Dec. 20, 1960

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2,965,180

PROPELLER FAN WHEEL

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2 Sheets-Sheet 1

FIG. 1

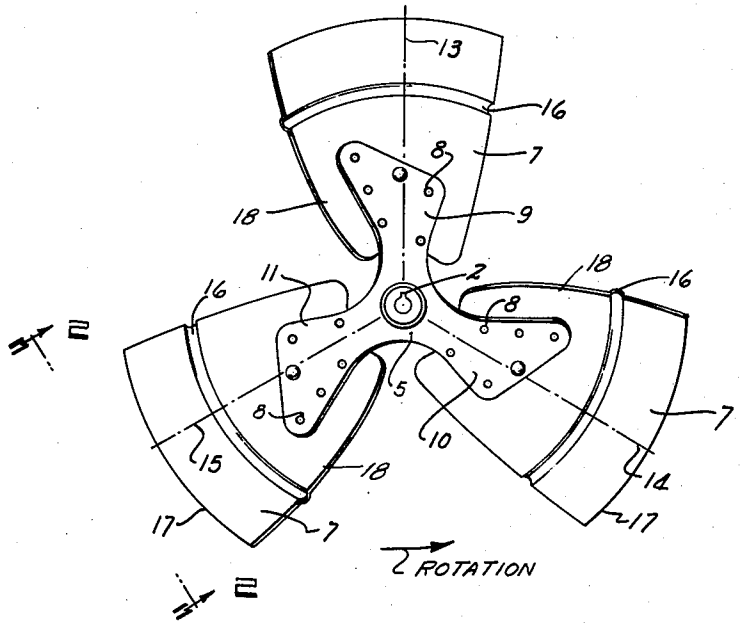
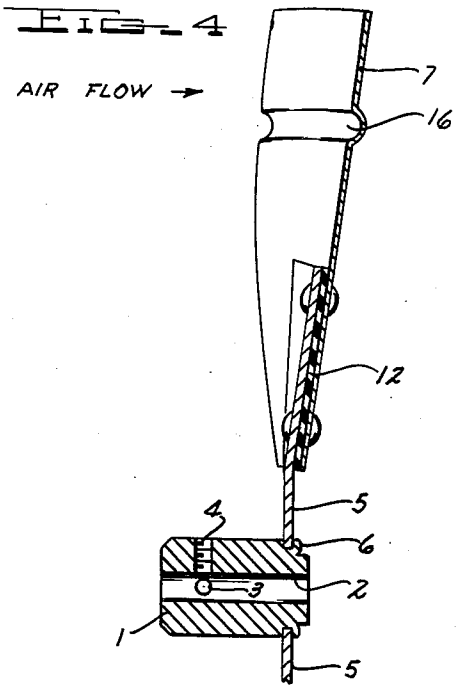


FIG. 4



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FIG. 3

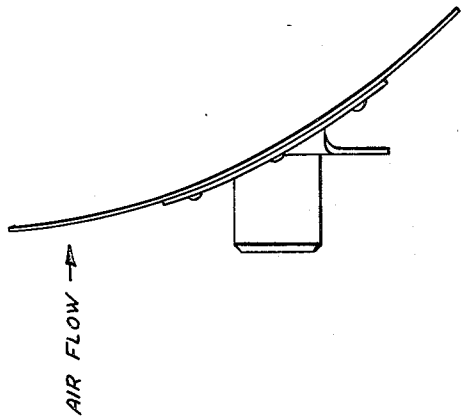
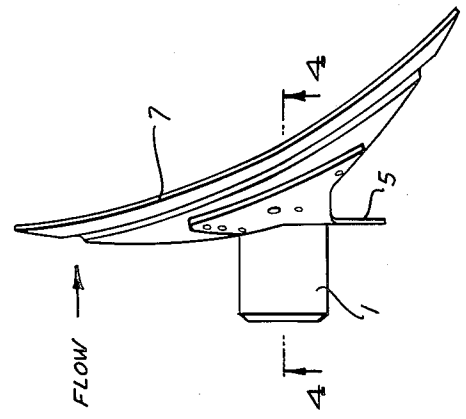


FIG. 2



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PROPELLER FAN WHEEL

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3 Claims. (Cl. 170—170)

This invention relates to propellers. Its application to date has been in air-circulating fans, although it is susceptible to use in other fields.

Conventional air-circulating propellers are so designed as to propel the air in directions parallel to the propeller axis. Most of the work is done adjacent the tips of the blades, and as a result there is a low pressure area adjacent the propeller axis in which comparatively little air flow takes place. The creation of this low pressure area is unsatisfactory both from the standpoint of air moving efficiency and also from the standpoint of noise emission.

From the standpoint of air moving efficiency the low pressure area is believed unsatisfactory because it causes the formation of turbulence in those areas where the slow moving air adjacent the propeller axis meets the fast moving air coming from the blade tips.

From the standpoint of noise emission the aforementioned low pressure area is believed unsatisfactory because the turbulence which it creates causes the formation of undesired sound waves. Undesired sound waves are also formed because the incoming air is received on the propeller blades at an improper angle. Conventional air propellers are so designed that the air is received on the blades at oblique angles relative to the blade planes as opposed to being received thereon at a ninety degree angle. As a result the leading edge of each blade is in a sense moving against the air flow instead of cutting through the air at right angles to the air flow. This blade movement is believed to contribute to the high noise characteristics of conventional propellers.

An object of the present invention is to improve the efficiency of propellers by causing them to give the medium being propelled a more compact and uniform movement than has heretofore been considered possible.

This object is attained in the case of an air propeller by so designing the propeller that the air is directed from the propeller blades at a slight angle toward the propeller axis instead of parallel thereto as is the case with conventional propellers. This "angular" movement of the air causes the fast moving air particles adjacent the blade tips to converge and blend together in a substantially non-turbulent manner, whereby to cause a more compact and uniform air blast.

Another object of the present invention is to provide a propeller having reduced noise emitting characteristics.

This object is attained in the case of an air propeller by so designing the propeller blades that their leading edges are substantially normal to the direction of air flow instead of at oblique angles thereto.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

Fig. 1 is an elevational view of one embodiment of the invention taken from a position upstream from the propeller.

Fig. 2 is a view taken on line 2—2 in Fig. 1 and with one only of the propeller blades being shown.

Fig. 3 is a view of a conventional propeller taken in the same direction as Fig. 2.

Fig. 4 is a sectional view taken on line 4—4 in Fig. 2.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring now to the drawings the illustrated embodiment will be seen to include a hub **1** provided with a keyway **2** and threaded bores **3**, **4** for receiving two set screws (not shown), whereby to fixedly secure hub **1** on the shaft of a motor (not shown). Fitting around hub **1** and fixedly secured thereto is a spider member **5**. Securement of the spider on the hub is effected by forming hub **1** with a flange **6** and turning the flange out into clamping engagement against the face of the spider.

Spider **5** includes three arms **9**, **10** and **11** which extend radially at right angles from hub **1** until they engage respective ones of three propeller blades **7**, at which point they take slightly tilted directions toward the downstream side of the propeller. The amount of tilt is preferably in the neighborhood of six degrees.

Blades **7** are preferably secured on the spider arms by rivets **8**. The various rivets are spaced radially from each other (instead of being on a common circumference) so as to set up more than one circumferential path through which rivet or blade failure could occur. Blades **7** are preferably constructed of aluminum, and the hub and spider are preferably constructed of steel. In order to minimize electrolytic action between the spider and blades and also to damp out vibrations, there is preferably provided between the spider arms and each of the blades a gasket **12**.

Blades **7** are curved about points along the axially extending planes defined by lines **13**, **14** and **15** so as to provide the desired propelling surfaces. Curving of the blades is preferably effected in a die. In order to prevent the blades from springing back toward a flat condition after they have emerged from the die, it has been found advisable to provide a reinforcing rib **16** of concavo-convex configuration near the tip or outer edge **17** of the blade. This reinforcing rib allows the blade to be stressed in the die to a greater extent than would otherwise be possible and to more effectively resist spring back of the metal, thereby reducing possible variation from desired blade curvature. A similar result could be achieved by increasing the blade thickness.

Since most of the work is done at the outer edges of the blades rather than near the blade inner edges **18**, the blades are made wider toward the tips and the blade tips are cut off sharply as at **17** to form what might be termed square tipped blades. The square tipped blades have been found to perform more efficiently than round or curved tipped blades.

Another feature contributing to increased efficiency lies in the fact that the blades are tilted in a downstream direction. This tilting is due to the aforementioned six degree tilt given to the arms of spider **5**. Actually each tilted blade forms a substantially conical surface having its apex at the propeller axis. As a result the propelled medium is directed at a slight angle toward the propeller axis. This angular movement of the medium has been found to give increased efficiency both as respects volume of air delivered and reduction in noise emission. A factor in the reduced noise emission is the angle at which

the incoming air is received on the blades. By reference to Fig. 2 it will be seen that the incoming air flow is substantially at ninety degrees to the direction taken by the leading edge of the blade. As a result the blade cuts through the air and has no component of motion working against the air flow. In the conventional construction shown in Fig. 3 the air is received on the blade at an oblique angle so that the blade is in a sense working against the incoming air. This working action of the conventional construction is believed responsible for undesired sound emission.

I claim:

1. A propeller comprising a tubular hub; a steel spider plate secured to the hub and having a plurality of integrally formed arms radiating outwardly therefrom; the outer end portions of said arms being tilted in a downstream direction; said outer end portions having a substantially constant circumferential curvature around lines radiating from the hub axis and located substantially midway of the arm lateral edges; a gasket positioned on one face of each of the arms; aluminum blades secured on the exposed faces of the gaskets and conforming to the tilt of the arms; said blades also conforming to the circumferential curvature of the arms so as to have substantially constant circumferential curvature from their leading edges to their trailing edges; said leading and trailing edges diverging from one another in outward directions, and the outer peripheral edge of each blade being located substantially on a circumference drawn from the hub axis so as to form substantially square corners at the junctures with the leading and trailing edges; circumferentially extending portions of each blade being deformed to provide a circumferentially extending concavo-convex rib for preventing blade flattening and flutter.

2. A gas propeller comprising a tubular hub; a spider plate secured to the hub and having a plurality of integrally formed arms extending substantial distances radially and circumferentially; the outer end portions of said arms being tilted in a downstream direction; said outer end portions having a substantially constant circumferential curvature around lines radiating from the hub axis and located substantially midway of the arm lateral edges; a propeller blade of sheet material secured to each of the arms and extending outwardly therefrom while maintaining the downstream tilt; said blade also conforming to the circumferential curvature of the arms so as to have substantially constant circumferential curvatures from their leading edges to their trailing edges; said leading and trailing edges diverging from one another in outward directions, and the outer peripheral edge of each blade being located substantially on a circumference drawn from the hub axis so as to form substantially square corners at the junctures with the leading and trailing edges; circumferentially extending portions of each blade being deformed to provide a circumferentially extending concavo-convex rib for preventing blade flattening and flutter, said rib being spaced inwardly from the outer edge of the blade, all of the concave blade surfaces facing in the downstream direction.

3. A gas propeller comprising a centrally disposed mounting structure; a plurality of propeller blades radiating outwardly from and supported by said mounting structure; each of said blades being of sheet material and having a radial inner area, an outer peripheral edge, a leading edge, and a trailing edge; said blades each being tilted in a downstream direction from its radial inner area to its outer peripheral edge; each of said blades having a substantially constant circumferential curvature from its leading edge to its trailing edge, with all of the concave blade surfaces facing in the downstream direction; the leading edge of each blade extending in a plane substantially normal to the mounting structure axis, and the trailing edge being displaced in an axial direction downstream by the aforementioned circumferential curvature; each of said blades having its outer peripheral edge located substantially on a circumference drawn from the mounting structure axis so as to form substantially square corners at the junctures thereof with the leading and trailing edges, circumferentially extending portions of each blade being deformed to provide a circumferentially extending concavo-convex rib for preventing blade flattening and flutter, said rib being spaced inwardly from the outer edge of the blade.

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