

April 4, 1939.

R. J. MINSHALL ET AL

2,153,266

RETRACTABLE HYDROSTABILIZER FOR AIRPLANES

Filed Aug. 3, 1937

4 Sheets-Sheet 1

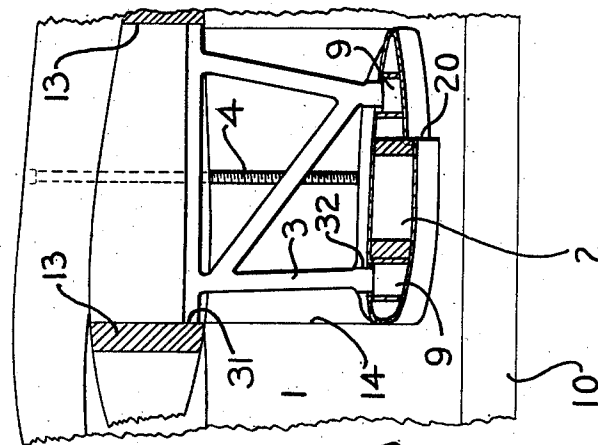


Fig. 2

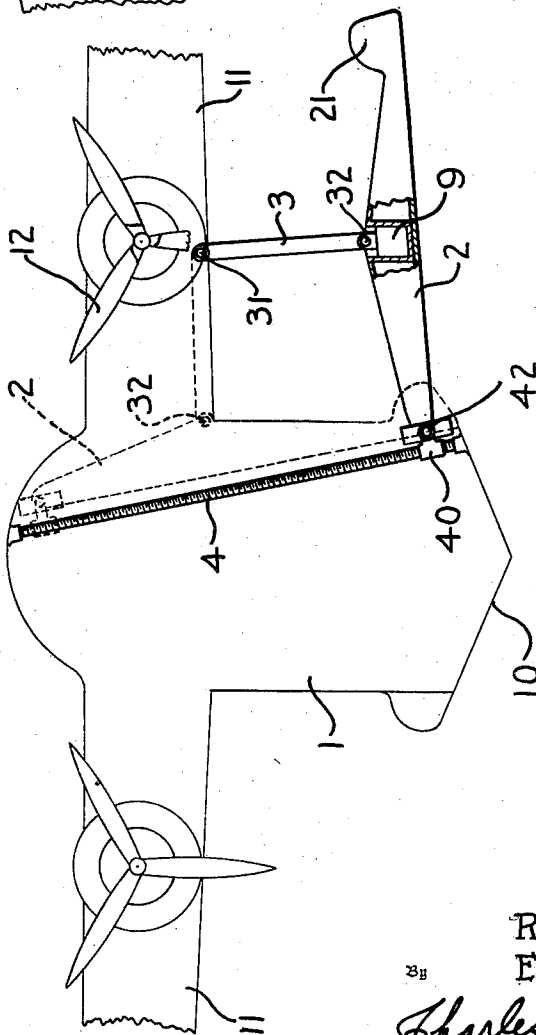


Fig. 1

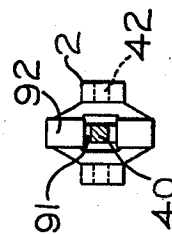


Fig. 1a

Inventors
Robert J. Minshall
Edward C. Wells
By Charles L. Reynolds
Attorney

April 4, 1939.

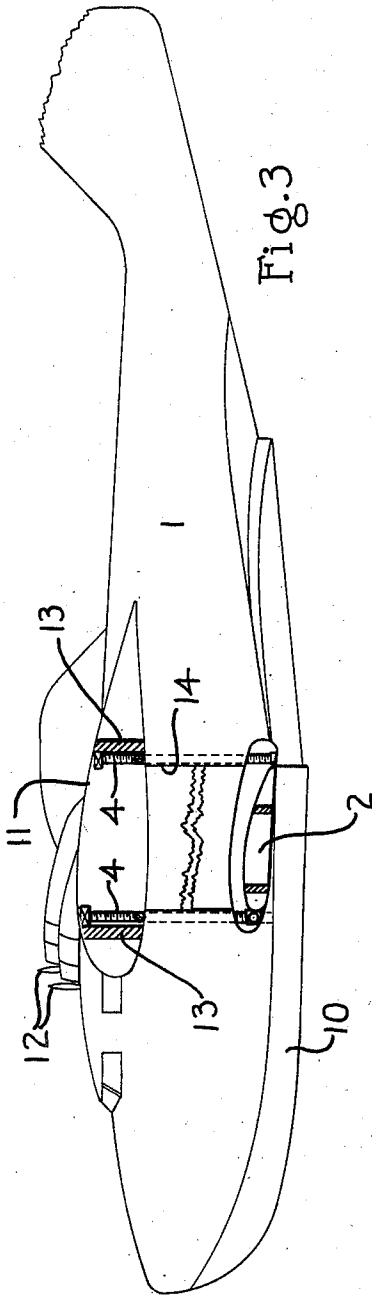
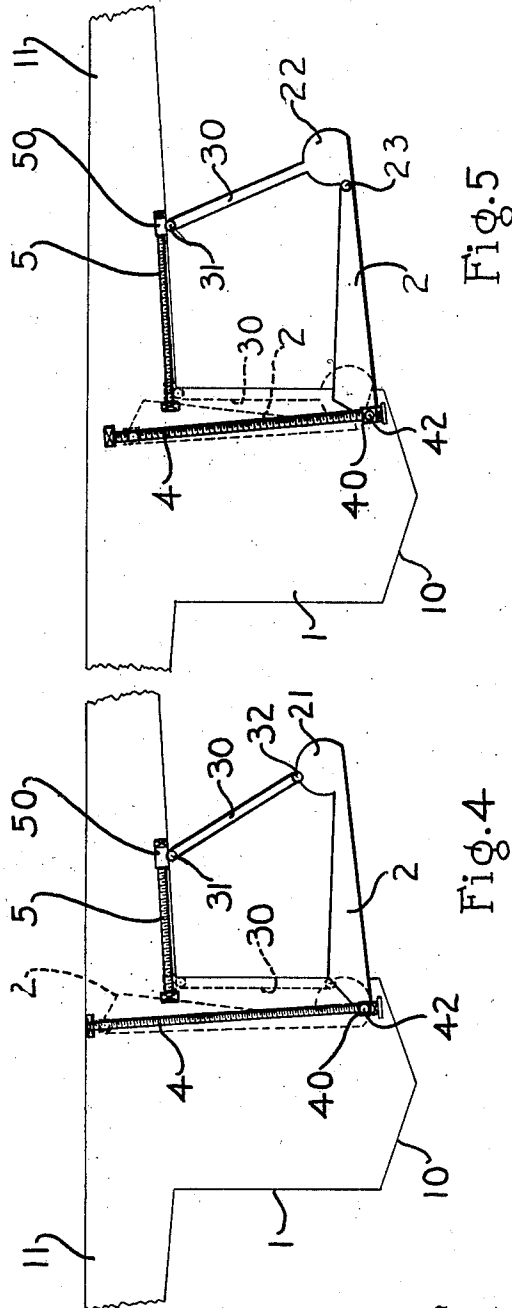
R. J. MINSHALL ET AL

2,153,266

RETRACTABLE HYDROSTABILIZER FOR AIRPLANES

Filed Aug. 3, 1937

4 Sheets-Sheet 2



Robert J. Minshall ^{Inventors}

Edward C. Wells

By

Charles L. Reynolds
Attorney

April 4, 1939.

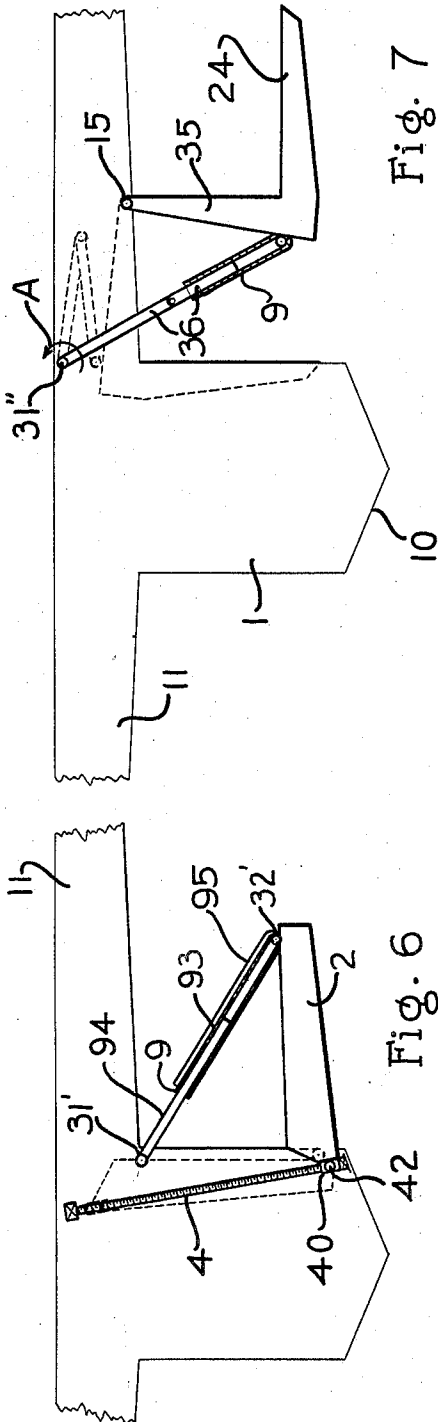
R. J. MINSHALL ET AL

2,153,266

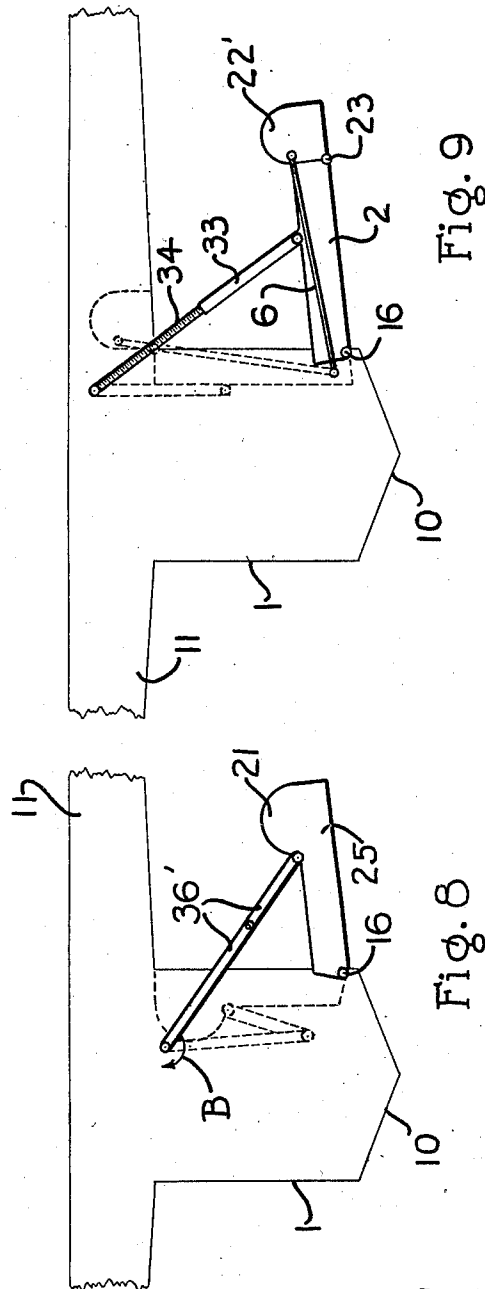
RETRACTABLE HYDROSTABILIZER FOR AIRPLANES

Filed Aug. 3, 1937

4 Sheets-Sheet 3



Fi 7



Fi. 9

Fi-
o-
di

Robert J. Minshall
Edward C. Wells
Charles L. Reynolds

April 4, 1939.

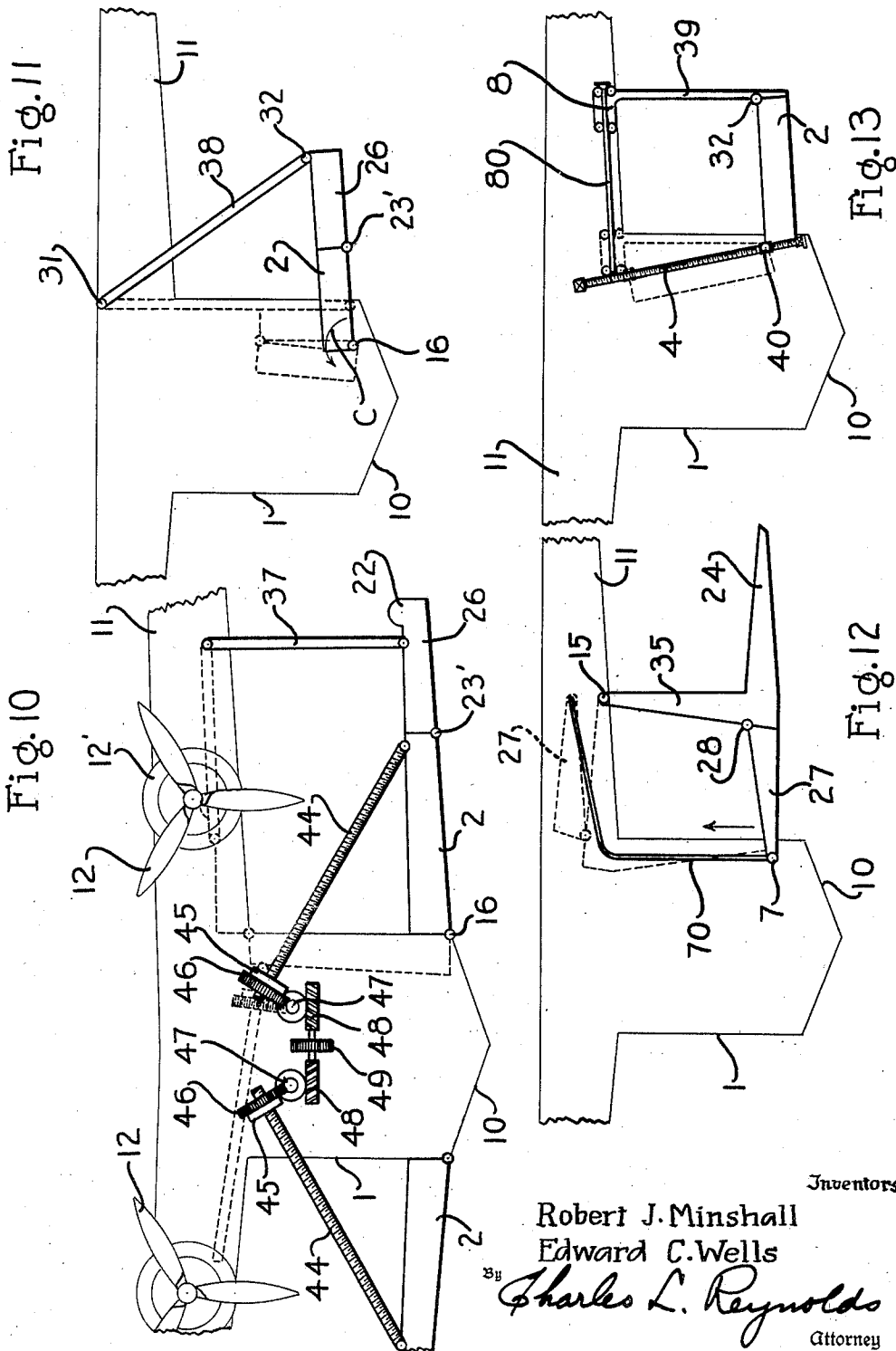
R. J. MINSHALL ET AL

2,153,266

RETRACTABLE HYDROSTABILIZER FOR AIRPLANES

Filed Aug. 3, 1937

4 Sheets-Sheet 4



Inventors

Robert J. Minshall

Edward C. Wells

Charles L. Reynolds

Attorney

UNITED STATES PATENT OFFICE

2,153,266

RETRACTABLE HYDROSTABILIZER FOR AIRPLANES

Robert J. Minshall and Edward C. Wells, Seattle, Wash., assignors to Boeing Aircraft Company, Seattle, Wash., a corporation of Washington

Application August 3, 1937, Serial No. 157,122

5 Claims. (Cl. 244-102)

This invention, in its primary aspect, pertains to airplanes of a type which are intended to float upon water, though in another aspect it pertains to any craft operable as a high-speed surface craft. While the aims of the invention may be realized with all types of airplanes intended to land upon and take off from water, whether flying boats or pontoon-supported, it will generally be employed with flying boats, inasmuch as pontoon-supported airplanes are normally small and have floats so placed as to insure lateral stability while floating, especially in protected waters where they are chiefly used.

It is typical of airplanes intended to alight upon water that means are provided to stabilize the airplane laterally, so that it will not roll unduly and so that its wings will not dip into the water. In small planes this can often be sufficiently accomplished by spreading two floats apart, these constituting the sole displacement means to support the airplane upon the water, and constituting also the planing surfaces by which it may rise upon the surface and eventually take off from the water.

In larger airplanes, however, it is necessary to provide outboard floats or sponsons of one type or another. In some instances these depend below the wings, sometimes at the tips of the wings; sometimes inboard from the tips, but usually are rigidly supported in position, and therefore a source of drag when the airplane is in flight, and when the float is no longer of any immediate value. Such floats have been made retractable by swinging them outwardly and upwardly into alignment with the wings, to constitute the tips of the wings, or inwardly and upwardly to a position wherein they are partly housed within and partly protrude from the under side of the wing, but in either such position, because of their necessary form for floating upon and taking off from the water, they are not aerodynamically efficient, and produce an undue amount of drag. In addition, they reduce the maneuverability of the airplane on the water, since the airplane can not be banked to make a turn at any speed, for if the floats, of small displacement, are to act as effective stabilizers when the airplane is operating as a displacement craft, they are so far outboard that they are in the way, and prevent banking while traveling on the surface.

Some designers prefer to employ sponsons, projecting laterally from the hull of a flying boat at the water line, these sponsons constituting the lateral stabilizing means when the airplane floats, but all such sponsons, so far as we are aware,

have been formed as an integral part of and fixed rigidly in a single position only to the hull of the flying boat, and permanently project from such hull, and since they have little or no lift characteristics while in flight, but produce appreciable drag, their presence, though necessary while floating, is undesirable when the airplane is in flight. Such sponsons, being closer to the center of buoyancy than wing-supported floats, permit somewhat greater surface maneuverability. However, they must act as displacement members while the airplane is floating, and as vanes when the airplane is acting as a hydroplane, or is "on the step", and these somewhat different considerations rather closely limit their location, shape, and position relative to the hull. As a result, it has heretofore been considered necessary to support and brace them as rigidly as possible from the aircraft structure, and such a rigid support and invariable position is not conducive to the absorption of shocks when landing, or to maneuverability at high speeds on the surface, when it is necessary to bank the airplane to any appreciable degree. The same considerations apply to a strictly surface craft acting at times as a hydroplane.

Accordingly it is a principal object of the present invention to provide hydrostabilizing means which are effective as to form and location when the airplane is acting either as a displacement craft or as a hydroplane, which facilitate maneuvering while traveling on the surface, but which in flight can be retracted into a position of lower drag, thereby producing the greatest efficiency both when afloat and when in flight.

It is also an object to provide hydrostabilizing means, particularly such as are in the form of sponsons in order to secure the advantages indicated above, which may have incorporated therein shock absorbing means, or which may be adjustable in angle relative to the hull in order to facilitate banking. By the inclusion of shock absorbing means, either in the bracing struts or at the point of connection of the hydrostabilizer to the hull, or at both places, a further object is attained, namely, the structure as a whole may be made lighter by the omission of consideration of landing shocks and their transmission to structural members, in the design of the aircraft. By the adjustment of angles the sponsons become maneuvering vanes, for better control of the craft while operating as a hydroplane, yet, being retractable, these maneuvering vanes may be moved to a position of lower drag, in flight, when they are no longer needed to facilitate maneuvering.

It is a further object to arrange such hydro-stabilizing means as to form and location, and with relation to the hull and wings of a flying boat, that when retracted the hydrostabilizing means, and in some instances the strut or struts supporting or bracing them from the aircraft structure, will fill recesses provided in the hull and other parts of the aircraft structure, and will restore the surfaces thereof to full aerodynamic efficiency, thereby almost or completely eliminating drag due to the presence of the hydro-stabilizing means or their adjuncts.

More specifically, it is an object to provide hydrostabilizing means of the general character indicated which may take the form of sponsons projecting laterally from the flying boat hull at or near the water line, and which will in general be retractable into recesses within the hull. It may be noted here that the term "water line" is used in a general sense. While the airplane is acting as a hydroplane the sponsons act as vanes upon the surface of the water, although one or the other may at times be lifted clear of the water. While the airplane is acting as a displacement craft, the sponsons will normally be partly submerged, serving as additional displacement members, or may on occasions be substantially wholly submerged. In stating that they are located "at the water line" it is meant that they are located in such a manner as to best fulfill these two normal functions.

It is a further object to provide such retractable hydrostabilizing means which will be retractable inwardly or toward the center of gravity of the airplane rather than outwardly. It is advantageous, in landing or taxiing, to concentrate the weight, so far as possible, adjacent the center of gravity, and to lessen the load necessary to be carried by wing spars and the like. This also makes the airplane more easily maneuverable in flight and while hydroplaning. By locating the hydrostabilizing means adjacent the hull there is avoided the necessity of strengthening wing spars to support and effect the operation of retractable wing tip floats.

It is a further object to provide such retractable hydrostabilizing means which can be made in a variety of forms to suit the ideas of different designers, which will occupy a minimum of space, and require the minimum of interference with structural, control, or load-carrying parts of the airplane, and which may be operated in a simple manner.

With these and other objects in mind, as will appear hereafter, our invention comprises the novel combination of an aircraft and such retractable hydrostabilizing means, and the relative formation and arrangement of the parts thereof, and of their retracting means, all as shown in the accompanying drawings, and as will be described in this specification and more particularly defined by the claims which terminate the same.

In the accompanying drawings we have illustrated our invention embodied in various typical forms, the illustrations being diagrammatic in character.

Figure 1 is a front elevation of the center section of such an airplane, illustrating the hydrostabilizing means in its extended and in its retracted positions, in a form and arrangement which is at present preferred by us, and Figure 2 is in general a section therethrough on a vertical longitudinal plane. Figure 1a is a detail of a

shock absorbing support for the hydrostabilizer at the hull.

Figure 3 is a section similar to Figure 2, but showing the entire hull of the flying boat, and illustrating a modified arrangement, and Figures 4 and 5 are views similar to Figure 1, showing modifications, either of which corresponds to the arrangement of Figure 3.

Figures 6, 7, 8, 9, 10, 11, 12 and 13 are all views similar to Figure 1, each showing a different modification.

While, as indicated above, the principles of this invention are applicable to any aircraft adapted or formed to float upon water, and indeed, in part to hydroplanes operating only upon the surface, it is principally applicable to flying boats, and will be described in conjunction with that type of airplane. Thus the hull of the flying boat, provided in this instance with a V-bottom, is sustained in the air by wings projecting laterally from the upper part of or above the hull, and by motors driving propellers. The wing thus projects laterally above the water line to a considerable distance at each side of the hull, and being subject to the action of winds, waves and other factors, tends to tilt the airplane laterally about the center of buoyancy, which is located within the hull. Such wings are usually constructed with spaced spars, acting as beams to sustain the load in flight, and it is desirable that these spars be not interrupted, as this requires added strengthening and consequent added weight, and it also follows that they should be as light as possible.

The hydrostabilizer 2, in the form shown in Figures 1 and 2, takes the form of a one-piece sponson projecting laterally from the hull at a level where it will be most effective for maintaining lateral stability, or for facilitating maneuverability, while the airplane is acting as a displacement craft or as a hydroplane, as pointed out above. The sponsons, when projected, are always at or near the water line. Their internal construction is largely immaterial, and to a considerable degree their external form may be varied widely, and the present invention is not primarily concerned with either their internal structure or their external form. It is sufficient to note that the bottom of such a sponson, intended to act as a plane when hydroplaning upon the surface of the water, is not of a form which produces any appreciable aerodynamic lift in flight, nor is its upper surface usually formed to produce any appreciable lift, so that the sponson or hydrostabilizer, together with any strut means by which it is braced from the airplane structure, in flight have usually constituted heretofore practically a dead drag.

In the form shown in Figures 1 and 2 the bottom of the hydrostabilizer 2 is provided with a step, although such a step is omitted in the form shown in Figure 3. Such a step may or may not be employed as proper design may indicate. Similarly the hydrostabilizer 2, as shown in Figure 1, is provided with a bulbous portion 21 at its outboard end, this constituting an added displacement correcting any tendency to dip the wing in this direction, since this buoyant portion 21 is thereby forced beneath the surface of the water, and by its displacement reacts, tending to force this side of the airplane upward. Such an enlargement may or may not be employed, and is not employed in the forms illustrated in other views, as for example in Figure 12.

Similarly the form and arrangement of the

strut means 3 is immaterial in so far as the present invention is concerned, except as hereinafter pointed out, and indeed, strut means may be entirely omitted if its point of connection to the hull can be made sufficiently resistant to the hinge moments acting thereon. It is preferable that these strut means engage the hydrostabilizer at two points, spaced longitudinally of the aircraft, and that they be similarly braced from the aircraft structure at two longitudinally spaced points, but this is largely a matter of design, and in no wise is to be considered as essential, through so shown in Figure 2. Likewise the point of connection of the strut or bracing means, both to the hydrostabilizer 2 and to the aircraft structure, is important only as bearing on considerations which will appear hereafter, and the strut means is in some of the forms herein disclosed connected to the wing 11, outboard of its junction with the hull, and is in some instances connected directly within the hull.

The hydrostabilizer 2 as shown in Figures 1 and 2, in a form which at present we prefer, is of a length, in a direction laterally of the aircraft, to afford proper stability, and yet to be housed entirely within the confines of the hull 1, with the possible exception of the bulbous extremity 21, if the latter be employed. Its operative or projected position is shown in full lines at the right of Figure 1, and in dash lines it is shown in its retracted position. At the left of Figure 1 it is shown in full lines in its retracted position, with only the bulbous extremity 21 projecting from the outline of the hull. To accomplish this movement of the sponson from one position to another its inner end is pivotally connected at 42 to a nut 40 threaded upon a screw 4 journaled within the hull, and appropriate means (not shown) are provided for accomplishing rotation of the screw 4 and consequent travel of the nut 40 lengthwise of the screw. The screw is set in a generally upright position, and the hull is recessed, as indicated at 14, to receive the hydrostabilizer. The strut means 3 are pivotally connected at 32 to the stabilizer, outwardly of and parallel to the pivot 42, and at 31 to the wing, likewise upon a pivot axis parallel to the pivots 32 and 42, and outwardly of the junction of the wing with the hull a distance which is equal to the length or height of the strut means, so that in the retracted position the pivot 32 lies substantially at the junction of the wing with the hull, and the wing may be recessed in its under surface to receive the strut means. Preferably the strut means are disposed entirely between the spars 13, so that the latter are not interrupted. The reception of the strut means within the recesses in the under side of the wing will close these recesses and will substantially restore the aerodynamic contour of the wing in flight. Likewise the upper surfaces of the sponson, at least such portion thereof as lies beneath the wing in the retracted position, may be formed to come substantially flush with the surfaces of the hull, when in retracted position, and in that way to restore the aerodynamic surfaces of the hull, thereby eliminating to the greatest degree possible any drag by reason of interruption of these surfaces of the hull and of the wing.

It will be obvious that as the screw 4 is rotated the nut traveling upward along the screw will draw the inboard end of the hydrostabilizer 2 upwardly and somewhat inwardly, the hydrostabilizer and the strut means 3 pivoting about the respective longitudinal pivots 32 and 31, and

the hydrostabilizer about the parallel pivot 42. When the nut 40 reaches the upper end of its limit of travel the hydrostabilizer will have been withdrawn into the hull within the recess 14 provided therefore, the strut means 3 will have been drawn inwardly and upwardly into its corresponding recess in the under side of the wing, and the aerodynamic surfaces of both the hull and wing will have been substantially restored to continuity, and substantially all drag by reason of the hydrostabilizer and its strut means will have been eliminated. The bulbous extremity 21 may be left projecting from the hull at the chine thereof, but this produces no material drag, particularly as compared with the drag which would be produced by the hydrostabilizer were it left in its projected position. Moreover, because of this drag, previous hydrostabilizers have been reduced as much as is safely possible in lateral extent, whereas with the present arrangement the hydrostabilizer may be extended laterally to a considerably greater degree, provided only that the height of the hull is sufficient to permit its retraction within the hull, which is readily possible with the large multiple-deck flying boats now constructed and projected.

When it is desired to project the hydrostabilizer it is only necessary to reverse the direction of rotation of the screw 4, whereupon the hydrostabilizer is again projected outwardly and guided to its proper position, where it is held and locked in its operative position by holding the screw 4 against rotation.

We prefer to include shock absorbing means between the outboard end of the hydrostabilizer and the aircraft structure to which the latter is braced. Such shock absorbing means are illustrated at 9, within the sponson 2, supporting the pivot 32 yieldably from the sponson. They might be arranged as a part of the strut means themselves, and are so shown in other forms. They may be capable of being lengthened or shortened to effect corresponding movement of the sponson, by hydraulic or other means, and shock absorbers capable of such operation are already known, hence we do not show means to accomplish such controlled lengthening or shortening. Such adjustment of the angle of the sponson, relative to the hull, may be employed to facilitate banking of the airplane when running at high speed upon the surface.

Shock absorbing means may be employed between the pivot 42 and the aircraft structure, either in lieu of or in addition to the shock absorber at 9. Thus, in Figure 1a, the nut 40 is shown connected to one of the relatively movable members, as the plunger 91, of a shock absorber, the cylinder 92 whereof supports the pivot mounting 42.

By effecting movement of one or both of the pivots 42 and 32 up or down, by controlled operation of the respective plungers through means known in the shock absorber art, the angle of the sponsons relative to the hull may be controlled at will.

It will be observed that by the arrangement described a minimum of space is occupied within the hull by the hydrostabilizer recess or well, and that there is ample room for free access between the parts forward of such recess and aft thereof. Further, but little space or interruption of parts is required within the wing, and this is important inasmuch as the space within the wing, between the hull and the wing-mounted engines, is usually occupied by such accessories as fuel and oil tanks,

engine controls, and conduits of various sorts, and as well as aileron and flap operating means and the like, and it is therefore important that a minimum of the space within the wing be occupied by the devices which brace or operate the hydro-

stabilizer.

While but a single operating screw 4 has been shown in Figures 1 and 2, it is obvious that two or a greater number of such screws may be employed as the occasion demands.

The arrangement shown in Figure 3, which corresponds generally to the two slightly different forms shown in Figures 4 and 5, differs but slightly from the arrangement heretofore described. The operating screw or screws 4 are slightly more upright, and the strut means, designated 30, is preferably connected adjacent the outboard tip of the hydrostabilizer, or to the bulbous extremity 21, as shown in Figure 4. Primarily the difference between this form of Figure 4 and that of Figures 1 and 2 is that the upper pivot 31 of the strut means is connected to a nut 50 which travels along a screw 5 disposed lengthwise of the wing, and which is synchronized, by any suitable means, not shown, with the operation of the retracting screw 4. During retraction the nut 50 is moved inwardly until in the retracted position the strut means lies substantially flush with the skin of the hull 1. The strut means in addition may be covered with a fairing or skin, so shaped as to cooperate with the skin of the hull to merge with the latter, and thus to close the recess 14 and to restore the streamline of the hull. In the arrangement shown in Figure 4 the bulbous extremity 21 is immovable with respect to the hydrostabilizer 2, and is withdrawn completely within the outline of the hull. In Figure 5, however, the bulbous extremity 22 is pivoted at 23 to the outer tip of the hydrostabilizer 2, and the strut means 30 is rigid with the bulbous extremity 22, the pivot at 23 being substituted for the pivot at 32. Thus during retraction the bulbous extremity pivots somewhat about the pivot 23 with respect to the hydrostabilizer 2, and in the retracted position may be left projecting slightly from the outline of the hull, as shown in dash lines in Figure 5. In other respects this form is similar to that described with relation to Figure 4.

In Figure 6 the arrangement is similar to those previously described, although there is shown no bulbous extremity of the hydrostabilizer, but in this arrangement the strut means is formed as a member which is extensible or contractible in length, consisting, for example, of a cylinder or cylinders 93 within each of which is received a plunger 94 of a shock absorber, pivotally mounted, in this instance at 31', upon the hull itself, rather than from the wing 11. The portion 93 is pivoted at 32', as before, to the hydrostabilizer 2 outboard of the latter's connection at 42 to the strut 40. Reciprocation of the plunger 94 within the cylinder 93, for retraction of the sponson, is accomplished by suitable means, not illustrated, since the particular form and arrangement of these means is not in itself a part of our invention. The element 93, constituting part of the strut means, may be covered with a cover or fairing 95, and in the retracted position this fairing serves to close the recess in the hull which receives the hydrostabilizer 2.

In Figure 7 the hydrostabilizer 24 does not project immediately from the hull 1, but rather is in water-contacting position from a point somewhat outwardly of the hull, and from thence out-

wardly toward the wing tip. In effect this hydrostabilizer 24 is pivotally mounted at 15 upon the wing, the pivot axis 15 being longitudinally disposed, and the depending portion 35 from the pivot 15 downwardly to the hydrostabilizer constituting in effect a part of the strut means bracing the hydrostabilizer. Additional strut means are provided in this form, consisting of toggle links 36 pivotally connected at the lower end to the hydrostabilizer, and pivotally mounted in the aircraft structure at 31'. One of these links may be formed as a shock strut 9. By applying a force, as indicated by the arrow A, the toggle links 36 are broken and their extremities are caused to approach, thereby drawing upward the inboard end of the hydrostabilizer 24 until it is received within a recess provided in the hull 1, the strut member 35 being likewise received in a recess in the under side of the wing. The surfaces of the hydrostabilizer 24 and the strut means 35 which will be exposed when in the retracted position, may be formed to reconstitute the angle at the junction between the wing and the hull, and to restore the streamline surfaces of the two.

In the arrangement shown in Figure 8 the hydrostabilizer 25, which is shown as provided with a bulbous extremity, is pivoted fixedly or through a suitable shock mount, at 16 to the hull adjacent the water line, and its outboard end is braced from the hull by toggle links 36'. By applying a force to the latter, as indicated by the arrow B, the outboard end of the hydrostabilizer is swung directly upwardly within its recess in the side of the hull, its under surface in this instance being formed to approximately restore the streamline surface of the side of the hull.

In the arrangement shown in Figure 9 the hydrostabilizer 2 is again pivoted at 16 to the hull, and is braced from the aircraft structure by cooperating extensible screw elements 33 and 34, or through an extensible shock absorber, previously described. In this instance it is provided with a bulbous extremity 22', pivoted at 23 to the outboard end of the sponson 2, and the movement of this member 22' is controlled by a link element 6, pivoted to the member 22' and within the hull in such manner that the member 22' is maintained substantially upright during retraction, and in the fully retracted position is received within a recess provided for it in the under side of the wing 11, as shown in dash lines in Figure 9.

The arrangement shown in Figure 10 is similar to that shown in Figure 9, except that the pivot 23', which takes the place of the pivot 23, is disposed inboard from the extremity 22, thus dividing the hydrostabilizer into two relatively movable parts 2 and 26. This permits the hydrostabilizer as a whole to be made of somewhat greater lateral extent, and the bulbous extremity 22 may be received within a recess provided in an engine nacelle 12'. Here the strut means 37, which may be of any type heretofore described, extends between the wing 11 and the outer portion 26 of the hydrostabilizer. Also the retracting means is shown in this instance as a screw 44 which is secured to the hydrostabilizer 2 outboard of its pivot 16, and a nut 45, which is journaled within the hull 1, and which is rotated by a nut 46 engaged by a worm pinion 47, operated in turn through skew gears 48, whereby both of the hydrostabilizers may be retracted and projected conjointly through a drive gear 49 connected to a suitable source of power and connected to both of the sets of skew gears 48. This, or any equiva-

lent means, may be employed in any modification, to effect simultaneous operation of the two hydrostabilizers.

In the arrangement shown in Figure 11 the hydrostabilizer is again formed of two separate parts 2 and 26, connected along a longitudinal pivot axis at 23', the inboard end of the hydrostabilizer being pivoted at 16 within the hull 1. The strut means 38 is identical in principle to that described in conjunction with Figures 1 and 2, being pivoted at a fixed point 31 to the upper part of the aircraft structure and at 32 to the outboard end of the hydrostabilizer. A force applied in the direction of the arrow C will swing inwardly the inboard portion 2 of the hydrostabilizer, and the two portions 2 and 26 will break about the pivot 23' to assume finally the dash line position. In this latter retracted position the strut means 38 will lie substantially flush with the side of the hull and will close the recess therein provided for the reception of the hydrostabilizer.

Figure 12 illustrates an arrangement similar to that of Figure 7, the principal difference being in the manner of retraction, and in the provision of a continuation of the bottom surface of the hydrostabilizer from its outboard extremity inwardly to the hull 1. This continuation consists of the member 27 pivoted at 28 to the inboard end of the hydrostabilizer 24, and the inboard end of this inward extension 27 is guided at 7 for movement along a track 70. Such upward movement of the point 7 swings the hydrostabilizer 24 inwardly about the pivot 15 until it fills the junction between the wing 11 and the hull 1, and in the final retracted position disposes the inward extension 27 in the dash line position above the strut element 35.

The arrangement shown in Figure 13 is similar to that shown in Figures 4 and 5. The inboard end of the hydrostabilizer 2 is pivotally connected to a nut 40 to travel along the upright screw 4, and its outboard end is braced from the aircraft structure by strut means 39, pivotally connected at 32 to the hydrostabilizer. The upper end of the strut element is formed as a carriage 8 traveling along a track 80 in the under side of the wing 11, and held against pivotal movement at this point. When the nut 40 is drawn upwardly the hydrostabilizer 2 is retracted inwardly, and the strut element 39 is drawn directly inwardly, the carriage 8 traveling along the track 80 until in the final retracted position the strut 39 or fairing carried thereby closes the recess into which the hydrostabilizer has been retracted, restoring the streamline surfaces of the side of the hull.

What we claim as our invention is:

1. In combination with an airplane having a recessed hull formed to float upon the water, and having a wing projecting from the hull, above the water, a hydrostabilizer projecting laterally from the hull adjacent the water line, strut means secured at its upper end to the wing upon a longitudinal pivotal axis, and pivotally secured at its lower end to the hydrostabilizer, and means to move the inboard end of the hydrostabilizer upward, thereby to swing the hydrostabilizer into

an upright position within the hull recess, the several parts being so proportioned and organized as to swing the strut means, by such movement of the hydrostabilizer, into substantial coincidence with the wing.

2. In combination with a flying boat, the hull whereof is recessed beneath the wing, and the wing whereof is recessed from its junction with the hull outwardly, a hydrostabilizer projecting laterally from the hull, adjacent the water line, strut means pivotally connected at its lower end to the hydrostabilizer, and pivotally fixedly connected to the under side of the wing at a distance from the hull substantially equal to the length of the strut means, and means to move the inboard end of the hydrostabilizer upwardly, thereby to move the hydrostabilizer into the hull recess, and to move the strut means into the wing recess.

3. In combination with a flying boat having a wing extending laterally above the water, a hydrostabilizer projecting laterally from the hull, adjacent the water line, an upright screw and a nut, one mounted in the hull and the other carried by the inboard end of the hydrostabilizer, whereby by rotation of the one to draw the inboard end of the hydrostabilizer upwardly, means bracing the outboard end of the hydrostabilizer from the wing thereabove, and means to swing the lower end of the bracing means inwardly, during upward movement of the inboard end of the hydrostabilizer, into a retracted position wherein the bracing means underlies the wing.

4. The combination of claim 3, wherein the hull is formed with a recess to receive the hydrostabilizer, and the wing is formed with a recess for the bracing means, the hydrostabilizer and bracing means in retracted position, substantially restoring the continuity of the skin of the hull and wing interrupted by such recesses.

5. In combination with an airplane having a flotation hull and a wing projecting laterally therefrom above the water line, a hydrostabilizer projecting laterally from the hull at the water line, means to anchor its inboard end to the hull, a strut pivotally connected to and depending from the wing to the hydrostabilizer, and pivotally connected to the hydrostabilizer between the ends of the latter, means guiding the anchoring means for the inboard end of the hydrostabilizer for movement upwardly as parts move towards retracted position, the hull having a recess in its side, and the wing structure being pierced in continuation of such recess, means to retract the hydrostabilizer into such recess, with its inboard end penetrating the wing, the strut and said guide means cooperating to guide the outboard end of the hydrostabilizer into a retracted position at the lower end of the recess, and the strut points of connection to the wing and to the hydrostabilizer being so located, and the parts so organized, as to bring the strut, when parts are retracted, into substantial coincidence with the lower surface of the wing.

ROBERT J. MINSHALL.
EDWARD C. WELLS.