Nov. 15, 1932. J. VERZILLO ET AL 1,888,056

FOUR-BLADE PROPELLER

Filed May 31, 1932

Fig. 1.

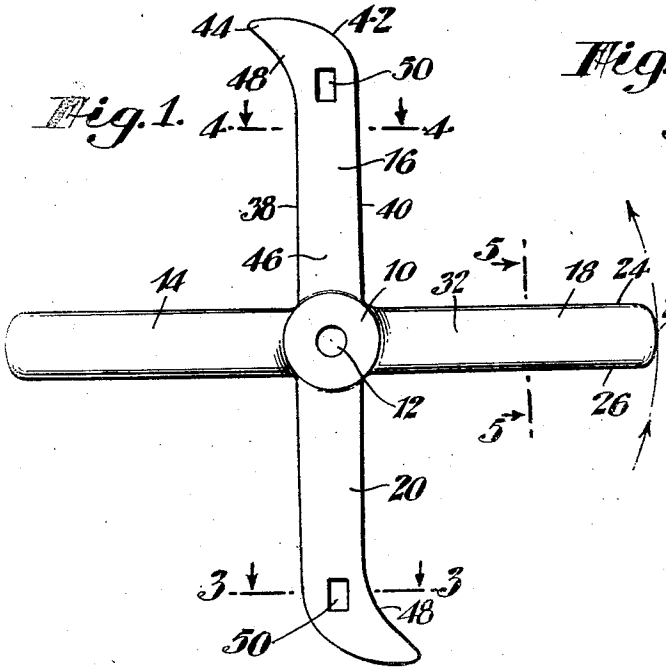


Fig. 2.

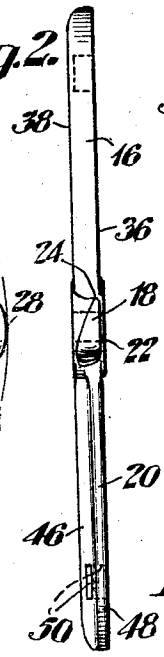


Fig. 4.

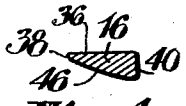


Fig. 5.

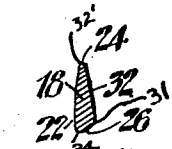


Fig. 3.

Fig. 6.

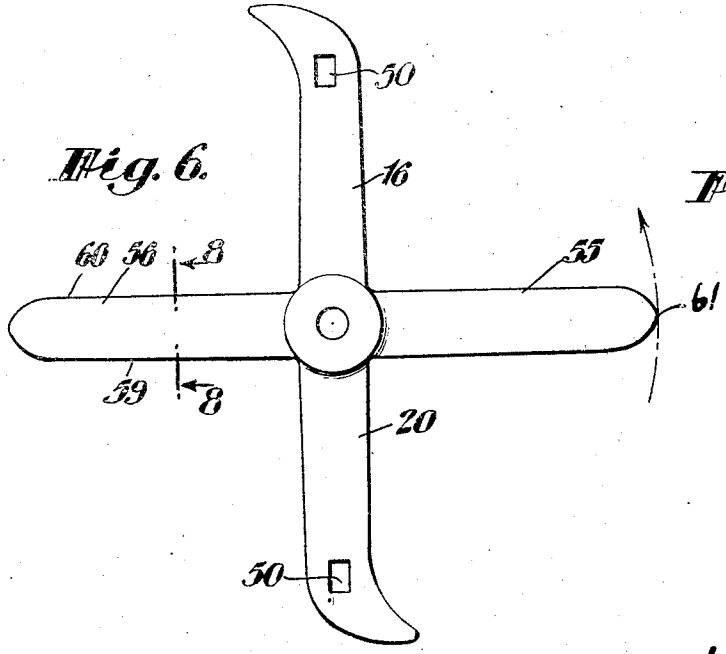


Fig. 9.

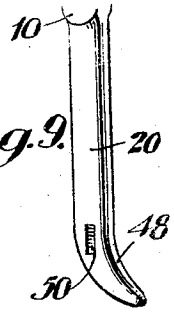


Fig. 8.

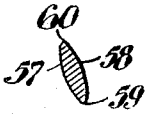
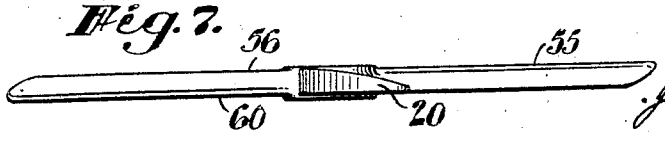


Fig. 7.



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UNITED STATES PATENT OFFICE

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FOUR BLADE PROPELLER

Application filed May 31, 1932. Serial No. 614,440.

This invention relates to propellers. More particularly it relates to four blade propellers for use in heavier than air motive vehicles, such as aeroplanes, and airships or dirigibles.

In the propulsion of heavier than air vehicles, two blade propellers are commonly used. While the use of such propellers has met with varied success, nevertheless their use is attendant with many hazards and dangers. While a two blade propeller in most instances is easier to make from a constructional or design viewpoint, there are certain disadvantages which must be seriously considered and obviated for safely and efficiently driving an aeroplane. For instance, if a blade of a twin blade propeller is broken or its lamellas are split or fall apart when in active use on an aeroplane, or an airship, it is obvious that a serious crash may result. Furthermore, twin blade propellers are not highly efficient for the combined lifting, propulsion and stabilization of an aeroplane, particularly in air regions where air pockets are prevalent.

It is an object of the present invention, therefore, to obviate the aforementioned disadvantages and defects.

Another object of this invention is to provide a four blade propeller which is simple to construct and which will be efficient for rendering propulsion, lifting, and stabilizing power in connection with heavier than air vehicles.

One further and more specific object of this invention is to provide a propeller, preferably of the four blade type, having blades made in pairs, in which each blade of each pair is in axial alignment and apart from each other at substantially 180°.

With the above objects and features in view, the invention in its preferred embodiments includes a four blade propeller, in which two of the blades are of equal design and construction, the blades of one pair of blades being in alignment with each other; and having propelling blades with leading and trailing edges of similar contour, while the working face is curvate, and the rear face is substantially and preferably flat. The blades of the other pair are for rendering the vehicle stationary and for lifting. They have the leading and trailing edges joined together to form a lip-like extending portion at the top thereof, said lips being tilted arcuately so that they are in the direction of rotation of the propeller. The working face of such blades is somewhat shallow, while the under surface is substantially flat. Each blade of the latter type has one or more rectangular or oblong-shaped openings therein whose axes are in alignment with the longitudinal axis of the blade. Such apertures may be arranged at any part of the blade along the axis thereof and may be closed whenever very little or no air pockets are encountered.

The invention also resides in the special construction, combination and arrangements of the several parts of a four blade propeller as more fully hereinafter described in connection with the accompanying drawing in which similar character numerals refer to like parts throughout, and in which:—

Figure 1 is a front elevational view of one embodiment of the invention;

Fig. 2 is an end view of Fig. 1, looking toward the left of the drawing;

Fig. 3 is a sectional view on line 3—3 of Fig. 1, showing the curvature of the working face of the blade toward the lip thereof and a section of the rectangular opening in the blade;

Fig. 4 is a sectional view looking in the direction of the arrows on line 4—4 of one of the blades in Fig. 1;

Fig. 5 is a sectional view looking in the direction of the arrows on line 5—5 of Fig. 1;

Fig. 6 is a front view of a modified embodiment of the invention, showing the horizontally disposed blades in the drawing, of somewhat different construction from the similarly disposed blades in Fig. 1;

Fig. 7 is a side end view of Fig. 5, looking upward from the bottom of Fig. 6;

Fig. 8 is a sectional view of one of the blades on line 8—8 of Fig. 6; and

Fig. 9 is a perspective view of a blade shown in Fig. 1.

Referring to the accompanying drawing,

which for the sake of illustration and clarity bring out the various features of the invention in its preferred form, a hub 10 has a bore 12 extending therethrough for the reception of the end of a rotary driving shaft of an aeroplane or dirigible motor, not shown. Both front and rear faces of the hub are flat surfaced. Extending from the hub and at intervals of substantially 90° apart around the axis of the hub as a center, are a plurality of blades 14, 16, 18, and 20. The blades of the propeller are preferably integral with the hub 10 or may be engaged thereto by any well-known means. The blades as shown in the drawing are in pairs of two different structural features. The blades 14 and 18 are of one kind and are in alignment with each other on opposite sides of the axial center of the hub, through an interval of 180°, while blades 16 and 20 are of another kind and also oppositely disposed but intermediate the blades 14 and 18 so as to be at 90° intervals to the latter blades while at 180° from each other.

For purposes of simplicity only, one blade of each type will be described, since both blades of each type are of the same constructional features. Blade 18 projecting from hub 10 has a flat forward face 22, while the leading or forward edge 24 and trailing edge 26 are straight-lined and gradually taper toward the outer end of the blade. The tapering of the edges, however, is so slight that they are substantially parallel with the center line of the blade, as indicated in the drawing. The end 28 of the blade is rounded, particularly at the parts merging with the leading and trailing edges for permitting efficient cutting of the fluid in which the blade is used.

The working face of the blade is somewhat curved, as shown in Fig. 5, having a gliding portion 32′ forming an acutely angled cross section between the forward face 22 and sharp leading edge 24. The gliding portion 32 extends only partly beyond the longitudinal axis of the blade to form a ridge 31 with a follow-up portion 26 whose face is somewhat obtuse with respect to the trailing edge 34.

From the foregoing described constructional features, it will be noted that the blades have a working face with a ridge extending beyond the longitudinal axis to provide efficient means for forming stream lines for the propulsion of the aeroplane or dirigible. The leading edge 24 is acute for cutting the air and permitting it to glide along the working face portion 32 and then downwardly along the part 26.

The blades 16 and 20 have their rear faces flat and in the same plane as that of hub 10. Considering for example, blade 16, which is of the same construction as blade 20, a leading edge 38 extends part of the length of the blade parallel with the longitudinal axis thereof. The leading edge then tapers slightly outwardly of the blade. The opposite or trailing edge 40 of the blade 16 or 20 is also parallel with the axis of the blade and at its end portion is curved toward the longitudinal axis to describe a broadened arc 42. The curved edges meet together to form a lip 44 pointing in the direction of rotation of the propeller as indicated by the arrow. It is apparent that by its constructional feature the lip 44 easily cuts through the air fluid.

The blade 16 has a working face 46 of gradual curvature or slope leading from the trailing edge 40 to the working or leading edge 38. The trailing edge 40 is preferably perpendicular to the face 36, thereby forming a 90° intersection of the faces. The part 48 of the face toward the lip 44 is somewhat more deeply sloped or shallowed, as shown in Fig. 3, in order to provide for the easy passage of streams of air from the lip onto said face and over toward the trailing edge, as shown in Figs. 2, 3, and 4.

Each of the blades 16 and 20 are also provided with an opening 50 preferably rectangular or oblong shaped whose axis is in alignment with that of the blades. The aperture extends through the thickness of the blade and is located in Figs. 1 and 6 merely for the purposes of illustration at the lip portion of the blade. One or more apertures of varying size may be disposed at any position along the blade axis, depending upon the number and size of openings desired. Such apertures permit the passage of air therethrough during rotation of the propeller, and tend to cooperate with the blades to stabilize the aeroplane. When it is desired not to use the blades with the apertures, small blocks of wood or other material, of which the propeller is made, are provided having a shape and outline corresponding with the apertures. Such blocks are used for closing the apertures when desired, and are retained in position within the blade by any well-known fastening means.

The blades 16 and 20 maintain the lift of the plane or dirigible and also tend to stabilize the same. Also the air entering the apertures of the blades forms eddy currents around the propeller blades. The blades 16 and 20 by their formation and shallow working faces help the propeller to effectively cut the air medium, thus to permit the vehicle to forge smoothly and with a minimum of resistance.

In the modification illustrated in Figs. 6 to 8, the lifting blades 55 and 56 have their working and rear faces 57 and 58 respectively of similar and even curvature, as shown in Fig. 8, the leading edge 59 and the trailing edge 60 are of the same contour and meet together at the end of the blade to form

a tapering tip point 61. As shown in Fig. 8, the leading edge 59 is to the right of the vertical plane so that the longitudinal plane of the blade intersects the vertical central plane of the hub 10. By such curvature of the blade faces, they efficiently cut the air and permit the flow of air along the faces thereof and also reduce frictional resistance in the propulsion of the aeroplane. The blades 16 and 20 of this modification are the same as those described in connection with the first embodiment.

From the foregoing description of the preferred embodiments of the invention taken in connection with the accompanying drawing, it is apparent that a four blade propeller may be constructed and designed for efficiently propelling and stabilizing aeroplanes, dirigibles and the like. The propeller is provided with two pairs of blades, each pair of different contour, outline, and section. One of said pairs is suitable for propelling, while the other pair is adapted for stabilizing and lifting in connection with the first pair. In one pair of blades, apertures, openings or holes, are provided therein at any point along the longitudinal axis of the blades for preventing bumping, tilting or dropping, particularly in air regions where numerous air pockets exist. Such openings may be closed by using blocks whose shape corresponds with that of the openings.

While preferred embodiments of the invention have been described herein in connection with the accompanying drawing, it is evident and to be understood that various changes or further modifications may be made with respect to the face curvature of the blades. Also the contour of the leading and trailing edges may be modified or varied without departing from the spirit and scope of the invention and defined in the appended claims. Therefore, various modifications as to form, size, shape, material, and structure may be made without being limited to the specific construction shown in the accompanying drawing and described herein.

Having thus described the invention, what we claim as new is as follows:—

1. A propeller having a hub and a plurality of different pairs of oppositely disposed blades extending therefrom, one pair of the blades having trailing and leading edges substantially parallel to each other and a working face of inclined cross section toward the leading edge thereof, and the other pair having a leading and trailing edge merging toward each other whereby an extending lip portion is formed leading in the direction of rotation of the propeller.

2. A propeller with a hub and a plurality of blades extending radially therefrom at intervals of 90° from the center of the hub, said blades occurring in pairs, each blade of one pair being in alignment with the other, the blades of one pair having a slightly inclined working face, while the blades of the second pair contain a leading and trailing edge merging to form a lip thereon, the trailing edge being arcuately formed whereby the lip is in the direction of work of the propeller, said blades of the second pair having openings therein in alignment with the longitudinal axis of the blades.

3. A propeller comprising a hub, a plurality of blades extending radially from said hub, the rear face of said blades and hub being substantially flat faced, two of said blades being apart from each other at an interval of substantially 180° around the hub and having leading and trailing edges substantially parallel with each other and their working face rounded and with an obtuse angled ridge adjacent the trailing edge thereof, and another pair of blades each intermediate the other blades around the hub.

4. A propeller comprising a hub, a plurality of blades extending radially from said hub, the rear face of said blades and hub being substantially flat faced, two of said blades being each apart from the other at an interval of 180° around the center of the hub and in alignment with each other, said blades having their leading and trailing edge coming to a rounded point to form a lip projecting away from the leading edge and a working face of shallow curvature, and two other blades with their longitudinal axis intersecting the other two blades at the hub at 90° and having a flatly rounded working face thereon.

5. A propeller comprising a hub, a plurality of blades extending radially from said hub, the rear face of said blades and hub being substantially flat faced, two of said blades being each apart from the other at an interval of 180° around the center of the hub and in alignment with each other, said blades having their leading and trailing edges coming to a rounded point to form a lip projecting away from the leading edge and a working face of shallow curvature, two other blades with their longitudinal axis intersecting the other two blades at the hub at 90° and having a flatly rounded working face thereon, said first two blades having a plurality of apertures disposed with their longitudinal axis in alignment with that of the blades thereof.

6. A propeller comprising a hub, a plurality of blades radially extending from the hub, two of said blades being apart from each other at an interval of 180° around the center of the hub and in alignment with each other, said blades having a flat rear face, leading and trailing edges on the blades coming to a rounded point to form a lip projecting from the leading edge in the direction of rotation of the propeller and a working face of shallow curvature, and two other blades with their longitudinal axes intersecting the other two blades at the hub at 90° and having work-

ing and rear faces of convex curvature extending the length of the blade, the edges of said blades coming to a tip on the longitudinal axis thereof.

In testimony that we claim the foregoing as our invention, we have signed our names hereto.

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AUGUSTINE YODICE.