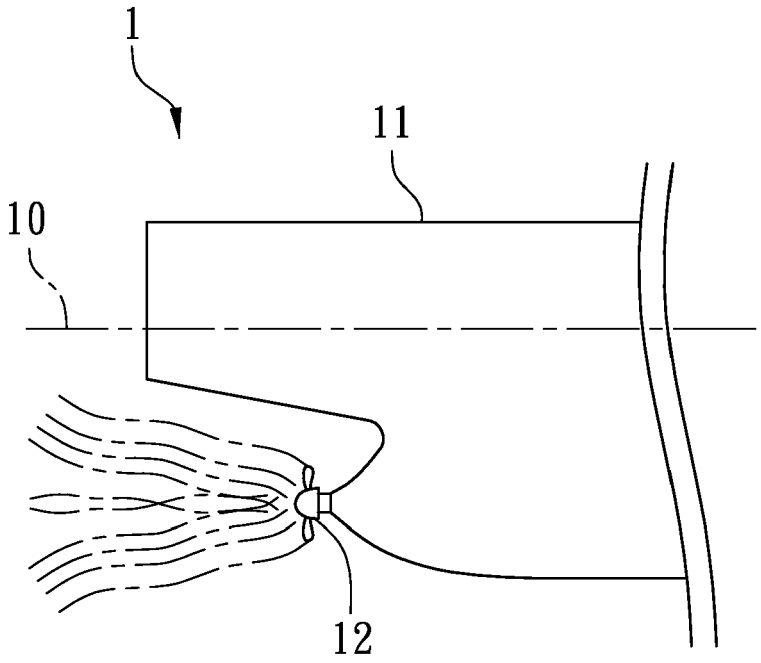

FIG. 1
PRIOR ART

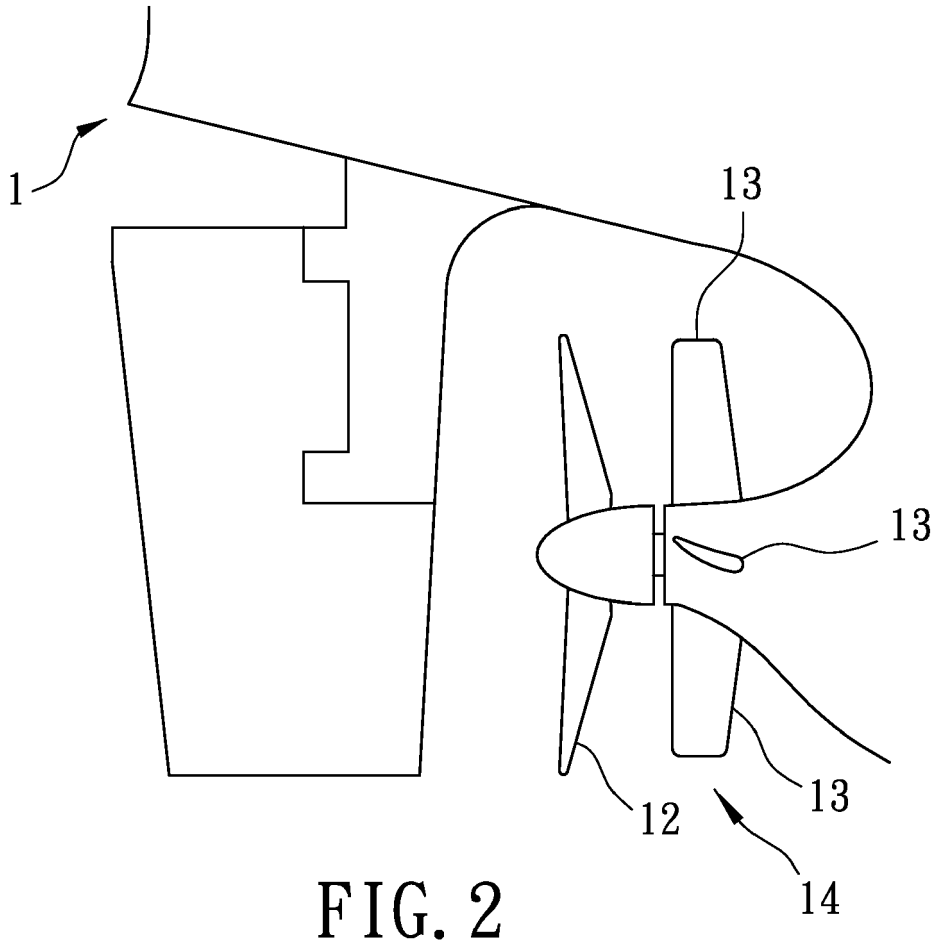

FIG. 2
PRIOR ART

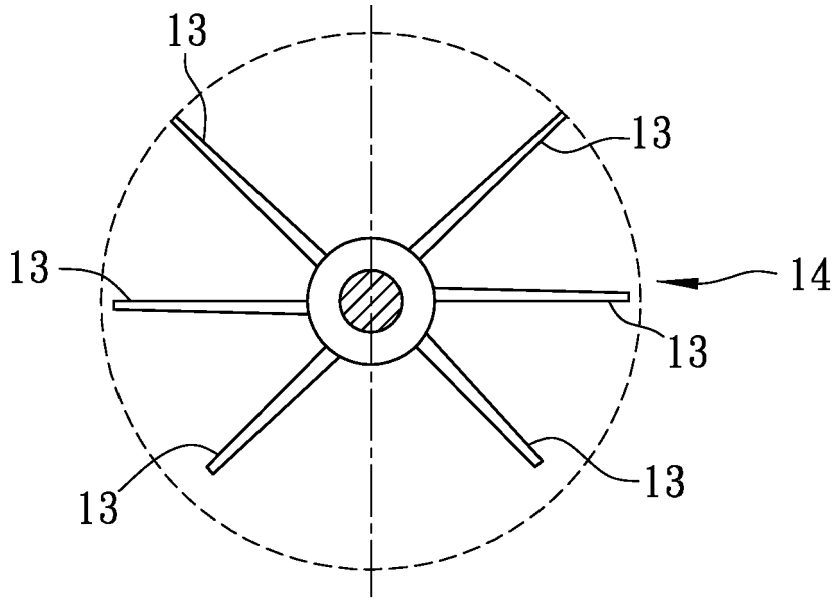

FIG. 3 PRIOR ART

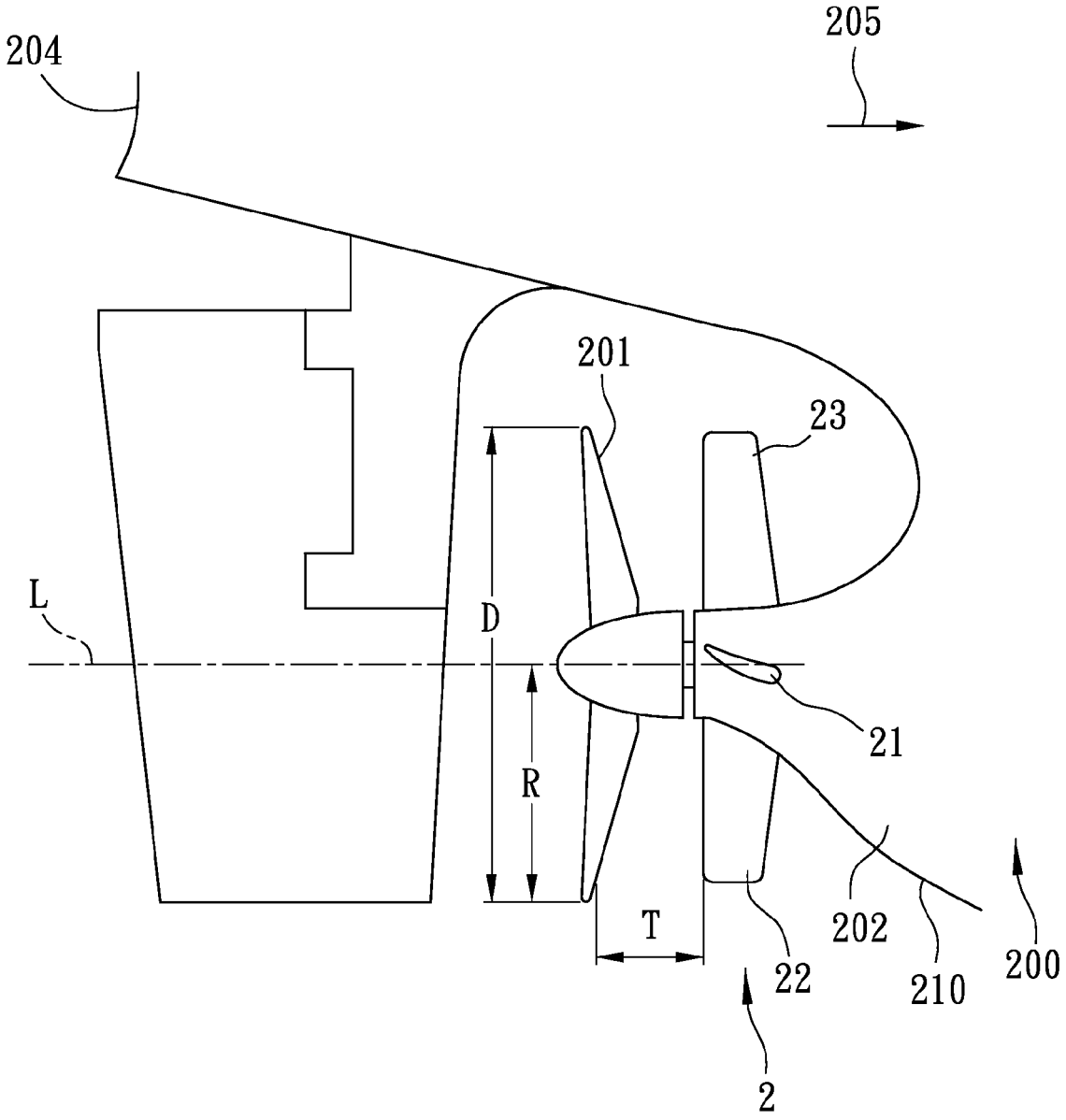

FIG. 4

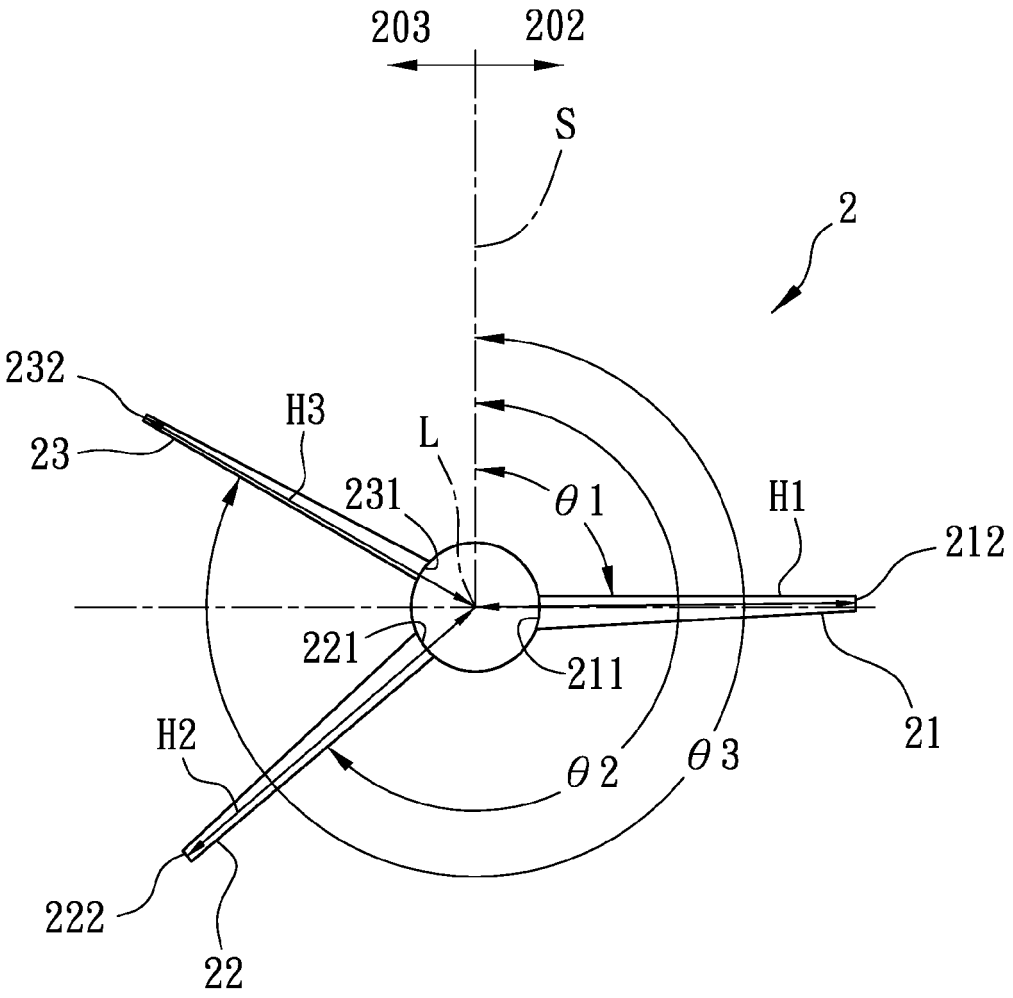

FIG. 5

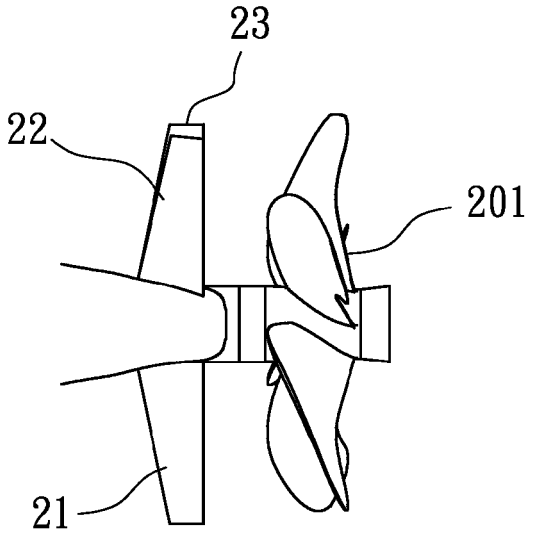

FIG. 6

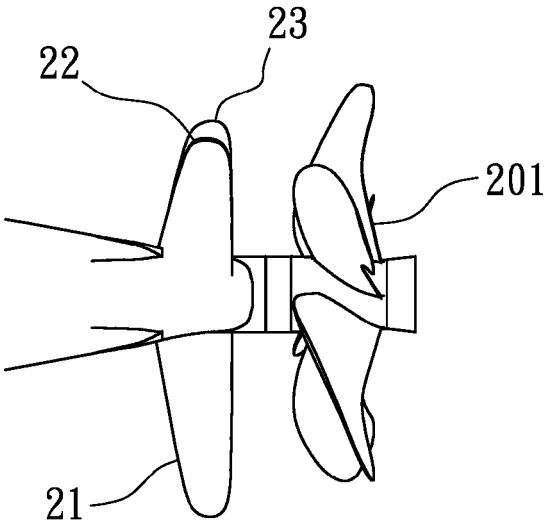

FIG. 7

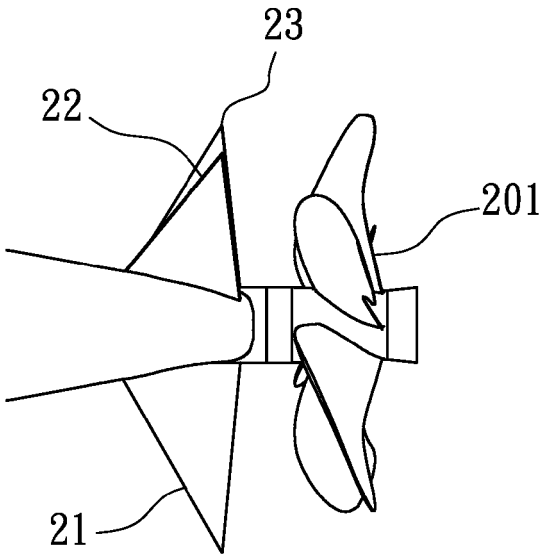

FIG. 8

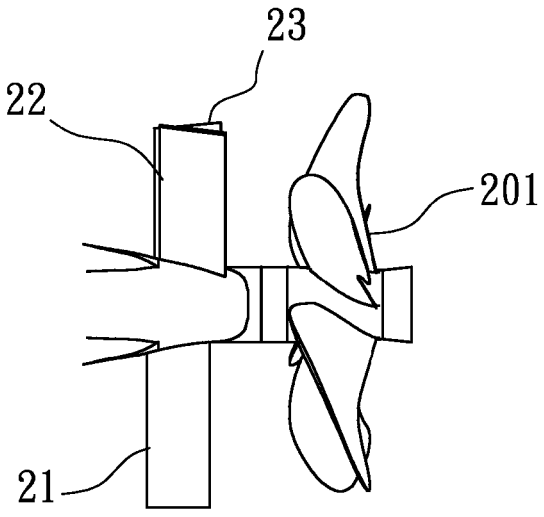

FIG. 9

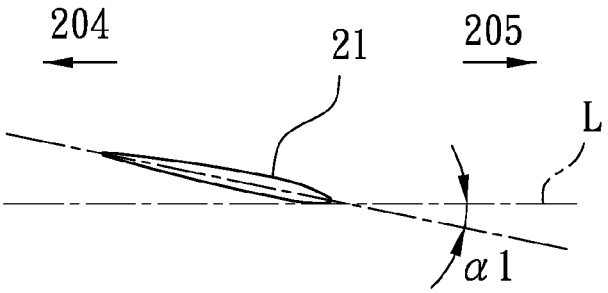

FIG. 10

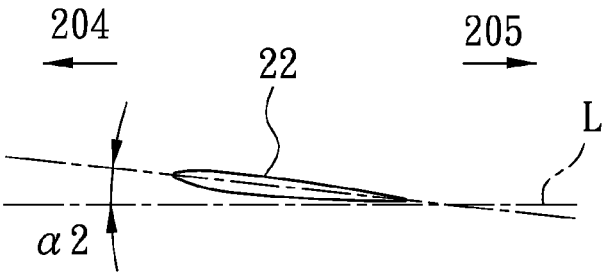

FIG. 11

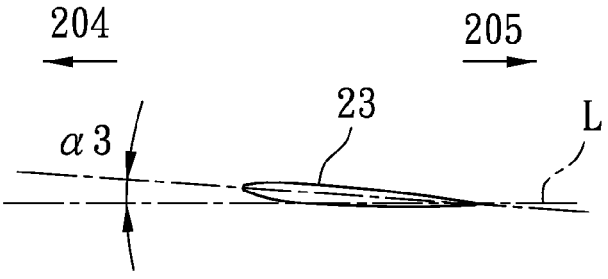

FIG. 12

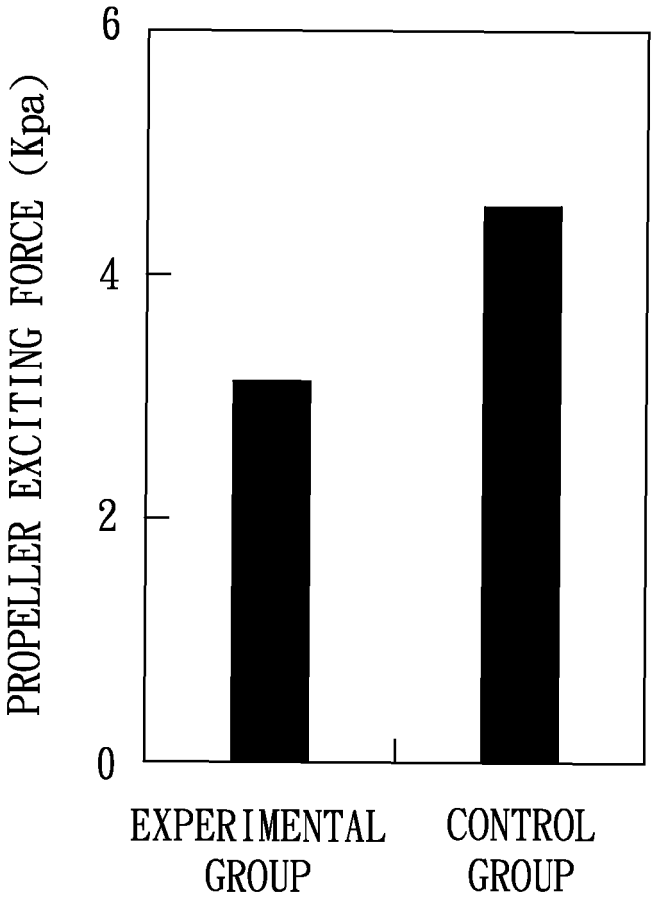
PROPELLER EXCITING FORCE (Kpa)
6
4
2
0
EXPERIMENTAL GROUP
CONTROL GROUP

FIG. 13

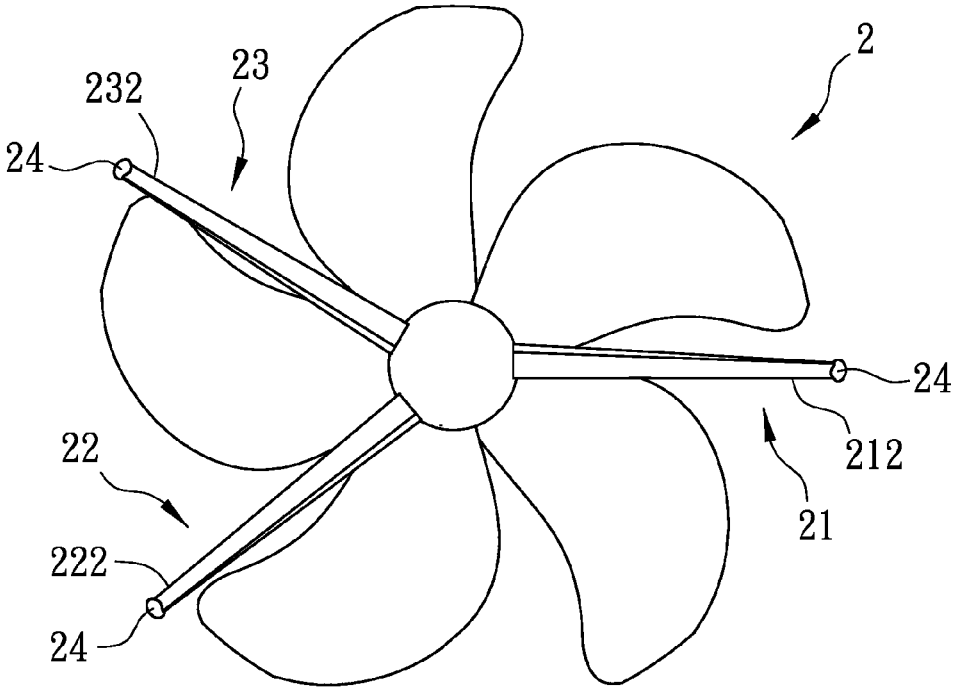

FIG. 14

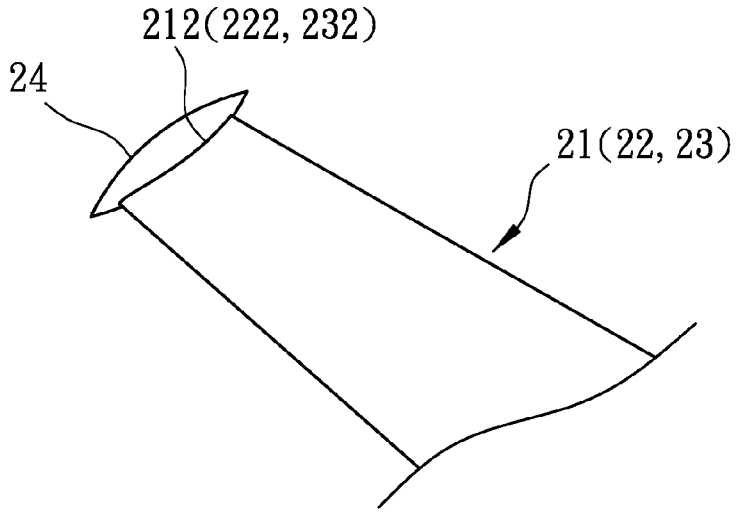

FIG. 15

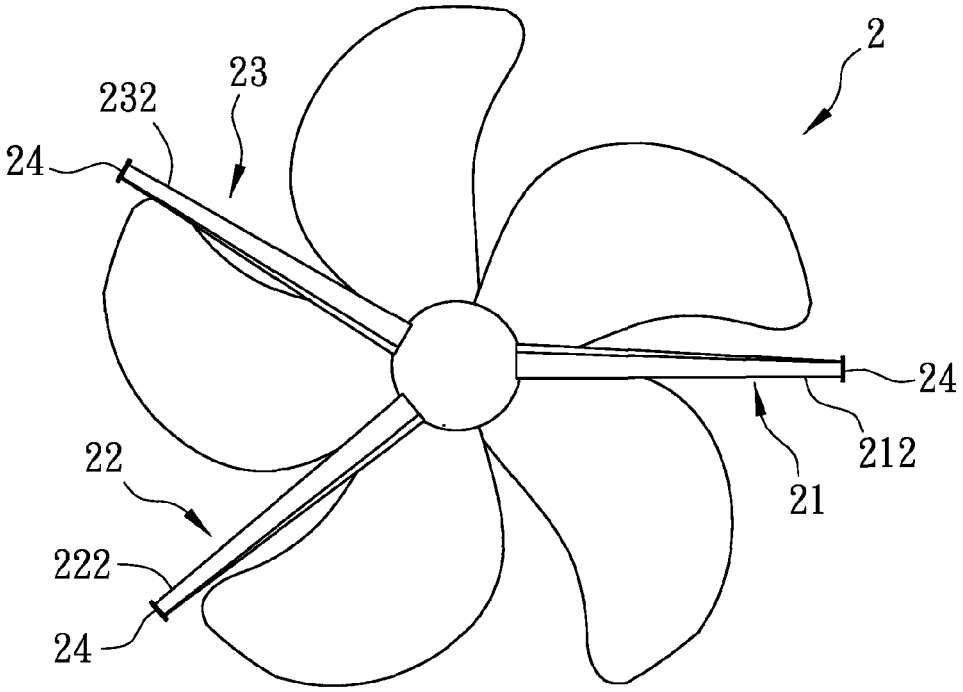

FIG. 16

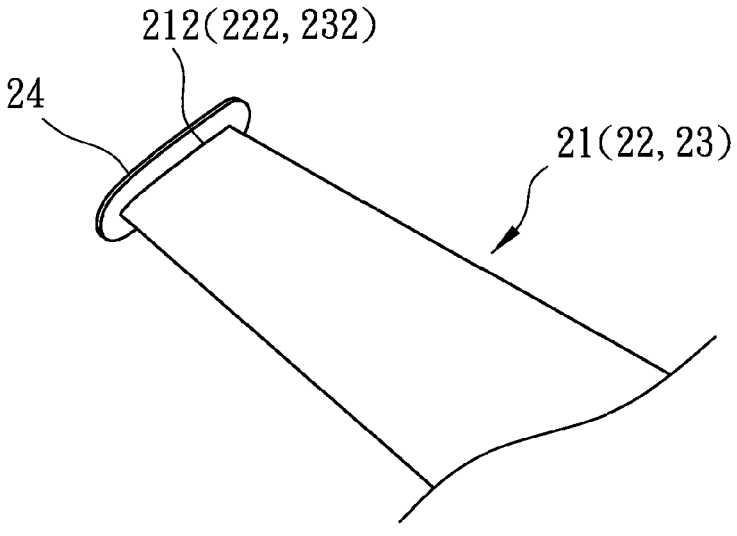

FIG. 17

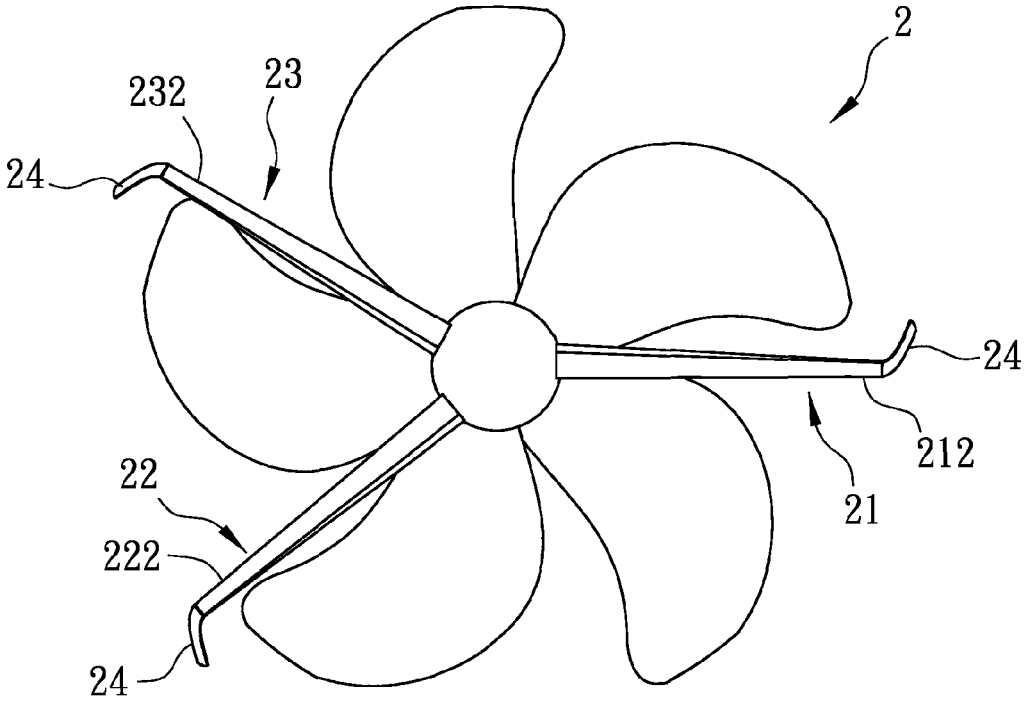

FIG. 18

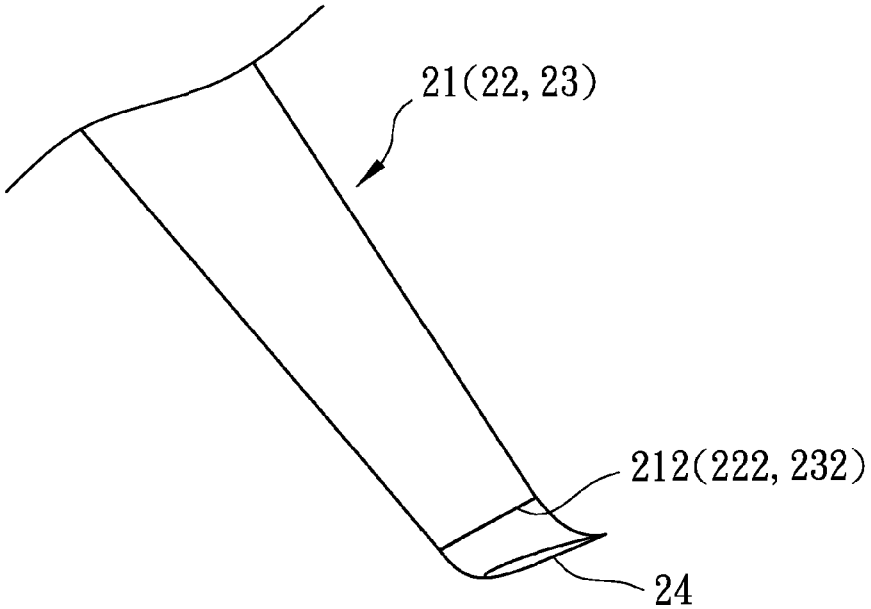

FIG. 19

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 1048461 C **[0004] [0009]**