March 8, 1932. L. M. FOSTER 1,848,705

PROPELLER WHEEL FOR AIRCRAFT

Filed July 15, 1927

FIG. 1.

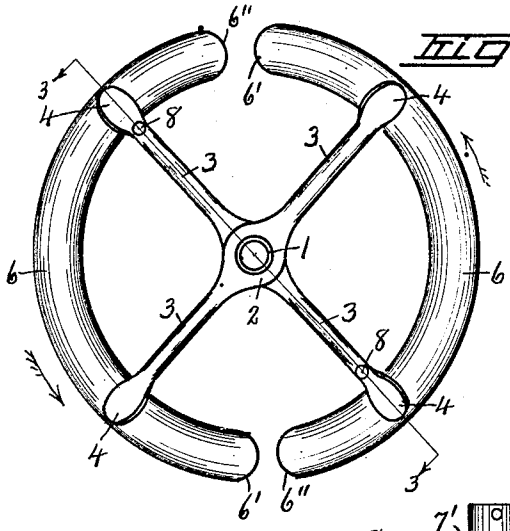


FIG. 4.

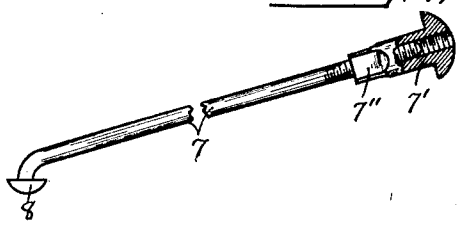


FIG. 2.

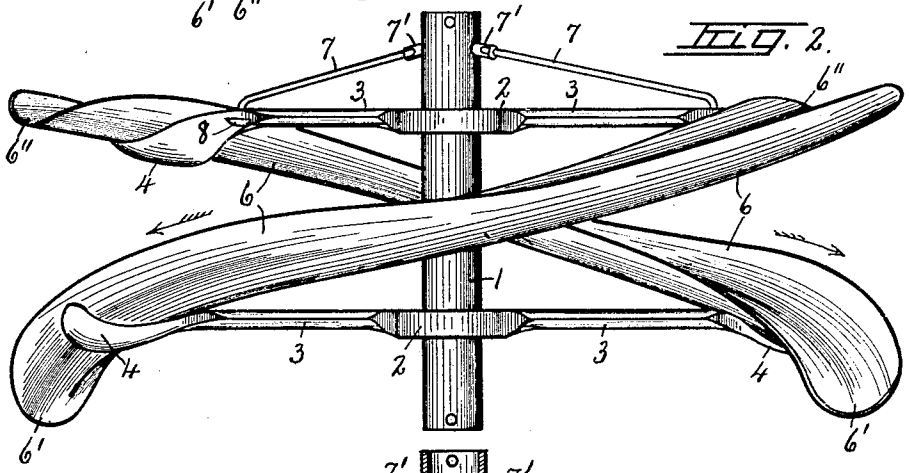
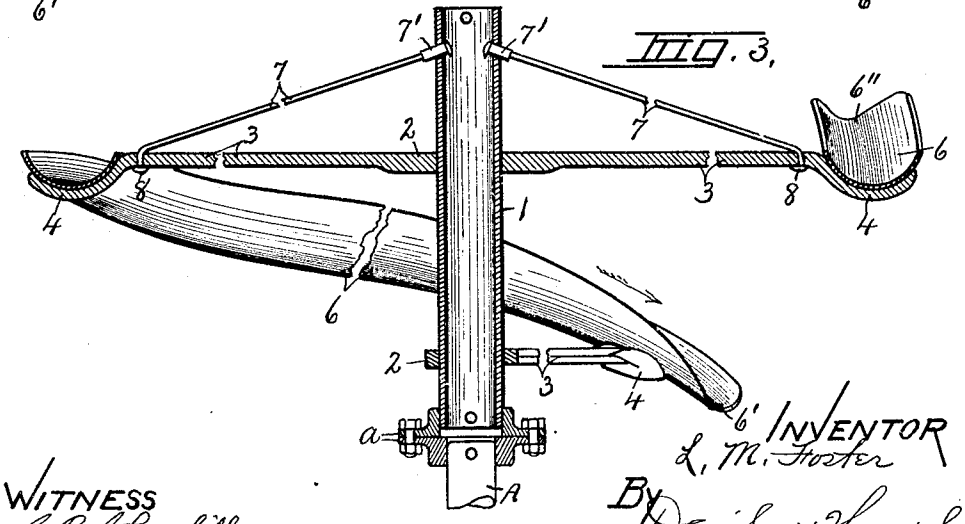


FIG. 3.



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PROPELLER WHEEL FOR AIRCRAFT

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This invention relates to a rotary propeller wheel for airships in which a plurality of relatively thin sheet metal blades are arranged to extend circumferentially and spirally around a suitable supporting hub in uniformly spaced relation circumferentially and concentric with the axis of rotation as distinguished from the radially extending wooden blades now in common use.

The main object is to obtain a maximum propelling power with a minimum weight of the propeller.

Another object is to construct and assemble the blades in such manner that all portions thereof will retain substantially their normal form and contour against deflecting, twisting or vibrating strains by impact with the air, particularly when driven at high speed under heavy load.

A further object is to obtain a maximum area of impact of the blades against the air with a minimum radial width of the blades and at the same time to maintain a closer continuity of such impact throughout the circumferential length of the wheel than has heretofore been practised by making the impact sides of the blades concave in cross section and causing adjacent ends of the blades to approach closely to a radial plane between them so that the air leaving the heel of each blade will immediately impinge against the toe of the next succeeding blade.

Other objects and uses relating to specific parts of the propeller will be brought out in the following description.

In the drawings:—

Figure 1 is an end view of a propeller wheel embodying the various features of my invention.

Figure 2 is an enlarged plan of the same propeller.

Figure 3 is an enlarged lengthwise sectional view taken on line 3—3, Figure 1, portions of one of the blades being broken away.

Figure 4 is an enlarged elevation, partly broken away and partly in section, of one of the braces.

As illustrated, this propeller comprises a tubular hub —1— having axially spaced collars —2—, each provided with a pair of diametrically opposite radial spokes —3— having their outer ends provided with concave seats —4— adapted to be brazed or otherwise rigidly secured to the convex sides of a pair of propeller blades —6— of concavo-convex cross section.

All of the parts of the propeller are preferably made of comparatively thin and light, yet strong and durable non-corrodible metal constructed and assembled in such manner as to reduce the resistance of the air to a minimum when the propeller is rotated.

The tubular shaft —1— is adapted to be connected at either end to a suitable driving shaft as —A— through the medium of separable coupling sections —*a*— so that the same propeller may be used at either end or at either side or similar propellers at both ends or both sides of the airship.

In fact, the construction of the propeller permits it to be used on any part of the airship, either in a vertical position for lifting purposes or in a substantially horizontal position for forward driving purposes.

The collars —2— may be welded, brazed or otherwise permanently secured to the periphery of the tubular hub —1— in axially spaced relation depending somewhat upon the spiral pitch and circumferential length of the blade —6— so that the spokes on both hubs may be disposed in substantially parallel planes at right angles to the axis of the hub —1— corresponding approximately to the transverse planes of the ends of the propeller blades.

That is, the spokes —3— of each hub 2 are substantially straight and radial, as shown more clearly in Figure 1, the outer end of each spoke being brazed or otherwise secured to the convex side of the corresponding end of one of the blades while the other spoke is similarly secured to the convex side of the corresponding end of the other blade, the portions of the spokes adjacent the blades being widened and comparatively thin and also made concavo-convex longitudinally to conform to the convexed contour of the adjacent portions of the blades, thereby to afford a relatively broad bearing for the blades and at the same time reducing to a minimum the air resistance of the adjacent portions of the

spokes. The intermediate portions of the spokes between the collars —2— and blades are preferably elliptical in cross section and relatively thin transversely of the axis of the propeller so as to afford a maximum strength and also to reduce the air resistance when the propeller is rotated.

The propeller blades —6— are similar and nearly, but not quite, semi-circular circumferentially and extend circumferentially and spirally around the hub —1— concentric with the axis thereof and in planes intersecting each other substantially midway between the collars —2— so that the opposite ends of each blade will lie in transverse planes substantially equal distances axially from the plane of intersection and will also approach closely to a medial plane passing diametrically through the axis of the hub whereby when the blades are rotated the more or less compressed air leaving the heel of each blade will instantly impinge against the toe of the other blade for maintaining a substantially continuous pressure against the air as the propeller is rotated.

These blades —6— are preferably made of thin sheet metal and concavo-convex in cross section throughout their lengths with their convex sides secured to the outer ends of the spokes —3— and their concave sides facing rearwardly for propelling impact with the air.

That is, the cross section of each blade is in the form of the arc of a circle of relatively small radius as compared with the radius of the propeller thereby greatly stiffening all portions of the blades against warping or axial deflection by impact with the air and at the same time forming in each blade a continuous channel open at both ends which affords a relatively large air impact area as compared with its radial width and causes the air to become pocketed or confined within the cross sectional limits of the channel as the propeller is rotated in the direction indicated by the arrows.

It is found that when this propeller is rotated at the required velocity for efficient work the air pressure in the channel surface of each blade rapidly increases from the toe to the heel of the blade reaching its maximum pressure at the heel and while the peculiar concavo-convex cross sectional area and circumferential circularity of each blade may under ordinary conditions be sufficient to hold all portions of the blade against yielding under this gradually increasing air pressure it may be desirable particularly under heavy loads to use braces as —7— having their inner ends connected to the end of the hub adjacent the concave sides of the blades and their outer ends fastened to the adjacent set of spokes which are attached to the heels of the blades and thereby to assist each spoke in holding the heels of the blades where the air pressure is greatest, against warping or forward deflection by air pressure.

The inner ends of the braces —7— are provided with internally threaded nipple sections —7'— having their heads engaged in apertured parts of the hub —1— and their threaded portions engaged with the adjacent threaded ends of the main bodies of the braces which are preferably made in the form of strong wire and are provided at their outer ends with heads —8— engaged in apertured portions of the outer ends of the spokes —3— to which the heels of the blades —6— are secured.

The nipples —7— are provided with angular outer ends —7''— accessible for the reception of a wrench or equivalent tool whereby the braces may be tightened or loosened at will.

Operation

When the propeller is constructed in the manner described, and rotated in the direction indicated by the arrows the air will be picked up by the toes as —6'— of each blade and caused to travel along the spirally inclined channel side thereof with gradually increasing pressure sufficient to propel the machine forwardly until the maximum pressure at the heel as —6''— of the blade is reached at which time the air under more or less high pressure is instantly released and allowed to impinge against the toe of the other blade to travel along the channel thereof with equal force and power until the highly compressed air leaves the heel of the second blade and impinges against the toe of the first blade thus completing the cycle and equilibrium of pressures on both blades for propelling the machine forwardly.

It is found that during this rotation of the propeller the inner end walls of the blades serve to prevent excessive centrifugal throw of the air and to closely confine the air in said channels from end to end thereof thereby obtaining a maximum driving efficiency with blades of relatively small cross sectional area.

I have found that the use of two similar blades of nearly semi-circular form circumferentially are best suited for air craft propulsion, but it is evident that a greater number of blades of equal circumferential length may be employed if desired, without departing from the spirit of this invention.

It will be noted that the propeller blades —6— arranged in the manner described spirally and circumferentially around the axis of the hub —1— constitute what may be termed a sectional rim of the wheel in which the sections of the rim travel endwise through the air about the axis of the hub as distinguished from the edgewise travel of the wooden radial blades commonly used thus permitting the use of the entire area of the channeled sides of the blades or rim sections to act

against the air as the impelling force for propelling the machine whereas in the ordinary wooden radial blade the impact area is limited to a relatively small section of the outer end thereof.

Furthermore, by making the rim sections or blades approximately semi-circular and arranging them so that their corresponding ends approach closely to a medial plane passing through the axis of the hub establishes a substantial continuity of impact with the air which permits the propeller to be driven at a lower rate of speed than would be possible with the use of radial or other blades with more or less circumferentially elongated air gaps between them.

This continuity together with the substantially equal cross sectional impact area also produces a substantially balanced end thrust of the propeller and reduces to a minimum any liability of side thrust so common in radial blades so that the resultant effect is less wear of the bearings and greater stability of the motion of the machine and consequently less liability of shattering or disintegration of any portion of the blades.

While I have shown and described the propeller wheel as adapted to be used more particularly for aircraft, it is evident that the same principle of construction may be used in connection with water craft, ice craft and land craft without departing from the spirit of this invention.

What I claim is:

1. An aircraft propeller wheel comprising a hub having a pair of diametrically opposite radial spokes arranged in axial spaced relation, a pair of substantially semi-circular concavo-convex blades extending spirally and concentrically about the axis of the hub, the toe ends of the blades being connected to one pair of spokes and the heel ends of the blades to the other pair of spokes, said blades being of substantially uniform cross section throughout their length and arranged with their concave sides facing rearwardly and having the edges of each blade in such a position that any line taken radially across said edges, will be at substantially right angles to the axis of rotation to prevent excessive centrifugal throw of the air as said air travels along the inclined concave sides of the blade with gradually increasing pressure.

2. A propeller wheel as in claim 1 in which a pair of obliquely disposed braces have their outer ends connected with the heel-supporting spokes adjacent the inner edge of the respective blade and the inner ends of said braces secured to diametrically opposite sides of the hub at the rear of the concave side of the blades for maintaining said blades against forward deflection.

In witness whereof I have hereunto set my hand this 13th day of July 1927.

LUCIAN M. FOSTER.