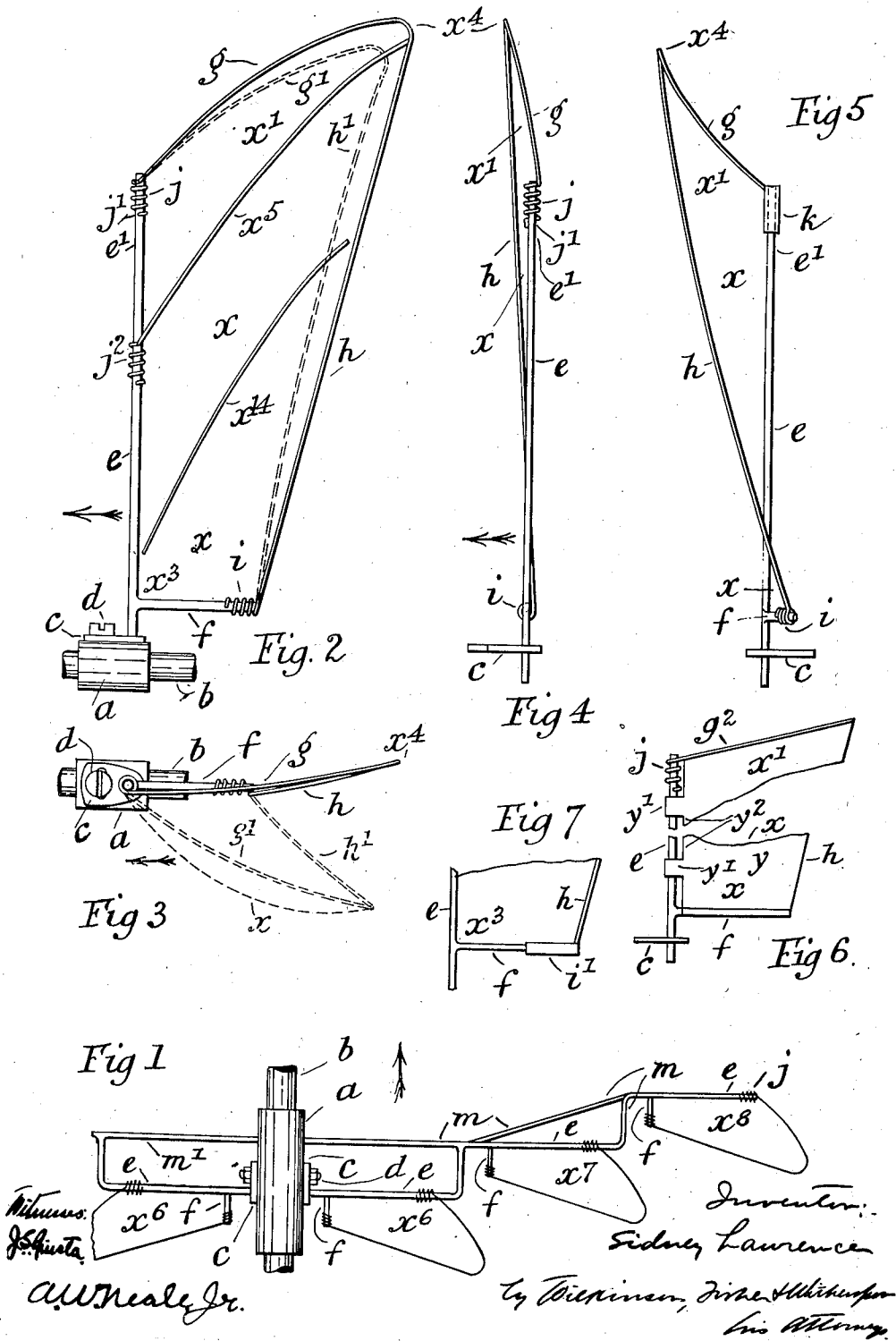


991,331.

Patented May 2, 1911.



UNITED STATES PATENT OFFICE.

SIDNEY LAWRENCE, OF MICHELDEVER, ENGLAND.

AERIAL PROPELLER.

991,331.

Specification of Letters Patent.

Patented May 2, 1911.

Application filed November 23, 1909. Serial No. 529,622.

To all whom it may concern:

Be it known that I, SIDNEY LAWRENCE, a subject of the King of Great Britain and Ireland, &c., residing at Micheldever, Hants, England, have invented certain new and useful Improvements in Aerial Propellers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in aerial propellers which I so construct that during rotation variations of surface shape, and set or position of the blades (relatively to the shape, and set or position of the parts when at rest) occur automatically, being produced by, and of advantage under the working conditions prevailing from time to time, which conditions vary considerably. I find that neither rigid planes, nor those having merely general flexibility (for example presenting when flexed, convexity to the atmosphere impinged upon), are satisfactory.

Any suitable propeller blades are in this invention used, their size, number, contour, material, relative positioning, and mode of mounting, being variable so far as consistent with features of this invention hereinafter claimed.

I make each blade of material possessing rigidity in part, flexibility in part, and resiliency in part, whereby the composite effect is that the blade surfaces during rotation vary more or less from their position and form when at rest. Thus the pitch alters; parts which at rest were flat planes become, under air resistance, concave, and parts which were concave become more so. The changes occurring during propulsion will depend partly upon the speed of rotation of the propellers, partly upon atmospheric conditions from time to time, and partly upon the arrangement and construction of the blade in its "at rest" position. I provide blade framing which in large measure limits and controls the extent and nature of the aforesaid variations.

Notwithstanding the mass of theory extant as to propeller action, I have not found it satisfactory. Much of it is unreliable owing to failure to take all pertinent factors adequately into consideration. Practical experiments having proved my improvements important, I will without theorizing explain

embodiments of the invention as illustrated in the accompanying drawings or diagrams.

In the attached views, arrows show the direction in which the propellers drive the aeroplanes or bodies to which they would be attached. I use in some cases a series of comparatively small planes, blades or feathers to compose one larger combination blade or wing, and use a series of such wings on one boss.

Figure 1 shows a propeller wing comprising a plurality of feathers or planes. Fig. 2 shows, on a larger scale, a blade as used to the number of two or more extending from a suitable boss, to constitute an aerial propeller. Fig. 3 is a plan view, and Fig. 4 an edge view, of the parts in Fig. 2. The blade tip is shown curved, but though not to such advantage, straight tips are usable. The preceding figures show "at rest" positions. Fig. 5 is an edge view showing an altered form which the blade of Figs. 2 to 4 may attain when revolving. In this view the direction of travel of the aeroplane or the like is however different from that in Fig. 2, as will be seen from the position of the boss attachment plate. Figs. 6 and 7 illustrate sundry details which may be used. In Fig. 5 a variation of detail is also shown from the construction in Fig. 2.

To a boss *a* on a propeller shaft as *b* I fix attachment plates or terminals *c* of the blades.

d indicates a fastening screw; parts *a* to *d* are in practice of any preferred construction; thus blades may have framing or inner ends integral with the boss. Each blade has a webbing or filling *e*, and a strong rigid leading edge *e*, usually a metal or other rod, which either does not bend, or only bends to a negligible extent when the blades are rotated. It has or may have, however, a limited power of twist or bend on its longitudinal axis, so that it shall have spring or resiliency toward the "at rest" position.

At or near the outer end *e*¹ of arm *e* is attached to it, or integral with it, a spiral or other spring *j*, having an end continued to form or connected to a rib or like member *g*, forming the blade tip, or at about the said tip. This rib may be rigid or flexible and springy. I continue rib *g* to form a trailing edge *h*, or join it to such an edge, which extends to the blade inner arm *f* which forms a rigid edge, though arm *f*

has, or may have, limited power of twist or bend on its longitudinal axis. The web or the like x of the blade is of flexible sheet metal, or fabric, or consists of a combination of materials fastened to the outer framing.

y indicates thin metal forming a web attached at or near each end of rod e , by eyes as y^1 , or in any suitable way. The blade body has in some cases springy ribs x^{14} , x^5 , or the like, to permit the flexion desired, insure strength and promote resilience to the "at rest" position, or approximately thereto. After the concaving occurring during flight, web x , especially when of some materials, retains a little of the concavity so imparted to it.

The blade in Fig. 2 is supposed to be at the top of its stroke and to be about to turn with the tip descending in a direction away from the observer. The air resistance would retard web x so that the concavity would be on the side away from the observer. Each blade is fashioned so that its outer or tip area x^1 slopes, or extends outward to a substantial extent, from the leading edge or arm end e^1 . Tip edge g may be integral with the blade web; or consist of or include any suitable rod. As the blade of Fig. 2 rotates the composite influences aforesaid alter it,—what is shown in Fig. 5 illustrating this. As angle x^3 at the blade root is practically constant, the concaving gradually increases from points i , j , toward tip area x^1 , and point x^4 . Air resistance retards the tip area materially so that the said point and adjacent edges may take a position as dotted at g^1 , h^1 , Figs. 2 and 3. It is found that in some cases, as when the web is of fabric, and at some speeds, the area in the vicinity of corner x^3 may not be concave to the air in front of it. Even some convexity has occurred, for I find that whatever air resistance occurs in front of the web will in some parts of it be noticeably modified by the air effect on its other side. But the main effect on the forward surface of the web is by said air resistance, that is as to the larger part of the web the making of concavity as indicated; different parts of the web during flight becoming differently concaved or modified because of the controlling means provided as springs i , j .

With a web of thin metal as in Fig. 6, having a free edge y^2 (except for links or the like y^1 which allow the web to yield forwardly or backwardly)—the web fixed along rigid edge f , and thin and free along trailing edge h , and fixed also to a rigid or other tip edge or outer edge g^2 , with only one spring j ,—I have found in practice that at speeds I have employed a concavity occurs over the whole web and is to some extent retained after stopping.

Instead of spring j , Fig. 2, a sleeve or cap k is shown in Fig. 5 engaging rod e around which it will turn somewhat according as air resistance retards the web. This device allows of the yielding and concaving action, the desired resilience being secured by the action mainly of spring i .

Fig. 7 illustrates the use of a collar or ring i^1 set at the end of the short arm f when the construction is otherwise substantially as in Fig. 2; the result being that j may be the only spring. Springs as j and i may have ends entering holes in or locked on the bars e , f , as at j^1 ; and such springs are in any suitable way, in some cases, so arranged that their tension or resilience can be regulated at will, as will be well understood.

The collars k , i^1 and various other parts throughout my construction, may be modified in detail and arrangement while retaining their utility. Thus any rib as x^5 may have a spring as j^2 which will exert resiliency in conjunction with any other spring used as j .

In Fig. 1 three feathers or blades with webs x^6 , x^7 , x^8 , are supported by framing m , m^1 , at each side of boss a . The number of blades so placed for each wing may be greatly increased at will. Details of these are such as are already indicated by reference to the other figures; but in addition there is stepped setting of the blades; they do not overlap, or do so only slightly. The outer ends of the wings are in advance of the inner ends, that is web x^8 is more forward in the direction of flight than web x^7 , or x^6 .

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

1. In aerial propellers, the combination of a central boss and propeller blades each having a substantially rigid radial arm extending from said boss, a substantially rigid inner axial arm, an outer arm of greater length than said inner arm and mounted to swing on the outer end of said radial arm, and a flexible web supported by said inner and outer arms, substantially as described.

2. In aerial propellers, the combination of a central boss, a plurality of wings each comprising a substantially rigid radial arm extending from said boss, a substantially rigid inner axial arm, a resiliently mounted outer arm carried at the end of said radial arm, and a flexible web supported by said resiliently mounted arm and said rigid axial arm, substantially as described.

3. In aerial propellers, the combination of a central boss and propeller blades, each comprising a substantially rigid radial arm extending from said boss, a substantially rigid inner axial arm, a resiliently mounted outer arm carried at the outer end of said radial arm and of greater length than said

axial arm, and a flexible web supported by said outer and inner arms, substantially as described.

4. In aerial propellers, the combination of
5 a central boss and propeller blades, each
comprising a radial arm extending from
said boss, an inner axial arm and a resiliently
mounted framework connected at one end
to the outer end of said radial arm thence
10 extending for a length greater than the
length of said axial arm and then bent upon
itself and connected at its other end to the
outer end of said axial arm, and a flexible
web supported by said resilient frame, sub-
15 stantially as described.

5. In aerial propellers, the combination
of a central boss, a support extending
radially from said boss and shaped to form
a plurality of radial arms offset from each
20 other and provided with a plurality of
axially disposed arms, outer arms of greater
length than said axial arms and at their

inner ends mounted to swing on said radial
arms, and flexible webbing supported by
said outer arms and axial arms, substantially
25 as described.

6. In aerial propellers, the combination
of a central boss, a support extending
radially from said boss and formed to pro-
vide a plurality of radial arms offset from
30 each other and each radial arm being pro-
vided with an axially disposed arm at its
inner end, outer arms mounted to swing on
the outer ends of said radial arms and of
greater length than said axial arms, and
35 flexible webbing supported by said outer
arms and axial arms, substantially as de-
scribed.

In witness whereof I have hereunto set
my hand in the presence of two witnesses. 40
SIDNEY LAWRENCE.

Witnesses:

VERA BROOKSMITH,
BEATRICE M. LOWE.