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IMPELLER, PROPELLER AND THE LIKE FOR PRODUCING AXIAL EFFECT, PARTICULARLY AXIAL AIR FLOW

Filed April 16, 1958

FIG. 1.

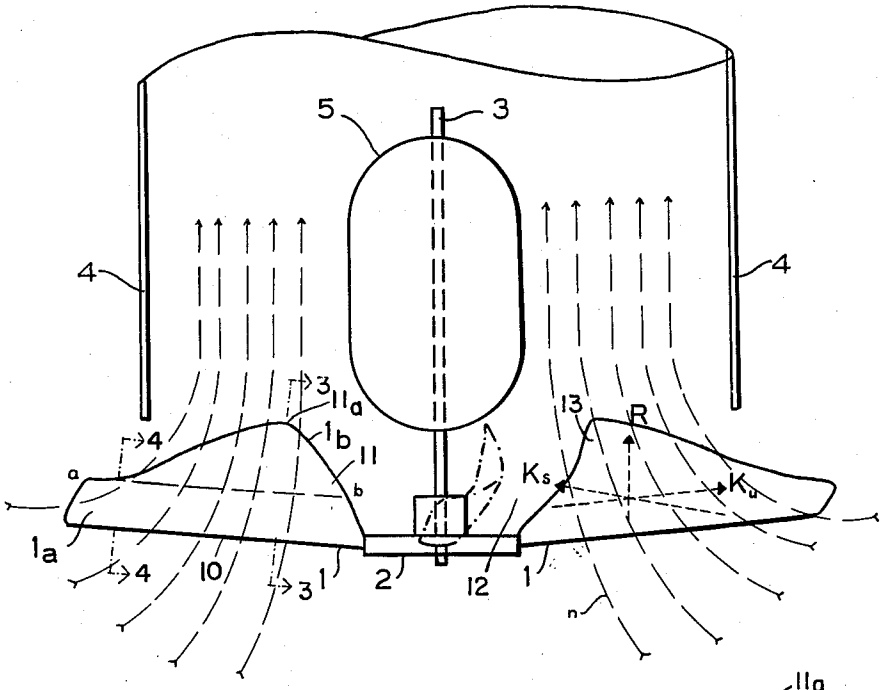


FIG 2

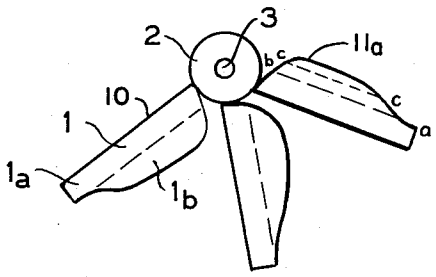


FIG 3

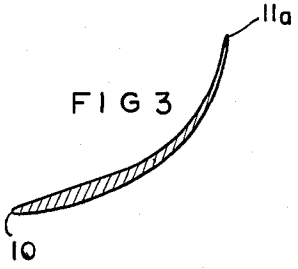
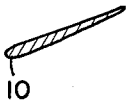


FIG 4



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IMPELLER, PROPELLER AND THE LIKE FOR PRODUCING AXIAL EFFECT, PARTICULARLY AXIAL AIR FLOW

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This invention relates to an impeller, propeller and the like for producing axial effect, particularly axial air flow.

The impeller and the like of the invention is chiefly characterized in that each blade is provided with a winglet extension on the trailing edge of said blade and extending axially of the impeller axis. The impeller blades are fixed in such a position that their forward side is partly inclined towards the current to be produced, advantageously so that the relative angle between the said forward side or the longitudinal direction of the blade and the impeller shaft is approximately 85°.

The blades are secured to a hub so the inner ends thereof will be spaced a determined distance from the impeller shaft.

Blade structures of this kind tend to produce substantially two kinds of current flows. Rearwardly of the blades, specifically of the winglet extensions there is a tendency for partial vacuum to form and due to the resulting suction effect, air in strong currents is drawn from the side of the blades which is opposed to the winglet extensions and also radially from the outside, to fill the vacuum. This current flow terminates on the inner base of the blades about the shaft where a zone of air concentration is formed. On the other hand, due to the rotation of the blades there is formed ahead of the forward side of the blade an outwardly directed current which draws air from the air concentration zone discharging it against the forward face of the blades. As a result of the two current flows there is produced on the winglet extension a substantially axially and outward directed resultant current flow, which is advantageous.

Conversely, the impeller of the invention does not produce a radial outward flow from the blades.

Hence, the blade structure of the invention sucks in air substantially radially from a large area and forces along the winglet extension this air into an appreciably restricted space chiefly corresponding in cross section to the outer edges of the winglet extensions so that an axial current flow is produced.

From this it follows that the efficiency of the blade structure of the invention is much greater, even several times greater than that of prior art axial-flow type impellers which are only capable of sucking air chiefly in the axial direction while the major part of the current flow produced thereby is just consumed in producing radial current flow and in friction losses.

Since the impeller of the invention does not produce radial flows the same may be mounted (e.g., for ventilation purposes) in front of a tubular guide. The produced appreciable increase in efficiency is due in part to the great increase of the amount of air sucked in.

Moreover it is advantageous to arrange each blade so that when viewed the impeller in the flow direction of the current to be produced, the forward side of each blade will angularly deviate from the radial direction so that the inner edge of the winglet extension adjacent to the shaft will, during rotation of the impeller, travel ahead of the rest of the forward side of the blade. The forward side of the blade is advantageously straight or may be rearwardly curved. Then the forward sides of the blades will cut into the encountered air obliquely from which it follows that the noise made by the fan is low.

The impeller or propeller of the invention is described more in detail in the following description referring to the accompanying drawing which illustrates by way of example an embodiment of the invention.

In the drawing, FIG. 1 is a side view of the impeller of the invention used as an air circulating fan, with a motor and a tubular air guide, two fan blades being shown in side view while an end view of an intermediate blade is shown in dash lines.

FIG. 2 is a fragmentary end view of a portion of the fan.

FIG. 3 is a cross-sectional view taken on line 3—3 of FIG. 1.

FIG. 4 is a cross-sectional view taken on line 4—4 of FIG. 1, said section being taken at a point where the outermost end of the winglet extension meets with the main portion of the blade. In FIGS. 1 and 2 the "dividing line" between the primary portion and the blade extension or winglet is marked by the dash-line *a—b*.

In the drawing, the reference numeral **1** indicates the blade, **2** the blade supporting hub, **3** the fan shaft, **4** the tubular current flow guide, **5** the fan motor, **1***a* the blade portion without an extension or winglet and **1***b* the winglet extension. The pitch of the primary portion of the blade is advantageously fairly great. However the pitch may be small or zero under certain conditions. Portion **1***a* is flat or at least substantially flat and on the one side thereof along line *a—b* projects a winglet portion **1***b* which has a cross-sectional area shaped substantially in the form of an arc, curving gradually more and more towards the fan shaft or the air current to be produced. The end portion of the winglet extension starting from the line *c—c* is advantageously further curved to extend in the axial direction of the fan or substantially axially of the fan's axis of rotation. The currents of air moving outwardly along the forward side of the blade are indicated by arrow K*u* in FIG. 1. The air currents moving past the forward side of the blade from the leading to the trailing edge of each blade in the direction indicated by arrows *n* are marked K*s* in FIG. 1. The resultant air flow R flows into the tubular guide **4**.

The forward side of the blade advantageously deviates appreciably from a plane normal to the fan axis. This deviation varies approximately from 3° to 10° or more, and is preferably 5°. Even a smaller angle of deviation (e.g. 1–3°) has a substantial effect on the operation of the fan.

The propeller and the like of the invention has high efficiency even at low rotational speeds.

If very great efficiency is desired, two or more fans of the invention may be secured in tandem to the rotary shaft of the one and same motor adapted to in which case it is advantageous to mount the fans so the blades of the one fan will, as viewed in the axial direction of the fan, be offset to the blades of the second fan.

The position, shape and dimensions of the fan blades as also the number of blades employed depends upon the purpose for which the impeller is intended to be used. Hence in addition to controlling efficiency by varying the rotational speed, the efficiency of the impeller may also be controlled so that the number of blades, pitch of primary portion of blades, position of the winglet extensions, relative angle between the blades and fan shaft are made adjustable and that one or more of the last mentioned factors are adjusted as needs may be by using any conventional prior art mounting and adjustment structure.

By way of example the dimensions of a blade structure of the invention which has proved in tests to be very advantageous are mentioned here.

The blade with the winglet as viewed in side view is triangular in form and is mounted on the hub assembly in the following way:

(*a*) The longest leading edge **10** of the triangular blade forms an angle of about 85° with the longitudinal axis of the propeller shaft,

(*b*) The blade pitch is 24°,

(*c*) The shortest side of the triangular blade (the inner edge **11** closest to the shaft) forms with the shaft an angle of about 30–45° leaving a corresponding open space **12** around the shaft,

(*d*) The tip portion **13** of the triangular blade (in the axial flow direction) is bent to form the winglet extension **1***b* so the angle between the winglet extension and the fan shaft gradually approaches 0° as the rear end **11***a* of the edge **11** at the tip of the winglet extends parallel to the axis of rotation,

(*e*) The blades cut the incoming air obliquely so that the noise made by the propeller is as low as possible.

Other constructional modifications and changes may be made in the impeller of the invention without departing from the scope and spirit of the invention.

What is claimed as new and desired to be secured by Letters Patent is:

1. An impeller rotatable about an axis for producing an axial flow of a fluid, the impeller comprising a plurality of blades and a hub supporting said blades in a position in which the edge of each blade leading in direction of rotation is located forwardly in the flow direction of the fluid, each blade including a radially extending base portion defining a pitch angle with the axis of rotation, and a triangular integral winglet extension rearwardly projecting from the trailing portion of said base portion, and extending from the inner end of said base portion to a point spaced from the outer end of said base portion along a line substantially parallel to said leading edge, the tip portion of said winglet extension being located rearwardly of said base portion in flow direction, and extending substantially in axial direction so that the cross-section of said winglet extension is substantially arc-shaped and said winglet extension being wider in the region of said tip portion and tapering toward said point at said outer end of said base portion, each winglet extension having the inner edge thereof which is located closest to the axis of rotation extending at an acute angle to said axis closely spaced from said axis so that said inner edges of said winglet extensions define during rotation a space about said axis widening in flow direction, said leading edges of said blades defining with said axis an angle less than 90° so that said leading edges are inclined to the flow direction.

2. An impeller as set forth in claim 1 wherein said inner edge of each triangular winglet extension is shorter than the outer edge of the winglet extension, and wherein the side of said triangular winglet extension extending from the inner end of said base portion to said point is longer than said outer and inner edges of the winglet extension.

3. Impeller as set forth in claim 2 and including a shaft secured to said hub, said shaft passing through said space defined by the inner edges of said winglet extensions during rotation.

4. Impeller as set forth in claim 2 wherein the pitch angle at the outermost portion of said base portion is zero.

5. Impeller as set forth in claim 1 wherein the base portion of each blade is substantially flat.

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