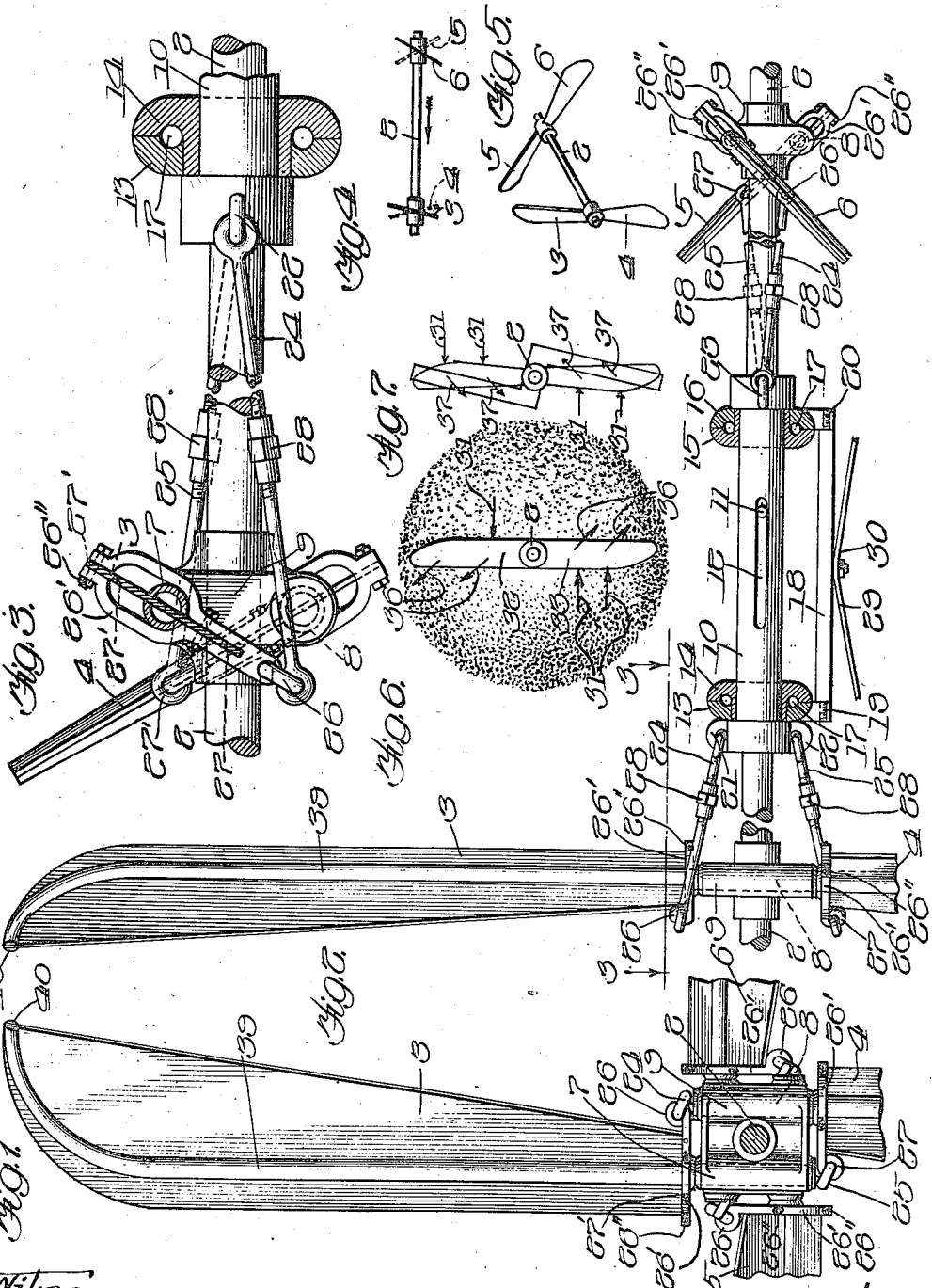
W. S. & A. H. BARROWS.

AERIAL PROPELLER.

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UNITED STATES PATENT OFFICE.

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AERIAL PROPELLER.

1,144,521. Specification of Letters Patent. Patented June 29, 1915.

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To all whom it may concern:

Be it known that we, WILBER S. BARROWS and ASAHEL H. BARROWS, citizens of the United States, residing at Chicago, Cook county, Illinois, have invented certain new and useful Improvements in Aerial Propellers, of which the following is a specification.

Our invention relates to aerial navigation, and has particular reference to the construction of propellers for aeroplanes.

The object of the invention is to provide improvements in the propeller to the end of adjusting its pitch, even during flight, to the atmospheric conditions and the acquired speed of the aeroplane once it is in motion.

Another object of the invention is to provide adjustable aeroplane propeller blades so that propellers arranged tandem may have the pitch of their respective blades adjusted with respect to the relative air currents that they encounter, and in view of the fact that the rear of a tandem pair of propellers must operate upon a current of air set in motion by the forward propeller of the pair.

Other subsidiary objects of the invention will appear from the detail description of the invention, which consists in the novel construction, combination and arrangement of parts, hereinafter described, illustrated in the accompanying drawing and incorporated in the appended claims.

In the drawing, Figure 1 is a side view of one of the propeller blades, together with its axial mounting and portions of the remainder of the propeller. This view also shows sections of the companion blades on the same shaft for the arrangement shown in Fig. 5. Fig. 2 is a view taken on a vertical plane at right angles to the vertical plane of Fig. 1 and represents a tandem pair of propellers on the same shaft, as in Fig. 5, parts being broken away, and also the adjusting mechanism to vary the pitch of the blades. Fig. 3 is a section taken substantially on the line 3—3 of Fig. 2. Fig. 4 is a reduced diagrammatic view showing the difference in pitch between the blades of, respectively, a forward and a rear propeller arranged tandem on a single shaft. Fig. 5 is a perspective view showing on a reduced scale a tandem pair of propellers to be adjusted in accordance with the means provided for such adjustment shown in the larger views. Fig. 6 is a diagrammatic view showing the theoretical effect upon the air of a propeller having blades arranged in the usual way, or extending on true radial lines from their axes of rotation. Fig. 7 is a diagrammatic view representing the relative effect of the present arrangement of propeller blades upon the air-currents encountered, in comparison with the effect shown in Fig. 6.

Referring in detail to the several views, 2 represents a propeller-shaft having a propeller thereon at each end, the blades of the propeller at one end being designated as 3 and 4 while the blades of the propeller at the opposite end are labeled 5 and 6. Each propeller blade or wing is mounted to turn on its longitudinal axis and for that purpose is provided with a journal or socket portion, this portion for the blade 3 being represented as 7 and that for the blade 4 as 8. The propeller having blades 5 and 6 is identically constructed. The journals 7 and 8 are mounted in a pair of parallel sockets in the propeller hub 9 keyed to the shaft 2, and these sockets are arranged on opposite sides of the shaft 2 which disposes the axes of the blades tangentially to the circular path of the propeller, as shown most clearly in Fig. 1. The mechanism for rotating the propeller blades of either one propeller or both of them together is represented by a sleeve slidably mounted on the shaft 2 and caused to rotate with said shaft by means of a pin or stud 11 which is fixed in and projects at right angles from the shaft into a slot 12 in the sleeve, which permits its sliding movement. In Fig. 2 this sleeve is shown connected with the four blades of the two propellers, but it is equally adapted for operating the blades of a single propeller by simply disregarding the connections at one of the ends of said sleeve. On the ends of the sleeve are shrunk, or otherwise suitably secured, ball-bearings 13, 14, 15 and 16. The bearing-member 14 of the pair of members at one end of the sleeve, is secured to the sleeve and rotates with it, while its companion member 13 is stationary. The same is true of the members 15 and 16 where the member 15 rotates with the sleeve and the member 16 is stationary. Balls 17, provided with the usual ball-races, are inserted between the respective pairs of bearing-members. The stationary members 13 and 16 are yoked together, or connected, by a rod 18 which has threaded engagement with apertured and threaded ears 19 and 20 on

the members 13 and 16, respectively. To the extreme ends of the sleeve 10 are secured two oppositely disposed pairs of ears, the pair at the left end being designated as 21 and 22 and the pair at the opposite end, of which only one is disclosed in Fig. 2, as 23. 21 and 22 may be regarded as a side elevation of 23, and 23 an end view of 21 and 22, the one pair of ears being arranged at right angles to the other pair. The inner ends of the blades of each propeller are, laterally of their axes or swivel joints in the hub, connected with the sleeve 10 by means of rods 24 and 25 which are linked to the ears 21 and 22 on the sleeve and ears 26 and 27 on bars or levers such as 26′ in Fig. 1 adjustably secured in any suitable way as, for instance, by means of bolts 26″ which engage holes 27′ which pass through the lever and blade. Referring to the ear or eye 26, by shifting the bolts 26″ into different holes 27′, 26 may be removed farther away from the axis of the blade. Thus a given thrust or pull movement in the rod 24 will, when the lever is lengthened, produce a smaller turning movement in the blade than when the eye 26 is nearer the axis. By means of this adjustment the blades of one propeller may be set at a pitch different from the pitch of the other propeller blades on the same shaft by making the levers 26′ longer on the one set of blades than on the other. The connecting-rods themselves are made variable in length by making them in two sections connected by a turn-buckle 28. In Fig. 4 the propeller blades 5 and 6 represent the rear of a tandem pair and are there shown set at a greater pitch than the pitch of the blades 3 and 4.

29 represents a suitable strap, cord or other connection secured at 30 to the sleeve 10, leading to a suitable lever or other control (not shown) at the usual operator's seat, by means of which the sleeve may be moved to and fro on the shaft to vary the pitch of the blades 3 and 4 where only one propeller is used, or blades 3 and 4 and 5 and 6 where the propellers are arranged tandem as in the drawing. By changing the inclination or pitch of the propeller blades the speed of the machine may be varied. Again, when the machine is in motion the blades of the propellers, when set at a fixed pitch, do not obtain the same hold upon the air that they do when the machine is standing still. In the one case the blades take hold of a comparatively still atmosphere while in the other the atmosphere is in motion relative to the machine. If the pitch of the blades can be changed to adjust them to the change from the relatively still to the relatively moving air, the initial grip, which must be comparatively powerful to start the machine, may be maintained to a large extent after the machine is under way, or in flight. As the rear blades of a tandem pair of propellers must take hold of air in greater motion than that which the forward blades must operate in, by reason of the rearward current set in motion by the forward blades, the differential adjustment provided by the turnbuckles 28 is provided so as to enable the operator to set the relative pitch of the rear blades accordingly.

With reference to the mounting of the axes of the blades on opposite sides of the axis of rotation of the propeller as a whole, Figs. 6 and 7 show the theoretical effect of this change from the usual radial arrangement of the blades shown in Fig. 6. In these figures 31 represents parallel arrows or a given direction of current, while 32 and 33 represent radially extending propeller blades and 34 and 35 the tangentially arranged blades shown in the drawing, the offsets of the blades from the propeller's axis being somewhat greater than in Fig. 1 for the purpose of better illustrating the idea. In Fig. 6 the arrows meet the respective blades at substantially right angles with a tendency to deflect the current by centrifugal force in the direction of arrows 36, or toward the tips of the blades. In Fig. 7 the blades meet the arrows or given current direction at an obtuse angle with reference to the axis of the propeller which tends to scoop in or condense the air in front of the propeller instead of dissipating or rarefying the air outwardly, thus giving the tangent blades a firmer body of air to take hold of. 38 in Fig. 6 represents the theoretical greater density of air at the outer circle of the propeller's circle of movement at the expense of air drawn from the center. If, on the other hand, the air is drawn inwardly in the direction of arrows 37 the surrounding air-supply will be drawn upon to make the air in the path of the propeller denser.

The construction of the blades 3 to 6 is shown in the drawing adapted for the use of light metal such as aluminum for the body of the blade, said body being strengthened by a rib 39 made of tubing split longitudinally and secured to one side of the blade in any suitable manner. The journal portions 7 and 8 may be projecting undivided portions (or circular instead of semicircular in cross section) of the tubing 39 or stiffening rib. As shown the outer end of the rib is curved toward the tip 40 of the blade.

We claim as our invention—

1. The combination with a propeller shaft, of a pair of propellers, a hub on said shaft into which blades are swiveled, a member slidably mounted on said shaft and stationary relative to said shaft's rotary movement, levers upon said blades, connec-

tions between said levers and said member, means for varying the lengths of said connections, and means for varying the length of throw of said levers.

2. The combination with a propeller, of a hub for the blades of said propeller, journals on said blades, bearings in said hub for said journals, means for turning said blades in said bearings, and means for varying the lever connections to vary the extent of the turning movement of said blades.

3. In a propeller, the combination with the blades of said propeller, of a hub having journal bearings therein, a stiffening rib for each of said blades, said rib having a journal portion mounted in the journal bearing, a longitudinally adjustable lever mounted on each propeller blade at right angles to its axis of rotation on its journal, and means for swinging said lever to vary the pitch of the blade.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

WILBER S. BARROWS.
ASAHEL H. BARROWS.

Witnesses:
MAE C. ALLEN,
J. W. BECKSTROM.