G. H. CURTISS.

HYDRO AIRCRAFT.

APPLICATION FILED FEB. 28, 1917.

1,355,736. Patented Oct. 12, 1920.

FIG. 1.

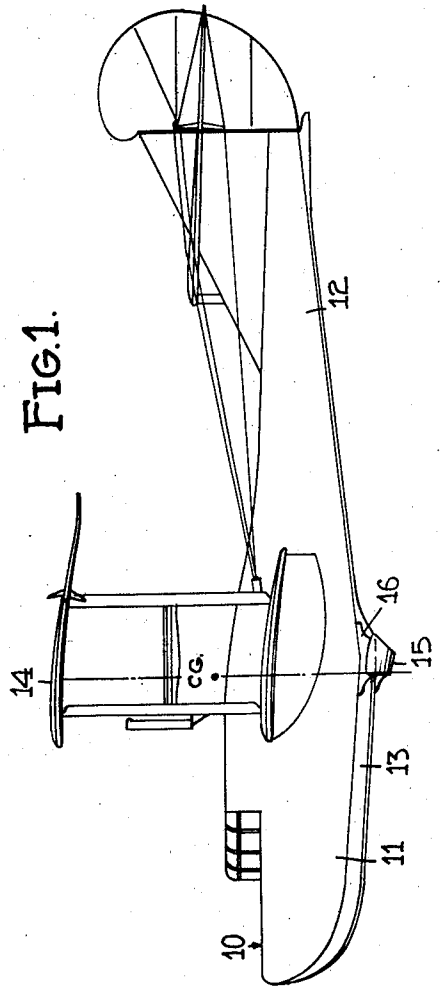


FIG. 3.

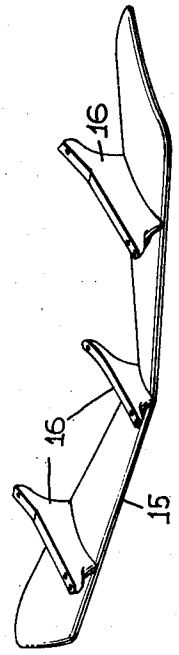
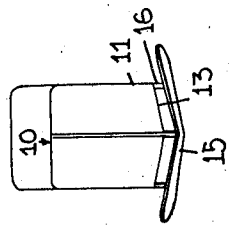


FIG. 2.



Inventor

GLENN H. CURTISS

By John P. Faeber

Attorney

UNITED STATES PATENT OFFICE.

GLENN H. CURTISS, OF BUFFALO, NEW YORK, ASSIGNOR TO CURTISS AEROPLANE & MOTOR CORPORATION, A CORPORATION OF NEW YORK.

HYDRO-AIRCRAFT.

1,355,736. Specification of Letters Patent. Patented Oct. 12, 1920.

Application filed February 28, 1917. Serial No. 151,502.

To all whom it may concern:

Be it known that I, GLENN H. CURTISS, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Hydro-Aircraft, of which the following is a specification.

My invention relates to heavier-than-air flying machines and more particularly to hydro-aircraft in which flight from the surface of the water is obtainable through gradual diminution of the hydro supporting effect with a corresponding reduction of skin friction, rather than through an increase in lift due to sudden increased air reaction upon the aeroplane wings. In other words it is proposed to gradually increase the moving speed of the craft to flying speed that aerial flight from the surface of the water may be attained without altering the angle of incidence of the wings.

Several successful methods of gaining aerial flight have heretofore been advanced. Ordinarily the flotation body of a hydro-aero-machine is constructed to provide a transverse edge about which the craft may be rocked fore and aft to suddenly increase the angle of incidence of its wings. Where this edge is eliminated and fore and aft oscillation is prevented, aeroplane wings having a variable angle of incidence have been proposed. There are other proposed schemes most of which are apparently practical but many are mechanically and dynamically inefficient.

This invention advances a new principle which has been proven to be of high efficiency. A submerged hydroplane of a peculiarly individual construction and location is used. One of the principal characteristics of the invention is that this submerged hydroplane has a section similar to that of the ordinary aeroplane wing and a dihedral angle. In addition it tapers divergently outwardly whereby the depth of the plane is least at its lowest point or apex. Thus as speed is acquired by the craft, the hydro supporting surface is not only decreased by reason of the dihedral angle but also by reason of the decrease in depth of the plane as more or less of it is lifted above the surface of the water. Said surface is preferably auxiliary to the principal surface or integral hydro bottom of the flotation body and underlies approximately a horizontal line passing transversely through the center of gravity of the machine.

In the drawings, wherein like characters of reference designate like or corresponding parts:

Figure 1 is a side elevation of a flying boat equipped with a hydroplane surface of the form described herein;

Fig. 2 is a front elevation of the hull, and

Fig. 3 is a detail perspective view of the hydroplane.

In the embodiment of my invention selected for illlustration, 10 designates in its entirety a hull for flying boats comprising a fore body 11 and tail portion 12, the bottom of the latter extending rearwardly and upwardly and the bottom of the former forwardly and upwardly, the bottom of the hull in its entirety making a salient angle longitudinally. The bottom of that portion of said hull in advance of the point of maximum saliency *i. e.* the lowermost point, is constructed in hydroplaning form and will be hereinafter referred to as the principal hydroplaning surface of the craft. Said surface I have designated as 13.

Supporting surfaces 14 extend intermediately across the hull 10 to function with the hydroplane surfaces of the craft in sustaining the weight of the machine during hydroplaning action at speed over and upon the surface of the water, said surfaces, after the craft rises into the air, functioning alone as the suspending or sustaining means. CG indicates the center of gravity of the craft which I preferably locate intermediate the leading and trailing edges of the supporting surfaces that the point of maximum saliency may underlie said center, said point lying, as inferred, in the transverse vertical plane of the point CG. This much of the craft is of the well known "Curtiss" type and forms no part of the present invention except in so far as hereinafter pointed out. Although illustrated in connection with a flying boat, the invention is equally as well adaptable to hydroplanes in which pontoons are utilized as the flotation means.

Beneath the point of maximum saliency, and consequently in the approximate transverse vertical plane of the center of gravity, an auxiliary hydroplane, designated in its entirety by the numeral 15, is disposed. This hydroplane (see Fig. 3) is of ordinary aerofoil section and of equal area at opposite

sides of the fore and aft axis or keel line of the hull. The surfaces, at opposite sides of said axis make a dihedral angle if viewed from the front or rear. In addition said surfaces taper divergently outwardly whereby the depth of the hydroplane is least at its lowest point or apex. Thus, as speed is acquired in hydroplaning, the hydro supporting surface and skin friction not only uniformly decrease by reason of the dihedral angle, but also by reason of the decrease in depth of the plane as more or less of it is lifted from the surface of the water. Supporting blocks 16, suitably spaced and complemental to the underneath surface of the hull and to the top surface of the hydroplane, support the latter beneath the hull bottom and at the angle of incidence desired.

By the provision of an auxiliary hydroplane surface beneath the plane of the principal hydroplane surface, and approximately beneath the center of gravity, flight from the surface of the water is obtained through gradual diminution of the hydro supporting effect. It is obvious that as speed increases skin friction is reduced and the support of the craft gradually shifted from the hydro supporting surface to the aeroplane wings until the principal supporting surface 13 shall have risen above the surface of the water and only the auxiliary hydroplane surface 15 remains in contact therewith. This surface, by reason of its sectional form, decreases its hydroplane lift as the craft continues to speed up until flying speed is attained, whereupon said surface leaves the water and the machine rises into the air. No variation in the angle of incidence of the aeroplane wings and no rocking action fore and aft is required, although both may be relied upon to quicken aerial flight should occasion demand. The shifting of the lift load onto the aeroplane wings can be made so gradual as to be unnoticed by the occupants of the machine. Moreover, the hydroplane wings enable the machine to alight safely, because, owing to their slight area, the action of the water is gradual and not instantaneous, thus, fitted with hydro wings even the highest powered and heaviest machines can alight comfortably without shock absorbers.

In addition, the float or floats proper, if designed solely with a view to produce static support on the water, can be made of perfect streamline form, and light, since they are not designed to take shocks. Also, the hydroplane wings aerodynamically produce lift during flight through the air. Furthermore, the hydroplaning wings may be dropped down considerably to increase the gap between them and the bottom of the hull, although the best location can be determined in view of the exigencies to be met. If distantly removed from the hull bottom aerodynamical lift is increased and skin friction during hydroplaning at high speed reduced, yet interference in beaching and launching is apparent.

Although I have described more or less precise forms and details of construction, I do not intend to be understood as limiting myself thereto as I contemplate changes in form, the proportion of parts and the substitution of equivalents as circumstances may suggest or render expedient and without departing from the spirit of the invention as claimed. Obviously, the number of auxiliary hydroplane surfaces or hydroplane wings may be increased, the wings in each instance being superposed or arranged one beneath the other, and located beneath the center of gravity.

What is claimed is:

1. A hydroaircraft including a main flotation body having a forward principal hydroplaning surface together with an auxiliary hydroplaning surface spaced beneath the lowermost point of the principal hydroplaning surface, the auxiliary hydroplaning surface having portions of its length extended laterally beyond the chine lines of the float.

2. In a hydro-aircraft, a flotation body having an integral V-type hydroplaning surface, and an auxiliary V-type hydroplaning surface spaced beneath said principal hydroplaning surface in the approximate transverse vertical plane of the center of gravity of the machine.

3. In a hydro-aircraft, a flotation body having a principal hydroplaning surface, and dihedrally angled auxiliary hydroplaning surfaces placed beneath said principal hydroplaning surface with the vertex of the angle underlying the fore and aft axis of the machine, said auxiliary hydroplaning surface being wider than the principal hydroplaning surface to project laterally therebeyond at both sides of the float.

4. In a hydro-aircraft, a flotation body having a V-bottom, and a dihedrally angled hydroplaning surface spaced beneath said V-bottom with the vertex of said angle underlying the vertex of the V, said hydroplaning surface in its entirety lying substantially beneath a horizontal line passing transversely through the center of gravity of the machine.

5. A hydroaircraft including a flotation body having its bottom surface interrupted in a fore and aft direction by a rearwardly facing step, that portion of the bottom surface in advance of the step constituting the principal hydroplaning surface of the craft, together with a separately formed auxiliary hydroplaning surface spaced beneath said principal hydroplaning surface, the relative arrangement of the principal and auxiliary

hydroplaning surfaces being such that the latter is situated substantially directly beneath the step.

6. In a hydroaircraft, a boat hull having a V-bottom in transverse section, at least a portion of the V-bottom of the hull constituting the principal hydroplaning surface of the craft, a rearwardly facing step formed on the bottom of the hull in the vicinity of the lower-most point of said principal hydroplaning surface, and a V-type auxiliary hydroplaning surface spaced beneath the V-bottom in the vicinity of the step, the angle defined by the V-bottom at the step and the angle defined by the auxiliary hydroplaning surface being similar though not necessarily identical.

7. In a hydroaircraft, the combination with a flotation body having an integral principal V-type hydroplaning surface, of a V-type auxiliary hydroplaning surface spaced beneath said principal hydroplaning surface to prolong the hydroplaning effect after the hydroplaning effect of said principal hydroplaning surface shall have ceased, the apex of the V of the auxiliary hydroplaning surface underlying the apex of the V of the principal hydroplaning surface and the auxiliary hydroplaning surface in its entirety lying approximately beneath a transverse horizontal line passing transversely through the center of gravity of the machine, the portions of the auxiliary hydroplaning surface at opposite sides of the vertex of the angle diverging upwardly and outwardly whereby the depth of the hydroplaning surface is least at the lowest point.

In testimony whereof I hereunto affix my signature.

GLENN H. CURTISS.