Sept. 8, 1925. 1,552,637

S. A. MOTHERAL

PROPELLER

Original Filed Feb. 9, 1922

Fig. 1,

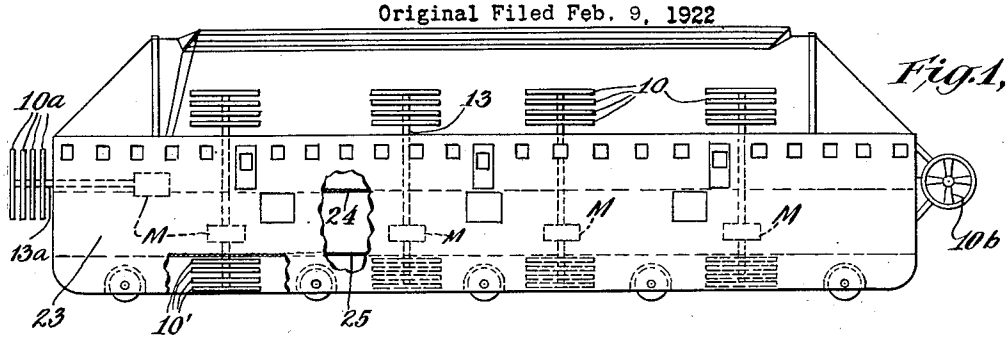


Fig. 2,

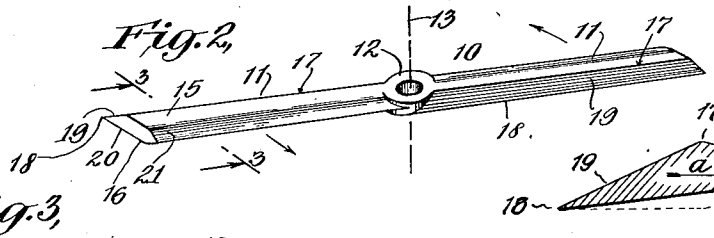


Fig. 10

Fig. 3,

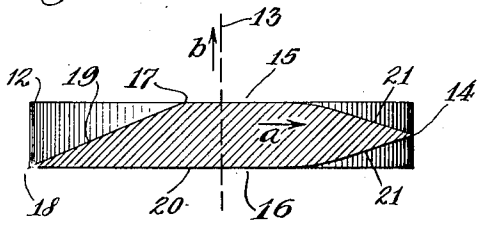


Fig. 4,

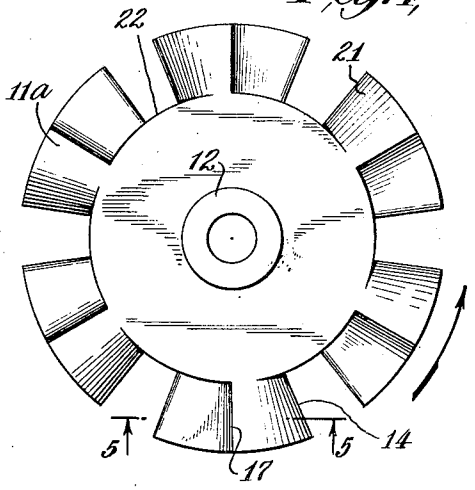


Fig. 6,

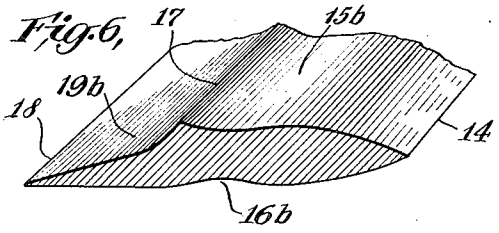


Fig. 7,

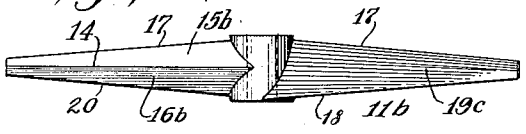


Fig. 5,

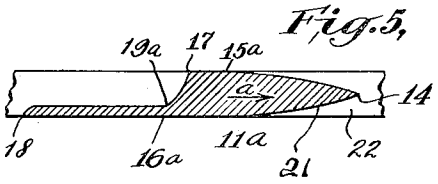


Fig. 8,

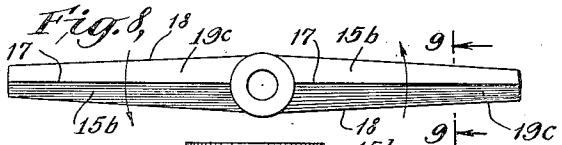
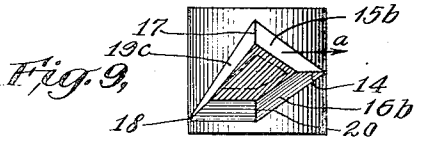


Fig. 9,



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UNITED STATES PATENT OFFICE.

SAMUEL A. MOTHERAL, OF OSSINING, NEW YORK.

PROPELLER.

Application filed February 9, 1922, Serial No. 535,238. Renewed December 5, 1924.

To all whom it may concern:

Be it known that I, SAMUEL A. MOTHERAL, a citizen of the United States, residing at Greenmont, Ossining, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Propellers, of which the following is a specification.

This invention relates to lifting or propulsion devices for general use on various kinds of vehicles or other purposes, with special reference to rotary propellers adapted for co-operation with any fluid medium, such as air or water.

Generally speaking the propeller shown and described herein is designed particularly for use in connection with flying machines or other air vehicles, and broadly considered the invention relates to the subject matter of my co-pending applications for flying machines filed May 8th, 1919, Serial No. 295,566, and vacuum flying machines filed December 11th, 1918, Serial No. 266,239, and renewed November 19th, 1921, under Serial No. 516,512.

Among the objects of this invention is to provide a propeller the efficiency of which is dependent primarily upon the rapid movement of the blades thereof through the medium, with a view of causing the leading edge portion of each blade to pass through the medium with the least amount of resistance, forming in effect simply a parting or cleavage of the medium, as distinguished from the action of the conventional propeller blade which is depended upon for its efficiency to impart a thrust to and movement of the medium in a direction parallel to the axis of the propeller. It will be borne in mind, therefore, that for a propeller blade to be so shaped as to cause or create a decided thrust upon the medium, it follows that the resistance tending to retard or prevent the rotation of the propeller must be relatively enormous, whereas in my new propeller the resistance tending to retard or prevent its rotation is so slight as to be hardly more than negligible.

Another object, as a corollary to the statement just made, is to provide a propeller, the blade or blades of which, being so shaped as to reduce to a minimum the resistance of the medium to rotation, will possess maximum strength and so consequently may be constructed of such relatively light or thin material as to provide incidentally for maximum speed of rotation, and still be perfectly safe and reliable.

Another object is to take advantage of and utilize what may be termed the static pressure of the fluid medium, causing the same to be exerted on one face or side of the propeller blade with a force superior to the corresponding pressure on the opposite side or face of the blade.

With the foregoing and other objects in view the invention consists in the arrangement and combination of parts hereinafter described and claimed, and while the invention is not restricted to the exact details of construction disclosed or suggested herein still for the purpose of illustrating a practical embodiment thereof reference is had to the accompanying drawings, in which like reference characters designate the same parts in the several views, and in which—

Figure 1 is a diagram indicating an air ship equipped with my improved lifting and traction propellers.

Fig. 2 is a perspective view of one design of propeller having two blades and adapted especially for high speed of rotation.

Fig. 3 is a cross section of the blade on the line 3—3 of Fig. 2.

Fig. 4 is a plan view of a disk shaped propeller provided with more blades than two but having the fundamental characteristics above set forth.

Fig. 5 is a transverse section on the line 5—5 of Fig. 4.

Fig. 6 is a detail perspective view indicating a slightly modified form of high speed propeller blade.

Figs. 7 and 8 are edge and plan views respectively of a type of propeller designed more particularly for maximum strength.

Fig. 9 is a cross section on the line 9—9 of Fig. 8.

Fig. 10 is a cross sectional view of a further modification.

With specific reference to the construction of Figs. 2 and 3 I show for high speed rotation a propeller 10 having two blades 11 extending in diametrically opposite directions from a center or hub 12, which hub however may extend beyond the plane of the blades or not depending upon the specific assemblage in which the propeller may be employed. The hub however is indicated in order to establish the axis 13 of the propeller and to bring forth the fact that the

blades lie and move ordinarily in a plane to which said axis is perpendicular.

As shown best in Fig. 3 each blade comprises a relatively sharp leading edge 14 midway between the forward and rearward faces 15 and 16, respectively, which are parallel to each other and consequently lie in parallel planes perpendicular to the axis aforesaid. The term "forward" as applied to the face 15 will be understood as being relative in significance and will be employed to establish the action of the propeller blade rather than to limit the position of the propeller with respect to any specific equipment. In other words when the propeller is employed for lifting and with its axis arranged vertically the face 15 will be uppermost and the direction of movement of the blade will be toward the right as indicated by the arrow *a*, while the effective direction of movement of the machine will be understood as being in the direction of the arrow *b* parallel to the axis 13.

The trailing edge portion of the blade is reduced below or back of the plane of the face 15, the same being indicated in Fig. 3 as being beveled from the point or line 17 at the trailing edge of the face 15 to the point or edge 18 constituting the trailing edge of the rear face 16. While this trailing portion is indicated as beveled in a flat surface 19 in Fig. 3 it will be understood that the reduction may be otherwise formed, such as concave as shown at 19^a in Fig. 5 or at 19^b in Fig. 6. From the point 20 directly opposite the point 17 there is provided a flat trailing face portion constituting a continuation of said rearward face 16, and so that portion of said rearward face between the points 18 and 20 constitutes or determines the extent and area of the rearward face 16 in excess of the effective flat portion of the forward face 15. The leading edge portion between the cutting edge 14 and the two substantially flat surfaces 15 and 16 may be variously proportioned or shaped according to the specifications of the machine as to speed of rotation and lifting power. As shown, however, in Figs. 3, 4, and 6 the surfaces 21 of the blade adjacent to the leading edge 14 are indicated as practically flat and meeting at the leading edge in an acute angle. In all cases however the forward and rearward faces of the leading edge portion of the blade are symmetrically shaped with respect to the median plane of the blade which coincides with the leading edge 14. It follows therefore that when the blade is moved in the direction of the arrow *a* and said median plane thereof, there is little or no tendency for either the forward or the rearward face thereof to drive the medium either forward or rearward, the medium rather being simply separated or split by the cutting or leading edge portion of the blade, thereby maintaining the normal static pressure of the medium constant on a unit of area on both the forward and rearward surfaces 15 and 16. Such pressure being exerted on the face 15 directly toward the blade is neutralized by the pressure on all of that portion of the rearward face back to the point 20, respecting the surface equal in extent to the forward face 15.

As a result of rapid movement of the blade in the direction of the arrow *a* a vacuum tends to be formed and is formed to a greater or less degree according to the speed of rotation of the propeller adjacent to the reduced trailing portion of the blade or next to the surface 19. Consequently the rearward pressure of the medium on the upper or forward face of the blade, considered now as a whole all the way from the point 14 to the point 18, will be reduced below the pressure on the rearward face of the blade, considered between the two extreme points 14 and 18, in proportion to the degree of vacuum formed adjacent to the surface 19. In other words, theoretically if a perfect vacuum be produced between the points 17 and 18 along the surface 19, the static pressure of the medium, being constant along the flat surface 16, will all be exerted without opposition with respect to the surface or area between the points 18 and 20, tending to push or lift the propeller in the direction of the arrow *b*.

The leading edge portion of the blade may be termed a divider for splitting or cleaving the medium, the sides of the divider being of equal width and disposed at inclinations of equal angle with respect to the median plane of the blade. As a result of extensive experiments it has been proved that this type of blade does possess phenomenal lifting and propelling power based upon the theory just described, and that the power remains constant irrespective of the direction or position of the axis of the propeller. That is to say, the blade has a lifting power, measured in terms of pounds per horsepower, exactly equal to its horizontal thrust when rearranged for traction purposes, the prime mover and other conditions remaining unchanged.

It will be now understood that a propeller such as indicated in Figs. 2 and 3 and whose blades are relatively thin and glide with but slight resistance through the medium is capable not only of high speed rotation but is subject to the least likelihood of breakage or distortion.

In Fig. 4 I indicate a disk shaped propeller having a hub 12 and any suitable disk or web 21 designed for maximum strength and the least amount of resistance against rotation. At the periphery 22 of this disk are formed or fastened in any suitable man-

ner a series of blades 11^a, shown as six in number, but each having as shown a maximum thickness equal to the thickness of the disk. Hence this construction while producing slight resistance to rotation will afford maximum lifting or traction properties due to the increased area of the combined rearward surfaces 16^a over the forward surfaces 15^a. The principle of operation in all forms of my propeller shown herein remains the same.

In Fig. 6 the forward face 15^b and rearward face 16^b differ from the form in Fig. 3, except as above noted, only in providing slight concavities along these portions which were described above as being flat and parallel. The efficiency of this form of blade lies in the flat trailing portion of the rearward face as in the other forms of the device.

In Figs. 7, 8, and 9 I provide a propeller of the two blade type, diametrically oppositely arranged as in Fig. 2, but each blade 11^b of which is materially strengthened adjacent to the hub. In other words the construction is of considerable fullness adjacent to the hub but with a taper outward toward the ends of the blades. The leading edge 14, however, following the novel principle of construction above indicated, is as sharp as the massiveness of the blade will permit and is located in the median plane or midway between the remote portions or edges of the forward and rearward faces 15^b and 16^b respectively. As in the other forms there is yet observed on the rearward face of these blades a flat portion between the points or lines 18 and 20 which is essentially perpendicular to the axis except as may be incident to the aforesaid outward taper of the blade as a whole. Opposite this flat lifting or propelling surface is located the surface 19^c.

The air ship indicated in Fig. 1 comprises a body 23 having an upper deck 24 for passengers and light baggage and a lower deck 25 for heavy baggage, freight, machinery, fuel, or the like. For the lifting of the ship I provide a plurality of propellers or lifting elements 10 mounted on vertical axes and adapted to be rotated by any suitable prime movers indicated at M. Attached to the shafts 13, or other shafts below the deck 25, are other propeller elements 10′ designed for the control or neutralization of the effect of the lifting propellers 10. While this air ship is designed for a vertical rise or descent within any space that will receive its length and width, and independent of traction or steering mechanism, it also will be capable of remaining stationary at any desired elevation in the atmosphere by virtue of the lifting ability of the new type of propeller herein described. At the front end of the body 23 are arranged one or more traction propellers 10^a on a shaft 13^a and which because of the peculiar merit of the propelling elements will propel the machine forward at high speed while the propellers 10 or some of them continue in operation to sustain the air ship at its desired elevation. One or more steering propellers 10^b of any suitable type are provided upon a transverse horizontal axis at the rear end of the body through which the ship is steered laterally.

Fig. 10 indicates a practical form 10^d of my improvement which illustrates that while the leading edge 14 is essentially midway between the extreme forward and extreme rearward parts 17 and 18 of the blade, it is not necessary in all cases for the surfaces 15^d and 16^d leading from said leading edge to be exactly symmetrical, for the one may be more abrupt in inclination than the other, but the results obtained are approximately equivalent to the results obtained from the forms of the invention first described.

I claim:

1. In a flying machine, the combination with a body and power means therein, of a lifting member for the body serving to lift the same bodily and operated from said power means, said lifting member comprising a propeller including a substantially flat blade movable at high speed around an axis parallel to the direction of lifting movement and carrying at its leading edge a divider serving to split the air and thereby produce a rarefaction of the air and a corresponding reduction of downward air pressure over the upper surface thereof, while the condition and upward pressure of the air beneath the blade remains essentially constant, said divider having sides of equal width and disposed at inclinations of equal angle with respect to the median plane of the blade.

2. A power element for flying machines or other vehicles comprising a blade having flat spaced parallel longer and shorter rearward and forward surfaces respectively, a leading edge connecting said surfaces, the crest of the leading edge being substantially midway between said surfaces, said shorter surface lying directly forward of the leading portion of the longer surface, and the remaining portion of the longer rearward surface constituting a flat extension of said rearward surface and extending in a perpendicular direction from the plane intersecting the trailing edge of the shorter surface.

3. The herein described propeller comprising a blade for rapid rotation around an axis in a plane perpendicular to said axis, said blade comprising two substantially parallel surfaces both perpendicular to said axis, one of said surfaces having a trailing portion extending beyond the trail-

ing edge of the shorter surface, and the trailing edges of both surfaces being connected by a surface offset rearward from the plane of the shorter surface toward the plane of the longer surface.

4. A propeller blade as set forth in claim 3 in which the extended trailing portion of the longer surface is flat and lies within the plane of its movement.

5. A propeller blade as set forth in claim 3 in which the blade is provided with a leading dividing edge midway between the two parallel surfaces and having adjacent surfaces of equal symmetrical form leading from said leading edge into the parallel surfaces.

6. The herein described propeller comprising a blade for movement at high speed around its axis, said blade comprising a leading edge midway between the foremost and rearmost parts of the blade and being united to said foremost and rearmost parts by symmetrically formed surfaces, said surfaces and the leading edge connecting them constituting a divider for parting the medium equally with a minimum resistance, and said rearmost portion of the blade being included in an extension leading to the trailing edge of the blade and lying in the path of movement of said rearmost portion while the forward side of the blade is reduced for the formation of a vacuum between the trailing edge of the foremost portion of the blade and the trailing edge aforesaid.

7. A propeller blade for movement at high speed around its axis comprising a leading edge midway between the foremost and rearmost parts of the blade and being united to said foremost and rearmost parts by surfaces constituting with the leading edge a divider for parting the medium equally with a minimum resistance, and said rearmost portion of the blade being included in a trailing extension more remote from the leading edge than the trailing part of the foremost portion of the blade, whereby a vacuum is formed on the forward side of the blade adjacent to the trailing edge portion thereof and opposite said extension of the rearmost surface aforesaid.

In testimony whereof I affix my signature.

SAMUEL A. MOTHERAL.